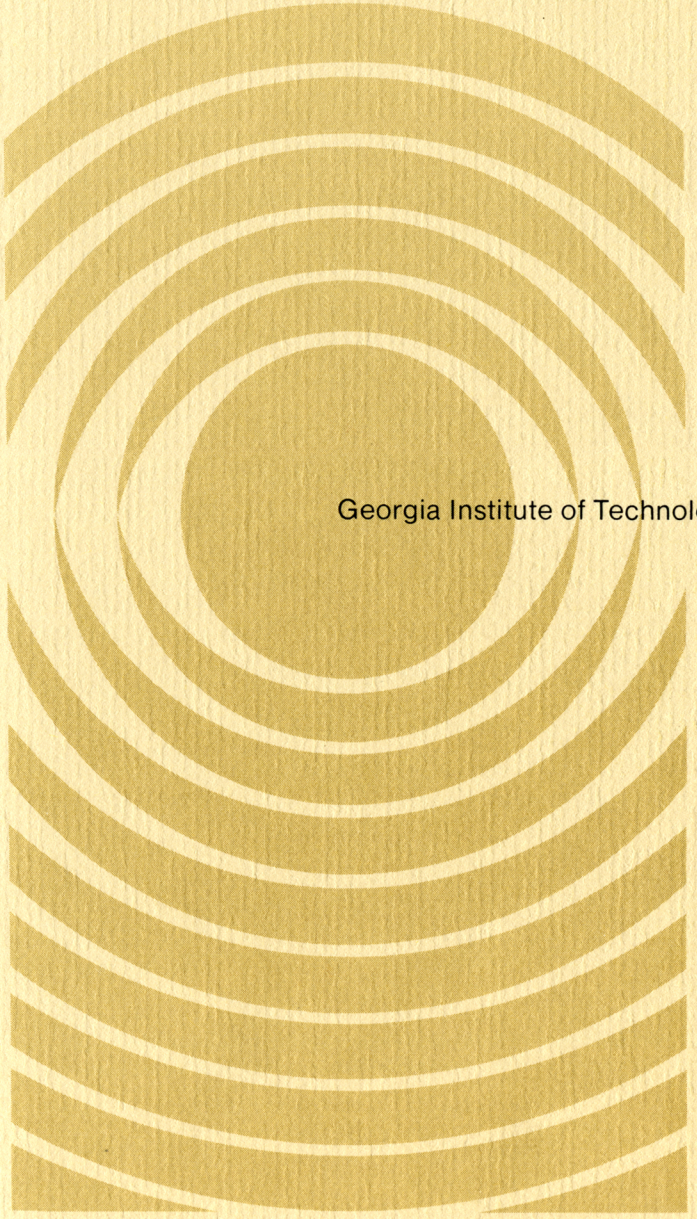
ENGINEERING EXPERIMENT STATION



Georgia Institute of Technology

SERVING TECHNOLOGICAL NEEDS OF GEORGIA

JANUARY 1972

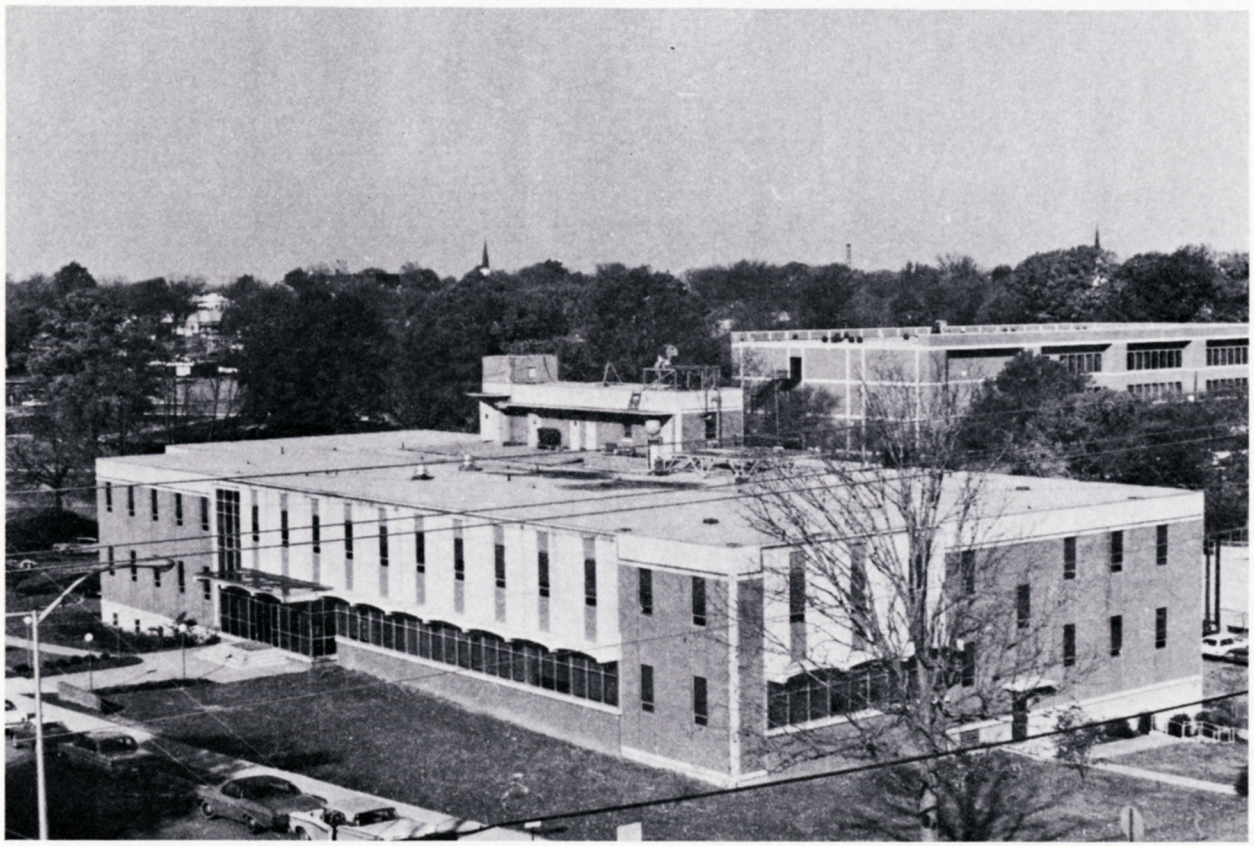
The State Engineering Experiment Station was created by the General Assembly of Georgia in 1919 for the promotion of engineering and industrial research in the interest of the development of the natural resources, the industries, and the commerce of the State of Georgia. Early financial support did not materialize and the Station was not activated until 1934. A limited base of industrial and governmental support was then built, and in 1946 the Station began to receive major funding from federal agencies. At that time the Georgia Tech Research Institute began to function as the contract organization for EES.

