

Clemson University



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ANNUAL REPORT 1983-84



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PREFACE

Clemson University is pleased to present this summary of activities for 1983-84. The year was significant for the University in terms of accomplishments, honors and growth.

Leading the list of accomplishments was Clemson's designation by a consortium of top microelectronics manufacturers as the national center for reliability research on VLSI (Very Large Scale Integrated) circuit technology. In heading this \$1 million program, Clemson joins a select group of 10 institutions that includes Cornell, Stanford and MIT, which have been chosen to delve into other aspects of VLSI technology — a key to future generations of computers.

A number of Clemson faculty and students were tapped for major honors. For the first time in Clemson's history a faculty member, Professor John Wourms, won a prestigious Guggenheim Fellowship to continue his biological research of embryonic development in fish. Chemical engineer Jim Haile received one of the National Science Foundation's first Presidential Young Investigator Awards, recognizing his standing as one of the top 200 young scientists in the United States. A phenomenal six out of six Clemson nominees for Fulbright Scholarships were accepted by the Fulbright organization for graduate study in Europe. The national acceptance rate was 21 percent. And the Clemson Players' production of David Mamet's *American Buffalo* was chosen as one of the seven best college theater productions in the nation. The troupe was invited to stage the production at the Kennedy Center for the Performing Arts in Washington, D.C., in April.

In a year of hot debate about the quality and future direction of public education, Clemson continued to demonstrate how publicly supported institutions can compete in the higher education marketplace. Last fall, 320 Clemson freshmen exempted 2,547 hours of coursework in 11 subject areas through advanced placement testing. As of spring 1984, roughly one-third of all South Carolina high school seniors ranked first in their class had completed the application process to Clemson for the fall semester. Despite a national downward trend, the average SAT score of entering Clemson students in 1983-84 was 1,014 — the highest of any State school in South Carolina and more than 100 points above the national average and 200 points above the State average. Early figures for fall 1984 suggested the figure would rise to approximately 1,020 for 1984-85. Clemson's commitment to excellence was also reflected in the maintenance and continuing expansion of more than a dozen major scholarships and fellowships for superior students, and a like number of named professorships, endowed chairs and awards for outstanding faculty members.

While an improving economy has given the University some respite from the fiscal challenges of recent years, Clemson continues to make substantial progress in its ongoing program to augment State funds with money from other sources. Total academic private support, which includes the Clemson Annual Fund, the Clemson University Foundation, and direct gifts to our Development Office, continues to rise. As of December 1983, such support stood at more than \$4.7 million, up from \$4.3 million in 1982. During spring 1984, Clemson also reorganized its entire area of Institutional Advancement and initiated a formal set of policies and guidelines to coordinate all academic fundraising and communications activities. By avoiding duplication of efforts and working toward clear goals in those areas, the University can be expected to make significant progress in attracting financial support from outside sources.

In all, 1983-84 was one of outstanding accomplishments, pride and growth for the University. More details on the year's activities are contained within the body of this report.

Bill Atchley
President

ACADEMICS 1983-84

Graduate School

Arnold E. Schwartz, Vice Provost and Dean

Undergraduate Studies

Jerome V. Reel, Vice Provost

College of Agricultural Sciences

Luther P. Anderson, Dean

College of Architecture

*Harlan E. McClure, Dean**

College of Commerce and Industry

Ryan C. Amacher, Dean

College of Education

James E. Matthews, Dean

College of Engineering

J. Charles Jennett, Dean

College of Forest and Recreation Resources

Benton H. Box, Dean

College of Liberal Arts

Robert A. Waller, Dean

College of Nursing

Mary Lohr, Dean

College of Sciences

Henry E. Vogel, Dean

* Resigned as dean July 1, 1984. Paul David Pearson appointed dean effective August 1, 1984.

COLLEGE OF AGRICULTURAL SCIENCES

Agricultural Instruction

The instructional programs in agriculture at Clemson University continue to be guided by the mandate of the will of Thomas Green Clemson, "to afford thorough instruction in agriculture and the natural sciences connected therewith." Because agriculture has grown into a complex industry encompassing far more than farming, academic programs must constantly grow and change to prepare graduates to serve this diverse and critical industry. As the only institution in the State authorized to offer a full spectrum of curricula in agriculture at or above the bachelor's level, program quality is critical to ensure the best preparation of students who as graduates will be leaders in this basic industry.

At no time in history has agriculture been of greater importance to the human race. The traditional roles of providing food and fiber for humans and feed for domestic animals while protecting natural resources constantly assume added importance. In addition, agriculture is a major employer in the United States, accounting for more than 20 percent of the nation's jobs, and is the strongest positive element in our nation's foreign trade. Within the State, agriculture is a \$1 billion industry in production, with an additional \$1 billion in processing and packaging, or value added industries. In both production (farming) and processing/marketing, agriculture is the epitome of a high technology field. Not only must students appreciate recent advances in biotechnology and computer applications to serve the diverse areas of agriculture, they must be competent in these emerging technologies.

To satisfy the basic instructional mission of the College of Agricultural Sciences, several curricula are available and emphasis is placed on applying principles to recognize and solve problems. This requires constant caution to avoid over-emphasis on the technology, rather than the principle. All facets of instruction are constantly reviewed and revised to help ensure that students receive the most current information. Faculty members doing research supported by the South Carolina Agricultural Experiment Station bring the most recent information to their students. This must be considered one of the greatest educational benefits of the association of agricultural faculty with both teaching and research responsibilities. Research activities also make equipment and facilities available to students.

Graduate education is recognized as a responsibility of the college, and growth in this essential part of the instructional programs reflects maturity of the college and of Clemson. Efforts to attract the most highly qualified and highly motivated students at all degree levels have been intensified in response to projections of serious potential deficiencies in

numbers of agricultural graduates in the near future.

Special instructional activities in the form of short courses, workshops and seminars are presented throughout the State to serve current professionals and help maintain and improve their level of technical competency. International agriculture is recognized as an area of responsibility, and this is served through programs at Clemson and abroad.

In line with a national trend, the 1983-84 academic year saw a continued decline in agricultural enrollment at Clemson. Numerous reasons have been suggested for that decline, one being the image of agriculture. The vast majority of high school students, their parents and their teachers do not view agriculture as a career field. Agriculture is commonly equated with farming, and recent losses because of severe weather as well as other bad financial conditions have further damaged people's perception of farming.

However, the decline is slowing and there are moderate indications that it has reversed at Clemson. This resulted partly from intense recruiting activities initiated more than four years ago.

In our recruiting programs we have emphasized the diverse career opportunities and growth potential for agricultural graduates, and for agriculture as a high technology, professional field that involves much more than farming. New brochures and other recruiting material that stress these concepts have been prepared.

Practical and business experience is still sought by employers. The growing internship program provides students with experience. In some areas there are more internship opportunities than students to fill them.

Affirmative action efforts also have been linked to both recruiting and internships. The college has had grants through the U. S. Department of Agriculture to support minority internship students. These and similar grant funds have provided critical support for minority recruiting efforts.

The success of the instructional programs can be measured in several ways. Although enrollment is down, demand for graduates is very high; in 1983-84 more than a dozen companies and agencies made formal recruiting visits to the college, and many more made inquiries about the availability of graduates.

In addition, scholarship support of undergraduates is exceptional. College-wide, 110 scholarships with a value of more than \$75,000 are sponsored by 53 donors. In addition, nearly 50 scholarships are associated with specific departments.

In the past year three critical faculty vacancies in food technology have been filled. As a result, the proposed Ph.D. in Food Technology has been reactivated, and approval of this program during the 1984-85 academic year is anticipated. Integrated Pest Management has grown, and a revised graduate curriculum is now under study in this field. A significant administrative event in 1983-84 was the transfer of the Department of

Agricultural Education to the administration of the College of Agricultural Sciences. Demand for off-campus graduate courses is greater than our resources to provide them.

International Agriculture

The College of Agricultural Sciences maintains services to international agriculture in several areas. During the 1983-84 academic year, nine undergraduate and 29 graduate students were enrolled in degree programs.

In addition, the college hosted more than 30 foreign visitors whose stays ranged from a few hours to several months. Foreign programs in the Seychelle Islands, Mali and Thailand (sponsored through the Southeast Consortium for International Development) are ending, and Clemson faculty are returning from various assignments. During the spring and summer, new cooperative programs in horticulture, plant pathology and agromedicine (jointly with the Medical University of South Carolina) were being negotiated with the government of Egypt and the United States Agency for International Development.

Continuing Education

Continuing education activities sponsored by the College of Agricultural Sciences serve a widely dispersed and diverse clientele. Extension Service personnel, farmers, home gardeners, pesticide operators and consultants are but a small sample of persons attending a wide variety of short courses, conferences, schools, seminars and workshops sponsored by the college.

Such programs, tours and field days are offered on campus, at branch experiment stations and other locations throughout the State.

COLLEGE OF ARCHITECTURE

The 1983-84 academic year marked the 25th anniversary of the College of Architecture. In the words of retiring dean Harlan E. McClure, FAIA, who had served as dean the entire period, it was an occasion for carefully assessing the past while looking to future challenges.

The College of Architecture has been built around the concept of mutually supportive departments closely serving one another as resources in educating design professionals.

Annual College Programs

For each of the past 28 years, the Clemson Architectural Foundation has provided a distinguished series of public lectures. The 1983-84 offerings were of special timeliness because of the outstanding celebration speakers who were included.

Dean McClure opened the season with his illustrated lecture, "How Is a Humane Urban Environment Created?" Ralph Knowland offered the second, a report on the experiences he and his wife had while leading the graduate students in the Genoa Center the previous year.

The speakers for the two-day anniversary symposium on October 14/15 included professor Harold Fleming of the Potomac Institute; Douglas Stoker, head of cybernetics for Skidmore, Owings and Merrill; Mexican architect Ricardo Legorreta; National AIA president David Notter; and Lawrence B. Anderson, FAIA, dean emeritus of MIT.

The speakers in spring 1984 included several notable design professionals: David Bennett, AIA, of Minneapolis, Minnesota; Hugh Newell Jacobsen, FAIA, of Washington, D.C.; Armund Burgun, FAIA, of New York City; and Peter Blake, FAIA, the Honors Day speaker. In addition, Peter Morrin, curator of twentieth century art at the Atlanta High Museum talked in connection with the opening of the South Carolina Arts Commission Exhibit.

The Clemson Architectural Foundation sponsors annual exhibitions in the Lee Hall Gallery. In 1983-84, in addition to the South Carolina Arts Commission Exhibit, 10 other shows were displayed, including an architectural alumni show, an exhibit of paintings by the late Tennessee artist Walter H. Stevens and a show featuring the work of John Acorn and Betty Hahn.

Two student shows also were presented, the Architectural Thesis and Terminal Project Exhibits, and the MFA Thesis Show.

Teaching, Public Service and Research

In fall 1983, architectural graduate students under the direction of Frederick "Fritz" Roth, FAIA, worked with the city of Georgetown and its chamber of commerce to develop urban design studies for the

Georgetown waterfront. Public hearings and presentations enabled the town's merchants and citizens to have a detailed understanding of two alternative plans.

The concepts were accepted by the city council, the chamber and the merchants association, and steps will be taken to enter a second phase of development.

In spring 1984, graduate students who had just returned from the Daniel Center in Genoa began design feasibility studies for property immediately north of The Citadel.

Simultaneously, graduate students in architecture and planning in the Genoa Center worked with professors Cesare Fera and Yuji Kishimoto on a Genovese urban design public service project. The student work resulting from the Genoa design project during the fall and spring terms was published in the nationally distributed newspaper *IL SECOLO XIX*. Projects of this kind, undertaken twice a year, have done much to help create a strong sense of identity between the College of Architecture CAF/Daniel Center for Building Research and Urban Study in Genoa and the city's professional people. The center has been cited as a rare example of an American academic unit abroad that seems to belong to and serve its host city.

In 1983-84 the college's commitment to public service continued to benefit the State. Graduate students in the Department of Planning Studies concentrated on small town and rural planning as well as urban design projects with architectural graduate students.

Another development in planning studies was the establishment of Public Service Assistantships. Funded by local communities needing quasi-professional help, the program allows graduate students to earn while still in school. In the light of personnel demand, the College of Architecture proposed a three-year graduate program leading to the M. Arch. and M.C.P. degrees with a common concentration in urban design. Such a possibility exists in a number of leading architectural schools. It is badly needed at Clemson, and professional offices and agencies are eager to employ graduates in this field.

One of the most fruitful areas of graduate public service and research has been in the master of architecture studio in Health Care Facilities Planning under the direction of George C. Means, FAIA. The two major health care public service studies in 1983-84 were the York County Council on Drug Abuse and Alcoholism Facility in Rock Hill and the Lexington/Richland Counties Alcohol and Drug Abuse Center — the LARADA Project. Both project studies were funded through the Clemson Architectural Foundation.

Faculty and graduate students of the health care studio met with the Family Practice Program at the Medical University of South Carolina in Charleston concerning the day-care public health problems in that city.

The meetings were related to plans being formulated by the Medical University to develop a model day-care center. The health care studio also helped the Chester Youth Council make more effective use of a new building.

Professor Means attended a meeting of the AIA/Health Care Committee in Los Angeles, and the conclusions reached from the debates in which he was a participant indicate the national need for increasing the number of architectural graduates concentrating in health care facility planning.

A research grant of \$25,263.03 has been awarded to the Planning Studies Department to study water resource use in South Carolina. This research will provide a compendium of information, not now available in one place, of existing water source systems identified by type, location, water source and capacity, and the area served by each system. The studies also will review existing studies of each of the systems to anticipate future needs.

Professor Barry C. Nocks of the Planning Studies Department worked with the city of Allendale on a general development plan, and Professor Glenn Varenhorst, planning studies, prepared "A Bibliography on the Official Map," Chicago, Illinois, for the American Planning Association. Professor Olgun Ersenkal, planning studies, worked on urban design projects for Williamston and Honea Path. Professor Jose Caban, planning studies, worked with a group on creative sketch planning studies for Greenville County health facilities.

The visual artists of the Department of Visual Arts and History exhibit their work in galleries nationally and internationally. In 1984, an example of their work was in the exhibit "The New South," at the galleries of the Palazzo Venezia in Rome, Italy. The work of about 40 South Carolinians was included, five of whom were members of our faculty: John Acorn, department head and sculptor; Tom Dimond, gallery director and painter; Sam Wong, professor and photographer; Mike Vatalaro, associate professor and ceramist; and Syd Cross, assistant professor and printmaker. In addition, 11 artists who have received their M.F.A. degrees at Clemson were included.

Professor Harold N. Cooledge, Alumni Professor of Architectural History, prepared the material on Samuel Sloan included in the recent McMillan Encyclopedia of Architects. Cooledge also received a grant from the Barra Foundation for work on his biography of Samuel Sloan. The manuscript has been accepted for publication by the University of Pennsylvania Press.

Cecelia Voelker, associate professor of art and architectural history, presented a paper at the International Congress marking the 400th anniversary of the death of Carlo Borromeo.

The recently established American Council for Construction Education visited and accredited the Department of Building Science Manage-

ment for the maximum five-year period. It is one of only 16 programs in the nation to be approved. The Department of Building Science and Management joins the Department of Architecture (accredited by the National Architectural Accrediting Board) and the Department of Planning Studies (certified by the American Planning Association) as fully accredited schools among those requiring accreditation.

Faculty Honors and Awards

Twice during the past academic year Dean Harlan E. McClure received special honors. As part of the Quarter-Century Symposium, Governor Richard Riley conferred the Order of the Palmetto on him in recognition of distinguished service to the state and its physical environment. The Order of the Palmetto is the highest civilian award bestowed by the State. At the symposium banquet he also was presented a plaque in recognition of an endowment fund established by alumni in his honor. This endowment also includes funds for a portrait of him to be presented to the college at Homecoming '84. The Silver Medal of Tau Sigma Delta also was presented to Dean McClure in recognition of his presidency of the architectural honor society. Later in the year the governor, in a special ceremony on behalf of the South Carolina Arts Commission, presented McClure the 1984 Vernor Award and a piece of sculpture in honor of his contributions to the arts in South Carolina over a 28-year period.

Clarence Addison was promoted to full professor in the Department of Building Science and Management and also received the Award of Merit of the American Association of University Professors in recognition of his outstanding service in minority recruitment and university relations.

Ralph Knowland, head, Department of Building Science and Management, was elected to serve as chairman of the College of Architecture's search committee for a dean to succeed Dean McClure, who announced his retirement from that position effective July 1, 1984. Professor Paul David Pearson of the City College of New York was selected. Professor Pearson, a native of Greenville, was educated at Clemson and Georgia Institute of Technology, with graduate degrees from Columbia University and London University. He assumed office August 1.

Roger Liska, associate professor, building science and management, was elected president of the Piedmont Chapter of the American Institute of Constructors. Ralph Knowland was elected third vice-president.

Gayland Witherspoon, professor of architecture and former head of the Department of Architectural Studies, was elected secretary of the South Carolina Chapter of the American Institute of Architects at the chapter's spring meeting in Columbia. He also was promoted to full colonel in the engineering branch of the active Air Force Reserve. He has played a major role in the development of the Air Force Honors Awards in Architectural Design.

James Dalton, professor of architecture and assistant to the dean, was named director of the School of Architecture, Kent State University, Ohio, effective July 1, 1984.

Student Awards

The top academic award of the College of Architecture went to Brian Frank Ridgeway of Norwalk, Connecticut. The runner-up, and a previous winner of the AIA/AHA fellowship, was Thomas H. Bast, AIA, of Clemson, who received the National AIA School Medal. The John Mauthe Memorial Award and Medal in Building Science was presented to Lory Anne Norbut of Sanford, Maine. The Alpha Rho Chi Medal, presented to an outstanding graduate in the master of architecture program with the best record in leadership and professional promise, was awarded to Samuel Bennett Herin, Columbia.

Frank Arnold McClure, II, of Varnsville was presented the Second Year Faculty Award. Roger Wiggins of Central received the AGC Award of Achievement, and Alan W. Grey of Carrolton, Georgia, received the AGC Citation for Merit. The Piedmont Contractors Award went to David H. Willis of Charlotte, North Carolina. The American Certified Planners Award was presented to John H. Truluck of Lynchburg, and the Alumni/Faculty Planning Award went to Charles William Smith of Florence.

The Visual Arts Undergraduate Citation was given to Todd Garrett Beck of Conover, North Carolina, and the Visual Arts Graduate Citation to Jeanne Petry of Lebanon, Pennsylvania. History citations were presented to Ernest Fava of Alexandria, Virginia, undergraduate, and Joseph William Moore of Waccabuc, New York, graduate. Amy C. Spitzmiller of Ft. Lauderdale, Florida, a rising graduate student, received a national AIA/AHA Foundation Scholarship for 1984-85. Molly Scanlon of Pittsburgh, Pennsylvania, a sixth-year health care student, was the 1984-85 AIA/AHA Fellowship winner. Susan Cole of Aiken received a grant from an anonymous CAF donor to assist her in completing her final year of graduate study. In addition, 18 students in the College of Architecture received special grants in the form of scholarships, endowed fellowships and other similar awards.

Continuing Education

In connection with the October celebration in 1983, a special operating exhibit of computer-aided design equipment was set up in the college for instruction and review by practicing architects, planners and others.

Alumni of the college and other members of the Clemson Architectural Foundation were offered the sixth CAF Study Tour to Germany, Austria, Italy, France and Hungary. Arranged by Dean McClure and his wife Susan, the tour included several days at the Daniel Center and visits to selected architecture, both historic and modern.

COLLEGE OF COMMERCE AND INDUSTRY

The College of Commerce and Industry comprises the School of Accountancy, the School of Business and the School of Textiles. The college is also responsible for the Office of Professional Development and the Small Business Development Center, separate entities reporting directly to the dean.

The School of Accountancy and the School of Textiles have completed their first year as separate schools within the college. This year the School of Accountancy continued to offer its traditional undergraduate curricula in accounting, as well as complete its first master's in accountancy program.

The School of Textiles pays special attention to textile programs with an emphasis on business. The school began accepting students into its new textile management program in fall 1983.

The School of Business focuses on traditional business fields: economics, finance, marketing and management. The school's curricula are designed to prepare students for a variety of careers as well as to furnish an education on which to build for a lifetime. The curricula recognize the need for an understanding and appreciation of the nature of human interaction and the comprehension of the economic, political and social environment.

The college continues to maintain a stable enrollment. In fall 1982, 2,429 undergraduates were enrolled in its 14 degree programs. The graduate programs include 110 master's and Ph.D. students. The Clemson at Furman MBA program enrolled 194 students.

The total perspective of the college is best shown through descriptions of its major components.

The School of Business

Department of Economics

The economics faculty continued to receive national recognition for their scholarship and teaching. In the past year, their research produced 10 books, 26 articles, 24 monographs and contributions to books and journals, 20 papers presented at professional meetings and three completed grants.

In addition, Clemson economists served as referees and editorial board members on major professional journals, consulted with government agencies and private firms, wrote numerous columns and editorials for local and national newspapers and appeared on several television programs.

Robert Tollison, holder of the Abney Chair of Free Enterprise, is president of the Southern Economic Association. Professor Tollison will

be on leave during the next academic year and will serve as director of economic analysis for the Federal Trade Commission and as a member of the Center for the Study of Public Choice at George Mason University.

Several outstanding economists joined the faculty beginning in the 1984-85 academic year. Matt Lindsay was named the first J. Wilson Newman Professor of Managerial Economics. Professor Lindsay joined the faculty after serving as professor of economics at Emory University and UCLA. The Center for Economic Research recently was approved by the South Carolina Commission on Higher Education to support faculty development and assist faculty members in their research. Roger Meiners is the center's first director. With degrees in both economics and law, Professor Meiners has done extensive research in both areas.

Roger Miller, an internationally known author, has been named an adjunct professor of economics at Clemson University. He has written more than a dozen economics textbooks. Our affiliation with Professor Miller will enhance Clemson's national reputation.

William Chappell has accepted a position as assistant professor of economics. His research interests are public finance and industrial organization. Two visiting assistant professors, Darrell Parker and Caryl Ersenkal, joined our faculty and will teach and do research.

In addition to the new appointments, Bruce Yandle has returned from his two-year leave of absence as executive director of the Federal Trade Commission. Professor Yandle has been named an Alumni Professor of Economics, an honor that recognizes faculty members who have demonstrated outstanding teaching ability.

The Center for Economic Education continued to offer economics courses to public school teachers in South Carolina. While enrollment in the overall economics curriculum remained constant last year, enrollment in economic education courses increased because of the new high school requirement that each high school student take at least one economics course. Funding for the classes was provided by Anheuser Busch and the Greenville Chamber of Commerce. At the same time, Du Pont and Liberty Life expanded their financial support for the economics programs.

Our faculty's research efforts continue to grow. More than 40 articles are under review by professional journals, and countless papers are in progress.

Department of Finance

During the year, the Department of Finance continued to enhance its reputation through faculty research and professional publications. The department was stabilized when it hired its first department head. Faculty members undertook new research projects that took them throughout the United States. Programs, presentations and seminars were made in a

number of places including Florida, Washington, D. C., and New York.

Enrollment in the finance major program continued to grow during the year. More than 150 freshmen were admitted, bringing the number of majors to 525. A new student organization, the Investment Club, was very popular with both faculty and students. The Finance Club continued to be one of the most productive organizations in the School of Business. Membership continued to grow, and interest by the professional community reached an all-time high. The club heard talks by several executives from major corporations and also made field trips to Atlanta and Washington, D. C.

Department of Management

The department is making substantial progress in pursuing its two primary goals of teaching and research. In teaching, the department continues to offer the most popular undergraduate degree program on campus, the B.S. in administrative management. More students are enrolled in this B.S. program than any other on the campus. In addition to the B.S. in administrative management, there is a B.S. in industrial management that focuses on the production/operation side of industry. Industrial management also offers an M.S. and a Ph.D. Since the Ph.D. in industrial management was transformed from a Ph.D. in engineering management in summer 1982, enrollment in that program has grown substantially, as the following numbers attest.

1983-84 Enrollment:

Undergraduate	1,247
Graduate Resident	73
Clemson at Furman MBA°	<u>191</u>
TOTAL	1,511

Degrees Awarded by Type:

Bachelor of Science	299
Master of Science	19
Master of Business Administration°	37
Doctor of Philosophy	<u>3</u>
TOTAL	358

°Taught and administered by Furman University.

Additionally, the total number of students taught by the department increased about 10 percent last year, reflecting the growing number of students in other degree programs who are interested in management issues.

To help pursue our goals of teaching and research, we recruited five new faculty during the academic year. Mike Crino from Louisiana State University has joined us in the area of organizational behavior and

personnel; Ray Jacobs from the University of North Carolina in production and operations management; Don Parks from Texas A&M University in strategic management; Karen Stine from the University of North Carolina in safety and health; and Bob Barrett from Virginia Polytechnic Institute and State University in management science.

Research in the department picked up last year, a reflection of the increased number of Ph.D. students working on dissertations with faculty, the increased number of journal articles published by the faculty and two grants received in the department over the past year.

To help increase the relevance of our programs, the department formed an Industrial Advisory Board. One of the member firms, Burlington Industries, announced a \$125,000 contribution to endow the department's first chaired professorship. A search to attract a nationally known scholar in the area of manufacturing policy will begin in 1985. Another member firm of the board, NCR Corporation, donated 20 microcomputers and associated software to establish the NCR Microcomputer Applications Laboratory. That grant is worth approximately \$100,000.

Department of Marketing

The 1983-84 academic year was the second year of operation for the Department of Marketing. Jacquetta McClung from the University of Oklahoma joined our faculty in August. She brings particular expertise in the areas of marketing management and marketing for small business. Robert Landry of Louisiana State University joined our faculty in January. His primary interest is in the area of international marketing.