The 1950's and 1960's were characterized by a growing volume of activity, particularly in those areas relating to the research and development needs of defense and space exploration. State support was at a low level during this period, and it was federal funding which enabled EES to be at the forefront of science and technology and to develop facilities of importance to industrial growth as well as research on the Georgia Tech campus.

In 1956 the Engineering Experiment Station began to pioneer in the methodology of economic development. The Station's charter was broadened in 1960 to provide an industrial extension service to meet the technical, informational, and other needs of industry and local development groups and the name was changed to the Engineering Experiment Station. In 1961 the first of a statewide system of field offices was opened in Rome to support local development efforts and provide technical assistance to business and industry in the area.

The directions and emphases of the 1970's were indicated by the formation in January 1971 of a Task Force on "Technology, the Environment and Economic Growth" to determine ways in which EES can anticipate and apply its technological capabilities to the constantly changing needs of Georgia.

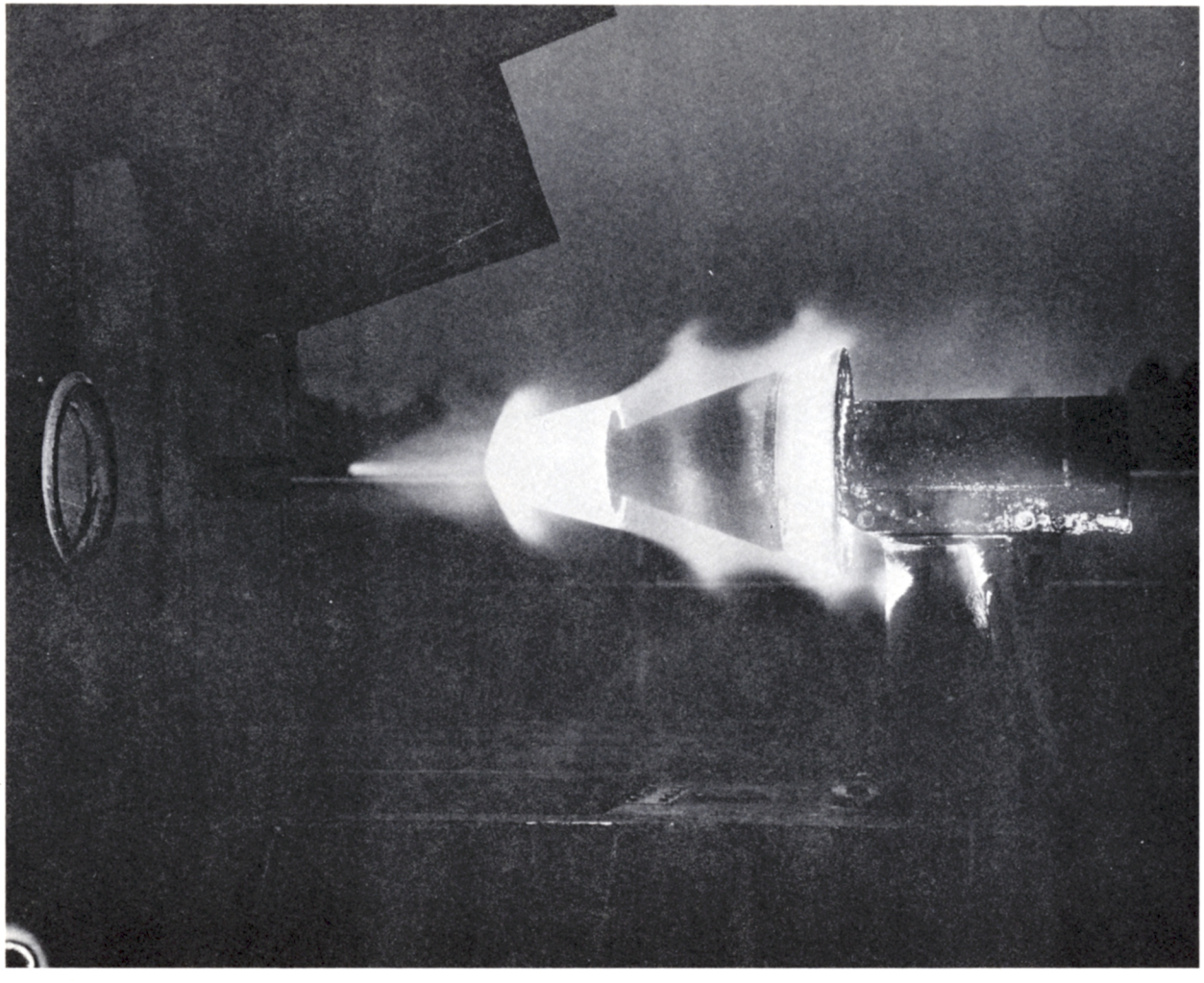
The research activities presented here are a representative sample of the work ongoing at the EES in fulfillment of the goal to serve the technological needs of Georgia.



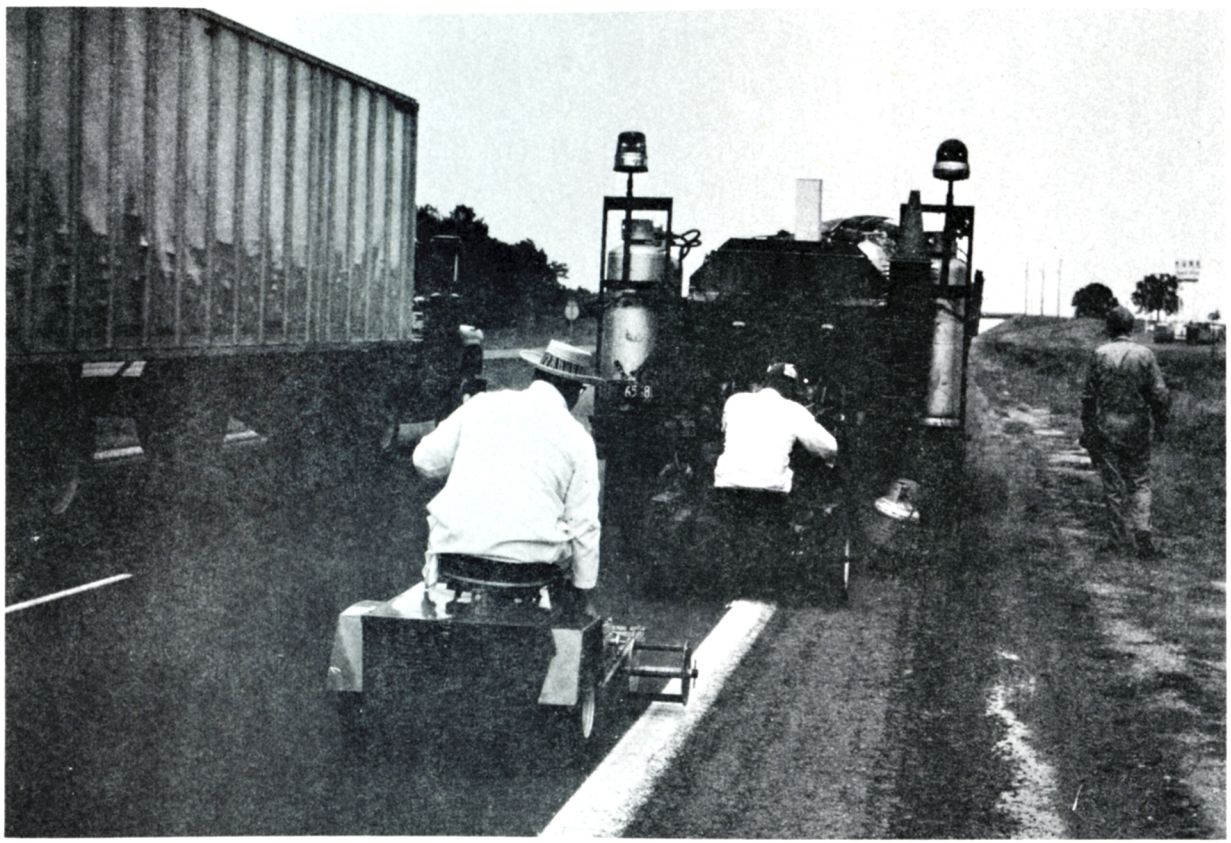
Typical Engineering Experiment Station Facilities

Much of the work aimed at solving Georgia problems through the application of technology would not be possible without the background and expertise provided through the contract research carried out for governmental agencies. Studies directed toward finding better materials for use in incinerators, for example, are an outgrowth of work on the effects of high temperatures upon materials and the subsequent improvement of these materials which was done for the National Aeronautics and Space Administration. NASA had to find materials that could withstand the heat of reentry into the earth's atmosphere, and funded research and development efforts in the area. This knowledge is now available for use in other fields such as improvement of incinerators.

Sophisticated communications and speech analysis work conducted for the Department of Defense has provided the background necessary for another study — the development of speech training aids for deaf children. A feasibility study has shown that an instrument something like a TV set with a large screen divided into several areas, each representing one of the vowel sounds, could be developed. The child would face the screen and make practice sounds into a microphone. If he pronounced a sound correctly, a light would appear in the proper area of the screen. With such an instrument, a deaf child could practice on his own with much less teacher supervision than is required now and the training should be much more effective.



Testing Ceramic Materials Under Reentrant Conditions



Hot Thermoplastic Traffic Line Receiving a Corrugating Surface Texture
While Still Molten to Enhance Its Wet Night Visibility

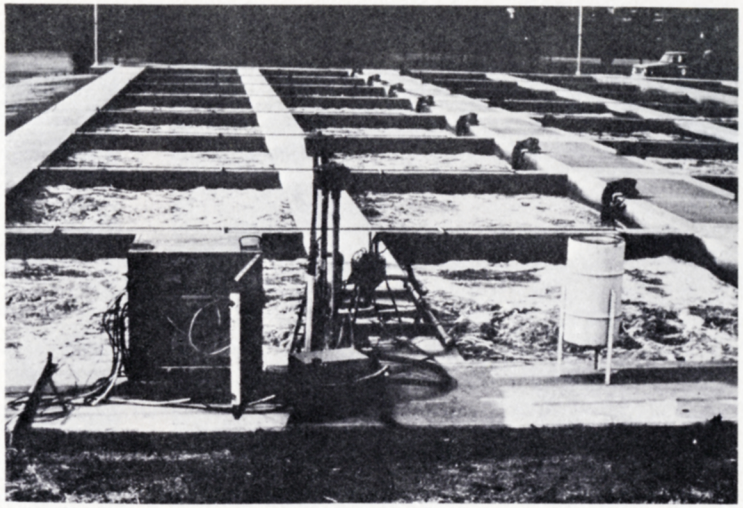
Highway safety and improved traffic control are two areas of interest to the EES. For a number of years, EES scientists have been conducting research to improve traffic paints for highway markings, with particular emphasis on increasing visibility at night and under wet conditions. Protective coatings for extending the life and improving the safety of highway structures such as bridges also have been investigated. This work includes design of the special instrumentation needed to test and evaluate the coatings, as well as development of new and improved coatings and highway markings.

A recent study of traffic flow patterns in Atlanta demonstrated the feasibility of a computerized traffic control system. One of the most expensive parts of a computerized traffic control system is the cable to carry the information between the computer and each intersection. EES engineers went to work on the problem and devised an improved communications scheme that will significantly reduce the costs of the control system. Research also has been pursued on development of electronic sensors to warn wrong-way vehicles on expressways. The objectives of this program have been to detect automobiles entering the expressway on the wrong ramp, to warn oncoming motorists, and to stop the offenders.

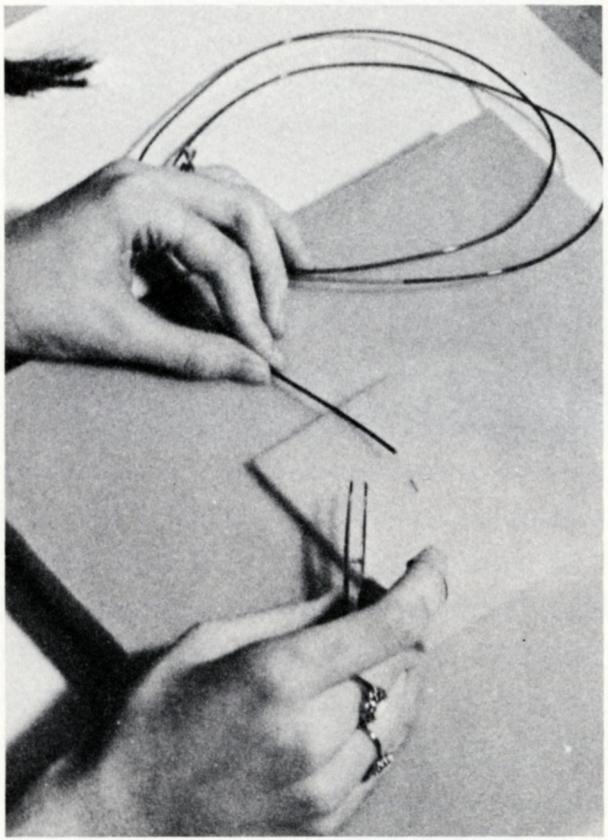
The Engineering Experiment Station is actively involved in environmental protection, an area which is of vital concern to citizens of the state. An example of this type of work is the ongoing effort with Georgia communities to help them improve their sewage treatment facilities. This activity has resulted in the development of experimental on-line instrumentation for measurement and control of the waste water treatment process.

Noise pollution is another problem for which EES engineers have been trying to find solutions. They have made noise measurements in industrial plants, analyzed the results, and offered recommendations for reducing the noise level. This type of assistance makes Georgia manufacturing plants pleasanter and healthier places to work. Other studies have been made for a Georgia community on levels of noise pollution from the Atlanta airport. EES also has measured and analyzed the noise emanating from expressways so that the best routes for these superhighways can be found.