During the fall semester, Marie Cheatham, television actress on "Search for Tomorrow," visited the campus for several days. She spoke to the Marketing Club and several classes on the marketing problems of daytime soap operas. Students in several marketing classes wrote a major research report on this topic and submitted it to Proctor and Gamble, the owner of "Search for Tomorrow."

In the spring semester, Joan Mazza, vice president and sales manager of Mary McFadden of New York, visited the campus. She spoke to the Marketing Club and several classes and helped students develop a major report on the marketing of high fashion, which was submitted to Mary McFadden at the conclusion of the semester.

During the year courses in sales management and retailing were taught for the first time.

Enrollments continue to grow as students show more interest in marketing as a career. Firms are beginning to recognize that Clemson does have graduates with a marketing background and as a result are increasing their recruiting at Clemson.

The faculty's research efforts have gained wide acceptance by profes-

sional associations and journals, thus increasing recognition of our department by colleges, universities and businesses across the nation.

School of Accountancy

Since the creation of the School of Accountancy in December 1981, the work on the Master of Accountancy program has been completed. During 1982-83 the first students were admitted. Although the program was initially started with on-campus courses, it expanded in the summer of 1983 to Greenville Technical College, where selected courses are offered at night. Interest in the new professional program continued to be strong throughout the year, and by the summer term enrollment exceeded 20 students. The first students were graduated in May 1984.

The undergraduate program continued to be strong during the year. Although accounting majors increased by only 1 percent, the demand for accounting courses increased approximately 4 percent because the accounting majors took more electives in accounting to strengthen their basic accounting knowledge, and, as the overall job market tightened, students in other majors sought accounting courses as areas of minor concentration. During the fall term, more than 2,750 students were enrolled in accounting courses.

The fund drive for the professional program that began in 1981 continued. Contributions and pledges have exceeded \$93,000. These funds have been earmarked for such areas as the development of the professional program, increased library holdings, faculty development, and student recruiting and placement. Although the funds were received and pledged from many sources, the major commitment was made by CPA firms.

To begin the year the school hired two new faculty members in the areas of taxes and information systems. These additions increased our faculty positions to 21, 19 of which are permanent.

The major effort in student activities was the first full year of our Beta Alpha Psi chapter. Beta Alpha Psi is the national honorary fraternity that admits students who meet minimum grade requirements and have at least junior standing. The Accounting Club was also restarted after a year of inactivity.

School of Textiles

Growth and change highlighted the School of Textiles. The first group of textile management students completed the initial year of course work, and several had the opportunity to gain intern experience in manufacturing during the summer months. Two teachers experienced in textile manufacturing and applied science were recruited to fill faculty vacancies. The credentials of candidates to fill two additional faculty positions established through the retirements of senior faculty are being reviewed

by a faculty search and screening committee. Aggressive recruiting efforts and improved perception of textiles as a career area have boosted undergraduate enrollment. Consequently, freshman course enrollments in textiles during the forthcoming academic year are projected to be at the highest level in more than a decade. Textile graduates from the class of 1984 found jobs readily available and salary offers at levels higher than in many other fields.

Textile research for private industry expanded and is continuing in spite of a Christmas day flood caused by a burst sprinkler pipe that devastated our entire facility. We continue to be at the forefront of applied science and technology. New research in fiber processing, spinning, yarn treatment, weaving, dyeing, printing and finishing is under way, and research involving composite materials, medical structures, computer applications, color instrumentation and nonwovens has been expanded. The increased research has forced us, in some instances, to use instruments and space on a loan basis. To expand our research capability, our technical facilities need improving.

Cooperation with textile firms and support organizations is at a record high. Our faculty work closely with textile manufacturers and suppliers. Through active participation in professional organizations and our association with industry, we have supported the University's public service mission.

Office of Professional Development

The Office of Professional Development is South Carolina's largest provider of continuing professional education for business and industry (based upon preliminary 1983-84 enrollment figures). During 1983-84, some 18,750 people from the Southeast, the nation and overseas attended more than 550 Professional Development seminars, conferences and short courses. These figures represent an increase of 36 percent in the number of individuals served and a 48 percent jump in the number of courses offered over the 1982-83 levels, which themselves were 150 percent higher than those of the 1981-82. All Professional Development programs are run on a self-sustaining basis.

Textile Conferences

Professional Development offers a wide selection of programs geared to the needs of the textile industry, including one-day workshops, two- and three-day technical conferences and an intensive, two-week Textile Leadership for Tomorrow program. These conferences, bringing together leading industry experts and textile faculty from Clemson, N. C. State, Georgia Tech and top research institutions, provide updates on textile technology and developments for textile managers, supervisors and executives from throughout North America and Europe. New con-

ferences are continually developed in response to new problems and opportunities facing the textile industry. In 1983-84, 26 textile conferences on topics ranging from basic processes to advanced process and equipment applications drew more than 1,650 textile managers and executives — an increase of 65 percent over 1982-83, even though the number of programs remained the same.

One-Day Management Series

Professional Development entered the one-day management seminar market in fall 1982 to meet the needs of Southeastern business and industry for economical training alternatives. Since then, more than 25,300 people from thousands of businesses, industries, agencies and organizations have taken advantage of this low-cost, high-quality training option. Each of these seminars covers one of 20 or more topics in a compact, seven-hour format and is presented in any one of 41 major cities throughout the Mid-Atlantic, Southeast, and South Central regions. These seminars offer business people the opportunity to attend good training programs as easily as they might commute to their own jobs, with no added travel or accommodation expenses.

In-Depth Management Programs

Professional Development presents a comprehensive series of two- and three-day programs covering vital management topics such as productivity improvement, quality control, computer applications, purchasing, inventory, maintenance, marketing, construction cost estimating and employee involvement. These programs provide in-depth reviews and updates on the continually evolving progress of American management theory, technique, style, philosophy and practice, and are always presented with application in mind.

In-Plant Programs

In recent years, the "in-plant" or "in-company" training program — in which an entire seminar is brought to a company's own plant — has become popular among cost-conscious training managers. Professional Development, one of the Southeast's pioneers in in-plant training, continues to offer 50 or more of these "any topic, anywhere, any time" programs yearly. From leading Fortune 500 corporations to fast-growing new entrepreneurs, from the Department of Defense and NASA to the Boy Scouts, Professional Development has brought and continues to bring training where it's needed, when it's needed, in the form in which the customer needs it most.

Special Events

Whenever new developments create new needs and opportunities, Professional Development responds with "special events" programs designed to meet needs unmet by its more conventional offerings. When women began to make an impact upon executive positions in the Southeast, Professional Development responded with its pioneering "Professional Development for Women" workshop, which continues to draw more than 300 business and professional women each spring. When *In Search of Excellence* topped the nonfiction best-seller list, Professional Development responded by bringing in top McKinsey & Company executives for an executive briefing on the decade's most talked-about book. When Dr. Terry Deal took those ideas to the heart of the matter in his book *Corporate Cultures*, Professional Development sent Dr. Deal on a four-day Washington-to-Fort Lauderdale series of executive briefings. When the textile industry's concern with Washington's response to the textile-imports issue became increasingly urgent, Professional Development took a group of industry executives straight to the source with its "Textile Briefing on Capitol Hill." These and other special programs underline Professional Development's commitment to meeting the needs of its constituency.

International Outreach Programs

The Office of Professional Development's mission today reaches around the world to bring American managerial and technical expertise to those who want and need it and to give American executives a first-hand look at their overseas counterparts. As part of an expanding relationship with the world's second largest textile firm, Professional Development has presented two two-week comprehensive training programs ("Fortnights at Clemson") for Courtaulds of Great Britain, and has presented extended training sessions at Courtaulds' Manchester (UK) headquarters. Further training sessions for the British textile giant are already planned. In 1983, Professional Development conducted a wide-ranging training effort for officials of CATGO, the international cotton arbitration and testing organization. Representatives came from CATGO headquarters in Cairo to attend. In addition, the United States Department of State sought out Professional Development to present a series of management training programs for embassy personnel in Costa Rica. Talks are under way for additional overseas training projects in Latin America, the Far East, the Middle East and Europe. And in a turnabout of sorts, Professional Development took a group of American textile executives to China in late September 1984 for a two-week fact-finding mission. The Clemson delegation toured Shanghai's textile mills with one of China's top textile officials, Zhang Hui-Fa, as their guide.

Small Business Development Center

The Small Business Development Center of South Carolina is a consortium of four universities in the State. During 1983, the regional center at Clemson conducted 30 continuing education courses attended by more than 700 small-business persons. In addition, more than 360 clients used the consulting services offered by the center during 1983. During 1984, 41 programs attended by more than 1,000 small-business persons were presented. Each course addressed the basic needs of small businesses, such as accounting and payroll procedures, inventory control, cost reduction and computer management.

Projections show that during 1984 more than 410 small businesses will seek assistance through the Clemson SBDC. These services include market research, business start-ups, initiating record-keeping processes and general management advice. Research and consulting for small-business persons are handled by graduate students and faculty members from the College of Commerce and Industry.

Clemson's Basic Service Center, located in Room 425 Sistine Hall, serves 12 counties, with satellite offices located on the USCS campus in Spartanburg and on the Lander College campus in Greenwood. With demand for SBDC services increasing, a new satellite office is planned for the Greenville area.

COLLEGE OF EDUCATION

As one of the four institutions in South Carolina with nationally accredited teacher education programs at the undergraduate and graduate levels, Clemson is committed to the best possible teacher education.

During 1983-84, the College of Education laid the groundwork for program changes necessary to implement the recommendations of the National Commission on Excellence in Education and Governor Riley's educational reform program.

Major goals of the education reform movement include recruiting academically superior students for teacher education programs and developing more demanding teacher education curricula with emphasis on subject matter.

Clemson's secondary teacher preparation program has long stressed in-depth study in the subject to be taught. In effect, secondary education students receive a double major: the subject and education. A concentration of subject area study also is required by the elementary education program. Thus, a major portion of the rigorous teacher preparation curricula is taught by Clemson's faculty in other departments. This emphasis upon content far exceeds the requirements for certification and has helped Clemson graduate well prepared public school teachers.

During the past year, an education student recruitment task force, chaired by a faculty recruitment coordinator, began to develop a potential student data base and to design activities to attract top-level students to the college. Approximately 150 superior high school juniors who had expressed an interest in teaching were brought to the campus in April for an orientation to Clemson's teacher education program.

Instruction

The Learning Resource Microcomputer Lab operates on a 12-hour daily schedule to help students upgrade their basic skills. The programs serve approximately 150 students per week. Graduate and undergraduate classes also use this laboratory for "hands-on" instruction in the educational applications of computers. The lab also serves the research and writing needs of education faculty members.

The bachelor's degree program in graphic communications implemented in 1982 had attracted more than 100 majors by the end of the 1983-84 school year. Twenty-nine new students were identified as beginning freshmen for fall 1984. A new faculty member was added due to increased enrollment in this program.

The Doctor of Education degree program in vocational-technical education made excellent progress during the past year. Twenty-seven students have been admitted to the program, and a new faculty member

was added. Two graduate teaching assistantships, approved for the doctoral program, began in fall 1984.

Agricultural education faculty members developed advanced units in the computerized farm management instruction program, including farm business management contest materials, farm financial statement preparation and depreciation computation.

In-Service

During 1983-84, the College of Education offered 89 courses at 41 locations throughout the State. Enrollment in these courses was 1,329.

During the 1984 spring and summer semesters, 13 courses in mathematics, science and computer education were taught with funds from the State Department of Education. Two hundred seventeen teachers were enrolled in these courses.

During the year the ComputerVantage program traveled more than 9,000 miles and participated in a variety of activities. These activities included:

- assisting in off-campus graduate classes
- conducting in-service sessions for school districts
- conducting five-week computer classes for public school students
- conducting two-week computer camps
- participating in college week for senior citizens at Clemson
- participating in Innovations Day at Piedmont Technical College

The agricultural education faculty conducted in-service workshops throughout the State. Two hundred thirty-five teachers participated in these workshops, which dealt with such activities as agricultural mechanics, farm business management, horticulture, special needs learners and supervised occupational experience programs.

Research and Grants

The Department of Industrial Education produced two computer programs during 1983-84. The Printing Industries of the Carolinas (PICA), sponsor for the research, has begun marketing software "MAT" (Make A Test) and "Quick Score" on a nationwide basis. Proceeds from these programs will support research and further development.

During 1983-84 the Department of Industrial Education continued to receive support from industry in the form of equipment and supplies. Electrical supplies, paper for printing, ink, a flexo printing press and other equipment were donated to the department. The estimated value of these donations exceeded \$100,000.

The Department of Industrial Education received a \$55,984 grant from the State Department of Education to continue the Trade and Industrial Teacher Education program offered throughout South Caro-

lina. This grant continued the relationship with the Office of Vocational Education, in which Clemson provides teacher education activities for the new teachers employed to teach the trades in vocational education centers.

Three elementary and secondary education faculty members earned national recognition for their research on the effect of an NCAA regulation on high school academics.

The Department of Agricultural Education continued to assist high school agricultural departments in program evaluation through a Standardized Achievement Testing program designed to measure the cognitive domain of students enrolled in off-farm occupations courses. This service provided standardized pre-tests and post-tests for first- and second-year students in agricultural mechanics, first- and second-year horticulture, forestry, pulpwood harvesting and environmental and natural resources. More than 12,000 students were tested this year. During 1983-84, the recently revised pulpwood harvesting test was administered to collect additional data for performing item analyses and developing more reliable norms.

Special Activities and Services

Last year, the College of Education provided a variety of services to the South Carolina Department of Education, school districts and teachers who are continuing their education. For example:

- A mobile computer classroom was developed to provide school districts with on-site instruction in using microcomputers.
- Special institute graduate courses on the educational applications of microcomputers were developed and taught in various school districts.
- The Clemson Writing Project, a joint venture of the College of Education, the College of Liberal Arts and seven nearby school districts, worked with classroom teachers to help them teach writing in the public schools.
- The College of Education, in cooperation with the State Department of Education, provided staff development programs for vocational agriculture teachers, trade and industry teachers, and other vocational teachers.
- Special institute courses were developed to help school districts implement the Basic Skills Assessment program. They have been taught in a number of school districts.
- Annually the College of Education, Piedmont Technical College and the school districts in the Greenwood region sponsor an Innovations Day in Education to update teachers and administrators on the latest developments in education.

- The Clemson Reading Conference provides an opportunity each year for reading and elementary teachers to obtain information from national leaders on how to improve reading instruction in the schools.
- The College of Education has assisted the State Department of Education implement Act 187, including consultative services in the development and validation of tests as well as assistance in training educators in the use of the Assessment of Performance in Teaching (APT) instrument.
- Under the joint sponsorship of the Strom Thurmond Institute and the College of Education, a six-month Education Forum was held at Clemson. This program was designed to deal with the findings and recommendations of the report of the National Commission on Excellence in Education, "A Nation at Risk." From January through April, a number of nationally prominent speakers addressed the topic of needed changes in public schools. Speakers included Governor Lamar Alexander of Tennessee; Robert Cole, Editor of *Phi Delta Kappan*; Emeral Crosby, member of the National Commission on Excellence in Education; Admiral Hyman Rickover; and James L. Ferguson, Chairman of the Board and Chief Executive Officer of General Foods. In conjunction with the speakers on campus a group of South Carolina leaders in education, industry and government studied the issues and will develop a white paper detailing implications for education in South Carolina for the next decade.
- In the subject areas, rigorous work has been developed for public school teachers at both the undergraduate and graduate levels. For example, the University has developed graduate history courses that emphasize extensive reading in historical method and content so the graduate student/public school teacher is exposed to the most current literature. This same type of special course work has been developed in every appropriate curriculum.
- In addition, special summer laboratory courses have been developed in biological sciences. These courses range from one to six weeks and are arranged so a public school teacher can attend one or all sessions in any summer for in-depth work in one set of laboratory problems.
- Clemson University has provided special advanced placement programs for public school teachers in mathematical sciences. In the future, we propose to offer advanced placement seminars for public school teachers in all appropriate areas of the sciences and also, in the near future, for the areas of English and history.

Through this variety of programs, Clemson has attempted to expand the opportunities for public school teachers and students throughout the State.

COLLEGE OF ENGINEERING

Clemson University's College of Engineering was founded in the belief that people have the ability to improve their lives by changing the world around them. Due in part to this belief and those who have acted on it, this nation has the highest and most comfortable standard of living in the history of the human race.

Technological preeminence has been the backbone of this nation's economic achievements. The recognition that qualified engineers are needed to maintain this preeminence creates a demand for them in industry, government and education. In the effort to meet the demand for more engineers while maintaining high quality in education, research and public service, Clemson University's College of Engineering continues to improve the efficiency and quality both of its faculty and its curriculum.

On February 17, 1984, the Semiconductor Research Corporation (SRC) announced that Clemson University had been chosen as one of a group of 10 institutions nationwide to house centers or programs in a major research effort on Very Large Scale Integrated (VLSI) Circuits, which are "fifth generation" computer chips with artificial intelligence capability.

A Center for Semiconductor Device Reliability was approved by the State Commission on Higher Education in May 1984, making Clemson the national headquarters for the project's research on VLSI chip reliability. The program at Clemson involves both the College of Engineering and the College of Sciences.

Other events in the College of Engineering during 1983-84 include the appointment of mechanical engineering professor Eugene H. Bishop to associate dean of engineering for instruction. Mechanical Engineering Professor Walter E. Castro was appointed assistant dean of engineering for undergraduate studies. Dr. Castro succeeds Professor Emeritus James L. Edwards who retired in June 1984 after more than 35 years at Clemson. Robert Davis was appointed new head of the Department of Industrial Engineering.

Instruction

In 1983 the Department of Interdisciplinary Studies was renamed the Department of Bioengineering with a board of advisers appointed for the department.

The new undergraduate program in industrial engineering was begun this year, bringing the number to 10 undergraduate, 11 master's and nine doctoral degree programs. One advanced and six basic engineering programs plus the Engineering Technology program are accredited by the Accreditation Board for Engineering and Technology.

An important step was taken by the college when engineering faculty

approved a uniform freshman year. Studies are now under way to postpone the choice of a major until the end of the freshman year when students will have a better basis for selection.

The College of Engineering is the largest academic unit on campus. Fall 1983 enrollment reached a high of 3,604 students, of which 3,261 were undergraduate and 343 were graduate students. In 1983-84, 513 baccalaureate, 95 master's and 11 doctoral degrees were awarded.

Many Clemson engineering students found the Cooperative Education program to be an increasingly important part of the University's curriculum. During 1983-84, more than 85 percent of all participants in the program were engineering students. Providing curricula-related industrial work experience, the program is sponsored by approximately 200 Southeastern companies.

Because starting salary offers for B.S. graduates remain high, the incentive to enroll in graduate programs remains low. The average, accepted non-government starting salary for a 1984 Clemson engineering graduate with a B.S. degree was \$25,040 per year. With more students wanting to enter the B.S. degree programs to take advantage of those industrial pay scales, and with comparatively fewer Ph.D. graduates, the engineering education profession is experiencing faculty shortages. Although the College of Engineering is being challenged to meet the demands of industry, our primary objective is still excellence in education for our students.

The demand for women and minority engineers also continued to rise in the past year. In response to this, minority enrollment increased from 144 in fall 1982 to 202 in fall 1983. Enrollment of women in engineering also increased. Fall 1983 figures show that women comprised more than 18 percent of the total enrollment in the College of Engineering and more than 22 percent of the freshman class.

Clemson University was officially accepted into membership in the National Consortium for Graduate Degrees for Minorities (GEM) in October 1982. Three engineering students were awarded fellowships during 1983-84. The primary purpose of GEM is to increase minority enrollment in engineering graduate schools.

The Summer Engineering Minority Program for high school students marked its seventh year in 1983-84 and continues to be a success. More than 500 qualified students have participated in this program, which is sponsored by industry and foundations at a level of about \$50,000 per year.

This past year industrial engineering students, under the direction of C. R. Lindemeyer, initiated a University chapter of the Institute of Industrial Engineering. The chapter received its official charter effective July 1, 1984.

Industry provides the College of Engineering with considerable sup-

port for its instructional programs. One example is a major gift by the Intel Corporation valued at more than \$55,000 to help equip a microcomputer laboratory for the Electrical and Computer Engineering Department. This donation, coupled with matching funds from the University and a donation of more than \$10,000 worth of printers from Data South, Inc., is providing a modern, 20-station facility for students in electrical and computer engineering. As another example, Motorola donated \$15,000 for portable radios.

Within the Department of Electrical and Computer Engineering, the summer Master of Engineering program, begun in 1980, is funded totally by AT&T Technologies. Thirty-eight students were enrolled for the first session of summer 1984. Twelve students will receive M.E. degrees in December 1984, bringing the total number graduated from this program to 25. Another successful program for the Electrical and Computer Engineering Department is the Industrial Graduate Fellowship Program. Fifteen M.S. students now participate in this program. Each student receives a fellowship of \$3,000 to \$5,000, a summer job and a graduate assistantship providing total support ranging from \$8,000 to \$10,000 for the academic year.

The primary goal of the Department of Chemical Engineering is to strengthen its graduate program. Three new programs were implemented in 1980-81 to achieve this goal: the Master of Science Industrial Residency Program, the Program for Teaching and Research in Process Automation and the new Industrial-Graduate Fellowship Program. During 1983-84 five companies and eight students participated in one or more of these programs, with financial commitments from industry totaling about \$144,000.

As part of a new faculty exchange program, Will Thompson, a senior group manager at Digital Equipment Corporation, is teaching in the Department of Electrical and Computer Engineering for a year. Maurice Wolla, Clemson Professor of Electrical and Computer Engineering, spent a semester at Digital working on computer hardware and software development. This faculty exchange is part of an effort to bridge the gap between industry and academia. Faculty become involved with the newest industrial technology, while the industry professional has a chance to become acquainted with problems facing the people who supply many of industry's employees.

Several students in the college were awarded industry-sponsored fellowships or scholarships. A Clemson graduate in electronics was awarded a pre-doctoral fellowship by the Solid State Circuits Council of the Institute of Electrical and Electronics Engineers (IEEE), which gives only one award nationally each year. Two undergraduates were awarded Digital Equipment Corporation Minority Engineering Scholarships on the basis of academic excellence. Other key student awards include a

Fulbright Scholarship to a chemical engineering student, a fellowship grant from the Federal Highway Administration to a civil engineering student and one of the two first H. W. Close Fellowships endowed by Springs Industries of Fort Mill, S. C., to a mechanical engineering student.

The College of Engineering faculty also received a number of awards. Linvil G. Rich, Alumni Professor of Environmental Systems Engineering, was honored this past year by being named Educator of the Year (1983) by the Piedmont Chapter of the South Carolina Society of Professional Engineers. C. P. Leslie Grady, R. A. Bowen Professor of Environmental Systems Engineering, was the recipient of the 1984 McQueen Quattlebaum Engineering Faculty Achievement Award, given annually to the faculty member in the College of Engineering with the most significant accomplishments during that year. R. F. Nowack, associate professor of civil engineering, was the winner of the Byars' Prize for Excellence in Teaching in Engineering Mechanics.

Research

Clemson University continues to be the leader in engineering research among institutions of higher education in South Carolina. Engineering research at Clemson has three essential objectives: to seek new knowledge, to seek answers to both the short- and long-term problems of the State and nation, and to support advanced educational programs by providing research experience for students.

Traditionally, the College of Engineering at Clemson receives a greater percentage of research funds (30-40 percent) from industry than do engineering departments at most other universities. Almost \$7 million in grants and contracts was funded for research in 1982-83. Also, more faculty members and students were engaged in research in 1983-84 than in previous years. During the past year 84 faculty were engaged in research. Their efforts were supported by 159 graduate and 99 undergraduate students.

On May 3, 1984, the South Carolina Commission on Higher Education approved the Center for Semiconductor Device Reliability within the Department of Electrical and Computer Engineering, for implementation by June 1, 1984. The center will focus on research, but will offer no courses or degrees. In the past, states that successfully attracted large numbers of high technology industries have done so on top of a pre-existing base of manufacturing for semiconductor devices. Until now, South Carolina has had no such base, nor could its universities provide the inducement of supportive experimental facilities for semiconductor device research. Potentially, this program could attract semiconductor related industries to South Carolina. A facility like the one now at Clemson should attract \$300,000 to \$500,000 in externally funded research each year.

Approved by the South Carolina Commission on Higher Education in 1981, the Engineering Center for Automated Manufacturing Technology (CAM) continued to grow in 1983-84 under the direction of Frank W. Paul, McQueen Quattlebaum Professor of Mechanical Engineering. The research center has two industrial sponsors, Reliance Electric Company and the Torrington Company.

The South Carolina Energy Research and Development Center, directed by J. Charles Hester, assumed additional responsibilities when it took over the Governor's Office of Energy Resources. The consolidated offices provide a mechanism to respond quickly and effectively to energy research and educational needs in South Carolina and the region. State and federal agencies provide more than \$2 million for energy activities.

The Harris Corporation donated an H800 computer system to the Electrical and Computer Engineering Department for use in research and graduate studies. The system, valued at more than \$330,000, will enable the department to undertake projects in computer communications systems, radar image and signal processing, computer-aided design and computer simulations.

The Department of Electrical and Computer Engineering also has secured funds to improve facilities for microelectronic research. Clemson University provided more than \$330,000 to supplement approximately \$400,000 from external sources for upgrading the University electron microscope facility with a JAMP-10S Auger Microprobe (with scanning attachment) and a JSM-848 high resolution scanning microscope. These two new scopes feature the latest in computer control and analysis instrumentation.

A partial list of other projects gives an indication of the scope and breadth of engineering research at Clemson:

- Ceramic Engineering investigations include a Westinghouse Corporation-sponsored effort on ceramic seals, research at the Savannah River Plant on radioactive waste disposal methods and a new project on waste disposal sponsored by Argonne Laboratory. Work continues on the passive solar housing project and on the development of new low temperature, nonsilicate glasses. The industrial associates program is continuing with the Norton Company, and a new project on copper diffusion in solar cells has begun.
- In Chemical Engineering, the Center for Polymer Processing continues to receive both national and international recognition. The major thrust of research is toward technical developments in the field of fiber production.
- With substantial support from the National Science Foundation and the South Carolina Energy Research and Development Center, several different thermal systems are being investigated in the Department of Mechanical Engineering. These include packed beds,

phase-change thermal energy storage, fluidized beds, dynamic hyperfiltration membranes and high pressure ratio thermocompressors. Fundamental engineering research in separated flows with heat addition, natural convection in enclosures and single droplet evaporation also is being conducted.

- In the applied mechanics area of the Department of Mechanical Engineering, the principal research activities are focused on the mechanical behavior of composite materials. This research has been supported by NASA. Analyses of the buckling behavior and fracture of composite materials were completed this past year.
- Research activities in the Department of Mechanical Engineering in the area of robotics and flexible manufacturing attract national attention. Research activities include the investigation of industrial robots, endeffectors or smart hands, computer-aided design of forging dies and computer-aided selection of materials for gears.
- Researchers in the Department of Civil Engineering, with the help of a 40-foot wind tunnel, are working to help structural engineers and contractors understand how structures react to wind. The wind tunnel allows the testing of models of buildings to see how well they can withstand the forces of nature. The results of this research may be particularly useful for buildings in areas prone to tornadoes or hurricanes.
- The Clemson Hydraulics Laboratory is continuing a two-year study on unsteady turbulent discharges, funded by the National Science Foundation at \$85,000. An 18-month, \$54,000 grant by the S. C. Department of Highways and Public Transportation to study and provide more efficient designs of storm water inlet capacities is being continued. The S. C. Energy Research and Development Center gave \$4,000 for research on the feasibility of desiccant assisted evaporative coolers. The S. C. Water Resource Research Institute funded \$23,000 in August 1983 for a study to measure evaporative losses of irrigation systems; this project has been funded for an additional year. Research on the feasibility of using physical hydraulic models to study pollutant transport in ground water is being continued, funded by the Electric Power Research Institute (EPRI). EPRI and MIT funded a \$62,400 study on the efficiency of power plant cooling ponds, and the Clemson Athletic Department funded \$16,000 to study air circulation effects in the University's football stadium to evaluate fan and player comfort.
- Solar cell reliability research is continuing in the Department of Electrical Engineering. Total expenditures since December 1977 for this project have been approximately \$860,000. The project is sponsored by the Jet Propulsion Laboratories for the Department of Energy.

- Electrical engineers continue the study of fabrication and properties of very small transistors. The project has received more than \$300,000 in research support from the Office of Naval Research, the Rome Air Development Command, the Naval Research Labs and the National Bureau of Standards. The program is continuing and will be expanded in the coming year.
- Environmental systems engineers continue research on the rate of breakdown of man-made organic compounds by bacteria in the natural environment and in wastewater treatment systems. This project is supported by a major grant from the National Science Foundation.
- In the Department of Engineering Technology research was conducted for Arrow Automotive, Spartanburg, S. C., in automated manufacturing. A correlation receiver was designed and constructed for Security Tag Systems, Tampa, Fla., to detect the presence of a known signal corrupted by random noise.
- In the Department of Industrial Engineering, a series of research and development projects on the design and implementation of a Unified Data Base for the United States Air Force was completed. A project through the CAM concerned with group technology and manufacturing systems simulation has begun.

Several members of the college faculty received special recognition in 1983-84 for their accomplishments in research and public service. Linvil G. Rich, Alumni Professor of Environmental Systems Engineering, was named the 1983 recipient of the Rudolph Hering Medal awarded annually by the American Society of Civil Engineers to the author of the paper contributing most to the environmental engineering profession. Professor Rich also was awarded the National Wildlife Federation's Exceptional Service Award for sustained contributions to his profession, the nation, and a quality environment. Benjamin C. Dysart, III, professor of environmental systems engineering, was elected to a second term as president of the National Wildlife Federation. C. P. L. Grady, R. A. Bowen Professor of Environmental Systems Engineering, was named to the working Task Group on Mathematical Modeling for Design and Operation of Biological Wastewater Treatment. The members of this working group, from five different countries, are considered to be among the most outstanding experts in the area of biological wastewater treatment.

For his innovative use of computers to study liquids, J. M. Haile, associate professor of chemical engineering, was named one of the first Presidential Young Investigators by the National Science Foundation. The Presidential Young Investigator Awards program was established in 1983 as a way to keep the nation's most promising and outstanding young scientists and engineers on American campuses.

Associate Professor of Electrical and Computer Engineering John Bennett was elected chairman of the S. C. Council of IEEE, representing four sections and more than 1,000 members. John Bennett, Jim Long and Dave Dumin, all of the Department of Electrical and Computer Engineering, received IEEE Century Medals. Bob Gilliland, associate dean for research and planning and professor of electrical and computer engineering, was elected to a three-year term on the Board of Directors of the Relations With Industry Division of the American Society of Engineering Education. John Spragins, professor of electrical and computer engineering, was appointed to the national editorial board of *Transactions on Computers*, a publication of the Institute of Electrical and Electronics Engineers.

C. E. G. Przirembel, Department of Mechanical Engineering head, was elected a Fellow of the American Society of Mechanical Engineers (ASME). Dr. Przirembel was also elected to the Board of Directors of the American Society for Engineering Education (ASEE) as chairman of the Professional Interest Council I. Mechanical Engineering Professor J. Leo Gaddis was awarded a certificate of recognition from the NASA Johnson Space Center for the disclosure of an inventive contribution, "Method of Forming Dynamic Membrane on Stainless Steel Support." Mechanical Engineering Professor James G. Goree was selected as the recipient of the 1984 Clemson Chapter of Sigma Xi Outstanding Research Scientist award.

Three faculty members had books or manuals published in the past year. Jack C. McCormac, professor of civil engineering, had the fourth edition of his book, *Structural Analysis*, and the fourth edition of the accompanying manual, *Solutions Manual to Accompany Structural Analysis*, published by Harper & Row. In the Department of Engineering Technology, D. L. Ryan had two books published: *Computer-aided Architectural Graphics*, Marcel Dekker, Inc.; and *Mini/micro Computer Graphics*, Brooks/Cole. Breton Publishers published *Thermodynamics for Engineering Technology* by Professor Emeritus Robert L. Perry of the Department of Engineering Technology.

Public Service

The Continuing Engineering Education (CEE) program is the primary public service arm of the College of Engineering. As such, it is the vehicle by which the lifelong learning needs of the region's practicing engineers are served. The advancement of technology and the increasingly competitive environment in which engineers and companies must operate mandate a constant renewal of technical competence. The CEE program strives to remain in touch with the engineering community and to offer the most responsive seminars, short courses and conferences possible. Where a need exists and Clemson faculty are not available, outside resources are employed. The key criterion is responsiveness, and constant

self-evaluation and innovation are used to ensure this criterion is met.

During the 1983-84 fiscal year, 3,680 individuals attended CEE-sponsored courses. The program consisted of 36 seminars, workshops and short courses, two major industry conferences and 120 professional engineering review courses.

These figures show an 18 percent decrease in attendance from 1982-83. As a result of the economic recession, companies have revised their policies regarding the professional development of their engineers and other technical and managerial personnel. Expenditures for continuing education now more than ever must be justified by a direct return on the training investment. Trainees are expected to acquire direct problem-solving skills related to the company's immediate situation. Consequently, Clemson's CEE program, like those of similar institutions nationwide, must find new ways to deliver continued training to industry.

One way is to get away from standard two- or three-day, on-campus seminars. In-plant delivery of customized courses, which results in significant cost and manpower savings for client companies, will be encouraged. A pilot program of video-delivered seminars is being developed, wherein a live, on-campus seminar would be transmitted to a plant by one of several electronic means. Programmatic changes being made include increased program cosponsorship with private entities such as corporations, industry associations, professional and technical societies, and trade or technical journals. These links to the professional/industrial world serve to keep the program current, to assure use of the widest resource base available and to foster the interaction of College of Engineering faculty with their counterparts in industry.

A significant "first" for the college this year was a satellite-transmitted seminar originated by the IEEE from a site in Indianapolis using newly acquired down-link equipment from the Clemson University Communications Center and the college's wide screen projection monitors. CEE will participate in five additional IEEE video-conferences during the coming year.

COLLEGE OF FOREST AND RECREATION RESOURCES

The College of Forest and Recreation Resources at Clemson University is the forest and recreation resources center for South Carolina. The importance of this college's function comes into sharp focus when we realize that the forest products industry annually adds \$2.5 billion (28,500 employees) while recreation and tourism contribute an additional \$2.5 billion (68,000 employees) to the economy of South Carolina.

The State's only teaching, research and extension activities in forest management, wood utilization, and recreation resources and services are done by the College of Forest and Recreation Resources. In addition, the Regional Resources Development Institute (RRDI) operates under the auspices of this college to investigate the management and development of natural resource allocation in the Southeast.

Founded in 1970, the college is dedicated to promoting the wise management, use and stewardship of the State's forest resources and to enhancing the quality of life of its people through a rewarding use of leisure.

Department of Forestry

The Department of Forestry's programs in education, research and extension are unique in South Carolina. The department plays an important role in supplying the foresters who manage the 12.5 million acres of forest land in the State. Clemson's curricula in forest management and wood utilization emphasize the role of the forester as a steward of our forest resources. Research programs emphasize problem solving to gain fuller understanding of the forest and its use. Extension programs are designed to be sensitive to the needs of forest landowners with special emphasis on the owners of small, private landholdings.

During the year, the department awarded its first Cleaveland Scholarship to an incoming freshman. This four-year continuing scholarship will be made to a deserving freshman every year and is the result of a \$30,000 bequest in the will of the mother of an alumnus. The graduate program received support from the South Carolina Forestry Commission with its long-term commitment to fund one graduate student each year on a mutually defined problem area.

Professor David Hon was hired to initiate the new multidisciplinary research program in wood chemistry. This program, funded by a \$100,000 appropriation from the South Carolina General Assembly, is the result of a recognized need to integrate research in the fields of textiles, chemistry and forestry — the three major industries in South Carolina. In the first six months of 1984, Professor Hon received grants from both

industry and government agencies, which exceeded the seed money appropriated by the General Assembly.

As a group, the forestry faculty produced approximately 50 scientific and professional publications, including eight departmental bulletins and research papers.

Teaching

During the academic year, 17 candidates received the Bachelor of Science degree, 13 were graduated from the forest management program and four from the wood utilization program. Ten graduate degrees were awarded: five Master of Science and five Master of Forestry.

For the fourth consecutive year, the forestry faculty taught two three-week continuing education sessions in silviculture to U. S. Forest Service personnel. The department also sponsored the U. S. Forest Service short course on Sale Layout and Timber Harvesting, which attracted foresters from all over the eastern United States. The choice of this department as the sponsor for both of these courses is a credit to its reputation in silviculture.

Research

The Department of Forestry does research in timber production, forest management, wood utilization and biological productivity. It is supported by State appropriations, federal McIntire-Stennis funds and outside grants.

The timber-production area comprises scientists in forest soils, silviculture, entomology, genetics, pathology and tree physiology concerned with problems that prevent full timber productivity. Twenty-two projects are presently funded by State and McIntire-Stennis funds. New projects were started to study wildfire and the maintenance of oak stands in the oak-pine uplands of the Southeast, use of prescribed fire as a means of site preparation after clearcutting in Southern hardwoods and the effect of carbon dioxide enrichment on growth and field survival of containerized loblolly pine seedlings.

Another 15 projects are supported by grants from the Forest Service, other federal agencies, private industry and State agencies. The U. S. Forest Service, through the Southeastern Forest Experiment Station, funded a \$5,415 study on growth and development of sprout origin versus seedling origin yellow-poplar trees. Another cooperative proposal was initiated for \$15,530 to summarize and analyze the usefulness of prescribed burning to manage understory hardwoods in the loblolly pine forests of the lower coastal plain.

Other grants received this year were as follows:

- Southern pine beetle impact estimates — \$25,000. Integrated Pest Management program, USDA Forest Service.

- Integrated Pest Management in South Carolina, Phase II — \$45,000. Integrated Pest Management program, USDA Forest Service.
- Managing pine bark beetles in Georgia's forests — \$30,375. Georgia Forestry Commission.
- Ecosystem effects of whole tree harvesting — \$56,073. Union Carbide Corporation.

A number of articles about results of research projects also were published. Among them was a 40-page booklet describing a common-sense approach to improving low-quality, oak-pine woodlands using low-cost silvicultural options and a review of the effects of prescribed burning on the Southern Appalachian and Upper Piedmont forests. A study with Du Pont Corporation resulted in information concerning the effect of effluent and sludges on tree growth. A detailed study on the effect of climate on oak decline in the Southern Appalachians and Coastal Plain identified a series of four drier-than-normal years as responsible for an unusually high incidence of red oak decline and death in the mountains, and two severe summer droughts as responsible for decline and death of urban and forest trees along the coast.

Research in forest management seeks solutions to forest-based, multiple-use problems. Approximately 10 state projects are under way in this area. Two new projects were started this year, one to study the diffusion of silvicultural innovations on the social system of nonindustrial private forest landowners, the other to develop a recreation site management plan for use by forest managers. Two grants were funded this year by the U. S. Forest Service, Southeastern Forest Experiment Station, as follows:

- Development of telemetry techniques for studying dispersal of the red-cockaded woodpecker — \$11,572.
- A microcomputer-based, decision-making aid for managers of Southern hardwoods — \$10,090.

Three projects were completed in this diverse area of investigation. A three-year study that used satellite imagery to analyze the vegetation and biomass resources of Pickens County, South Carolina, was completed. An analysis of firewood consumption in South Carolina and Greenville County in particular was completed, and publications detailing consumption patterns and the methods of measuring firewood were released. A two-year study on the use of snags as wildlife habitats in Piedmont forests was completed. Results detailed mean snag densities for various forest types and indicated that densities of suitably sized snags for larger snag-dependent species were lacking.

Wood utilization research received its strongest boost in the area of wood chemistry when a new position to head multidisciplinary research in forestry, textiles, and chemistry was filled. Besides this, State projects

were started to study the effect of accelerated air drying of wood particles and the effect of chromated copper arsenate preservative on the strength of Southern pine.

Five grants were received:

- Utilization of Southern hardwoods for manufacturing of cement excelsior board — \$17,000. U. S. Forest Service, Southeastern Forest Experiment Station.
- Surface characterization of weathered wood by electron spectroscopy and Fourier Transform Infrared Spectroscopy — \$38,555. U. S. Forest Service, Forest Products Laboratory.
- Growth rate, butt log quality and wood properties of yellow-poplar crop trees following release and fertilization — \$10,300. U. S. Forest Service, Southeastern Forest Experiment Station.
- Studies on plastization of wood and its application — \$14,450. National Science Foundation.
- Water soluble cellulose derivatives — \$56,242. Hercules Corporation.

Four State research projects were completed this year. The BTU values of selected hardwood stems and branches were determined. Results indicated a difference in heating value between stemwood and branchwood for sweetgum and yellow poplar, but not white oak. A study in drying degrade and yields in hardwood dried by a high-frequency-vacuum (RFV) system versus a conventional kiln showed that the highest yields for furniture parts were recorded by drying lumber by the RFV method, then cutting the dimension stock. A similar study that compared shrinkage in wood dried by the two processes indicated that the conventional kiln maintained the lowest moisture gradient across the wood thickness and the lowest stress level. However, the pattern of moisture distribution was similar for both processes, and the lumber in the RFV dried in approximately $1/17$ the time required for a conventional kiln.

In the fourth study, above-ground green weight biomass tables of some commercially important species were completed and sent to the Forest Service for publication.

Four of the department's faculty are located in the South Carolina Coastal Plain either at the Belle W. Baruch Forest Science Institute near Georgetown or the Forest Sciences Laboratory in Charleston. All of them work in the general area of biological productivity in which 12 State or McIntire-Stennis projects are under way.

New projects begun this year were a study of the randomness of pollination and potential for inbreeding in Southern pine seed orchards, a study of stand variation in susceptibility to coneworms and seed bugs as exhibited by loblolly pine and slash pine seed orchards and a study of the

possible allelopathic effects of tallowtree (*Sapium sebiferum*) on loblolly pine.

Two studies dealing with deer and their habitat were completed. Specifically, a seven-year monitoring study of a deer population resulted in a technique that gave an index of the population with high precision to herd size. Disease incidence, general health and breeding sites were documented. The other study investigated the effects of prescribed fire on deer forage production and nutrient regimes on 50-60-year-old loblolly pine stands. Annual and seasonal movements and habitat use by deer were described.

The National Science Foundation continued support for a study allowing continued monitoring of the Hobcaw Barony groundwater and its relationship with the intertidal region.

Extension

A timber yield and economic analysis program is being installed in county Extension offices across the State. This program will allow county offices to evaluate for landowners the economic opportunity of growing tree crops as an enterprise and will give agents one of the most effective and powerful forestry investment analysis tools available.

Activities in the areas of timber harvesting included sessions for the Sale Layout and Harvesting Institute for U. S. Forest Service personnel. In addition, the 19th American Pulpwood Association short course was held this past spring.

A Nantucket pine tip moth advisory model is being tested this year. This model is being used to assist Christmas tree growers in knowing when to apply various chemicals for the management of the Nantucket pine tip moth. This will increase Christmas tree quality and reduce the use of chemicals. This model, once fully developed, should be able to be extrapolated to forest management situations.

Department of Parks, Recreation and Tourism Management

Teaching

The program of instruction in the department reflected enthusiasm by students and faculty to the adjustments in the curriculum made during 1982-83. The adjustments were predicated on our need to change in order to be useful to the professions we serve. The skills taught are aimed at providing leadership through a cadre of well educated young people who can serve the needs of the people of this State in county and municipal recreation agencies, in park systems (State and county), in therapeutic recreation settings and in the broad field of travel and tourism. Not only must our graduates know how to provide recreation services, they also must know how to manage our recreation resources so they will be preserved for future generations.

Public Service/Research

The record of the PRTM faculty during the past year speaks to the return of the investment of research dollars. In spite of heavy teaching responsibilities, the faculty completed research that resulted in 29 national and 17 regional presentations. Fifteen articles were published in research journals, and 29 technical bulletins were produced. Of equal importance was the continuing support from the National Park Service for continuing and expanding the work of the Cooperative Research Unit administratively housed in the department. The growing national reputation of the department is reflected in the invitations that come to the faculty for review board and editorial participation.

Public Service/Extension

The extension activities of the department were substantial. The department assisted more than 30 counties, cities or agencies during the past year with activities from site planning to computer applications. Workshops covered such diverse topics as leisure service delivery systems, maintenance, liability, motivation, design, planning and tourism development.

Outdoor Laboratory

The programs provided through the Outdoor Laboratory reach every county in the State through its summer residential camps. Expansion to a year-round operation has enabled us to serve even greater numbers through the units which make up the University community.

New use records were set in 1983-84 in nearly every category of service as reflected by the following:

- Jaycee Camp Hope served 268 mentally retarded children and adults during a six-week program.
- Camp Sertoma served 168 children in three, one-week sessions. These included sessions for underprivileged children and for children with speech and hearing problems.
- Camp Running Brave served 40 hemophiliacs.
- Camp Lions Den served 26 visually handicapped children.
- Senior Adventure Camp served 116 senior citizens for the 13th consecutive year.

Budgets for the programs listed above totaled \$102,000.

The Outdoor Laboratory staff conducted the 14th Annual College Week for Senior Citizens. Four hundred eleven senior citizens were served on a budget of \$41,000.

During 1983-84, 160 groups used the laboratory facilities with more than 9,100 persons served.

Professional Development Programs

There was continued growth in the number and diversity of programs and in the number of clients served. Services rendered are at the maximum level until the staff can be added specifically for our professional development program.

Regional Resources Development Institute

The Regional Resources Development Institute (RRDI) is a cooperative venture between the Southern Appalachian Research/Resource Management Cooperative (SARRMC) and the College of Forest and Recreation Resources of Clemson University. The institute stimulates and coordinates multi-state research in natural resources allocation and management, energy availability and conservation, and socio-economic implications of natural resource and energy policies in the Southeast. Problems of both access to resources and conservation of those resources are regional rather than local: Thus, solutions must be regional. The institute works with scientists at SARRMC-member universities and agencies to address problems common to the Southeast.

In January 1984 the institute's name was changed from the Energy and Resource Development Institute (ERDI) to the Regional Resources Development Institute. This change was undertaken to eliminate confusion with the South Carolina Energy Research Development Center, to more accurately reflect the array of institute projects and to provide a broader base of exposure for future research support.

RRDI is advised on research programs by a policy board at Clemson University and by the SARRMC Executive Board. The SARRMC Board comprises members from Virginia Polytechnic Institute and State University, North Carolina State University, Western Carolina University, University of Tennessee, University of Georgia, Clemson University, U. S. Forest Service, National Park Service, Tennessee Valley Authority and U. S. Fish and Wildlife Service. In addition to program and operations advice, the institute receives advice on specific projects from leading scientists throughout North America.

The current research portfolio of the Regional Resources Development Institute includes projects relating to energy-efficient housing, marketing and use of wood as an energy source, natural resource allocation, subsidies and taxing mechanisms associated with resource management programs, and consequences to tourist industries resulting from fuel costs and availability.

As a result of its unique relationship with regional universities and natural resource management agencies, RRDI bridges the gap between specific local studies and research programs needed in the Southeast. Through this regional cooperative mechanism, RRDI is assisting the southeastern United States in a transition from an era of readily available

natural resources to an era of expensive and sometimes scarce traditional resources. RRDI's regional approach provides an effective, efficient method of meeting this challenge through a program of research, development, education, public service and evaluation.

Computer Laboratory

On May 1, 1984, Dean Benton Box welcomed a group of National Park Service personnel to the college's new microcomputer laboratory. The new laboratory in Lehotsky Hall affords students in the College of Forest and Recreation Resources an opportunity to acquire important technological skills. Also, the new laboratory enables professionals in the fields of forestry, parks and recreation, and tourism development to upgrade their knowledge and understanding of microcomputer applications.

The college's personal computer laboratory consists of 16 IBM personal computers, a Sony diagonal color teaching projector and video playback capabilities. Each of the 16 IBM personal computer work stations has 192K memory, a printer, a monochrome monitor and is housed on a handcrafted oak table capable of seating two students per station. In addition to the best hardware, each station is equipped with software complements such as Lotus 1-2-3, dBase II, the WordStar Professional package, MS-DOS 2.0 and an IBM hardware tutorial.

The College of Forest and Recreation Resources has determined to integrate the personal computer into the curriculum of the Department of Forestry and the Department of Parks, Recreation and Tourism Management. The job of the college faculty will be to incorporate the hardware and software into as many courses as possible, thus affording our students the opportunities to learn needed technical skills.

COLLEGE OF LIBERAL ARTS

It has been said that no university can ever become a great institution of higher learning without a strong program in the humanities and social sciences. The College of Liberal Arts recognizes that dictum; it is founded upon the idea that a self-governing society requires of its citizens a basic general education that will enable them, regardless of their occupation or profession, to lead fuller, more useful lives and to contribute to the general welfare of society.

Even with these lofty ideals, the College of Liberal Arts, like all undergraduate colleges at Clemson, is steeped in a tradition of practical endeavor. Though only about 9 percent of the student body major in liberal arts fields, the faculty of the college teach almost a third of the credit hours taken by the student body. This underscores the importance of the college's courses to all curricula in the University.

The college is composed of the departments of English, History, Languages, Music, Political Science, Psychology and Sociology. All departments except Music offer the Bachelor of Arts degree. English and History offer the master's degree as well.

Seventy-five percent of the Liberal Arts faculty hold the doctoral degree or other terminal degree in their fields. Graduates of the college enter some of the outstanding graduate and professional schools in the country as well as work in business and public service.

Public Service

The college's public service role throughout the State and region continues to grow. Frequently the departments of Political Science and Sociology are called upon by units of local and State government or business and industry for advice on such problems as poll-taking, tax matters, governmental organization, the impact of industrial development on society, and mental health and alcoholism. Psychologists provide clinical service to Clemson's Redfern Health Center; management training for area industry and hospitals; consultation on jury selection, eyewitness validation and expert witness on criminal sanity; survey studies for local State agencies; and a weekly newspaper column on labor-management relations. In cooperation with the College of Nursing, Redfern Health Center and the Counseling and Career Planning Center, the psychology faculty also sponsor a local stress management clinic. Members of the English faculty work with industry by conducting seminars and workshops in technical report writing.

The Department of Languages continues to stress a practical, business orientation by encouraging Clemson students to major or minor in a modern language while also preparing themselves in business administration, engineering, computer science or textile science. Given the large

foreign investment in South Carolina industry and the need for development of overseas trade markets, this is an important career option for the State's students. A \$35,000 grant from the Office of Education enabled the department to expand cooperative education opportunities in multinational corporations in South Carolina. The Department of Languages sponsors an annual Language Declamation Contest, which draws hundreds of participants from South Carolina and nearby states. The department also conducted summer foreign-study programs in France, Germany and Mexico. An outstanding recognition of Clemson's language students came this spring when the national Fulbright Award Committee selected six students for a year's scholarship to study abroad, five to Germany and one to France.

Among the recipients of the college's public service activities are the State's schoolteachers. Improved civic education in South Carolina's public schools is the goal of the Thurmond Seminar conducted by the Department of Political Science with funds from The Strom Thurmond Institute for Government and Public Affairs. Twenty-nine social science teachers from South Carolina's secondary schools participated in this summer's institute.

Twenty-four Piedmont-area teachers interested in teaching writing attended the second six-week summer institute of the Clemson Writing Project sponsored by the English Department and the College of Education. Each fall the English Department presents a well-known and widely attended Children's Literature Symposium for the State's librarians and teachers. A faculty member is president of the state association.