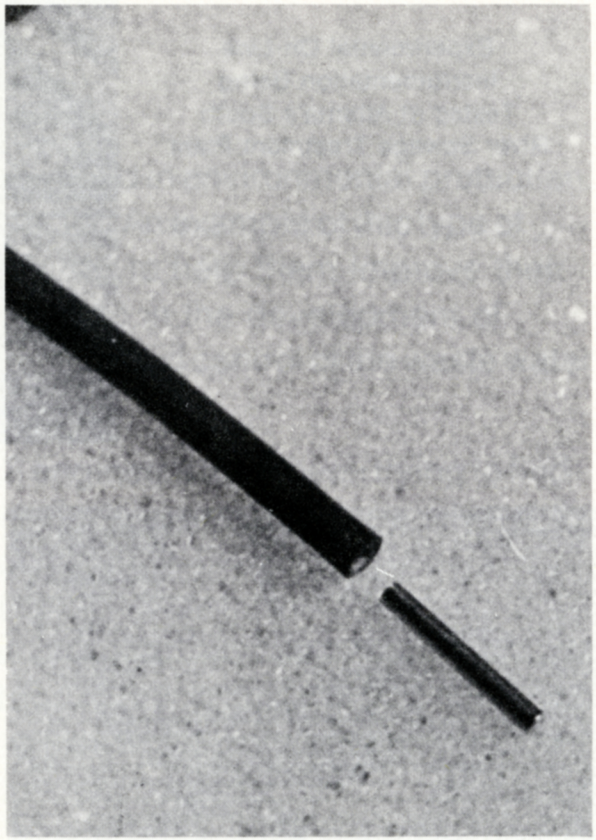
Experimental On-Line
Instrumentation Being
Tested at Atlanta's South
River Sewage Treatment Plant



Monitoring Level of
Highway Noise with Portable
Instrumentation

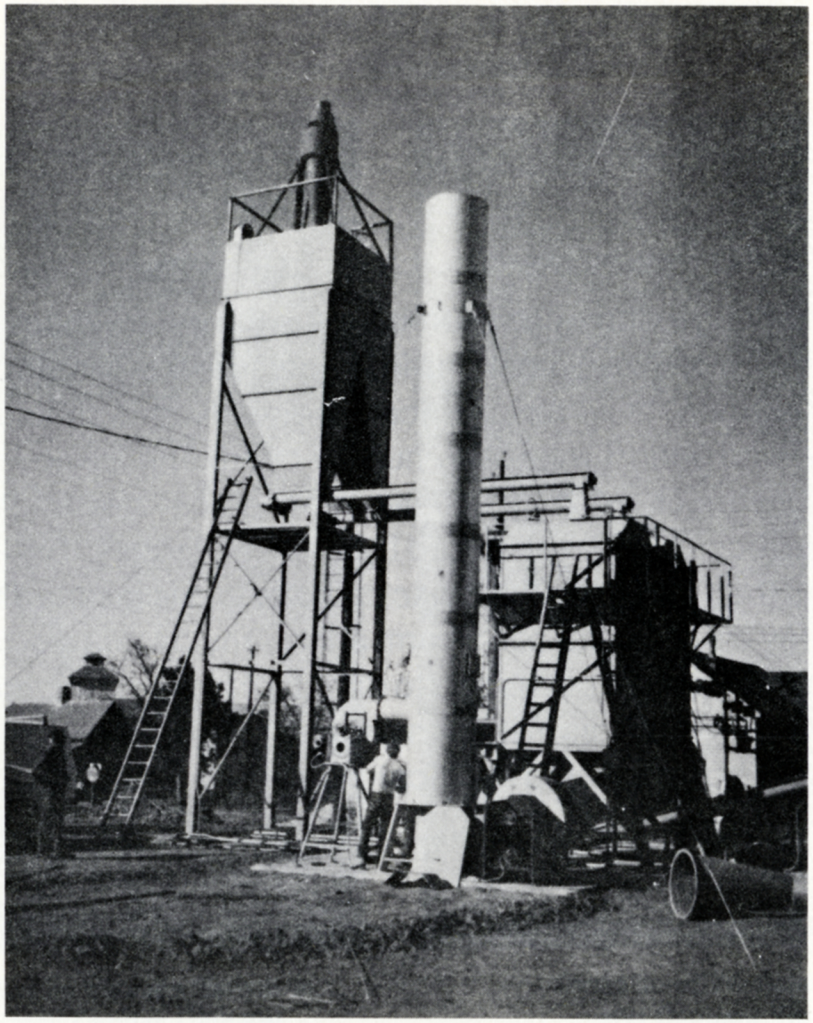


Mounting the Barium Titanate Sensor in
the Tip of a Small Cardiac Catheter



Close-up of Transducer
and Catheter Tip

Application of engineering techniques to problems in the life sciences is another facet of EES activities. One of many investigations in progress in this area is concerned with the development of a micro-miniature device for directly and simultaneously measuring pressure and sound within the human heart. The device is a barium titanate cartridge transducer, which translates mechanical stress into electrical impulses that may be recorded and analyzed by medical doctors. The tiny sensing device is mounted on the tip of a small cardiac catheter that is inserted into the heart or a large blood vessel through a needle in an arm artery. The device also can be used to explore arterial pulse in the renal pelvis and to directly monitor "second heart sound," a measure of the level of anesthesia in human patients. Tests are being conducted in cooperation with local hospitals and medical schools.



Peanut Hull Charcoal Reactor at Dawson, Georgia
First Installation Built by Tech-Air Corporation, Licensee of the EES Process

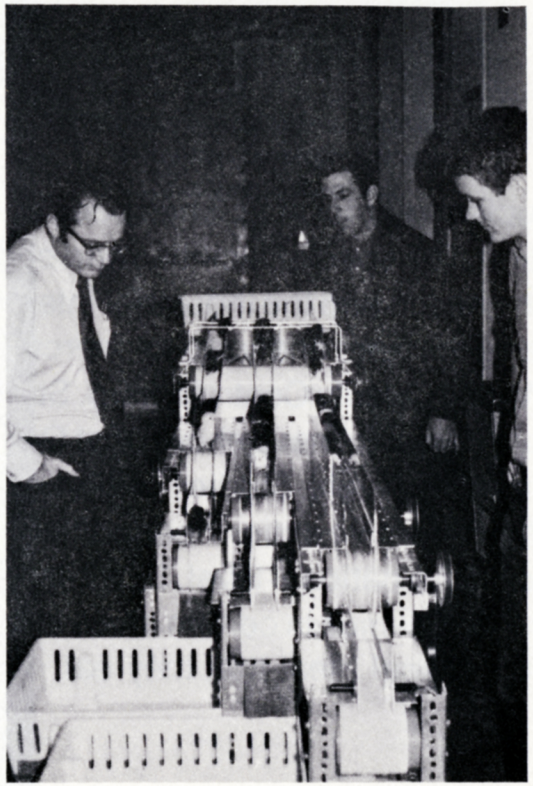
Air pollution has become a significant problem for several Georgia industries. One of these is the peanut industry. For years peanut shellers have disposed of their discarded peanut shells by burning, causing excessive pollution of the atmosphere. Upon recognition of this problem, EES engineers set out to find a solution. The studies led to the development of a process for converting peanut hulls to charcoal. (The solution they found not only solves the air pollution problem, but also is creating a new industry in Georgia).