Members of the college serve regularly as program leaders for the South Carolina Committee for the Humanities. Again this spring they helped organize, conduct and contribute to the Piedmont Humanities Scholars Forum. Clemson hosted the spring meeting of the committee's board in April. Faculty of the Music Department regularly act as resource people, performers and judges in the State and region.

The College of Liberal Arts serves the student body in a variety of ways. The Model United Nations Program, sponsored by the Department of Political Science with student participation from throughout the University, competes annually. The Department of English conducts an innovative course designed for freshmen with poor verbal skills. In addition, a writing laboratory is open to all students with writing deficiencies. As an aid to foreign students, a course in English as a second language is made available. The departments of English and History cooperate in a summer workshop for minority students entering Clemson. Language students each year present full-length plays in French, German and Spanish.

The college also contributes to University life by sponsoring a large number of student organizations and extracurricular activities. The English Department sponsors the Clemson Players, the student drama group,

which presents four plays during the academic year and two during summer school. This spring the Players' production of *American Buffalo* was selected from among 477 plays to be one of seven presented at the Kennedy Center in Washington. The department also sponsors the debating team and helps manage student publications, including *The Tiger*, *The Chronicle* and *The Calhoun Literary Review*. The Department of Music sponsors and manages the University Concert Series, the Liberal Arts Chamber Music Series, the Clemson Chorale, summer school concerts and student musical organizations, including the "Tiger" band, the symphonic band, the University chorus, the Four-Thirty Thursday Singers and the jazz ensemble.

The State's elementary and secondary school students are another constituency served by the college's public service activities. The Department of Psychology, in cooperation with the College of Sciences, supports a series of summer science camps to acquaint students with the sciences, including computer science and psychology. The Department of Languages offers instruction in French, Spanish and German to area elementary school students.

Three publications of national interest emanate from the College of Liberal Arts. *The South Carolina Review* is edited and published by faculty members in the Department of English. This distinguished journal provides a forum for literary scholarship, original poetry and outstanding fiction. *The Journal of Political Science*, with an international editorial board under the editorship of a faculty member in the Department of Political Science, boasts a list of authors from leading universities and colleges throughout the United States and overseas. This journal pays special attention to the scholarly contributions of younger researchers. Within the past two years, the Department of Languages has assumed the editorship of *The Comparatist*, a journal devoted to the literary and language interests of scholars in the Southeast.

In addition to editing these scholarly journals, Liberal Arts faculty members contribute articles to a variety of professional journals and books published through numerous university and commercial presses. Several successful textbooks, especially in Political Science, Sociology and English, have been published in recent years, and more are in the final stages of development.

The Department of History continues to spread the name of the University through a free, syndicated book review column published in newspapers throughout the country. This history book review service is the only such regular newspaper feature by an institution of higher education. The Department of English provides a similar service for children's books.

The social sciences are also very active. Members of the Psychology Department faculty are conducting research on a variety of topics such as

aging, laterality of brain function, stress management and computer-assisted instruction. The Department of Sociology has revamped its curricular options to acquaint students not only with principles and theories but also their practical application in society. Faculty members conduct workshops and research in several areas, including crime, parental grief, children's responses to crisis, parental abuse and alcohol consumption, drinking and driving, and abortion.

Scholarly gatherings are regular features of the activities of the College of Liberal Arts. The highly successful conference Sport and Society, co-sponsored with the Athletic Department, is the only interdisciplinary conference of its kind in the nation. The college also conducts programs in cooperation with The Strom Thurmond Institute of Government and Public Affairs. Other regular features each year include events in observance of Black History Month and Women's History Week. On campus, this past year, the college hosted the annual meeting of the Carolina Symposium on British Studies and the Georgia-South Carolina College English Association; in Charleston it hosted the Southern Historical Association.

COLLEGE OF NURSING

A vital link between the University and its constituencies is provided by College of Nursing programs of instruction, research and service. These programs are directed toward prevention of illness and care of the ill, injured and infirm. Following are the programs that reflect concern for the health and welfare of others:

- A baccalaureate program, which prepares for the beginning practice of nursing.
- A master's program directed toward advanced practice of nursing.
- A continuing education program to help practicing nurses keep their knowledge and skills current, and to enable nurses who have left the profession to prepare for reentry into active practice.
- A nursing center, which offers a broad range of nursing services provided by faculty who are registered nurses and by nursing students under the supervision of qualified nursing faculty.

Undergraduate Program

The baccalaureate program leads to a Bachelor of Science in Nursing. It prepares students for beginning practice of professional nursing in a variety of settings such as hospitals, industries, clinics and public health agencies. This curriculum provides opportunities for men and women to attain sound preparation for nursing and a foundation for graduate study in nursing. During the first portion of the program, students are enrolled in liberal arts and basic science courses arranged sequentially to provide a foundation for the nursing major. During the junior and senior years, emphasis is placed specifically on the study of nursing.

Multiple community resources enable nursing students to learn and practice within a wide range of patient-care settings. Clinical nursing experiences under the guidance of the College of Nursing faculty take place with patients in local hospitals, clinics and other health agencies.

A significant increase in enrollment in the baccalaureate program has been achieved. This was a direct response to community demand for additional nurses to staff expanding facilities. Enrollment in the baccalaureate program October 1982 was 281; in October 1983, it was 381. In October 1984 an enrollment of 453 is expected — a 62 percent increase over fall 1982.

The proposal to offer the Clemson University Bachelor of Science Degree Program in Nursing at Greenville Technical College was considered by the Commission on Higher Education in November 1983. The Commission recommended that a cooperative arrangement between Clemson and the University of South Carolina at Spartanburg be developed. Such an agreement has been developed. The first cooperative

course taught jointly by both institutions on the Greenville Technical College campus began in August 1984. This effort will be expanded as demand develops.

Master's Program

The master's program provides a major in family health nursing. Emphasis is on caring for the ill, teaching health, counseling and helping students become articulate advocates for individuals as well as for family groups.

Recent major developments relative to this program follow:

- To help meet needs of nurses unable to travel to Clemson, off-campus courses were taught fall and spring semesters in Gainesville, Ga., and Greenville, S. C.
- A new clinical concentration in occupational health nursing was approved within the University and will be reviewed by the Commission on Higher Education during the coming year.
- A sequence of two nursing management courses of three credit hours each will be taught for the first time in fall 1984.
- Discussion of a Ph.D. program in nursing is under way with collaboration between the three university-based nursing programs in the State presently being considered.

Continuing Education

The continuing education program provided 45 workshops, seminars and conferences for registered nurses. Attendees came from 20 states to participate in a broad variety of educational programs held in a five-state area. The Clemson University campus and Greenville continue to be primary sites for meetings, but requests to meet the needs of non-local nurses have led to the decision to offer selected programs in several additional locations in the Southeast.

These short-term, intensive learning experiences are aimed at helping nurses in active practice keep on the "cutting edge" of new knowledge, and assisting inactive nurses to prepare for reentry into the profession. Therefore, Clemson University is rapidly developing a reputation as a major provider of continuing education for nurses in this region.

The Nursing Center

The Nursing Center, an ambulatory care setting on the first floor of the College of Nursing building, is operated to provide educational experiences for baccalaureate and graduate nursing students. Here, with faculty supervision, students provide health assessment, counseling and referral services, and engage in clinical research. The center also provides a practice setting for faculty to maintain and improve their own nursing practice and research skills.

The Nursing Center began offering services on a regular basis in January 1984. In just three months the case load grew steadily, reaching 96 client visits for March 1984. This rapid growth developed because Clemson does not have a health department located in the community. In the past, area residents desiring health department services have had to leave the area. Since the center offers services similar to those available in health departments (immunizations, TB skin tests, screening for chronic diseases, physical assessments), more area residents are finding the Nursing Center to be a convenient alternative to leaving the area. Second, an increasing number of University faculty and staff are using the center to receive some health services without leaving campus. Lastly, the center offers evening appointments which are particularly helpful to those who work and to families with only one automobile.

This year several groups received special services from the Nursing Center, including a package of services to the Clemson Child Development Center where each child received a complete health assessment, developmental assessment and needed immunizations. In May, a health screening was held for senior citizens during annual college week. During the 1983-84 academic year, the Nursing Center provided more citizens with nursing services than in any previous year, a trend that is expected to continue.

Student Recognition

In May 1984 Katherine Ann White, a College of Nursing senior, was awarded the Algernon Sydney Sullivan Award for outstanding service to the University. This is an annual award that recognizes two graduating students for "... their influence for good, their excellence in maintaining high ideals of living, their spiritual qualities, and their generous and disinterested service to others." Miss White has started her career in a staff position as a pediatric nurse.

Summer Workshop for High Ability Minority High School Students

In summer 1983, the College of Nursing offered a one-week workshop for rising minority high school juniors. Six students enrolled. The purpose of our workshop is to increase the number of minority students entering and successfully completing the College of Nursing's undergraduate program.

Students were selected on the basis of recommendations from high school teachers, counselors and others. Throughout the program, students lived in a Clemson dormitory with a student counselor enrolled in the College of Nursing. Nurses from minority groups participated in all phases of the program.

Emphasis was on preparing students for the demands made upon full-

time students in Clemson's nursing program and on helping them feel at ease within a college of nursing in a university setting. Each student was evaluated for strengths and potential areas of difficulty. Efforts were made to eliminate the weaknesses and to build on strengths. As appropriate, students were helped to improve study habits and test-taking techniques, to learn to use computer-assisted approaches to learning and to be comfortable asking the faculty for help. Experiences to develop self-reliance also were included to help students become more self-motivated. Selected clinical experiences were provided in the Nursing Center of the College of Nursing, a local hospital and one community health agency. College of Nursing learning laboratories were used to augment these experiences.

The following information was obtained from the Nursing Center, in helping a number of students to the Clemson Child Development Center where each child received a complete health assessment. Developmental assessment and medical interventions to help a child who was not doing as well as other children during annual college work. During the first of this year, the Nursing Center provided more clinical experiences than in any previous year. A trend that is expected to continue.

Student Recognition
In May 1988, Catherine Ann White, a College of Nursing senior, was awarded the Agnes Scott Fellowship Award for outstanding service to the University. This is an annual award that recognizes two graduating seniors for their leadership in good work, their excellence in maintaining high standards of their personal qualities and their generous and demonstrated service to others. Miss White has studied for a year in a full program of a Bachelor's degree.

Summer Workshop for High Ability Secondary High School Students
In summer 1988, the College of Nursing offered a six-week workshop for high ability high school seniors. Six students enrolled. The purpose of our workshop is to increase the number of high ability students enrolling and successfully completing the College of Nursing's undergraduate program. Students were selected on the basis of recommendations from high school teachers, counselors, and others. Throughout the program, students lived in a Clemson dormitory with a student counselor enrolled in the College of Nursing. Nurses from various schools groups participated in all phases of the program. Participants were on preparing themselves for the demands made upon them.

COLLEGE OF SCIENCES

The College of Sciences continues to attract a gradually increasing number of majors due to the continuing interest of students in the areas of preprofessional health, environmental concerns and energy-related problems. The area of computer science attracts more students than we can possibly accommodate at the freshman level, resulting in many being denied admission to this major upon entrance to Clemson University. This is unfortunate because experience indicates that almost half of those who select this major as freshmen will change that major by the beginning of their sophomore year due to a misunderstanding of the nature of computer science as a discipline. This is common, however, whenever a discipline receives as much publicity on a nationwide basis as computer science has.

The College of Sciences continues to be responsible for 30 percent of the total University teaching load due to a continuing increase in percentage of undergraduates majoring in engineering and other technically related subjects.

Although the availability of external funds for the support of research continued to decline on a nationwide basis, the faculty of the College of Sciences continued to increase its share of those funds during the 1983-84 fiscal year with the total value of all grants and contracts in force exceeding \$6 million. This represents an increase of more than \$2 million from the comparable figure for 1980-81. Of particular importance is the fact that our ratio of externally generated grant and contract funds to the State funds expended by the college in attracting this support continues to be the highest in the University, that ratio being 3:9 for 1983-84.

The Electron Microscope Facility in the College of Sciences played a role in helping to attract a major grant from the Semiconductor Research Corporation to a faculty member in the College of Engineering. As a result of this grant to Professor Jay Lathrop in the Department of Electrical and Computer Engineering, the Electron Microscope Facility will acquire an Auger Microprobe and a scanning electron microscope with attachments that permit sophisticated surface measurements to be made. This equipment is scheduled for delivery in August 1984 and will make our facility unquestionably one of the 10 best in the nation.

Department of Biological Sciences

The Department of Biological Sciences was formed July 1, 1983, by the merger of the departments of Biochemistry, Botany and Zoology. In fall 1983, the department had 160 students enrolled in undergraduate degree programs (71 in biochemistry, 10 in botany and 79 in zoology). We also had 21 M.S. students (1 in biochemistry, 7 in botany and 13 in zoology) and 42 Ph.D. students (1 in biochemistry, 6 in botany enrolled under the

program in plant physiology in the College of Agricultural Sciences and 35 in zoology). The doctoral program in zoology continues to serve the largest group of Ph.D. students at Clemson. During 1982-83, the department awarded 17 B.S. degrees (5 in biochemistry, 1 in botany and 11 in zoology), 7 M.S. degrees (5 in biochemistry and 2 in zoology) and 7 Ph.D. degrees (1 in biochemistry, 2 in plant physiology and 4 in zoology).

Research and training activities were supported by 15 grants and contracts: four each from the National Science Foundation and U. S. Army Corps of Engineers, three from the South Carolina Sea Grant Consortium and one each from the Electric Power Research Institute, the U. S. Forest Service, the U. S. Army Medical Research program and Calgon Corporation. Four grants were received from the Faculty Research Committee of Clemson University. Two faculty members were awarded Provost's Awards for their scholarship, and one received a University Research Award from Pennsylvania State University. Since 1974, the collective departments have received more than \$3.5 million to support their research and graduate training activities.

Scholarly activities by faculty and students during the year included papers presented at two international meetings and more than 41 papers delivered to national and regional meetings of scientific or professional societies. Twenty-three scientific papers, two book chapters and 28 abstracts, reviews or notes were published. At least 10 papers are in press. A doctoral candidate received an award for the outstanding student paper presented at the Southeastern Society of Parasitologists. Three graduate students received awards from Sigma Xi, and two received funds from the Lerner-Gray Fund for Marine Research and the Slocum-Lunz Foundation. Our faculty includes one Rhodes and one Danforth Scholar. This year, John P. Wourms was awarded the first Guggenheim Fellowship to be received by a faculty member at Clemson. Two faculty members (John P. Wourms and Carl W. Helms) were elected Fellows in the Explorer's Club.

Professional and service contributions by members of the faculty included the following activities: chairman, Heritage Trust Advisory Board of South Carolina; secretary, Animal Behavior Society; Board of Scientific Advisors (two faculty members, one serving as chairman) and Board of Trustees and member of the Executive Committee of the board of Highlands Biological Station; Board of Governors of the South Carolina Aquatic Plant Management Society; member of the University, State and district Selection Committees for the Rhodes Scholarship Trust; associate editors for the *Transactions of the American Microscopical Society*, the *Journal of Experimental Zoology* and the *Journal of Environmental Biology of Fishes*; and technical editor of the *Journal of the American Killifish Association*. Two faculty members served on the Faculty Senate,

and a number were members of commissions and other University, college and departmental committees.

Faculty members of the department gave seminars at nine other institutions. Ten seminars were presented by Clemson faculty members outside our department. Five seminars were given by our own faculty, and seven were given by doctoral students defending their dissertations. Fifteen outside speakers visited our campus to present seminars. A number of informal presentations also were made by faculty and students as part of our Brown-Bag Seminar series. Seminars are an integral part of our training program and serve to acquaint others with our facilities and activities while promoting the exchange of information and ideas.

The vertebrate museum and herbarium continue to support our teaching, research and service roles. The field station is used in a number of training and research activities, and the greenhouse and animal room facility are important to our integrated program.

During the year, the faculty approved By-laws and Guidelines for Promotion and Tenure for the department. Adjusting to the new administrative structure and opening internal lines of communication should contribute to future productivity in teaching, research and public service.

Department of Chemistry and Geology

The freshman chemistry program initiated in fall 1983 was deemed a success by both students and faculty. With further refinement in 1984-85, we hope to achieve our goal of a greater success rate for all students enrolling in first semester chemistry. More than 1,400 students are expected in that course for fall 1984.

Fifteen B.A. and B.S. degrees were awarded in the academic year 1983-84 along with four M.S. and two Ph.D. degrees. With a total graduate enrollment of 45, 1984-85 will show a substantial increase in the number of advanced degrees awarded. There are now approximately 30 majors in Geology and 100 in Chemistry.

Planning for the new chemistry building was completed in late 1983. Construction is scheduled to begin in August 1984. A major campaign is under way to raise private funds to help furnish the building with the best teaching and research equipment. When completed in June 1986, the building will be one of the finest in the Southeast.

This year saw a record in new external research funds reflecting the increasing stature of the faculty. The total value of new grants and contracts in 1983-84 exceeded \$1.25 million, making the department the most heavily funded in the College of Sciences. Major contributors to this funding were Professors R. A. Abramovitch (\$258,000), J. D. Petersen (\$217,000), J. C. Fanning (\$164,000) and D. D. DesMarteau (\$565,000). Included in this total is \$268,000 for the purchase of a high field, superconducting, nuclear magnetic resonance spectrometer. This instru-

mentation will greatly enhance research capabilities in chemistry, as well as in many other areas at Clemson.

Two additional new faculty were hired for 1984-85, Professor Arkady Kholodenko (Ph.D. University of Chicago) in theoretical chemistry, with a major interest in polymers, and Professor Stanford Spurlin (Ph.D. Iowa State) in analytical chemistry, with major interests in the applications of lasers in analytical chemistry. Our effort to hire a new faculty member in inorganic chemistry was unsuccessful. Very strong competition from other institutions for the top prospects and our lack of certain major research instrumentation were factors. The spectrometer mentioned above fills a major gap in this regard, and we expect to be successful in attracting a top candidate for 1984-85.

Department of Computer Science

The Department of Computer Science continued its rapid growth during the past year. The number of majors increased to approximately 500 B.S. and 70 M.S. students, an increase of 11 percent and 75 percent, respectively. Fifty-nine B.S. and three M.S. students were graduated, and demand for our graduates by employers continued to be very strong.

Response continues to be good to night courses offered in Greenville through the Clemson at Greenville TEC program. The department continued to offer two courses per semester through this program.

The Commission on Higher Education approved a proposal for a Ph.D. program in computer science to be implemented during 1984-85. A new B.S. program in computer information systems was initiated in the fall, and by the end of the year there were 40 majors in this program.

Externally funded research continues to increase, and the department currently enjoys a level of funding exceeding \$1 million annually.

Space continues to be a serious problem. The department has outgrown available space in the College of Nursing Building, and the lack of available space will severely limit our ability to perform effectively during the coming year. Current plans to provide additional space by completing the unfinished basement of Jordan Hall will provide sufficient space for the next two or three years if these plans are carried out.

Although the department successfully recruited two more faculty members, faculty recruiting continues to be a problem. Our inability to fill two available permanent positions during the past year continued a recent trend.

Department of Mathematical Sciences

The undergraduate credit hour production of the Department of Mathematical Sciences continued to be more than one-eighth that of the entire University, and the doctoral level credit hour production of the department was approximately one-seventh that of the University.

Twenty-six students who majored in baccalaureate programs and 19 students who majored in master's programs of the department received degrees along with four students whose doctoral dissertations were directed by faculty of the department.

In spite of national trends to the contrary, the department had more than 200 undergraduate majors and continued to attract high quality graduate students, 22 percent of whom graduated from colleges and universities in South Carolina, Georgia and North Carolina; 24 percent from colleges and universities in the rest of the Southeast; and 54 percent from U. S. universities outside the Southeast. The Provost's Academic Planning Committee followed its 1982 designation of the department doctoral program as excellent by giving the department's master's program a rating among the highest for all University master's programs.

Contracts and grants in force in the department during 1983-84 amounted to \$760,000. Included in this amount is the 14th year of funding of the department's Office of Naval Research Contract and a five-year, eight-participant National Science Foundation EPSCoR grant in discrete mathematics. Additionally, the department continued its long tradition of service to precollege education by securing extra-University funds to support nine teacher-training courses in mathematical sciences.

One member of the faculty has learned of his designation as fellow of the American Statistical Association. Another member has received a second Humboldt Research Fellowship for conducting research in West Germany. One member has been named a visiting lecturer in statistics by the Committee of Presidents of Statistical Societies. And one member of our faculty has been appointed to the Academic Affairs Council for the College Board, the highest advisory position for a mathematical scientist in the College Board.

Department of Microbiology

The department had a successful year with both its teaching and research programs. Approximately 120 undergraduates majored in the microbiology B.S. curriculum, and 26 students, 10 of whom were pursuing doctoral degrees, enrolled in microbiology graduate programs. During 1983-84, 24 B.S., three M.S. and four Ph.D. degrees were awarded. Recipients of the Ph.D. degrees accepted post-doctoral positions at Harvard Medical School, Food and Drug Administration (Cincinnati, OH) and Brookhaven National Laboratories. Graduates from the M.S. program were employed by industries or continued training in doctoral programs. B.S. graduates entered a variety of positions with industries and research organizations, continued with graduate education or were admitted to professional health programs in medicine, dentistry or pharmacy.

Funds provided by a grant from the Department of Defense (DoD), with matching monies from the University, were used to establish a high performance liquid chromatography capability for the department. Five systems have been purchased, valued at approximately \$130,000, which permit the separation and quantitation of a variety of compounds ranging from simple sugars to proteins. These analytical tools have been used in a number of research projects under way in the department. With a second DoD grant of approximately \$100,000, a preparative ultracentrifuge and related equipment will be purchased in the coming year.

Faculty have been successful in obtaining external funds to support their research and the graduate programs. Grants and contracts were obtained from Sea Grant, National Cancer Institute, Army Research Office, USDA and Diamond Shamrock Corporation. Areas of research have included: biological fixation of nitrogen by bacteria associated with the roots of sea-grasses; bacterial diseases associated with marine fish; studies at the molecular and genetic levels of enzymes capable of digesting cellulose at elevated temperatures; characterization of the cellulose digesting enzyme system produced by a marine bacterium; degradation of herbicides in aquatic sediments; biogenesis of methane gas; genetic engineering of bacteria and yeasts to produce chemical products of economic value; studies of melanoma cancer cells; molecular studies of cancer-causing chemicals with DNA; molecular studies with bacterial viruses; and enzymes that destroy the natural immunity factors against a bacterium responsible for dental caries.

Sixteen research articles were published by faculty in refereed journals. At national and regional meetings of the American Society for Microbiology, 11 papers were presented, and three sessions were chaired by faculty members.

A new faculty member specializes in biological nitrogen fixation pertaining to plants of agricultural importance. He emphasizes recombinant DNA and genetic engineering techniques in his research, and thereby strengthens the biotechnology expertise of the department.

Professor M. J. B. Paynter was recognized for his contribution to anaerobic microbiology by colleagues at the University of Florida, who named a newly discovered species of methane bacteria, *Methanomicrobium paynteri*.

Department of Physics and Astronomy

The Department of Physics and Astronomy increased its visibility significantly this year in both research and teaching. External support for research reached its highest level in history. Eleven faculty members held 16 grants this year. Support was obtained from the National Science Foundation, the National Aeronautics and Space Administration, the North Atlantic Treaty Organization, the Department of Health, Educa-

tion and Welfare, the Department of Agriculture, the Research Corporation and Fiber Industries. In addition, one faculty member received support through a Provost Research Grant. New grants were received from the University Research Committee and two Provost Research Grants.

The number of foreign visitors to our department was also at its highest level. There were four visits from faculty at the University of Kent, England, and one from the Indian Institute of Technology. In addition, the United States National Academy of Science, in collaboration with the Hungarian Academy of Science, sponsored a visitor from Eotvos University, Budapest to our department. Our faculty made reciprocal visits to England (5), France (2), Austria, Hungary, Germany, Israel, Canada and India. This last trip entailed a great deal of work as one of our faculty members, with NSF support, organized a joint Indo-US Conference on Diffusion in Solids.

The number of students enrolled in our graduate programs also increased, reaching nearly 30 for the first time in almost a decade. Two of our students were awarded R. C. Edwards Graduate Fellowships for their outstanding performance in research and class work. Graduate students also participated in programs at the National Magnet Laboratory, the Centre European Nucleaire, Saclay, France and Marshall Space Flight Center.

Several important changes have been made in our undergraduate programs. As a result of microcomputerizing our introductory laboratories, the projected enrollment is up by more than 100 students. A new course in microcomputerized instrumentation will provide valuable "hands on" experience for our students. Also, one of our faculty members was invited to present a workshop on the physics of toys at the joint annual meeting of the American Physical Society and the American Association for Physics Teachers. This is one of the most prestigious invitations these societies extend. Our undergraduates led the college in academics this year. Forty-eight percent were named to the President's List and Dean's List Spring Semester.

On Physics Day more than 100 students from neighboring high schools and colleges visited research laboratories, learned first hand about computer-assisted problem solving and listened to a lecture by Professor John Rigden, editor of the *American Journal of Physics*. This event has already been beneficial in recruiting students.

Biology Program

During 1983-84 approximately 4,500 students were enrolled in courses offered by the Biology Program. Eight lecture sections and 58 laboratory sections per week were taught by faculty and graduate students from the

Biology Program and departments of Microbiology and Biological Sciences.

The Science Learning Resources Center, which houses both audio-visual and microcomputer materials, was expanded and used successfully by several student lecture and laboratory sections. Using the computer-based Teacher Information Processing System, it is possible to pair individual students with audio-visual and computer materials appropriate for their levels of ability. Most students were able to improve their grades by 15 points or more by diligently using the Learning Resources Center.

The fifth Clemson University Biology Merit exam was conducted for more than 1,100 high school and junior high school students. Top winners were awarded scholarships to Summer Science Camp through a grant from the Alumni Foundation Fund.

The Biology Program faculty continued its involvement with teacher education in South Carolina, offering a science course for elementary teachers, an advanced update in biology course for high school teachers and a summer short course program for secondary teachers. The faculty developed a series of 25 laboratory exercises, which were presented at the South Carolina Science Council meeting and distributed to South Carolina teachers. The faculty also developed and ran a program for minority students and teachers in conjunction with the South Carolina Academy of Sciences.

Notable activities of the Biology Program faculty included: election of the director as vice president of the South Carolina Academy of Science; appointment of a second member to the Council of the South Carolina Academy of Science as executive secretary of the South Carolina Junior Academy of Science; a third is president of the South Carolina Association of Biology Teachers; a fourth serves as the regional representative to the American Association of Biology Teachers; and a fifth has been appointed director of the Medical Technology Program.

Additional activities included presentation of three papers at annual meetings of the National Science Teachers Association; invited presentation of a symposium on Techniques in Bioeducation at both the National Association of Biology Teachers and International Conference of Science Educators; invited direction of workshops at the National Association of Biology Teachers regional update and annual meetings; presentation of a workshop at the national meeting of the Association for Biology Laboratory Education; organization and direction of the South Carolina Junior Academy of Science Olympics; judging the South Carolina Junior Academy paper presentations; judging the western regional science fair and other state science fairs.

Four grant proposals were submitted; \$93,500 in outside funding was obtained. Two manuscripts were published, and four laboratory manuals were revised and published.

Medical Technology Program

The Medical Technology Program began its third decade this year. Muriel B. Bishop, professor of chemistry, resigned as coordinator of the program. Much of the success of the program is due to her dedication and hard work.

Mariette V. Ruppert, assistant professor of biology, became the new program coordinator this spring. She has since spent considerable time visiting hospitals, observing programs and attending orientation sessions to advise incoming students. The newly structured Medical Technology Committee is working smoothly.

Six students completed the baccalaureate degree requirements in medical technology in 1982-83, bringing to 115 the total number of graduates in this program. Forty students are enrolled in the program now. These students have made outstanding scores on the national certification examinations and have been successful in finding employment in the field.

GRADUATE SCHOOL

A two-year program to incorporate Graduate School records into the Student Data Base (SDB) was completed in August 1983. The major improvement derived from this effort was the full maintenance of cumulative grade summaries for graduate students. These summaries now appear on the grade reports and transcripts.

Fourteen outstanding graduate students were awarded R. C. Edwards Fellowships, and six were awarded Graduate Alumni Fellowships. Eight black students were awarded South Carolina Graduate Incentive Fellowships for the year. University-wide awards, fellowships and traineeships administered by individual departments provided 92 graduate students with tax-free assistance. This represents more than 10 percent of the full-time graduate students eligible for such assistance.

Enrollment for the fall semester was 2,131 students, including 191 enrolled in the Clemson-at-Furman MBA degree program. The University assumed full control of the program in July. Excluding the MBA enrollees, enrollment grew by approximately 2 percent.

Advanced degrees awarded during the year total 566, including 49 Ph.D. degrees.

The Graduate School implemented a new policy to withhold from public display those theses or dissertations that contain proprietary information relative to the interests of the sponsors of the research. In cases where this interest is to be protected, an agreement must be signed before the research project is accepted by a department. The agreement stipulates that the thesis or dissertation will be held for a maximum of one year, except under unusual circumstances.

UNDERGRADUATE STUDIES

The Undergraduate Studies Office works with undergraduate curricula, the honors program, academic standards, scholarships and awards, academic advising, University-wide lectures, new faculty-staff orientation, summer sessions. It also coordinates and administers the Clemson Career Workshops.

These workshops bring academically outstanding minority students to campus before their junior and senior years in high school. In 1982 and 1981, 140 rising juniors visited Clemson. In that same program, 90 rising seniors visited in 1982, compared with 34 in 1981. The 1983 program grew to include 198 rising juniors and 140 rising seniors. The 1984 program includes 345 students at the rising junior and rising senior levels. A new level for entering minority freshmen also has been added. It enrolled 25 minority freshmen in 1984.

In 1982, 48 minority students recruited through the previous workshops enrolled at Clemson. Eighty-six students enrolled in fall 1983, and the first minority students recruited through the program were graduated in spring 1984.

Plans call for the program to be expanded again in 1985 if revenues can be found.

OFFICE OF UNIVERSITY RESEARCH

The Office of University Research provides information and assistance concerning all aspects of the University research effort to faculty members, departments, colleges and other administrative units. The office helps prepare and submit applications for sponsored research, instruction and public service programs. During 1983-84 the office processed 564 faculty proposals.

The office also provides University liaison between the institution and all public and private, national and local organizations or entities concerned with any aspect of research support, regulation or administration.

Guidance and executive support were provided to the University Committee for the Protection of Human Subjects (51 active projects); the Biomedical Research Support Grant Committee; the University Research Grant Committee (33 faculty grants, 25 Provost Research Awards); the Committee for Laboratory Animal Welfare; the Institutional Biosafety Committee (2 active projects) and the Clemson University Patent Committee (11 patent disclosures processed).

THE STROM THURMOND INSTITUTE OF GOVERNMENT AND PUBLIC AFFAIRS

The Strom Thurmond Institute is the main program component of The Strom Thurmond Center for Excellence in Government and Public Service, which comprises a planned institute and archives building, a multi-purpose auditorium facility and a continuing education building. The Thurmond Center is funded entirely by private contributions and will make possible an endowment to support the six programs of The Thurmond Institute:

- The Thurmond Seminars in Government and Politics
- The Strom and Nancy Thurmond High School Achievement Program
- The Thurmond Scholars Program
- The Institute Lecture Series
- The Institute Distinguished Lecturers Program
- The Institute Governmental Research Program

Since its inception in July 1982, the Institute has sponsored public programs featuring a number of leading opinion makers addressing such subjects as the proposed balanced budget amendment, nuclear arms freeze, El Salvador, improvement of public education, farm and food policy, and civilian-military cooperation in defense research and engineering. Speakers featured have included Sen. and Mrs. Thurmond; Sen. Patrick Leahy, D-Vt.; Dr. Edward Teller; U. S. Rep. Michael Barnes, D-Md.; Dr. Helen Caldicott; Secretary of Commerce Malcolm Baldrige; Prime Minister Eugenia Charles of Dominica; Ted Turner; John Connally; Undersecretary of Defense Richard DeLauer; Admiral Hyman Rickover; and members of the Clemson University faculty.

The Institute has on-going governmental research programs in state and local government, volunteerism and civic participation, and defense studies. The Institute has a major research contract with the State of South Carolina to develop a long-range water policy for the State. The study involves six departments at Clemson University and two departments at the University of South Carolina.

The Institute publishes a lecture series, working papers on a variety of public subjects and proceedings of other programs it sponsors.

LIBRARIES

Unlike the previous two years, which saw a great deal of change, 1983-84 was a year of stability and progress for the Clemson University libraries. Organizational and physical changes made in 1981-83 were refined, and progress was made to improve the information transfer to students and faculty.

New Funds

The libraries received additional funding from both State and private sources. An additional \$200,000 was added to the libraries' materials budget, which permitted the libraries to keep many serial and periodical subscriptions and to acquire more rapidly the journals and monographs needed by faculty and students. This resulted in our processing 88 percent more monograph titles in 1983-84 than in 1982-83. This year we purchased nearly 10,000 titles from State funds.

Private funds increased, with the major gift being made by the Athletic Department and Block "C" Club, qualifying them to become the fourth Founding Patron. This gift has been used to purchase books to honor Clemson athletes who have won conference or national honors. A portion of the gift was used to re-equip completely the libraries' microfilm reading facilities, which were seriously deficient in the Cooper Library. Ten new microfilm and six new microfiche readers were purchased and tables were refurbished.

Joe Shirley, a major donor to the libraries, increased his endowment by more than \$10,000, bringing the Shirley Endowment to more than \$136,000. Tigerama once again provided \$5,000 for the libraries. These funds are used to maintain our subscriptions to *Magazine Index*, *Newspaper Index* and *Business Index*, the most popular indexes in Cooper Library. The Panhellenic Council and IFC donated \$1,500 to the libraries. This is the second year in succession these groups have raised funds for the libraries. Other donors during the year included Calhoun Lemon of Barnwell and Mickey Lund of Anderson.

The libraries received a second grant from the State Library to help convert our bibliographic records into machine-readable form. This grant was for \$11,400.

Library Automation

A great deal of background work took place during 1983-84 for the installation of NOTIS, the libraries' total integrated library system. The computer programs received from Northwestern University were thoroughly tested and debugged. The libraries' database of bibliographic holdings, cataloged since 1975, was acquired from the Southeastern Library Network, Inc. (SOLINET). These tapes also underwent careful

scrutiny. In April the cataloging module of NOTIS became operational so that now the Clemson database is updated with new records as they are cataloged. With the receipt of public use terminals early in 1984-85, patrons will have access to this database, or approximately 60 percent of the items in the card catalog.

The Gunnin Library in the College of Architecture has been totally converted and will be the first library on the Clemson campus to have its card catalog eliminated and replaced by LUIS (Library User Information System), the catalog on NOTIS. During 1984-85, we should see the tying-in of the existing terminals on campus to LUIS, the implementation of the acquisitions module of NOTIS and preparation for the implementation of the circulation module of NOTIS.

The libraries received two Digital Rainbow 100s which have been heavily used. One of these machines is used for online database searching, the other for a wide variety of administrative functions.

Collections

With the addition of \$11,000 from summer school budget, the libraries were able to add 131 new serial subscriptions. This was the first significant addition since the serial cancellation program in 1981-82.

During the year, the libraries began receiving the Department of Energy's Technical Report File. Clemson's is the only library in South Carolina selected to receive this vast collection.

Clemson provides a collection of materials at Piedmont TEC in Greenwood to support the courses offered there by the College of Education. During 1983-84 this collection was reviewed, and all of the periodical volumes were either bound or replaced with microfilm. The library at Piedmont TEC has helped by keeping these materials for Clemson.

Several new collections of papers were acquired during the year. Two former congressmen, John Napier of Bennettsville and Ed Young of Florence, donated their papers. James McDuffy of Anderson, a Republican Party leader, donated his papers. Calhoun Lemon of Barnwell donated his extensive files on IPTAY and Clemson athletics.

Significant progress continues to be made on processing the Thurmond Papers, especially the pre-1980 papers. But because many cubic feet of new papers — and some older ones now known to have existed — are received each year, part of 1983-84 was spent revising the Thurmond Plan of Work, which will be completed early in 1984-85. One major effort of the Thurmond archivist was the preparation of a proposal to merge, for the purpose of microfilming, Senator Thurmond's gubernatorial papers housed in the Caroliniana Library at USC, the State Department of Archives and History and Clemson University. This proposal, now ready to present to foundations for funding, would provide the money to bring all three collections to Clemson, organize them into series and microfilm

them. The result would be that all three institutions would have a complete collection of the Thurmond gubernatorial papers on microfilm. This is particularly important to Clemson since those are the documents needed to complete the Thurmond Papers.

Overall, the libraries' collections increased from 1,259,026 to 1,304,911. This figure includes cataloged material (597,715), documents and reports (550,264) and volume equivalents of microforms (156,932).

Other Activities

The Gunnin Library in the College of Architecture received a much needed improvement in its lighting during the year. The canned spot lights were replaced with fluorescent lighting. A new branch head was appointed during the year, upgrading the position from paraprofessional to professional. Leslie Abrams came from the College of Charleston in February to assume this position. Frances Colburn, circulation unit head, filled the position on an interim basis while the search was being conducted. Both individuals are responsible for a number of improvements in the Gunnin Library during 1983-84.

During the year, a complete inventory of the Cooper Library monographic collection was made by the staff of the Circulation Unit. This massive undertaking showed a loss rate of less than 1 percent since the last inventory taken more than five years ago.

During the year, more than 32,000 titles were converted to machine readable format by the Retrospective Conversion team. This is a long term project which is expected to take at least two more years.

A new serials cataloger was appointed after a 16-month search. Chris Gorsuch began work in June.

As the statistics at the end of this report show, the activity in the Reference Unit increased during 1983-84. Bibliographic instruction showed the greatest increase with 80 percent more classes taught during 1983-84 than during 1982-83. A workbook developed by the bibliographic instruction coordinator has been an effective teaching tool. Other areas of increased activity in the reference department were: reference questions answered, up 23 percent; online searches, up 11 percent; and interlibrary loans, up 24 percent.

Statistics

1. Collections

Books and Journals

	<i>Accessioned</i>	<i>Withdrawn</i>	<i>Cataloged</i>	<i>Total Holdings</i>
Cataloged: All Libraries	20,619	719	16,563	590,375
Uncat'd: Gunnin				4,461
Sirrine				2,879
TOTAL				597,715

Documents and Reports

Cooper	547,657
Gunnin	1,726
Sirrine	881
TOTAL	<u>550,264</u>

Microforms

	Microfilm	Microfiche	Microcards	Total Bound Vol. Equivalent
Public Documents	2,228	597,407		
Other	<u>17,973</u>	<u>54,799</u>	31,449	
TOTAL	20,201	652,206	31,449	<u>156,932</u>
GRAND TOTAL PRINTED HOLDINGS				1,304,911

Slides (Gunnin)	59,341
Maps (Public Documents)	27,956
Current Serial Subscriptions	
Periodicals	5,268
Other serial	<u>1,104</u>
TOTAL	6,372

2. Circulation

Door Count of Visitors

Cooper	714,825
Gunnin	35,789
Sirrine	N/A
TOTAL	<u>750,614</u>

Books Circulated

Cooper	190,991
Gunnin	12,911
Sirrine	<u>8,662</u>
TOTAL	212,564

3. Reference Services (Cooper)

Inquiries

Directional questions ...	8,948
Reference questions ...	29,214
Research questions	<u>324</u>
TOTAL	38,486

Computer Searches

Quick	67
Reference	14
Research	<u>307</u>
TOTAL	388

Interlibrary Loans

Loaned	4,145
Borrowed	<u>3,217</u>

COMPUTING SERVICES

Computer Center

In 1983-84 for the first time, the Computer Center offered a wide range of computing services on a system other than the central IBM network. The advent of the VAX network did not, however, threaten the preeminence of the IBM system in Clemson computing, but it did result in some shifts in emphasis.

The Riggs Hall computing facility was opened in time for the 1983-84 academic year. It contained two Digital Equipment Corporation VAX 11/780 computers: one for graphics and computer-aided design, the other for research computing. The lack of suitable graphics software inhibited use of the graphics machine until departments acquired the software they needed. Usage now is rising substantially.

The center has moved two full-time people to Riggs Hall to provide consulting and operations support. Support for the VAX machines is now being provided by Academic Computing Support, but operation of the systems will soon be taken over by the operations group at the Computer Center. Academic Computer Support will continue to provide consulting support. The Riggs Center now contains a third VAX machine, an 11/750, acquired to provide network access and file storage for a cluster of 50 DEC microcomputers to be installed in the library.

Installation of the library microcomputer cluster is in accordance with the plan developed by the Ad Hoc Long Range Computer Planning Committee. This plan calls for the installation of clusters of microcomputers at various locations around campus. These clusters are to be incorporated into the existing computer network. Two additional clusters are to be installed in 1984-85, one in the College of Engineering, the other in an as yet undetermined location. The plan also calls for installation of a combined voice/data switch to handle voice communications and casual access to the computer network from workstations in faculty offices, student dormitories and off-campus locations.

The IBM system has performed extremely well during the past year and has processed an increasingly heavy workload without any significant degradation of service. A major effort is under way to convert to the latest IBM operating system in time for fall 1984. This new operating system will permit more efficient use of the computer and extend its life.

Improved performance also will result from installing new disk drives to replace the ones now in place. The price paid is heavy, however. Under normal circumstances it would not be necessary to change disk drives now. The old ones have given adequate performance and still have a useful life ahead of them. The shortage of power and space at the center necessitated installation of drives which would hold more data and take up less power and floor space. Had more space been available, the center

would have been able to take advantage of a donation program under which the disk vendor would have installed additional older-technology drives at no cost.

The shortage of space at the center continues to be a serious problem, to the point where it is affecting service. There is no office space available to house new people, so the center cannot add staff to provide the consulting services required by users. The machine room is full of equipment, so new equipment can be installed only if other equipment is moved out, or by some suboptimal placement in remote parts of the campus. There are no conference or break rooms, storage space is practically non-existent and the air-conditioning and power systems are just barely adequate.

Despite space problems, the center has continued to receive grants and discounts from hardware and software vendors. Major discounts have been negotiated with Digital Equipment Corporation for a complete range of computer products. Storage Technology Corporation has made a sizable equipment grant to the center in exchange for the rights to use some Clemson-developed software, and the center's videotex public information delivery system recently received a boost by the grant of \$240,000 worth of videotex equipment by Contel Corporation.

The continued decline in the percentage of computer use by outside customers causes some concern. While income from outside users has risen, the percentage of the total use continues to fall. The University can expect to have to increase funding to the center by up to \$600,000 each year, exclusive of inflation, solely to cover this decline.

In its attempts to diversify its customer base, the center has had modest success. The center will be providing software and consulting services to the State's 16 technical colleges. This is expected to provide modest but increasing revenue over the next several years.

Division of Administrative Programming Services

The Division of Administrative Programming Services (DAPS) develops and maintains computerized information systems for the University administration. The division consults with University administrators and designs systems to support routine operational needs as well as management decisions. A key component of DAPS' mission is to design coordinated information systems that are supported by an integrated University data base. During 1983-84, DAPS accomplished the following:

- Completed the implementation of the grades processing and correcting portion of the Student Data Base.
- Assisted in the installation of the NOTIS library system for the R. M. Cooper Library. The on-line bibliographic data base is the first portion of the system being put in operation.
- Completed an automated billing and indirect cost charging system for the Grants and Contracts Department.

- Assisted in the evaluation and installation of an artificial intelligence software system (INTELLECT) for use by administrators in retrieving information using English language statements.
- Supported the use of data retrieval languages such as SAS and CULPRIT by administrative staff.
- Completed the implementation of a data security system for administrative information.
- Developed software to report Clemson financial information to the State Accounting and Reporting System.
- Expanded the capabilities of the terminals in administrative offices to allow on-line update to non-critical fields in the personnel data base.
- Implemented an on-line departmental encumbrance system used by departments to reduce the lag time for recording encumbered funds.
- Assisted in implementing fiscal year-end pay adjustments and budget/accounting processing.
- Maintained the effectiveness and ongoing operation of 60 administrative systems and responded to requests for enhancements by major users.
- Assisted departments in the selection and installation of microcomputers for administrative use and in downloading data from administrative systems for further analysis.
- Continued software support for the spring and fall budget processes.
- Designed a University fixed assets system and began programming the first portion, a property control system.
- Designed the third major phase of the Student Data Base, a Financial Aid and Collections system.
- Designed and programmed a University-wide employee leave accounting system to be used by all departments.
- Implemented a financial system for the Development Office on a microcomputer.
- Developed techniques to make student data available to authorized academic departments through a terminal.

Division of Information Systems Development

The Division of Information Systems Development (DISD) has had an extremely successful year, though this is not reflected in the balance sheet. The value of contracts is at an all-time high, and staff has been added for the first time in a number of years.

DISD's dependence upon the Department of Social Services (DSS) for the majority of its income has been sharply reduced by signing a major contract to supply administrative systems software to the State's 16 technical colleges. This contract represents a radical departure from previous contracts. First, the software is to be developed on a Digital

Equipment Corporation VAX computer and not on an IBM system; secondly, it is a fixed-price contract. The fixed-price nature of the contract and the fact that DISD had to submit a bid to obtain it caused some problems and confusion, but procedures are now in place to acquire such contracts more easily in the future.

The remainder of DISD's contracts appears stable, though DSS has requested that new staff be hired in anticipation of a major increase in the workload from DSS. This is a welcome request since the billings to DSS in the early part of 1983-84 were substantially below expectations.

New equipment has been acquired to support the TEC project, and the old IBM equipment has been replaced. Overhead has been reduced by a substantial reduction in administrative personnel costs.

The past year has been very profitable for DISD, but this will not become apparent until 1984-85 when the revenue from the TEC contract starts to arrive. Until then, income will lag somewhat behind expenditures.

OFFICE OF HUMAN RESOURCES

The Office of Human Resources has been an integral part of the University's successful efforts to fulfill the objectives of affirmative action, equal employment opportunity and the State Desegregation Plan, with at least the partial result that the national shortage of blacks for faculty positions has not affected Clemson.

Faculty appointments were offered to black candidates by the departments of History, English, Microbiology and Agronomy (dual appointment), Economics, and Electrical and Computer Engineering for the 1983-84 academic year. They were accepted in History, Microbiology/Agronomy, and Electrical and Computer Engineering. These faculty are returning for the 1984-85 academic year, and there has been an additional black faculty appointment in the Cooper Library as well as in the Department of Poultry Science. The latter is particularly commendable in view of the low availability of blacks with advanced degrees in that field.

There continue to be appointments of blacks in professional and executive positions, such as an assistant dean in the Office of Student Life, a minority business enterprise officer in Service and Support Facilities and a counselor in the student counseling center. This year, of 179 executive positions, 16 are filled by blacks, while 72 of 453 non-faculty professional positions are held by blacks.

The Administrative Management Trainee Program has been instrumental in increasing the number of blacks in professional, non-academic positions in the past, but of the three current trainees, one is in an academic position. This opens up a new avenue for the programs, which provide additional incentives for blacks to accept positions at Clemson. The trainee program was developed at Clemson and, of the six persons previously trained, all continue to be employed by the University.

Not only has there been an increase in black personnel, but also there is an increased focus on activities and programs that highlight the black experience. Black History Month, guest lecturers and entertainers, the Gospel Choir and the Pamoja organization have been well received.

During the past year black student representation also continued to increase. Fall 1983 black undergraduate enrollment was 1.24 percent greater than fall 1982 enrollment. This was due largely to the success of the Minority Career Workshops as well as to an active recruitment effort by the University's admissions counselors. First-time enrollment of blacks in the graduate program increased 1.29 percent from fall 1982 to fall 1983.

Retention has been addressed during the past year by a task force established to evaluate data relevant to retaining all students, blacks in

particular. Conclusions and recommendations are being formulated at this time.

The development of an affirmative action/equal employment opportunity manual for University-wide distribution is in progress. This manual will contain procedures, policies, definitions and guidelines relating to affirmative action and equal employment opportunity. It will be used in personnel decisions such as recruitment, selection, training and promotion. The manual is in the final stages of editing, and should be available in early fall.

Office of Human Resources also is pursuing a national conference directed to those in higher education. The conference would be developed and hosted by Clemson, and would focus on recruitment and retention of minority faculty, staff and students.

Development Office

The Office of Development, operating under the Vice President for Institutional Advancement and coordinated with the Clemson University Foundation is the duly designated fund-raising agency for the University. In the fiscal year 1983-84 the purpose of the Office of Development is to create an awareness of the University's financial needs that are not provided by state or federal support, and to implement plans designed to meet these needs.

In 1982, the Office of Development received \$1,500,000 in contributions and gifts. This amount is a record for the University. The total amount of contributions received in 1982-83 was \$1,400,000. The total amount of contributions received in 1981-82 was \$1,200,000. The total amount of contributions received in 1980-81 was \$1,000,000.

Alumni Relations and Research Development

Clemson alumni and friends continue to support the University in record numbers. Last year 20,188 participants provided nearly \$1 million in support to a record yearly high of \$1.5 million. This expansion of their continued confidence in what Clemson University means not only to the State but also to the nation.

A new recruiting campaign to bring more outstanding students to the campus was kicked off officially as the University's Board of Trustees put the highest priority on a revitalized scholarship program.

The President Robert E. Cook's Scholarship were increased to \$2 Twenty-five Alumni-Scholarships and five Frank J. Harvey Alumni Scholarships (both new programs) will be funded for fall 1984. The National Alumni Scholarships and 50 Alumni Presidential Scholarships also will be funded. Over a two-year period, within the current expansion schedule, there 141 renewable scholarships should grow to 200 offerings.

ACADEMIC FUND RAISING

The objectives of the private support efforts at Clemson University are deliberate and broad based. They encompass growth in the unrestricted permanent endowment, expansion of all phases of general and endowment support for faculty, increased sources of student financial aid and further development of the annual Loyalty Fund program that enhances the total academic environment.

While State appropriations are a part of the total support for the educational activities at Clemson, more than 50 percent of the total budget must come from other sources. In that context the ultimate quality of the University rests with private support from business, industry, alumni and friends of the University.

Development Office

The Office of Development, operating under the Vice President for Institutional Advancement and coordinated with the Clemson University Foundation, is the duly designated fund-raising agency for the University. In the broadest sense, the purpose of the Office of Development is to create an awareness of the University's financial needs that are not provided by State or federal support, and to implement plans systematically by which dollar needs can be met.

In 1983, business and industry donated \$1,559,460. Foundations contributed \$1,086,677, and professional and trade organizations added \$196,652. Trusts acquisitions amounted to \$14,160. Of these amounts more than half a million dollars was added to the Clemson University Foundation's assets, increasing its total worth to \$11.3 million.

Alumni Relations and Resources Development

Clemson alumni and friends continue to support the University in record numbers. Last year 10,168 participants pushed Loyalty Fund giving to a record yearly high of \$1.88 million, thus expressing their continued confidence in what Clemson University means not only to this State but also to the nation.

A new recruiting campaign to bring more outstanding students to the campus was kicked off officially as the University's Board of Trustees put the highest priority on a revitalized scholarship program.

The prestigious Robert F. Poole Scholarships were increased to 25. Twenty-five Alumni-Faculty-Staff Scholarships and five Frank J. Jervey Alumni Scholarships (both new programs) will be funded for fall 1984. The National Merit Scholarships and 80 Alumni Presidential Scholarships also will be funded. Over a four-year period, within the current expansion schedule, these 141 renewable scholarships should grow to 468 offerings

and bring to the campus many of the top high school achievers in the nation.