This work also led to the development of an advanced cyclone separator for removing particulate matter from stack exhausts. The unit shows great promise for meeting all existing air quality control standards. It will be applicable to many Georgia industries, not the least of which is the wood industry. Sawmills and pulpmills have traditionally burned bark, wood chips, and sawdust either as fuel for their boilers or as a means of waste disposal. Both activities emit noxious fumes; hopefully, the cyclone separator will offer the solution these mills need.

Locations of EES Field Offices

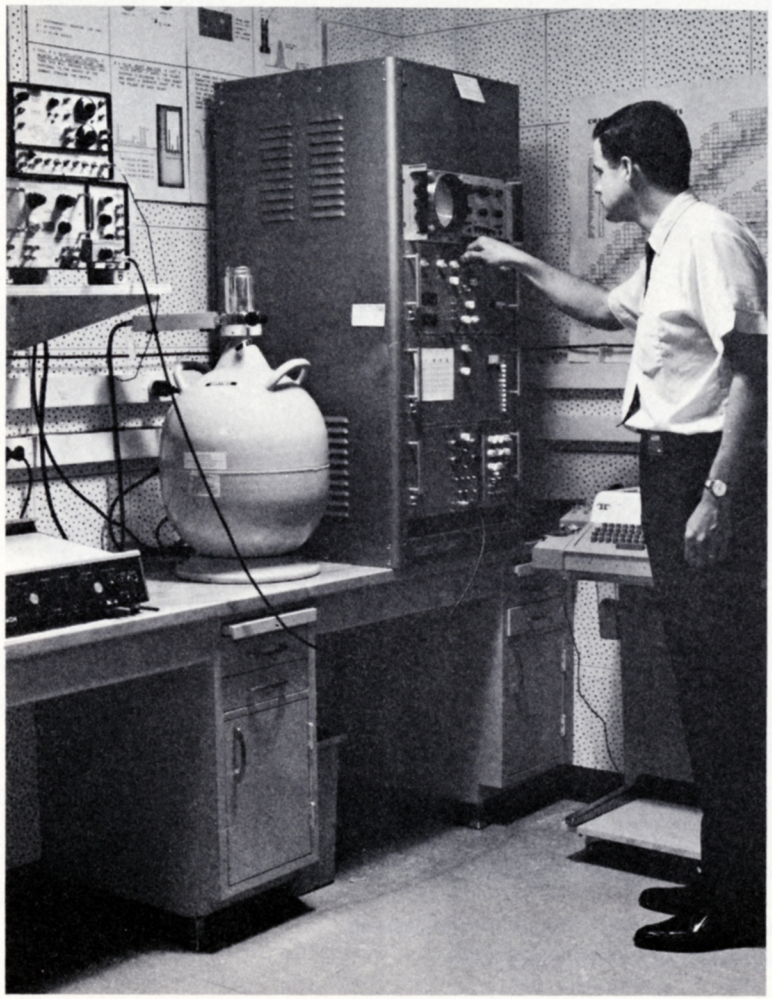
The Engineering Experiment Station maintains liaison with Georgia industry through a statewide network of field offices. Field representatives are able to observe problems firsthand by visiting industrial plants and talking with plant personnel. Problems that cannot be solved in the field are referred back to the EES, and an engineer is assigned to work on a solution. As a result of one such contact, the EES was made aware of the need for an electro-mechanical

baby chick counter capable of counting and batching hundreds of thousands of baby chicks per week. The Georgia poultry concern that had this problem could not find a commercially available product to satisfy its need. An EES engineer was assigned to the task and a preliminary design for a counter was developed. The final product is to be capable of counting better than 80,000 baby chicks a day and separating them into trays containing 100 each.

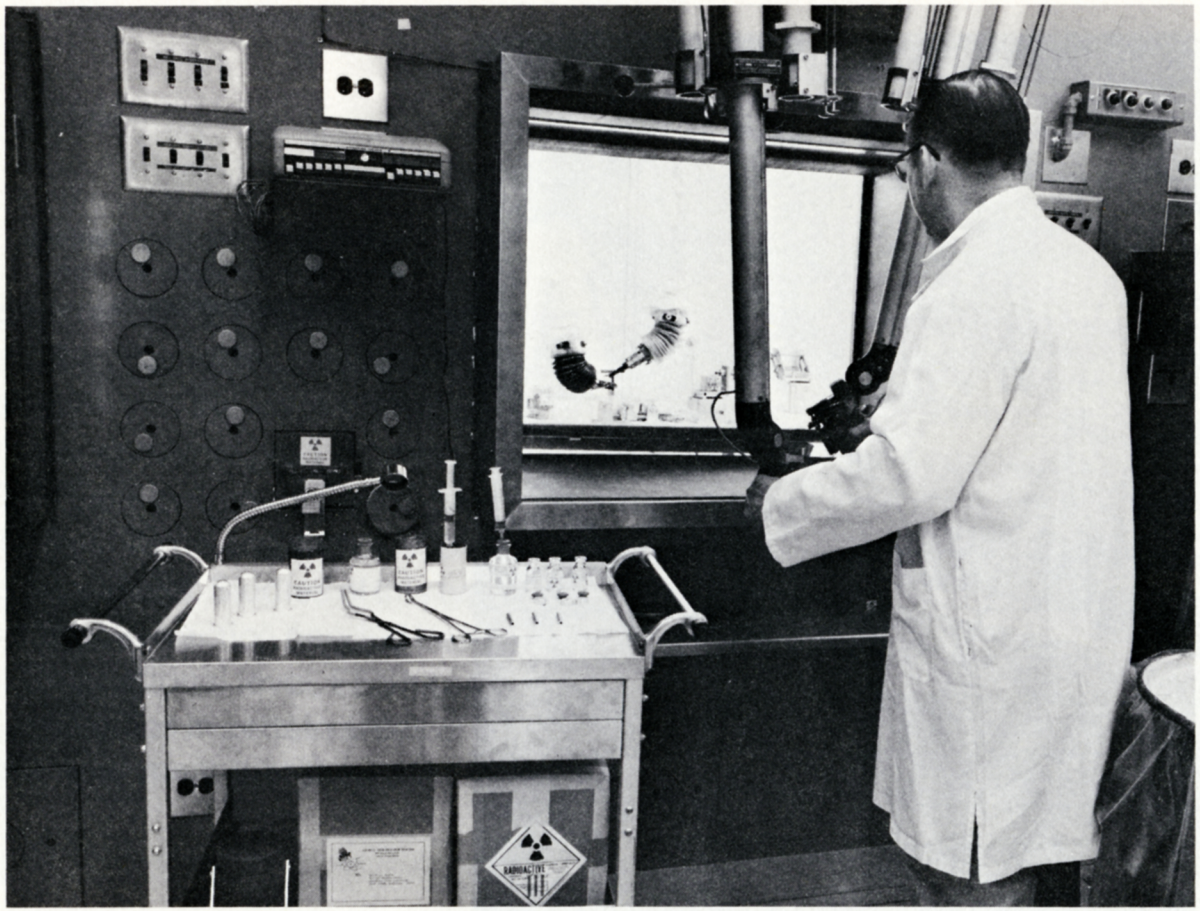


Testing the Electro-Mechanical Baby Chick Counter Developed at EES in Response to an Industry Need