As the University approaches its 100th birthday and looks toward the 21st century, the Office of Institutional Advancement is working on new approaches that focus on goals and sources of funds for developing centers of excellence at the University.

A Challenge to Greatness Campaign will bring together resources from the business and industrial community, foundation investments and expansion of traditional financial support from alumni and friends. Under this umbrella will be The Strom Thurmond Center, a multiplex structure for academia, the performing arts and archival material tracing the career of the distinguished senior senator from South Carolina, the Honorable Strom Thurmond.

Whatever the future of the national or State economy, it is clear that State appropriations have become a foundation on which to build, not a cushion on which to rest.

STUDENTS

The 1983-84 academic year marked the highest on-campus enrollment with 11,828 students registered for classes — 10,799 full time and 1,029 part time. An additional 631 were in various off-campus programs bringing the total enrollment to 12,459, a record high for the University. Of the total enrollment, 2,129 were graduate students.

The College of Engineering again had the highest on-campus enrollment with 3,492 students. The College of Commerce and Industry was second with 2,539, followed in order by Sciences, Education, Liberal Arts, Agricultural Sciences, Architecture, Forest and Recreation Resources, and Nursing. All colleges — with the exception of Agricultural Sciences — had enrollment increases.

Higher education continued to become increasingly accessible as evidenced by the increased number of freshmen entering college with advanced standing. In the 1983-84 fall semester new high school graduates entered Clemson with advanced standing by means of College Board Advanced Placement courses (320 students, 2,547 credit hours), concurrent enrollment in high school and college (178 students, 810 credit hours) and enrollment in summer school (178 students, 676 credit hours).

At Clemson, performance in high school has proven to be the best single predictor of success in the freshman year. The class ranks of entering freshmen have improved to the point that 45 percent of the freshman class entering in fall 1983 ranked in the top 10 percent of their class, 70 percent in the top 20 percent and 95 percent in the top 50 percent. While SAT scores were declining nationally during the past decade, the average SAT of freshmen at Clemson rose. In 1983 the freshman class average of 1,014 compared with an average of 893 reported by the College Board for all high school seniors. It is also the highest average among state-supported institutions in South Carolina.

Of the 7,783 new applications for admissions processed for 1983-84, 4,915 were accepted and 2,558 actually enrolled (including freshmen and transfer students). South Carolina residents accounted for 74 percent of the 12,459 students, including those enrolled in off-campus programs. Clemson students come from all 46 South Carolina counties, 48 states, Puerto Rico, the District of Columbia, Guam and 66 foreign countries (351 students).

Greenville County continued to have the most students enrolled on campus (1,210). Pickens County was second with 1,009 followed in order by Anderson, Charleston, Spartanburg, and Oconee counties. Most out-of-state students came from North Carolina (555), Georgia (540) and Florida (407).

Computerized pre-registration helped the record number of students get off to a smooth start for fall classes. More than 90 percent were pre-

registered and had their course schedules completed before they arrived on campus to begin classes.

Fall Semester Enrollment Comparisons for Recent Years

Year	Undergraduate	Graduate and others	Total
1972-73	7,686	2,071	9,757
1973-74	7,910	2,202	10,112
1974-75	8,171	2,415	10,586
1975-76	8,576	2,785	11,361
1976-77	8,620	2,763	11,383
1977-78	8,708	2,566	11,274
1978-79	8,925	2,553	11,478
1979-80	9,291	2,457	11,748
1980-81	9,427	2,152	11,579
1981-82	9,918	2,008	11,926
1982-83	10,151	1,983	12,134
1983-84	10,217	2,242	12,459

The 1983-84 figures include 340 students attending off-campus institutes and 190 in the Clemson-Furman University Master of Business Administration degree program.

The on-campus enrollment of women at Clemson reached an all-time high during the 1983 fall semester. There were 4,919 of which 4,320 were undergraduates. Enrollment of undergraduate coeds was 4.4 percent more than last year. Women now constitute more than 41 percent of the on-campus enrollment and 42 percent of the total enrollment.

The Clemson student body continues to be a working group receiving a significant amount of financial assistance in the form of loans, grants, scholarships and work assistance. In 1983-84 approximately 2,615 students earned an estimated \$6,536,955 working for the University. This figure does not include earnings from off-campus employment. Clemson awarded 337 long-term loans totaling \$397,950. The University also approved and certified 2,243 guaranteed student loans from a variety of lending institutions. Excluding donor-selected scholarships, 592 scholarships and grants valued at \$547,188 were awarded. The number of students receiving Pell Grants was 1,519 with awards totaling \$1,707,238. In all, an estimated 65 percent of the student body received an estimated total of \$14 million in financial assistance.

Students at Clemson University enjoyed educational experiences outside the classroom through participation in student organizations. This year the number of recognized organizations rose to a high of 236. Half of these groups directly complement the academic experience by providing

career-oriented fellowship, programs and trips to professional conferences. Our students enjoy competition through 37 sports clubs, socialization through 32 social clubs and fellowship through 21 religious organizations. In addition, more than 30 student groups have formed to provide associations with other students interested in fine arts, media, military, government and community service.

Student Government has grown to meet the needs of the student body. Approximately 300 people this year represented the students in the senate, the court system, and the Student Traffic Review Board, as well as providing services through various committees in the executive branch. This year's services included copy machines, typewriters, refrigerator rentals, security shuttles and free legal aid. For additional campus security in the evening, a walking escort system was provided by Student Government volunteers.

Student media organizations continued to win awards for journalism. The *TAPS* yearbook, *The Tiger* newspaper, and WSBF radio are enjoying a resurgence of student involvement.

Clemson's 10 sororities and 18 fraternities claimed total membership of 1,100 and 800 respectively. Sorority women emphasized academic excellence and maintained an average grade point ratio of 2.82, which was higher than the University's overall female student average of 2.70. Approximately 28 percent of the undergraduate women at Clemson were members of sororities, and 13 percent of the undergraduate men were members of fraternities.

Parking and traffic records are maintained to coincide with the academic calendar from August 15 to August 15 each year. During the period August 15, 1983, through May 11, 1984, 10,846 student parking decals were issued and \$18,905 was deposited to the Miscellaneous Income Account. The Clemson University police wrote 25,368 parking tickets plus 17,304 warning tickets during the same period. The total amount collected for parking fines by the Office of Parking and Vehicle Registration and deposited to the MIA was \$42,175, while \$124,593 was turned over to the accounting office for collections. The Student Traffic Review Board heard appeals from 1,314 students involving 1,538 parking tickets, or about 6 percent of the tickets written.

Career Services, composed of Placement and Cooperative Education, did not show a significant increase in activity in spite of an economy that continued to gain strength throughout the year.

The number of seniors registered with the Placement Office increased to 1,264 with 6,797 interviews. The number of employers recruiting on campus was 353, about the same number as last year. The number of offers was up slightly, while the salaries for most disciplines did not increase much over last year. Most salaries offered to Clemson students were in line with the College Placement Council's national average.

The Cooperative Education Office was able to regain some of the ground lost during the recession. Total student enrollment rose to 403, an increase of 10 percent from the preceding year. The number of new students joining the program increased from 104 in 1982-83 to 176 in 1983-84. Another encouraging sign was represented by the 32 companies or government agencies that decided to form co-op relationships with Clemson University during the past year. Student interest in cooperative education remained high, with more than 300 students applying for work assignments during the same period.

The Clemson University Union, working through its 11 student program committees and 300 volunteers, provided more than 1,000 different social, cultural and recreational programs. Highlights of 1983-84 programs included a Performing Artist Series, Homecoming USA with Bob Hope and 50 short courses offered to the University community.

In 1983-84 eight Clemson athletic teams finished in the top 10 in the nation, and the overall sports program finished eighth in the nation. This marks the seventh time in the past eight years the Clemson program has finished in the top 10 in overall sports programs. Clemson also claimed four Atlantic Coast Conference championships. The football record of 30-2-2 for the past three years is the best in the nation.

Clemson had 54 All-Conference athletes representing 15 different sports and 17 All-American athletes representing 11 different sports.

Number and Percent of Black Students

<i>Year</i>	<i>Number</i>	<i>Percent</i>
1972	179	2
1973	211	2
1974	216	2
1975	338	3
1976	307	3
1977	336	3
1978	290	3
1979	341	3
1980	305	3
1981	325	3
1982	429	4
1983	472	4

**Student-Faculty Ratio
(Full-Time Equivalent)**

<i>Year</i>	<i>Ratio</i>
1972	14.6:1
1973	16.8:1
1974	17.9:1
1975	18.3:1
1976	17.6:1
1977	16.3:1
1978	15.9:1
1979	16.0:1
1980	15.6:1
1981	16.4:1
1982	16.6:1
1983	17.0:1

**Average College Board Score
of Freshmen**

<i>Year</i>	<i>Score</i>
1972	995
1973	982
1974	984
1975	983
1976	996
1977	985
1978	1000
1979	1002
1980	1005
1981	1007
1982	1017
1983	1014

Number of Teachers
(Full-Time Equivalent Teaching Faculty)

<i>Year</i>	<i>Teachers</i>
1972	614.8
1973	578.4
1974	591.8
1975	602.5
1976	611.3
1977	654.4
1978	675.6
1979	691.8
1980	718.2
1981	709.7
1982	720.9
1983	713.5

Number in Freshman Class
(New Students)

<i>Year</i>	<i>Number</i>
1972	1,919
1973	2,034
1974	1,949
1975	1,901
1976	1,861
1977	1,838
1978	2,020
1979	1,998
1980	2,008
1981	2,284
1982	2,321
1983	2,122

Acceptance Rate of Applicants

<i>Year</i>	<i>Rate</i>
1972	83%
1973	83%
1974	84%
1975	77%
1976	69%
1977	69%
1978	69%
1979	60%
1980	59%
1981	59%
1982	52%
1983	63%

Retention Rate of Students (Freshman Class)

<i>Year</i>	<i>Score</i>
1971	84%
1972	82%
1973	83%
1974	83%
1975	82%
1976	84%
1977	84%
1978	87%
1979	87%
1980	87%
1981	89%
1982	87%

Number of On-Campus Students in Summer School

<i>Year</i>	<i>Number</i>
1972	5,232
1973	6,267
1974	5,997
1975	6,275
1976	6,100
1977	6,301
1978	6,393
1979	6,708
1980	6,858
1981	6,897
1982	7,149
1983	7,442

Number of Dorm Beds and Percent Being Used

<i>Year</i>	<i>Beds</i>	<i>Percent</i>
1972	5,174	100
1973	5,330	102
1974	5,592°	101
1975	5,616°	103
1976	5,625°	103
1977	5,662°	103
1978	5,683°	104
1979	5,726°	106
1980	6,317°	112
1981	6,864°	100
1982	7,149°	105
1983	7,113°	104

° Includes beds in the Clemson House:

- 1974 — 252
- 1975 — 262
- 1976 — 271
- 1977 — 308
- 1978 — 317
- 1979 — 324
- 1980 — 329
- 1981 — 330
- 1982 — 328
- 1983 — 331

1983-84 Clemson Athletics Review

<i>Sport</i>	<i>Home</i>	<i>Away</i>	<i>Neut.</i>	<i>ACC</i>	<i>Overall Record</i>	<i>PCT</i>	<i>ACC Reg Finish</i>	<i>ACC Trn Finish</i>	<i>National Ranking</i>	<i>All-ACC Players</i>	<i>All-Americans</i>
Football	6-0-1	3-1		7-0	9-1-1	.818	First	NA	11th	8	3
° Soccer	13-1-2	3-2		3-2-1	16-3-2	.762	Third	NA	12th	5	2
° Men's Tennis	13-1	8-2	6-6	7-0	27-9	.750	First	First	10th	8	1
Baseball	21-10	15-5	2-2	12-2	38-17	.691	First-T	Third		2	0
° Women's Basketball	9-2	8-5	4-3	9-6	21-10	.627	Third-T	Fifth-T		1	0
° Men's Swimming	6-1	0-3		3-2	6-4	.600	Third	Second-T		8	1
° Wrestling	6-2	1-2	2-2	1-2	9-6	.600	Fifth	Second		2	0
° Women's Swimming	5-0-1	0-4		2-2	5-4-1	.550	Fourth	Third		5	1
° Women's Tennis	5-4	3-6	11-6	7-2	19-16	.543	First-T	First	15th	5	1
Men's Basketball	11-5	3-7	0-2	3-12	14-14	.500	Eight	Fifth-T		0	0
Volleyball	5-3	2-13	8-7	3-4	15-33	.313	Fifth	Fifth-T		1	0
° Golf								Third	19th	2	1
° Men's Cross Country								First	Fourth	3	2
° Men's Outdoor Track								Third		2	0
° Women's Cross Country								Second	Seventh	3	1
° Women's Outdoor Track								Fourth		1	0
Men's Totals	76-20-3 (.783)	33-22 (.600)	10-12 (.455)	36-20 (.643)	119-54-3	.685	2 1st	2 1st	5 top 20	40	10
Women's Totals	24-9-1 (.721)	13-28 (.317)	23-16 (.590)	21-14 (.600)	60-63-1	.488	1st-T	1st	2 top 20	16	3
OVERALL TOTALS	100-29-4 (.767)	46-50 (.479)	33-28 (.541)	57-34 (.627)	179-117-4	.603	3 1st	3 1st	7 top 20	56	13

° Denotes advancement to postseason play as a team or individual.

**Fall Semester 1983 Enrollment by Colleges, and Degrees Awarded
December 1982-August 1983**

	<i>Main Campus Enrollment Fall Semester</i>	<i>Degrees</i>					<i>Total</i>
		<i>Associate</i>	<i>Bachelor's</i>	<i>Master's</i>	<i>Specialist</i>	<i>Doctorates</i>	
Agricultural Sciences	768	0	155	46	0	8	209
Architecture	511	0	81	46	0	0	127
Commerce & Industry	2,743	0	506	18	0	6	530
Education	1,480	0	228	155	8	0	391
Engineering	3,515	0	504	86	0	14	604
Forest & Rec. Resources	406	0	79	19	0	0	98
Liberal Arts	848	0	150	5	0	0	155
Nursing	424	1	43	4	0	0	48
Sciences	1,631	0	159	50	0	21	230
Non-Degree	133
TOTALS	12,459	1	1,905	429	8	49	2,392

Degrees awarded since 1896 (through August 1983) total 51,926 of which 426 have been associate degrees; 42,008 bachelor's degrees; 8,686 master's degrees; 111 education specialist degrees; and 693 doctorates. Includes 335 Clemson-Furman MBA degrees awarded May 1972-August 1983.

OPERATING FUNDS FOR THE YEAR ENDED JUNE 30, 1984

Revenues

	Unrestricted	Restricted	Total
Student Fees	\$ 23,996,518		\$ 23,996,518
Federal Appropriations	10,789,461		10,789,461
State Appropriations	72,984,022		72,984,022
Local Appropriations	2,510		2,510
Federal Grants and Contracts	922,694	\$ 7,236,978	8,159,672
State Grants and Contracts	65,112	869,447	934,559
Local Grants and Contracts		30,650	30,650
Private Gifts, Grants and Contracts	769,497	7,073,406	7,842,903
Endowment Income	9,266	265,030	274,296
Sales and Services of Educational Department	1,522,491	170,509	1,693,000
Sales and Services of Auxiliary Enterprises	26,017,348		29,017,348
Other Sources	4,154,972	468,416	4,623,388
TOTAL REVENUES	\$ 144,233,891	\$ 16,114,436	\$ 160,348,327

Expenditures And Mandatory Transfers

Educational and General			
Instruction	\$ 42,176,193	\$ 1,389,140	\$ 43,565,333
Research	3,913,726	4,399,506	8,313,232
Research-Agricultural Experiment Stations	13,579,380	1,984,963	15,564,343
Extension and Public Service	1,119,615	1,620,748	2,740,363
Extension and Public Service-Cooperative Agricultural Extension Service	19,700,598	633,310	20,333,908
Extension and Public Service-Regulatory Service	3,319,412	875,671	4,195,083
Academic Support	7,850,286	324,655	8,174,941
Student Services	3,856,380	78,355	3,934,735
Institutional Support	9,611,103	317,626	9,928,729
Operation and Maintenance of Plant	8,917,164	851	8,918,015
Scholarships and Fellowships	39,750	4,447,036	4,486,786
	<u>\$ 114,083,607</u>	<u>\$ 16,071,861</u>	<u>\$ 130,155,468</u>
Mandatory Transfers	344,708		344,708
Total Educational and General	\$ 114,428,315	\$ 16,071,861	\$ 130,500,176
Auxiliary Enterprises			
Auxiliary Enterprises Expenditures	\$ 24,861,328	\$ 42,575	\$ 24,903,903
Mandatory Transfers	2,105,000		2,105,000
Total Auxiliary Enterprises	\$ 26,966,328	\$ 42,575	\$ 27,008,903
TOTAL EXPENDITURES AND MANDATORY TRANSFERS	\$ 141,394,643	\$ 16,114,436	\$ 157,509,079
OTHER TRANSFERS AND DEDUCTIONS	\$ 495,934	\$ (1,021,192)	\$ (525,258)
NET INCREASE/(DECREASE) IN FUND BALANCES	\$ 2,343,314	\$ 1,021,192	\$ 3,364,506

PUBLIC SERVICE PROGRAMS OF THE COLLEGE OF AGRICULTURAL SCIENCES

Luther P. Anderson, Dean

The College of Agricultural Sciences administers statewide public service programs in addition to its programs for resident instruction. Among its public service functions are administration and coordination of the varied activities and services of the South Carolina Agricultural Experiment Station, the Cooperative Extension Service, the Division of Regulatory and Public Service Programs and the Livestock-Poultry Health Department. Reports of these divisions follow.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION

W. Cecil Godley, Director

Clemson's S. C. Agricultural Experiment Station conducts South Carolina's only state-funded agricultural research program.

Scientists in the College of Agricultural Sciences' 10 departments provide expertise for this program, with home economics research conducted at Winthrop College. Facilities at Clemson and four branch stations located across the State provide indoor and outdoor laboratories for scientists in agricultural economics, agricultural engineering, agronomy, animal science, dairy science, entomology, fisheries and wildlife, food science, horticulture, plant pathology and poultry science.

The Experiment Station's four branches enable researchers to conduct studies that relate to growers in their areas under the constraints of soils and climates.

The Experiment Station was established in 1886 under federal law and is State controlled, with annual appropriations from the South Carolina Legislature and supplemental funding from the United States Congress.

Experiment Stations operate in all 50 states and conduct both cooperative and complementary research, avoiding duplication of effort and trying to increase the wealth of information responsible for the advances of the past 50 years.

To meet future challenges, the S. C. Agriculture Experiment Station will continue to add research findings to those of researchers in other states with one common goal in mind — creating better standards of living for people through the best possible use of natural resources.

Highlights and Accomplishments

The following summary is a capsule review of the extensive research program at the Experiment Station. Many important studies have been

omitted, and the ones that follow are intended only to illustrate the scope of the Station's total program.

Agricultural Economics and Rural Sociology

A commitment to helping rural South Carolinians adapt to changes in technical, economic and social conditions underlies the research program of the Department of Agricultural Economics and Rural Sociology.

During 1983-84 marketing economists studied ways that agricultural marketing firms handle the risk inherent in their businesses, and how their strategies affect product prices and the distribution of risk among market participants. Particular attention was devoted to new institutions for managing risk (e.g. options markets) and to risk management beyond the farm gate. Beef and pork price discovery processes were investigated. Risk management strategies were evaluated for grains, livestock and mill feeds.

South Carolina cotton producers do not have adequate information to enable them to choose optimum marketing strategies from forward contracting, hedging, spot selling, storage for later sale and others. The optimum choice depends, among other things, upon the financial condition and attitude toward risk of the seller. Producers in strong financial condition may profit by accepting more risk than producers who are financially weaker. Cash sale at harvest and fixed-price forward contracts were the sales alternatives used most often by cotton growers, with storage for later cash sale and call price contracting preferred third and fourth, but the strategies of individual producers change in importance from year to year.

An emphasis on international trade has been initiated to support Extension activities. Literature and program development has been directed toward evaluating the effectiveness of expenditures by individual firms, including cooperatives, on foreign market expansion. An econometric analysis of the market for farm land indicated that 85 percent of the price variability was explained by location of tract, size of tract, urban influence, net farm income, land use, credit terms, land quality and year of sale.

In addition to their interest in the workings of the agricultural land market, resource economists have studied urban encroachment onto farm land. They have estimated the cost saving to industrial firms that develop sites on prime farm lands instead of on lands less suited to farming. Studies of resource use in the coastal area of the State and of the financing of local water supply systems (of which there are over 1,000) are under way.

Production economics and agricultural policy researchers used linear programming to estimate relationships among reduced-tillage crop production practices, farm incomes and the quality of water in the stream draining a Calhoun County watershed. The relative effectiveness and

attractiveness to farmers of subsidies and taxes as schemes for reducing stream pollution from sediment, phosphorus and nitrogen were investigated. Taxation was found to remove larger percentages of pollutants than subsidies and to cause smaller decreases in net farm incomes.

Research on pest management has included an effort to suppress boll weevils in North Carolina and South Carolina. That program was approved only after information on its potential effects was distributed to cotton growers. The distribution and value of the costs and benefits of weevil eradication are being estimated.

Rural sociologists conducted research on issues of current interest that pertain to community and resource development, rural development, demography, the structure of agriculture and rural labor markets.

Trends in social and economic characteristics of the population of South Carolina, its regions, Metropolitan Statistical areas, counties and incorporated places were studied during 1983-84. Changes in the geographic distribution of populations also were studied. Current regional research efforts are concerned with health and welfare services. Community and resource development research included a study of attitudes toward environmental regulation, land-use management and preservation of agricultural land in a rural-urban county.

Agricultural Engineering

Agricultural engineers have been involved in a wide range of research efforts aimed at increasing food and fiber production, while using less fossil energy and maintaining a high quality environment.

Water, soil and nutrient runoffs are being measured from plots double-cropped in wheat and soybeans. Tillage treatments for establishment of soybeans following wheat include no-till, chisel-disk and bottom plowing.

Soil moisture management as a factor in peach tree short-life is being studied at two intensively instrumented sites in an orchard in Edgefield County. Moisture uptake patterns by trees are being determined along with tree response to conditions of soil moisture deficiency and excess.

A project was begun to measure the growth rate of hardwood seedlings (green ash, yellow poplar and cottonwood) irrigated with swine lagoon effluent.

Corn silage is being used in a laboratory study to measure the potential methane production under temperatures of 35 C. Ensiled material may be a good source of substrate for methane digesters.

Based on a successful testing program involving growers in 12 counties, Clemson has signed an agreement with Valkenburg Equipment Co. of Greenwood, to manufacture and sell the Clemson Pasture Seeder/Renovator. Units are being manufactured at this time for the fall planting season.

A mechanical harvester prototype for dwarf fruit trees was constructed

and tested cooperatively with horticulturists. Results of initial tests with fresh market peaches grown in a "meadow" orchard indicated a potential capacity of 8-10 acres/day in a once-over harvest. Damage to machine-harvested fruit compared very favorably with hand-harvested fruit.

Basic information and instrumentation were developed, leading to more effective mechanical sorting of peaches and other fruit. Ground color preference charts developed jointly with the Department of Horticulture over the past two years are being used as a supplemental maturity grading standard under the new S. C. Peach Marketing Order. Nondestructive firmness sorting methods are being developed by analysis of fruit impact forces. An electronic camera and digital imaging techniques are being developed to detect blemished fruit in the packing house and on the tree.

Conversion of the mechanical oyster harvester to diesel has been completed, and the machine is currently being used by S. C. Marine Resources to transplant 100,000 bushels of oysters from polluted waters. A freshwater aquaculture facility consisting of 32 ponds is currently being built at Clemson for catfish and crawfish research.

A laboratory screening program was initiated to evaluate the potential production of ethanol from waste and byproducts of agriculture and industry. Ethanol production and energy efficiency tests continued, using a farm-scale plant to produce 180-proof fuel ethanol from agricultural feedstocks.

Progress was made toward developing an automatically controlled wood chip gasifier-combustor. A novel cyclonic combustor was designed and successfully tested for removal of char sparks from the exhaust gases. Progress was made on developing computer control of the gasifier-combustor.

Ventilation systems for caged broiler facilities have been investigated through the use of models. The most effective system used a slot inlet at a 10' high ceiling with the exhaust fan on the same wall. Computer modeling of the facility, including methane production and use, is proceeding.

A personal computer program has been developed to provide information for cotton management decisions regarding planting date, replanting, fertilization rates and dates, cultivation, irrigation, insect control and defoliation. On-farm testing is under way.

Nitrogen fixation by soybeans under elevated CO₂ concentrations has been shown to improve significantly, but not linearly. A computer-based water budget program to schedule irrigation of corn and wheat has been field tested.

Tillage energy requirements and tractor-implement performance factors were measured with a computer-based instrumentation system.

Energy inputs and soybean yield outputs were measured for different tillage implements, tillage depths and for five soil conditions.

Agronomy and Soils

The soils research program has facets oriented toward traditional agricultural problems as well as those which deal with current environmental issues.

The soils research oriented toward agricultural production deals with the nature of South Carolina's soils, their origin and their agricultural potentials. Research on soil mineralogy and the soil survey program, a joint activity with the S. C. Land Resources Commission, describes the nature and origin of this most important resource. Other research in soil physics, fertility, and microbiology completes the picture needed to establish a soils potential for agricultural production. The current program is allowing us to recommend when to irrigate a crop; when to use micro elements such as boron, zinc, and copper; what the benefits of subsoiling are; what amounts of the major fertilizer elements will be needed; how to avoid losses of nitrogen due to leaching; and how to improve our soil diagnostic techniques.

Other soils research deals with acid precipitation and how foreign substances such as those found in solid wastes move through soils. Both topics are of considerable social concern as a result of air pollution and the disposal of ever increasing amounts of solid wastes on the land. The nature and properties of soils are important to both issues. In the case of acid precipitation, research is identifying what changes take place as a result of acid inputs that exceed those added by natural processes. The ultimate environmental consequences of this phenomenon depend on the reactions which take place in soil. Regarding wastes, studies are determining how substances move through soil.

In crop research, breeding programs are maintained for most of the major agronomic crops grown in the State: soybeans, small grains, tobacco, forages and cotton. Many of these programs are done in collaboration with scientists in plant pathology and entomology to incorporate resistance to plant pests in the new varieties and hybrids being developed. This year PD-1, a new cotton variety, was developed through a joint program with the U.S. Department of Agriculture. PD-1 has high yield and superior fiber and disease resistance compared to other available varieties. Over the next few years we plan to use some of the new biochemical techniques in the breeding program in an attempt to improve breeding in one or more of the commodities.

Research on breeding forages is combined with physiology and production in a special program to develop improved forages for South Carolina. This activity is carried out in collaboration with the Animal Science

Department. Many of the agricultural lands of the State are far better suited to forage-livestock production systems than they are to row crops. In order to capitalize on the unique position of producers in this region and in this situation, emphasis is being placed on the breeding of improved cool season forages and their management under grazing. The goal is to produce sustained high yields of excellent quality forage for use in beef production.

A third major research program area deals with the physiology and control of weeds. A number of herbicides are available to growers. In addition, new experimental products are under investigation. The effectiveness of these products under South Carolina soil and weather conditions is an important part of our crop production research since weeds account for more economic losses than any other pest in South Carolina.

Animal Science

The death of newborn piglets continues to plague swine producers. Death loss of newborn pigs has been estimated to be as high as 25 percent during the first 24 hours after birth. Adequate energy intake either by the suckling of weaned pig appears to be the contributing factor to lack of growth and high death loss. Increasing the energy intake of the piglet will improve survival and growth rate.

Extruded soybeans have an abundant supply of energy in the oil they contain and provide an economical way of increasing the energy content of the diet. Survival to weaning was improved in pigs nursing sows that had received an extruded soybean diet for the last 21 days of gestation. The number of pigs born alive and their average birth weight were not affected by the extra energy from the extruded soybeans. Inclusion of dried whole whey in baby pig diets supplemented with extruded soybeans increased gains and efficiencies 13 percent to 14 percent.

The oil found in extruded soybeans appeared to have little benefit when extruded soybeans were the only supplemental protein source in the diet. Survival and growth rate of baby pigs improved by feeding five pounds of a high protein, high energy milk replacer immediately after weaning. The improved response may be due to the whey in the diet. Results of a subsequent experiment showed that adding 20 percent whey to the diets of baby pigs for one week improved growth rate and feed efficiency.

Ammoniation of forages results in improved nutritive value by increasing digestibility and nitrogen content. Losses in hay quality occur due to inclement weather while curing and to being stored at improper moisture levels. Anhydrous ammonia has preservative effects in high moisture forages. Large, round bales of dry and high moisture Coastal bermudagrass were placed in plastic bags and treated with 0 or 3 percent anhydrous ammonia. Ammoniation of large, round bales of high moisture

Coastal bermudagrass increased the crude protein equivalent content while decreasing the total aerobic bacterial and fungal counts of the hay. Ammoniation was effective in improving nutritive quality, and hay can be harvested as high moisture hay and be preserved through ammoniation.

The Southeast cannot profitably compete in long-term drylot feeding of beef cattle. This reduction in feedlot time makes it mandatory that the grazing period be increased. If the grazing period is increased, it must be profitable and comprise several forages. Results of experiments demonstrated that the most productive forage grazing systems were: fall — fescue and Tillman red clover; winter — rye and crimson clover; spring — fescue and red clover; and summer — Tifton 44 bermudagrass. Good and some choice grade cattle were produced from grass alone. It is also evident that if cattle are relatively heavy (80 percent of their optimum slaughter weight) the feedlot period was reduced. The color of the lean meat is acceptable; however, fat from cattle removed directly from grass has a yellow color. This color of fat was improved significantly after 45 days or more in the feedlot. Fat thickness, loin eye area and yield grade varied, but tended to increase with the group of steers finished on bermudagrass and 75 days in the feedlot. The benefit of this data is the possibility of so many different production alternatives. A producer can design a program for maximum profits. This is particularly advantageous to South Carolina cattlemen, since they are often bound to sell calves at weaning. Cattle now can be sold at any point in the production system, or they can be continued on the program to the finished product.

Dairy Science

Research is being conducted by dairy scientists in a broad range of areas involving production and processing of milk and milk products. Several formulations for process and cold pack blue cheese have been presented to taste panels for evaluation. Initial criticisms were that the cheese was too strong and too salty. These have resulted in our using more fresh curd in formulations. Color of product does not seem to be a problem as was anticipated (mold spores turning black). Shelf life studies to date are excellent. Concentrations in a cheese dip of .1 and 20 percent potassium sorbate and natamycin, respectively, show excellent control of surface mold growth during aging of blue cheese after three months. These studies are continuing.

Sodium benzoate, propionic acid and formaldehyde were compared as preservatives for colostrum for calves. Diets were 2.73 kg of 1) naturally fermented colostrum, or colostrum treated with 2) sodium benzoate (.5 percent by weight), 3) propionic acid (1 percent by weight), or 4) formaldehyde (.05 percent by weight). Prior to feeding, 25 g sodium bicarbonate was added to liquid diets of one half the calves on each

treatment. Daily gain favored calves fed colostrum treated with sodium benzoate or propionic acid. Addition of sodium bicarbonate to colostrum diets improved intake during the first week of feeding.

Researchers concluded that sodium benzoate is a suitable alternative to propionic acid and more desirable than formaldehyde as a preservative for colostrum fermented at warmer temperatures. Sodium bicarbonate is effective in improving intake of colostrum diets early in the feeding period. However, additional research is needed on the effects of NaHCO_3 in the diet of young calves.

The effect of stage of maturity on yield and composition of wheat was determined at 10 stages of growth of field-grown winter wheat in a randomized split plot design within a 40-acre field. Defined growth stages were: early vegetation, mid-vegetation, late vegetation, boot, early head, mid-head, milk, mid-dough, hard dough and mature. Dry matter, lignin and acid detergent fiber increased while protein, TDN, ENE_L and macro and micro elements decreased with advancing plant maturity. This wheat was ensiled in the boot to early head stage (W) and compared to corn silage (C) and sorghum silage (S) in a lactation trial. Pounds of 4 percent fat-corrected milk per day were 51, 53, and 51 for C, S, and W. There was no difference in dry matter consumption, and feed costs/100 lbs. milk were \$4.91, \$4.33 and \$4.88 for C, S, and W respectively.

In the area of aflatoxin research, several of the xenobiotic metabolizing enzymes of the bovine lymphocyte have been assayed and their role in detoxifying aflatoxin has been characterized. The influence of certain dietary/environmental compounds (e.g. methylcholanthrene, antioxidants, etc.) on the enzymes arylhydrocarbon hydroxylases, p-chloromethylaniline demethylase, UDP glucuronate transferase and glutathionine S-transferase has been partially determined.

Entomology, Fisheries and Wildlife

Hog mange can be a very serious disease and can reduce the profits of a swine operation. This disease is caused by the infestation of very small mites which burrow into the hog's skin.

Experiments were conducted at Clemson to determine how long these mites survive off hogs. This information would be valuable to producers because it would give them an indication of the need for treatment of pens if uninfested swine were brought into their operations.

Mites were collected, and placed in dishes where the environments were held at 40 F, 65 F, and 90 F. The dishes were examined daily until the mites died. Efforts were made to simulate the hog house environment as closely as possible.

The mites survived as follows: 90 F for six days, 65 F for 13 days, 40 F for 26 days. This experiment showed that the survival of the mites off the host depends on temperature.

The results of this experiment indicated that producers should be careful during the winter months when uninfested swine are placed in pens which were previously occupied by infested swine. If producers need to place clean swine into the pens before these time intervals, they should consider treating the floors, walls, feeding stations, etc. with a good acaridicide in advance.

Mexican bean beetles (MBB) reared on the different soybean genotypes showed significant differences in development. *Phaseolus lunatus* (garden beans) was the most suitable host for MBB in both years. Among the soybean genotypes in 1982, Bragg was the most suitable line for MBB development. Mexican bean beetle parasitoids, *Pediobius foveolatus*, parasitizing *P. lunatus*-reared MBB did not perform any better than *P. foveolatus* parasitizing larvae reared on the soybean lines. There was no pronounced effect of host diet on *P. foveolatus* except in 1983. In 1983, parasitized MBB larvae reared on a resistant soybean line, ED73-371, produced all male parasitoids. Therefore, the diet of the host may influence the sex of parasitoids developing in the host. The indirect effect of artificial diet on *P. foveolatus* was quite apparent in the second portion of this study. MBB larvae reared on *P. lunatus* were clearly the best hosts for *P. foveolatus*. MBB reared on the artificial diet and the diet plus acetone and water extract of *P. lunatus* leaves were much poorer hosts, although there was some *P. foveolatus* emergence.

Wood ducks were radio-tracked during the winter period on Steel Creek, Savannah River Plant. Males had significantly larger home ranges than females and moved greater distances during diurnal periods than females. Females made 0.5 to three-day excursions (N=10) to locations outside their home ranges. Males never left the boundaries of their delineated ranges during the tracking period. Wood ducks preferred emergent wetland habitat over scrub-scrub, forested and open-water habitat. The relatively small home ranges and restricted daily movements found in this study indicate that small impoundments, especially in the Piedmont, meet all the needs of wintering wood ducks in a distinct management alternative.

Food Science

Improving food products by processing technologies is an objective of research conducted in the Food Science Department. Examples of this research include processing techniques to alter the color and flavor profile of products made from dark poultry meat. The process involves tissue disruption, followed by several washing treatments, yielding meat which is mild in poultry flavor and almost as light in color as breast meat. With the smaller meat pieces that result, new product preparations such as salad mixes, sliceable luncheon meats and smoked chicken rolls appear feasible and will be investigated. The washing techniques in lightening the dark

tissue show promise of enhancing the gelation properties for this type of meat.

Studies of the effect of fluorescent light and oxygen transmission on color fading of the cured meat pigment in fermented sausages (such as pepperoni, German salami, and hard salami) show an acidity dependence for fermented meats. Shelf life upon display is decreased if oxygen and light conditions are not optimum and the product has not been fermented to a pH near 5.0 (which also yields the "tangy" acid flavor). It was also observed that during the fermentation step of processing, a higher content of nonprotein nitrogen compounds were produced when compared to nonfermented products. The nonprotein nitrogen compounds are thought to impart some flavor attributes to the final product.

Of particular interest were studies to evaluate the shelf life and quality of individually wrapped fresh peaches using heat-shrinkable polyethylene film. Flavor and other sensory qualities of the wrapped fruit were superior when compared to the unwrapped fruit. The shelf life of wrapped peaches at 50 F was approximately six weeks as compared to about three weeks for unwrapped peaches stored at 33 F. Research is continuing to optimize parameters such as film thickness, permeability, and storage temperature in an effort to maximize the shelf life of fresh peaches, cantaloupes and tomatoes.

Preliminary tests using an ultrafiltration system consisting of rigid metallic membranes with permeate flow from the inside out and extremely high pressures have indicated that conventional presses and filtration methods in apple juice processing can be replaced by the metallic membrane ultrafiltration system. In the process under investigation, apples are crushed, treated with pectinase and cellulase, and pumped directly into the ultrafiltration system to produce a highly clarified and cold sterilized juice. The flavor profile of the processed juice, as determined by gas liquid chromatography, is nearly identical to the flavor profile of juice from apples prior to processing.

Studies to examine the effect of fasting and refeeding on growth and subsequent weight gain in animals were conducted using laboratory rats in an effort to understand more completely the compensatory growth and rapid weight gain that are often observed following a period of fasting. Results indicate that the intestinal enzymes sucrase, maltase and lactase decreased in that order in certain areas of the small intestine, duodenum, jejunum and ileum. The activities of these enzymes also decreased from the anterior to the posterior of the small intestine. The activities of sucrase and maltase decreased in fasting animals, increased on the first day of refeeding, decreased on the third and fourth days, increased again on the fifth through eighth days and were constant thereafter. Oxygen use by the intestinal mucosal cells decreased by 15 percent in the duodenum, 5 percent in the jejunum, and 12 percent in the ileum for the first 12 days of

the refeeding period following five days of fasting. After this, oxygen use was normal. Data obtained to date seem to suggest that the secretion of selected intestinal enzymes may vary with feeding regimens.

Home Economics

Faculty in the School of Consumer Science and Allied Professions at Winthrop College conduct research in nutrition and textiles.

Third year data collected for the Southern Regional Research Project on the nutritional status of adolescent females were compiled with those from eight other southern states, and preliminary manuscripts were prepared. Winthrop faculty worked primarily on the dental health status of both black and white adolescent females. Relationships between dental health and snacking patterns and intake of selected nutrients also were explored. Blacks had more caries in permanent teeth, fewer fillings and more plaque accumulation than their white counterparts. The data indicated that white adolescents received better dental care than blacks. The number of caries in permanent teeth increased with more frequent snacking. As the intake of calcium increased, the total number of caries in permanent teeth decreased.

Preliminary manuscripts were prepared from data collected on 111 independent-living elderly males and females participating in a congregate meal program in two South Carolina counties. During the past year, work focused on sociodemographic data and dietary intake patterns. The sample studied was primarily white (69 percent) female (86 percent), ranging in age from 58 to 92 years. Fifty percent of the subjects questioned had attended school through grade eight, with another 41 percent finishing grade 12. Sixty-seven percent of the sample were employed in or retired from blue collar or service jobs. Seventy percent of the subjects were widowed. About 60 percent of the sample ate breakfast and dinner alone. In addition, 26 percent of those eating alone indicated they ate less when eating alone. Although no significant correlations were found between frequency of participation in the congregate meal program and blood levels of the nutrients studied, there was a trend toward higher vitamin C blood levels when participants ate at the congregate meal site at least three times a week.

Questionnaires were developed for the project dealing with effects of functional textile finishes on comfort and protection of consumers. These questionnaires will be mailed to selected York County farm families to determine pesticide use and laundry practices. Data from the survey will be used to establish potential health hazards to consumers caused by improper protection from pesticides by clothing, and/or lack of removal of the pesticides from clothing by laundering.

Horticulture

The Department of Horticulture conducts research throughout South Carolina on fruits, vegetables, flowers, ornamental perennials and turfgrass. There are 29 separate research projects, as well as many collaborative projects with other departments.

In ornamental horticulture the department has further developed the science of overseeding grasses. Growth regulators are being used to control the transition of ryegrass out of and bermuda grass into spring turf. Clemfine tall fescue, released by Clemson University in 1981, is rapidly establishing itself as a popular lawn grass for people who desire a year-round green lawn.

In vegetable crops research the Edisto Experiment Station in Barnwell County has been successful in its collaborative sweet potato breeding. Working with United States Department of Agriculture scientists from the vegetable laboratory at Charleston, they have released HiDry, Sumor and Regal, all of which are resistant to South Carolina soil pests. HiDry is intended for uses where high fermentable content is needed, e.g., alcohol production.

Integrated pest management research received a large boost by the appointment of a new weed management scientist who will conduct research on multiple cropping systems that combine agronomic and horticultural crops.

Plant Pathology and Physiology

From experiments designed to test the influence of time of pruning on incidence and susceptibility of peach trees to cold injury, it was learned that trees with short chilling requirements can be pruned in the fall in years when chill unit accumulation is late. Conversely, trees with long chilling requirements remained undamaged when pruned in the fall during years with colder falls. Combined with more accurate weather forecasting, this information may lead to more flexible fruit tree pruning recommendations. Stress, such as pruning during a growing period, delays or prevents normal dormancy and the trees are more susceptible to cold temperatures. Therefore, pruning should be done either early enough for the tree to readjust or after dormancy.

In work relating to nematode control, it was found that Telone II soil fumigant as a preplant nematicide performed better for controlling peach tree short life when used in broadcast treatments than in eight-foot strips. Both treatments lasted five years. As a post plant nematicide, Telone II controlled nematodes, but the treatment slightly reduced growth of three-year-old peach trees.

Fenamiphos was found to control ring nematodes, but it did best when used either in both the fall and spring, or applied as a split application in the fall. The Fenamiphos treatments lasted only one season.

The fungus *Hirsutella* suppressed ring nematodes in pot experiments in the greenhouse. This fungus has been found to reduce ring nematode populations in South Carolina orchards, but it is inconsistent as a control measure. Some of the factors which influence the ability of the fungus to feed actively on nematodes include stress on the nematodes, soil solutes, and fungicides used in the orchards. Since ring nematodes are primarily a problem in sandy soil, soil conditions are harder to manipulate than might be true of heavier soils. Nineteen wells in Barnwell County were sampled for EDB residues, and three were found to contain enough residue so that EDB was not defended for use as a nematicide in South Carolina.

Aflatoxin levels were higher in corn grown under minimum tillage than under conventional tillage. Aflatoxin levels were lower in irrigated than in nonirrigated corn. Maize chlorotic dwarf virus and maize dwarf mosaic virus strain A were identified from corn, and there were several instances of double infection with these two viruses. This information will provide a better basis for screening corn varieties for use in South Carolina. All 33 grain sorghum varieties being tested for production in South Carolina were susceptible to maize dwarf mosaic virus strain A.

Poultry Science

Poultry scientists developed an extremely sensitive test for determining the immune status of chickens and turkeys to fowl cholera. The widely accepted Clemson University fowl cholera vaccine imparts immunity to this devastating disease, but the degree of immunity varies with the age and health of the vaccinated birds and with unknown factors. Heretofore, the only method for evaluating immunity was by challenge of a sample of birds with a highly pathogenic cholera organism. This was time consuming, costly and potentially dangerous. The new test is an enzyme linked immunosorbent assay (ELISA) which requires blood from the birds, plus purified rabbit blood components and specialized equipment for numerical evaluation. The test is so sensitive that readings can be made from blood samples that have been collected and dried on paper strips and sent through the mail. The need for transporting, infecting and destroying birds has been eliminated while a much more sensitive measure of their immunity is available.

Poultry scientists in cooperation with agricultural engineers studied the feasibility of solar rearing of broiler chickens. Chick brooding is an energy expensive process, since young chicks must have room temperatures of about 90 F. This study showed that chicks could be solar brooded for 3.5 weeks in close confinement at about half the energy cost required under conventional systems. This experimental design system caused a slight reduction in early growth rate and feed conversion. The growth depression was largely overcome after broilers were transferred to conventional quarters to complete their production cycle. During this finishing phase,

feed efficiency was superior to conventionally reared broilers. This work demonstrates the feasibility of solar brooding for 3.5 weeks in combination with a finishing period in conventional housing. As energy costs rise, this system will become more attractive.

As freight rates increase under pressure from energy costs, the southern poultry industry finds escalating feed costs eroding their regional advantages. To counteract this trend, poultry scientists are evaluating locally produced feedstuffs. One product under study is the naked oat (*Avena nuda* L.). Contrasted with the oats commonly grown, the naked oat has no husk and is high in energy as required for poultry diets. Chemical analyses indicate that naked oats are superior to corn in amino acid profile, mineral content and unsaturated fatty acid composition. Feeding studies showed that oats at 69 percent of the diet reduced growth when compared to corn. At 40 percent of the diet the oats were equivalent to corn. South Carolina can produce oats in quantity and their use in poultry diets can be helpful to producers both of oats and poultry.

Branch Stations

The S. C. Agricultural Station's four branch stations continue to emphasize the specialties of the areas where they are located.

The Sandhill Station at Pontiac focuses on fruit and nut tree research, along with vegetable investigations. The S. C. Swine Evaluation Center and Livestock-Poultry Health Division are both located at Sandhill.

Florence's Pee Dee Station continues to expand crop research on tobacco, soybeans and corn on the site of the new Pee Dee Research and Education Center for Agriculture, a complex under construction that will replace the present station.

The Coastal Station at Charleston furnishes data to the Extension Service for work with vegetable growers in the Coastal Plain. Ornamental research is conducted at the facility, and a large urban research and demonstration area on Highway 76 South provides information to school classes, garden clubs and homeowners concerning flowers, herbs, shade trees, lawn grasses, vegetables and other plants.

The Edisto Station at Blackville designs its research for growers and cattle producers in the Upper Coastal Plain. Field crops such as corn, soybeans, small grains, melons and sweet potatoes are studied, along with cattle.

Active Research Projects, 1983-84

Agricultural Economics and Rural Sociology

Changing Structure of Agriculture: Causes, Consequences and Policy Implications.

An Economic Analysis of Alternative Marketing Strategies for Cotton Producers.

Acquisition and Analysis of Census and Other Demographic Data for S. C. and the U.S.
Economic Analysis of the Potential for Increased Swine Production in S. C.
Market Information and the Nature of Price Dispersion in Retail Food Outlets.
Economies of Size in Hog Slaughtering Plants in S. C.
Economic Issues in the Conversion and Protection of Agricultural Land in S. C.
Economics of Horticultural Crop Production in S. C.
Impact of Changing Costs, Institutions and Technology on the Southern Dairy Industries.
Improving Community Services in Non-Metropolitan Counties in the South.
U.S. Food Demand and Consumption Behavior.
Local Impacts of Economic Demographic Change in S. C.
Structural and Operational Efficiency of the Fruit and Vegetable Production-Marketing System.
An Economic Analysis of Risk Management Strategies for Agricultural Production Firms.
Economics of Improving Productivity in the Livestock-Meat Systems in the South.
Labor Markets and Labor Force Differentiation in Non-Metropolitan Areas.
Disturbances to Price Discovery-Risk Management by Marketing Firms in Southern Agriculture.
Economic Analysis of the Impact of Alternative Flue-Cured Tobacco Programs.

Agricultural Engineering

Soybean Production and Management Simulation Models.
Engineering Systems and Energy Needs for Cotton Production.
Flue-Cured Tobacco Bulk Curing Technology.
Trickle Irrigation in Humid Regions.
Animal Waste Utilization and Treatment Systems.
Viability of Soybeans in Storage.
Energy Reduction for On-Farm Processing of Agricultural Products.
Optimize Efficiency of Energy Utilization in Agricultural Housing Systems.
Ethanol Production and Energy Efficiencies for On-Farm Fuel Production.
Equipment for Mechanization of Production of Oysters and Other Shellfish.
Irrigation Scheduling Models for Efficient Use of Water and Energy.

Control Systems for Optimizing Tractor Energy and Fuel Consumption.
Physical Properties and Mechanized Sorting of Peaches.
Energy Reduction for Crop Production Systems.
Effects, Mechanisms and Control of Erosion and Sediment from Agricultural and Forested Lands.
Agricultural Meteorology and Climatology for Production in the Southern Region.
Control Algorithm for Two-Stage Combustors.
Water Table Management for Crop Production in the Coastal Plain of S. C.
Development of Vegetable Harvesting Systems.
Design of a Cord Wood Gasification and Gas Combustion System for Curing Tobacco.
Cultural Systems and Equipment for Mechanization of Peach Production.
Effect of Swine Lagoon Effluent on Hardwood Seedling Growth.
Methane Production Potential from Farm Crops.

Agronomy and Soils

Adaptation and Breeding of a Cool-Season Forage Grass Species.
Production Practices of Flue-Cured Tobacco.
Rate of Soybean Root Growth and Nutrient Uptake as a Function of Varieties, Soil Properties and Additives.
Soil Properties and Nutrient Levels in Relation to Nutrient Uptake by Corn and Soybeans.
Sunflower Improvement.
Significance and Distribution of Mineral Components in Southern Soils.
Grain Yields and Field Performance of Barley, Oats, Rye and Wheat.
Cultivar Performance Evaluation of Cotton, Soybeans and Peanuts.
Cultivar Performance Evaluation of Corn and Grain Sorghum Hybrids.
Sulfur and Nitrogen Components of Precipitation and Effects on Soil Fertility and Plant Nutrition.
Soybean Response to Irrigation, Plant Populations and Related Management Practices.
Soil Fertility Management for Irrigated Corn and Soybeans.
Evaluation, Establishment and Management of Forage Legumes and Legume Grass Combinations.
Cytological and Developmental Studies of Soybean and Clover Hybrids.
Boron Retention and Availability in Soils of S. C.
Nitrogen Source for Production of Forages.
Development of Improved Soybean Varieties.
Breeding Cotton for Improved Yield, Fiber Quality and Resistance to Insects.
Weed Control in Corn, Cotton and Soybeans.

Soybean Seed Germination Under Heat Stress.
Overcoming Factors Limiting Biological Dinitrogen Fixation by Leguminous Plants.
Cellular and Molecular Genetics for Crop Improvement.
Chemistry of Atmospheric Deposition: Effects on Agriculture, Forestry, Surface Waters and Materials.
Release of Aluminum from Soils by Acid Precipitation.
Breeding Disease and Nematode Resistant Flue-Cured Tobacco for Yield, Quality and Harvestability.
Heat-Drought Tolerance of White Clover Stolon Meristems (*Trifolium repens* L.).
Life History, Population Dynamics and Interference: a Basis for Understanding Weed Biology.
Small Grain Breeding and Genetics.
Spatial and Temporal Variability of Soil Characteristics and Material Fluxes in Field Soils.

Animal Science

Breeding Methods for Beef Cattle in the Southern Region.
Marketability and Acceptability of Beef Produced Under Forage-Grain Management Systems.
Forage Systems for Production of Beef from Conception to Slaughter.
Reproductive Physiology of Farm Animals.
Management Practices for the Early Weaned Pig.
Nutrition and Management of Swine for Increased Reproductive Efficiency.
Endocrine and Immunosuppressive Mechanisms and Maternal Recognition and Pregnancy in the Beef Cow.
Wintering Horses on Bermudagrass Pastures Overseeded with Oats, Rye or Rye and Ryegrass.
Physiological Role of Relaxin During Reproductive States in the Gilt.
Factors Affecting the Immune Process in Cattle and Poultry.
Simulation of Forage-Beef Production in the Southern Region.
Utilization of Forages for Production of Slaughter Cattle Throughout the Year.