The nuclear reactor at EES has been playing an important role in detecting mercury pollution. The special facilities and capabilities of EES have been applied to protecting both the health and the industrial interests of Georgians. In one study more than 400 fish samples were analyzed for mercury content. This was done in cooperation with the State Water Quality Control Board. Studies have also been made of the mercury levels of poultry. Results have shown that Georgia-raised poultry does not have dangerously high mercury levels. Studies of this type are made for Georgia industry so that they can take the corrective action needed before receiving an ultimatum from a regulatory agency. On a national level, EES has helped the U.S. Center for Disease Control to verify that Eskimos in certain areas of Alaska have abnormally high body mercury levels due to the seal meat that they eat.



Measuring the Mercury Content
of Poultry Through Neutron
Activation Analysis



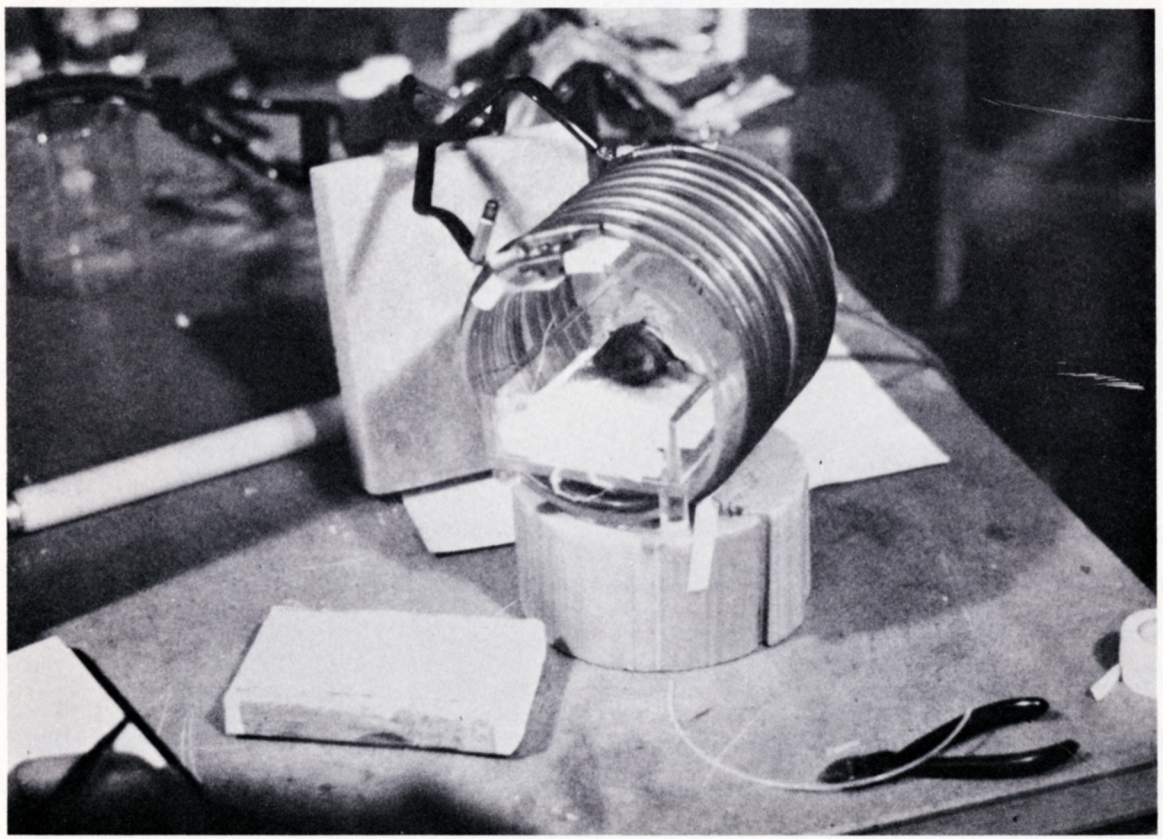
Producing Fluorine-18 at the EES Reactor for Use in
Cancer Diagnosis at Local Hospitals

Important new methods for diagnosis and treatment of cancer and respiratory diseases have been developed recently based on the use of short-lived radioisotopes such as fluorine-18. In the human body, certain chemicals such as fluorine concentrate in new growth of bones and teeth. These chemicals concentrate to a greater degree in abnormal bone growth such as cancerous lesions. Introducing a radioactive form of fluorine into a suspected cancer patient allows a "picture" to be taken with a "gamma camera" that sees radiation instead of light. The concentration of fluorine at the cancer site appears as a bright spot on the picture. The advantage of this diagnostic procedure over x-ray diagnosis is that it has been shown to detect cancer up to a year earlier.

These new methods are available only at advanced medical centers which have access to a reactor or cyclotron. Because the nuclear reactor at the Engineering Experiment Station is the only such operational facility in the Southeast, EES scientists have developed techniques to produce economically and make available to Georgians two of the most essential medical radioisotopes, fluorine-18 and xenon-133. Fluorine-18 was put into use for the first time in Georgia during August 1971. The isotope was produced at the EES and used for cancer diagnosis at the Emory University Hospital.

Radar technology also is moving into the field of bioengineering. Advances in the medical arts, particularly organ transplants, have increased the need for preservation and storage of healthy organs. Techniques have been developed by which organs can be frozen and preserved with very little or no damage. A major problem has developed in the thawing of these frozen organs; the outside thaws before the inside with resultant damage to some of the outer tissue. Work is now under way to investigate the use of microwave energy to thaw the frozen organs. Microwaves penetrate the tissue in such a way as to cause the inside to thaw along with the outside. This, hopefully, will prevent damage to the tissue.

This same principle is being applied to new techniques of cancer treatment. Not only do the microwaves penetrate the tissue, they also can be concentrated to permit selective heating of parts of the body by focusing the microwaves or by implanting materials that attract the microwaves. Chemicals can then be used that destroy the tissue that is at a raised temperature and not affect other parts of the body.



Testing New Radio Frequency Cancer Treatment
Techniques on Mice

As the state's major technological resource, the Engineering Experiment Station fulfills a public service function. In this role the EES works with other state agencies to provide them with needed technological support. For instance, EES engineers have cooperated with Solid Waste Disposal personnel in the State Department of Public Health in setting up a survey of industrial waste products. In addition, the EES has held air pollution workshops throughout the state in conjunction with the Air Quality Control Division of the Health Department. These workshops were instituted because the EES had received so many requests for air pollution control information from Georgia industry.

The EES also has assisted the Public Health engineers responsible for checking microwave oven installations. The hazards of microwave ovens constitute an area in which the EES has done some extensive research. An EES scientist has appeared on the TODAY IN GEORGIA show to explain these hazards and the proper precautions for microwave oven use to Georgia housewives.

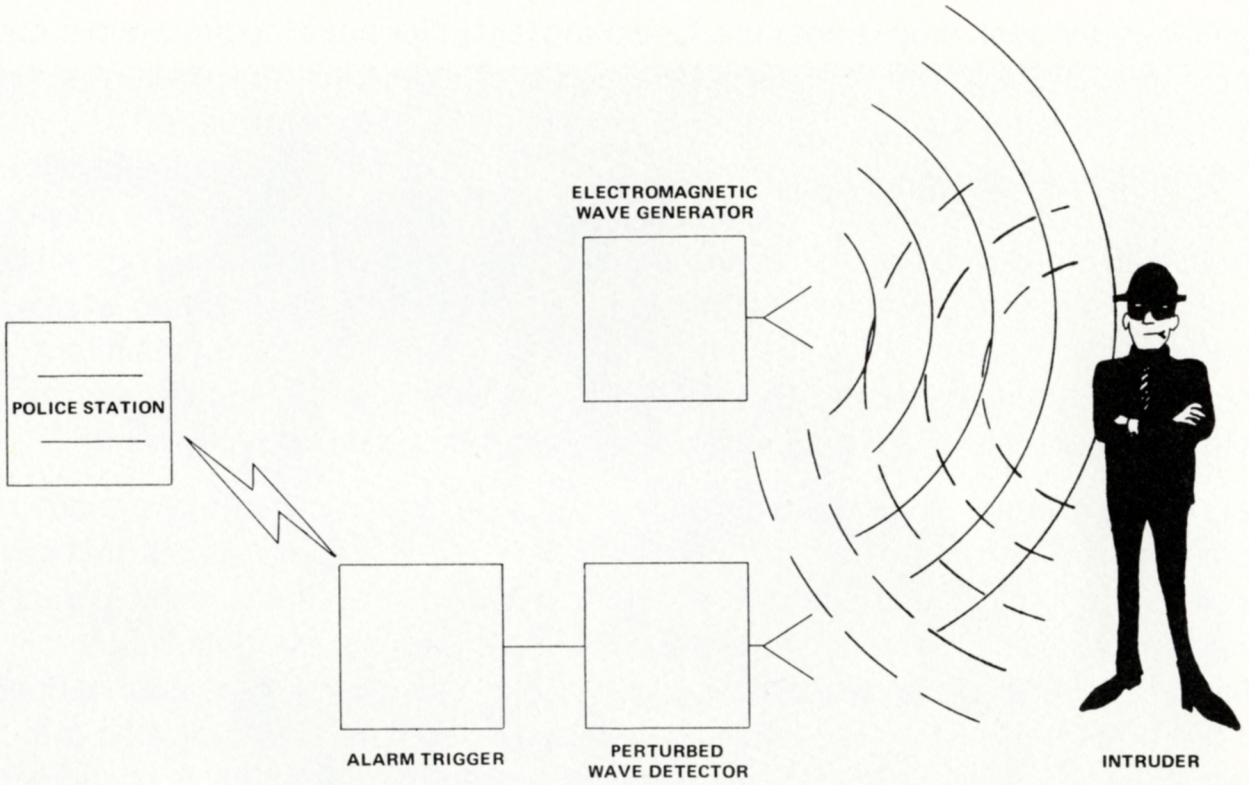
The Certified City program is another EES public service effort. This program was established to help Georgia cities evaluate themselves and initiate self-improvement projects in order to attract industry. The EES assists participating cities in starting their projects and provides basic economic data to help them in their evaluation.

Hazards of Microwave Ovens Explained to Georgia
Housewives on the TODAY IN GEORGIA Show

Using a Microwave Oven to Test the Feasibility of
Drying Peanuts with Microwaves

Georgia's biggest cash crop is peanuts. One thing that influences the price of peanuts is the presence of a mold which leaves a residue called afflatoxin. If the shells become cracked during the drying process, this mold can infect the meat and make it unsuitable for human consumption. The drying process currently in use involves forcing hot air up through a trailer load of freshly harvested peanuts. This technique causes the peanuts at the bottom of the load to become overdried and brittle with resultant shell cracking. Warm air pockets also are formed within the load of peanuts, a condition which encourages mold growth. In order to overcome this problem and get a more uniform and economical drying process, EES engineers have been working on a microwave drying techique. It is still in the experimental stages but appears to be promising.

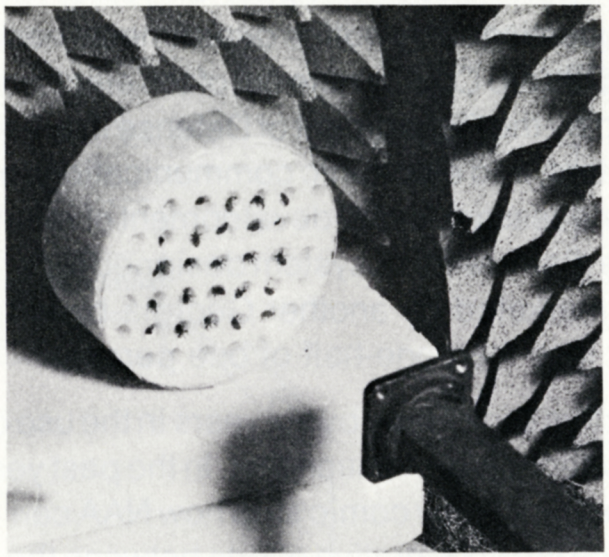
If a peanut crop in infected with the afflatoxin, the sheller can process it into peanut presscake or meal which can be sold only as fertilizer. Since these products are rich in protein, if an economical method could be found to remove the afflatoxin and extract the protein, then the protein could be sold as a food substitute at an enhanced value. Scientists at the EES have worked on this problem and developed a process that does extract the protein. Preliminary results show that all traces of afflatoxin also are removed. Work is continuing to improve the technique and to determine its economic feasibility. If the process does prove to be economical, Georgia will be a source of protein that can be used as a food additive or supplement in areas where the primary diet foods are deficient in protein.



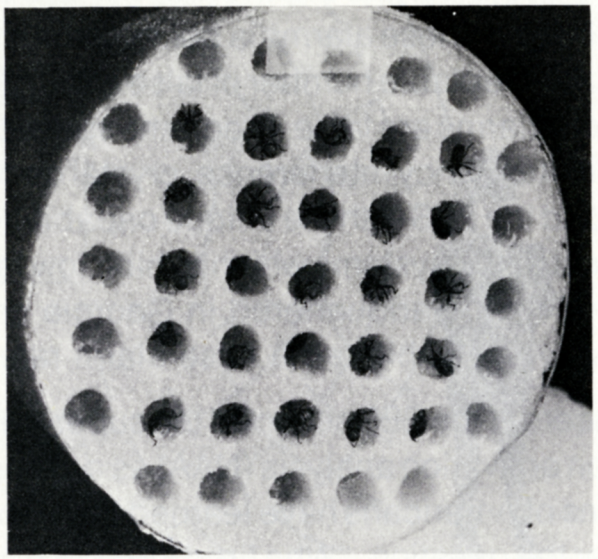
DIAGRAMMATIC REPRESENTATION OF AN ELECTRONIC INTRUSION ALARM

Many electric burglar alarm systems have been put into use in the past few years. The usefulness of these alarms is being seriously questioned by police departments because of an unacceptable number of false alarms. In DeKalb County nine out of ten electronic systems alarms are false. Programs sponsored by the Department of Defense in areas of radio frequency interference, crystal oscillators, and electronic communications have provided the EES with the unique capabilities necessary for the development of reliable low-cost alarm systems which exhibit low false alarm rates. A system designed for a national firm headquartered in Georgia and marketed by another Georgia-based company has exhibited a false alarm rate of less than one-half of one percent.

Engineers at the EES scooped the super-detective Dick Tracy by six years in the use of neutron activation analysis (NAA) as a crime detection/prevention tool. In the past year millions of Americans have learned through the Dick Tracy comic strip how NAA can answer the question, "Who fired the shot?" Since the cooperative efforts between the EES and the Georgia State Crime Lab were initiated in 1965, over 300 evidence samples have been analyzed using the reactor at the EES. NAA has also been successfully used to detect arsenic poisoning. Early analysis, in several cases, has saved the intended victim's life and has indicated how long the victim has been receiving the poison.



Boll Weevils Being Irradiated with Microwaves to Determine the Mean Lethal Dose



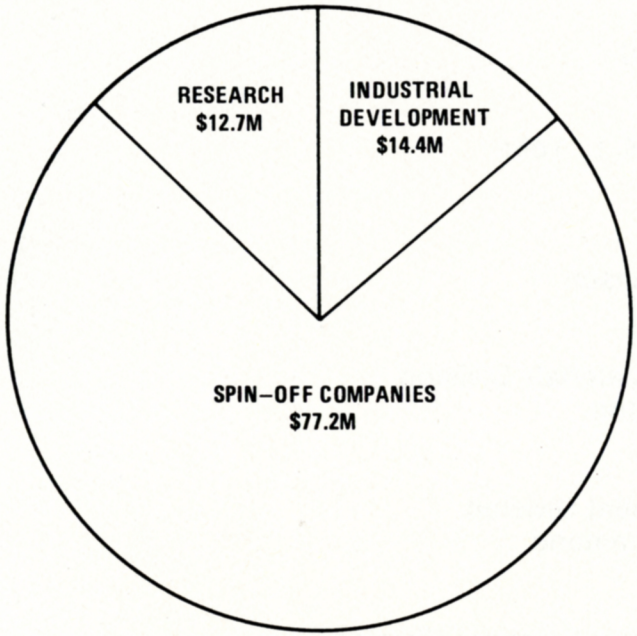
Close-up of Weevils in the Container

Restrictions on the use of chemicals such as DDT that have residual environmental effects are causing serious problems in insect control. One series of investigations now under way involves the use of microwave radar techniques for destroying insects in the larva or pupa stages and for preventing development into mature insects. Because of the penetrating qualities of microwaves, this approach could develop into an effective and economic method for use during the winter when many insects remain dormant in the ground or in trash above the ground. Experiments thus far indicate that pine weevils, pecan weevils, and boll weevils may be controlled in this manner.

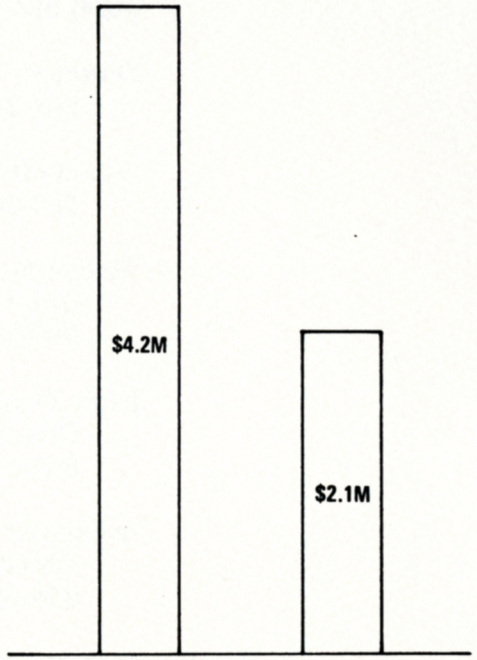
Another series of investigations is exploring the effect of infrared radiation on insects. Results of these studies will be useful in answering such questions as: How do insects find their food supply? How do they locate their mates? Answers to these questions will allow scientists and engineers to devise means of attracting insects such as the corn ear worm moth to traps.

The activities of the Engineering Experiment Station lead directly to the creation of thousands of new jobs each year throughout the state. One of the many projects aimed at furthering the industrial progress of Georgia is the management and technical assistance program. During the 1971 fiscal year, this program alone made a significant contribution to the creation of 1,934 identifiable jobs and in the saving of 527 jobs. Another 2,112 new jobs are in the process of being created or show definite promise of early establishment.

In addition to the number of jobs created or saved, the contributions of the EES to the state can be evaluated in terms of income generated by use of state tax dollars. The total direct and indirect impact of the EES research programs during fiscal year 1971 alone is estimated to be $27.1 million, and, if the impact of identified technological spin-off companies is added, the total impact is estimated to be $104.3 million for that year. As a result of this economic activity, the state received about $4.2 million in state taxes, over two times the state funds allocated for the EES during fiscal year 1971.



CONTRIBUTIONS TO TOTAL ECONOMIC IMPACT
OF $104.3 MILLION BY ACTIVITY



ECONOMIC IMPACT OF THE ENGINEERING EXPERIMENT STATION IN TERMS
OF CONTRIBUTIONS TO THE ECONOMY OF GEORGIA AND TAX REVENUES GENERATED

FOR ADDITIONAL INFORMATION:

Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332
(404) 894-3411

Director: M. W. Long
894-3400

Assistant Director: R. L. Yobs
894-3404

Electronics Division
Chief: R. C. Johnson
894-3516

High Temperature Materials Division
Chief: J. D. Walton
894-3661

Industrial Development Division
Chief: R. W. Hammond
894-3800

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

Physical Sciences Division
Chief: E. J. Scheibner
894-3430

Office of Industrial Assistance
894-3412