Dairy Science

Optimizing Nutritional Management of Dairy Calves.
Forage Feeding Systems for Growing and/or Lactating Dairy Cattle.
Influence of Ration Composition on Plasma Hormones and Lipid Metabolism in Dairy Cows.
Effects of Environmental and Management Stressors on Production and Reproduction in Dairy Cattle.

Metabolism, Toxicokinetics and Physiological Effects of Aflatoxin B₁ in the Bovine.
Effect of Media, Culture and Storage on Survival of Cattle and Sheep Embryos.
Protein Nutrients for Ruminants.
Preventing Light Induced Off-Flavor in Dairy Products.
Development of Cold Pack and Process Blue Cheese.

Entomology, Fisheries and Wildlife

Ectoparasites of Poultry and Synanthropic Flies Associated with Poultry and Livestock, Their Biology and Control.
Biology and Control of Arthropods Affecting Man and Animals.
Biological Control of Insect Pests of Soybeans.
Insecticide Resistance in Beneficial and Destructive Insects in Field Crops.
Entomopathogens for Use in Pest Management Systems.
Physiological Relationships Between Insects and Pathogens.
Comprehensive, Unified, Economically and Environmentally Sound Systems of Integrated Pest Management for Soybeans.
Control of Tobacco Insects.
Feral Swine Movement, Habitat Utilization and Pig Survival.
Identification and Distribution of S. C. Insects of Economic Importance.
Control of Vegetable Insects in the Piedmont Area of S. C.
Biology and Control of Arthropods on Apples.
Behavior and Potential of Endemic and Imported Natural Enemies in Management of Soybean and Insect Pests.
Insect Resistant Soybean Cultivars.
Biology, Behavior, Population Dynamics and Management of Peach Insects and Mites.
Integrated Management Strategies for Insect Pests of Forage Crops and Feed Grains.
Tactics for Management of Soybean Pest Complexes.
Warm Water Aquaculture.
Heliothis spp: Management Systems for Field Crops.
Territoriality and Dispersal in the Bobcat.
Dynamics of Harvesting a S. C. Coastal Plain Deer Herd.
Bionomics and Control of Insects on Cotton.
Improved Systems of Management for Pecan Arthropod Pests.
Bionomics and Ecology of *Heliothis zea* and *H. virescens* on Cultivated and Wild Hosts.
Biology, Ecology and Control of Domiciliary Cockroaches.
Bionomics and Control of the European Corn Borer.
Insecticide Resistance in Insect Pests and Their Predators in Cotton, Corn, Soybeans and Tobacco.

Food Science

- Function, Nutrient Composition, Quality, Stability and Efficient Production of Poultry Products.
- Factors Influencing Nutrient Absorption.
- Prediction of Nutritional Quality of Foodstuffs.
- Surface Activity and Hydrolytic Enzyme Effects in Emulsion Stabilization.
- Thermal Processing of Foods Packaged in Retortable Pouches.
- Functional Properties of Proteins.
- Interrelationships of Dietary Carbohydrates and Lipid Metabolism in Rabbits.
- Effect of Dietary Phosphorus and Calcium on Bone Metabolism in Rats.
- Microbiological and Process Factor Affecting Quality of Fermented Sausage.
- Maximizing the Use, Nutritive Quality and Consumer Acceptance of Sweet Potatoes and Their Products.
- Phytate-Reduced and Phenolics-Reduced Soy and Peanut Protein Isolates.
- Oral Health and Nutritional Status of Noninstitutionalized Elderly People.
- An Energy Audit of Laboratory Animals Using a Modified Whole Body Calorimeter.
- Water Hardness and Lipid Metabolism.
- Optimization of Thermal Processes for Conduction-Heated Foods in Retortable Pouches.

Horticulture

- Development and Evaluation of Rootstocks for Peaches.
- Plant Germplasm — Its Introduction, Maintenance and Evaluation.
- Quality Maintenance and Improvement of Fresh and Processed Horticultural Crops.
- Industrial By-Products as Container Mix Components for Plant Growing Media.
- Breeding and Evaluation of Sweet Potatoes for Fresh Market and Industrial Uses.
- Cultural Management of Centipede Grass.
- Characterizing and Delaying Ripening and Senescence in Peaches, Nectarines and Plums.
- Breeding Edible Southern Peas with Resistance to Insects and Disease.
- Weed Control Practices for Vegetable Crops.
- Urban Horticulture for Coastal S. C.
- Breeding and Evaluation of Watermelon and Cantaloupe Varieties.
- Breeding Disease Resistant Pumpkins for the Halloween Market in the Southeast.

Turfgrass Culture and Improvement.
 Growth Regulators and Scion-Rooted Trees for Peach Production.
 Bedding Plant Fertilization and Field Evaluation of Bedding Plants and Perennials.
 Determination of Cascading Chrysanthemum Response Groups and Cultural Program Development.
 Breeding Potential of African Okra Germplasm.
 Establishment of Landscape Plants with Low Resource Utilization.
 Cultural and Management Practices of Pecans.
 Vegetable Breeding: Developing Improved Cultivars and Germplasm.
 Breeding Improved Stone Fruit Scion and Rootstock Cultivars.
 Potential New Crops and Multiple-Cropping Schemes for Vegetable Production Systems.
 Irrigation and Fertilization Systems for Vegetable Production.
 Regional Advantages in Producing and Marketing Woody Ornamentals.
 Interactive Microcomputer Program for Landscape Design.
 Influence of Various Tillage and Cropping Systems on Integrated Pest Management in Soybeans.
 Cultural and Environmental Effects on Strawberry.
 Assessment of Progress in Breeding for Soil-Resistance in Sweet Potatoes.
 Detection and Evaluation of Plant Growth-Environment Relationships for Fruits and Vegetables.
 Orchard Ground Cover Management Systems for Peaches.

Plant Pathology and Physiology

Forage Legume Viruses.
 Tobacco Disease Control in S.C.
 Methodology, Dissipation and Fate of Pesticide Residue in Agricultural Ecosystems.
 Disease Control on Vegetables.
 Reduction of Aflatoxin Development in Corn by Cultural Practices and Breeding.
 Biological Control of Weeds with Fungal Plant Pathogens.
 Variability of Root-Knot and Cyst Nematodes and Factors Influencing Their Population Dynamics.
 Factors Contributing to and Control of Peach Tree Short Life in S.C.
 Etiology, Epidemiology and Control of Pecan Diseases.
 Causes and Control of Diseases of Cereal Grains in S.C.
 Etiology and Control of Fungal and Viral Diseases of Vegetables.
 Causes and Control of Diseases of Ornamental Plants.
 Biology and Control of Diseases of Soybeans.
 Biology, Epidemiology and Control of Viruses and Mycoplasma-Like Organisms Causing Disease of Corn and Sorghum.

Physiological Responses of Plant Tissue and Cell Cultures to Plant Growth Regulators.

A Physiological Approach to Peach Tree Short Life.

Etiology and Control of Tree Fruit Pathogens.

Mycotoxins of Corn and Other Feed Grains.

Distribution, Ecology and Pathogenicity of Ectoparasitic Nematodes of Soybeans.

Poultry Science

Function, Nutritive Composition, Quality, Stability and Efficient Production of Poultry Products.

Eggshell Quality in Avian Species.

Endocrine and Physiological Effects of Heat Stress in Poultry.

Secretory Activity of the Avian Adrenal and Reproductive Tract *in vitro*.

Eradication of Chlamydiosis, Paratyphoid and Avian Tuberculosis in Pigeons.

Management of Guineas.

Feed Additives and Dietary Amino Acid Requirements for Coturnix and Bobwhite Quail.

Seminal Phospholipid Concentrations and Phospholipase Activities During Storage of Chicken Semen.

Effects of Pinealectomy on the Reproductive Physiology of Male Turkeys.

Preserving Turkey and Chicken Semen, and Factors Affecting Semen Production in Turkeys.

Web Wing Vaccination of Turkey Breeders with an Avirulent *Pasteurella multocida*.

Disease Survey in Turkeys in S.C.

Fowl Cholera Immunity in Breeder Chickens Determined by the Enzyme Linked Immunosorbent Assay.

Control of Food and Water Intake in Poultry.

Dietary Factors Affecting Cholecalciferol Metabolism in Poultry.

Natural and Processed Ingredient Influence on Production of Poultry.

Live Mutant *Pasteurella multocida* Vaccine for Prevention of Fowl Cholera in Turkeys.

Experiment Station Publications, 1983-84

Departmental Research Series

- 103 — Growing Sorghum Silage in the Coastal Plains, R. F. Suman.
104 — Pearl Millet and Sorghum Sudangrass Crosses as Crops to Supplement Summer Pasture, R. F. Suman.
105 — Sunflower — A Potential New Crop for South Carolina, R. F. Suman.
106 — Performance of Grain Hybrids in South Carolina, 1979-1983, E. F. McClain.
210 — An Evaluation of Herbicides on Vegetables in 1982, W. L. Ogle and A. Melton. January 1983.
426 — South Carolina Crop Statistics, State and County Data, 1981 Revised, 1982 Preliminary. July 1983.
427 — South Carolina Livestock and Poultry Statistics, State and County Data, Inventory Numbers, 1982 Revised, 1983 Preliminary. Production and Value, 1981 Revised and 1982 Preliminary. July 1983.
428 — South Carolina Cash Receipts From Farm Marketings, State and County Data, 1981 Revised, 1982 Preliminary. October 1983.
429 — South Carolina Vegetable Statistics, State and County Data, 1983 Crop Year. April 1984.

Research Reports

- RR 83-5 An Economic Analysis of Options for Shellfish Bottoms Leasing Policy in South Carolina, J. C. Hite. August 1983.
RR 83-6 The Retail Market of Abbeville, South Carolina, E. L. McLean, E. D. Wynn, M. S. Henry and P. W. Stover. September 1983.
RR 83-7 Infrastructure Needs and Resources of Selected State and Local Government Programs in South Carolina, J. C. Hite, M. S. Henry and B. L. Dillman. September 1983.
RR 83-8 Trends in the Population of South Carolina Nonmetropolitan and Metropolitan Counties, 1960-1980, E. L. McLean and P. W. Stover. October 1983.

Technical Contributions

- 2193 — Nutrient Loading, Ph and Calcium Carbonate Equivalent of Acid Precipitation by U. S. Jones, E. L. Suarez and J. M. Griggs.
2194 — Case Study of a 100-year Storm on a Small Watershed in Northwestern South Carolina by J. T. Ligon, T. V. Wilson, D. E. Linvill.
2195 — Laboratory Biology of *Meteorus Autographae* (*Hyemnoptera: braconidae*), an Indigenous Parasitoid of Soybean Looper (*Lepidoptera: noctuidae*) Larvae by J. F. Grant and M. Shepard.
2196 — Life History Aspects of American Eel in Charleston Harbor, S. C. by W. K. Michener and A. G. Eversole.

- 2197 — Mechanical Impedence of Adult Pecan Weevil Emergence Related to Soil Moisture and Penetration Resistance by D. R. Alver-son, M. K. Harris, C. E. Blanchard, and W. G. Hanlin.
- 2198 — A Technique for Maintaining Cultures of *Ciborinia camelliae kohn* *in vitro* by L. W. Baxter, Jr., and Susan G. Fagan.
- 2199 — Mechanisms of Gel Formation by Proteins of Muscle Tissue by G. R. Ziegler and J. C. Acton.
- 2200 — A Low Cost Pasture Renovator Clover Seeder by C. E. Hood, T. R. Garrett, D. L. Cross and B. C. Morton.
- 2201 — Field Efficacy and Persistence of a Nuclear Polyhedrosis Virus of the Velvetbean Caterpillar in Soybeans by R. M. Beach, G. R. Carner and S. G. Turnipseed.
- 2202 — Broad Bean Wilt Virus in Dogwood (*Cornus florida*) by S. W. Scott and O. W. Barnett.
- 2203 — Influence of Soybean Looper (*Lipidoptera: noctuidae*) Density on Predation by Lebia Analis (*Coleoptera: carabidae*) by J. F. Grant, R. E. McWhorter and M. Shepard.
- 2204 — Growth of Braxton Soybeans as Influenced by Irrigation and Intra-Row Spacing by E. L. Ramseur, S. U. Wallace and V. L. Quisenberry.
- 2205 — Response of Broiler Type Chickens to Live *Pasteurella multocida* Duration of Immunity and Minimal Dose by W. T. Derieux.
- 2206 — Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forest by R. O. Hegg, A. T. Shearin, D. L. Handlin and L. W. Grimes.
- 2207 — Leaching from Livestock Lagoons to the Ground Water by Richard O. Hegg, Thomas T. King and Virgil Wilson.
- 2208 — Gonadal Condition of *Mercenaria mercenaria* in a South Carolina Estuary by Arnold G. Eversole, William K. Michener and P. J. Eldridge.
- 2209 — Incidence of Fusarium and Pythium spp. in Peach Feeder Roots as Related to 1, 2-Dibromo-3-Chloropropane (DBCP) Application for Control of *Cricodemella xenoplax* by A. P. Nyczepir and S. A. Lewis.
- 2210 — Sex Differences in Plasma Cortisol and Growth in the Bovine by D. M. Henricks, J. W. Cooper, J. C. Spitzer and L. W. Grimes.
- 2211 — Flexible Sequential Sampling Plans for Insects Using the TI-59 Calculator by Merle Shepard and John Grothusen.
- 2212 — Assessment of the Impact of Arthropod Predators on Noctuid Larvae in Field Cages in Soybeans by Tim Reed, Merle Shepard and S. G. Turnipseed.
- 2213 — Genotype X Environment Materactions and Stability Analysis for Quality Components of Intermediate Wheatgrass Clones by J. S. Rice and R. B. Brown.

- 2214 — Selected Criteria for Breeding Sweet Potatoes for Industrial Uses by Max G. Hamilton, Alfred Jones and P. D. Dukes.
- 2215 — Effects of Neuraminidase and Phospholipase C on the Fertilizing Ability of Fowl Spermatozoa by D. P. Froman and R. J. Thurston.
- 2216 — Selective Control Cowpea (*Vigna unguiculata*) in Soybean (*glycine max*) by Tim R. Murphy and Billy J. Gossett.
- 2217 — Seasonal Distribution of the Mediterranean Fruit Fly (*Ceratitis capitata* (Wiedemann)) Determined by Different Trap Types on the Island of Mahe, Republic of the Seychelles by M. Shepard and A. R. Young.
- 2218 — Incidence of Yellow Turkey Semen on Commercial Breeder Farms by Rex A. Hess and R. J. Thurston.
- 2219 — Interactive Microcomputer Implementation of a Circle Line Landscape Graphics Technique by N. Suzanne Robbins, R. Gordon Halfacre and Kevin D. Robbins.
- 2220 — Phospholipid and Cholesterol Profiles from Chicken Seminal Components During *in vitro* Storage at 5 C by W. D. Resseguie and B. L. Hughes.
- 2221 — Relationship of Milk Intake, by Sucking and by Drinking, to Reticular-groove Reactions and Ingestion Behavior in Calves by G. H. Wise, G. W. Anderson and A. C. Linnerud.
- 2222 — Exclusion Techniques for Determining the Impact of Arthropod Predators on Noctuid Pests in Soybean by Tim Reed, S. G. Turnipseed and Merle Shepard.
- 2223 — Effect of ACTH and Metyrapone on the Chicken (*Gallus domesticus*) Adrenal Gland L. *in vivo* Steroid Production by A. R. Ezzat, A. H. Al-Hussaini and G. P. Birrenkott.
- 2224 — Resistance of Goosegrass (*Eleusine indica*) to Dinitroaniline Herbicides by Laurence C. Mudge, Billy J. Gossett and Tim R. Murphy.
- 2225 — Inbreeding Under Selection from Related Families by Peter M. Burrows.
- 2226 — Characterization of Peanut Stunt Virus Strains by Host Reactions, Serology and RNA Patterns by ZeYong Xu, O. W. Barnett and P. B. Gibson.
- 2227 — A Technique for Demonstrating Meristematic Sites in Bulbs and Crons by D. F. Wagner.
- 2228 — Catabolism of Phospholipids by Chicken Seminal Components After Storage by W. D. Resseguie and B. L. Hughes.
- 2229 — Notes on North American Setodes (*Trichoptera: leptoceridae*) by Ralph W. Holzenthal and Steven C. Harris.
- 2230 — Response of Corn to Nitrapyrin and N Application Methods on Sandy Soils of the Southern Coastal Plains by J. P. Zeblena.
- 2231 — Calculating Energy and Mass Flow in Biomass Combustion Systems by F. A. Payne.

- 2232 — Anaerobic Microbial Degradation of Selected 3, 4-Dihalogenated Aromatic Compound by Tammy D. Steppe, N. D. Camper and M.J.B. Paynter.
- 2233 — Bovine Pregnancy and Nonreturn Rates Following Artificial Insemination Using a Covered Sheath by M. W. Richards, J. C. Spitzer, S. K. Newman and C. E. Thompson.
- 2234 — Factors Affecting CGA-1581 Caused Peach Abscission by D. C. Coston.
- 2235 — Protein, Cholesterol, Acid Phosphatase and Aspartate Aminotransaminase in the Seminal Plasma of Turkeys Producing Normal White or Abnormal Yellow Semen by R. A. Hess and R. J. Thurston.
- 2236 — Importance and Control of Blossom Blight in the Southeastern United States by Eldon I. Zehr.
- 2237 — Effects of Diets Keys 2000 and MIT 200 on Bone Metabolism in Rats by J. A. Gilbert and M. E. Kunkel.
- 2238 — Problems Associated with Evaluating a Mechanized Harvesting Handling System for Fresh Market Peaches by E. Ted Sims, Jr., C. E. Hood, Jr., R. E. Williamson, B. K. Webb, T. R. Garrett and C. E. Gambrell, Jr.
- 2239 — Fruit Survival Ratings of Peaches and Nectarines Following Late Spring Freezes During Two Years by D. W. Cain, John D. Ridley and W. C. Newall.
- 2240 — Effects of Fiber Constituents and Fibrous Food Residues on Calcium and Phosphorus Absorption in Rats by M. E. Kunkel, Z. K. Roughead, C. M. Gagne and J. C. Acton.
- 2241 — The Response of *Camellia Japonica* to Gibberellic Acid Application by L. W. Baxter and Susan Fagan.
- 2242 — Energy Efficient Drying Through Computer Control by J. M. Bunn, J. L. Dunlap, Jr. and Gordon Hammond.
- 2243 — An Easy Identity Character for *Dasymutilla archboldi* by D. G. Manley.
- 2244 — The Efficacy of Monensin and Sulfaquinoxaline Against the Rabbit Liver *Coccidium eimeria stiedae* by M. J. Gwyther and J. W. Dick.
- 2245 — Alternaria Leaf Spot, a Previously Unreported Disease of *Acalypha indica* l. *euphorbiaceae* by Graydon C. Kingsland.
- 2246 — Effect of Tillage System and Irrigation on Population Densities of Plant Nematodes in Field Corn by B. A. Fortnum and D. L. Karlen.
- 2247 — Rheological Properties of Comminuted Meat Batters and the Possible Relationships to Constituent Changes and Interactions by D. L. Burge and J. C. Acton.
- 2248 — Survey of Cowpeas in South Carolina for Six Viruses by M. H. Collins, J. F. Murphy, W. Witcher and O. W. Barnett.

- 2249 — Effect of Application Method of Efficacy of Planting Time Treatment of Carbofuran, Chlorpyrifos, and Terbufos Against the Southern Corn Billbug (*Coleoptera: curculionidae*) by John A. DuRant.
- 2250 — Influence of Edaphic Factors on Emergence of the Pecan Weevil, *Curculio caryae* (Horn): (*Coleoptera: curculionidae*) by David R. Alverson.
- 2251 — Influence of Infestation Duration on Southern Corn Billbugs (*Coleoptera: curculionidae*) Injury to Corn by John A. DuRant.
- 2252 — Relative Abundance of Predaceous Arthropods in Soybean in South Carolina by Tim Reed.
- 2253 — Identification and Characterization of Trypsin Line Protease Enzymes in Domestic Turkey (*Meleagris gallopavo*) Seminal Plasma by R. J. Thurston and D. P. Froman.
- 2254 — High Performance Liquid Chromatography of 4-Nitrophenyl Organophosphinates and Chiral Phase Separation of Enantiomers by Thomas M. Brown and John R. Grothusen.
- 2255 — The Effects of Dietary Acid Stress on Bone Metabolism in Young Ovariectomized and Intact Rats by M. Elizabeth Kunkel, Zamzam K. Roughead, Elizabeth A. Nichter and Juan M. Navia.
- 2256 — The Effect of Two Levels of Energy on Ovation and Ovarian Follicular Populations in the Postpartum Beef Cow by J. D. Rone, D. M. Henricks, C. L. Ferrell and S. E. Echternkamp.
- 2257 — A Comparison of Four Breeding Management Systems Using PGF_{2a} for Estrus Synchronization in Beef Cows by W. L. Skinner, C. E. Thompson, J. R. Diehl and S. G. Woods.
- 2258 — Silver Leaf, an Injury on Camellia Japonica by L. W. Baxter, Jr., and Susan G. Fagan.
- 2259 — Effects of Temperature, Relative Humidity, Date, and Time of Day on Activity of the Southern Corn Billbug (*Coleoptera: curculionidae*) by J. A. DuRant.
- 2260 — Potential of Exhaust Gas Recirculation for Controlling Gasifier Bed Temperature by F. A. Payne and P. K. Chandra.
- 2261 — Biological Control of Stranglervine in Citrus: a Researcher's View by W. H. Ridings.
- 2262 — Ground Color as a Peach Maturity Index by M. J. Delwiche and R. A. Baumgardener.
- 2263 — Surveying for Plant Viruses Design and Considerations by O. W. Barnett.
- 2264 — Studies in Neotropical *Leptoceridae* (*trichoptera*) I: *Achoropsyche*, a New Genus by R. W. Holzenthal.
- 2265 — The *Falcata* Species Complex of the Genus *Exyethira* (*Trichoptera: hydroptilidae*) by R. W. Kelley.

- 2266 — Evolution and Historical Biogeography of Leptocerina and Axioicerina (*Leptoceridae, leptocerninae, athripsodini*) by J. C. Morse.
- 2267 — The Genus *Phylocentropus* in North America (*Trichoptera: polycentropodidae*) by G. A. Schuster and S. W. Hamilton.
- 2268 — The Evolution and Classification of *Trichoptera*, Part I: The Groundplan of *Trichoptera* by J. S. Weaver III.
- 2269 — Effect of Irrigation and Kernel Injury on Aflatoxin B₁ Production in Selected Maize Hybrids by B. A. Fortnum.
- 2270 — Inbreeding Under Selection from Mixed Sex Families by Peter M. Burrows.
- 2271 — Camellia Tip Dieback, a Disease Caused by Cold Injury by Luther W. Baxter, Jr., Susan G. Fagan and Peggy A. Mitchell.
- 2272 — Evaluation of Parasites and Predators by Eldon I. Zehr.
- 2273 — Parasites of Cultured Eels by Donald W. Field and Arnold G. Eversole.
- 2274 — Influence of Three Soybean Genotypes on Development of *Voria ruralis* and on Foliage Consumption by Its Soybean Looper Host by J. F. Grant and M. Shepard.
- 2275 — Influence of Sweeteners upon Acceptabilities of Home Frozen Fruits by M. M. Cody and M. E. Kunkel.
- 2276 — Confidence Intervals for Elasticities and Flexibilities from Linear Equations by S. E. Miller, Oral Capps, Jr. and G. J. Wells.
- 2277 — Effects of Silver Nitrate, Daminozide, Ethephon, Defoliants, and CGA-15281 on Blossom Density and Bloom Delay in the Peach (*Frunus persica l. batsch*) by G. W. Krewer, D. C. Coston and E. T. Sims, Jr.
- 2278 — Effects of Lactation and Exogenous Gonadal Hormones on Plasma Glucose, Insulin and Free Fatty Acids in Young Postpartum Beef Cows by C. H. Chang, T. Gimenez, A. R. Ellicott and D. M. Henricks.
- 2279 — Fowl Cholera Immunity in Broiler Breeder Chickens Determined by the Enzyme Linked Immunosorbent Assay (ELISA) by J. W. Dick and J. W. Johnson.
- 2280 — Response of Cowpeas to Urea Nitrogen by S. M. Olson, H. D. Skipper and D. O. Ezell.
- 2281 — Relation of Urea Nitrogen Levels to Nodulation and N₂(C₂H₂) Fixation of Cowpeas by S. M. Olson, H. D. Skipper and D. O. Ezell.
- 2282 — Relationship of Blood Serum Enzyme Concentrations to Porcine Stress by Robert F. Borgman, Dale L. Handlin and George C. Skelley.

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COOPERATIVE EXTENSION SERVICE

Wayne T. O'Dell, Director

As the educational outreach arm of the Clemson University College of Agricultural Sciences, the Cooperative Extension Service provides information and statewide continuing education programs that can make life easier and more enjoyable for every South Carolinian. The programs cover 16 disciplines relating to agriculture, home economics, youth and community development, programs for the economically disadvantaged in addition to general education information. They are made possible through an agreement between Clemson University and the United States Department of Agriculture.

Funded by federal, state and county governments, the Extension Service was created in 1914 as a nationwide system designed to carry education from land-grant universities to these people. For 69 years Extension has worked closely with South Carolinians helping them build a better life through dissemination of practical, useful information within its assigned areas of responsibility.

Originally conceived to help rural people, Extension responded to the changed needs of those it served by broadening its scope of activities to include urban and suburban problems.

Clemson University, through Extension, maintains an office manned by county agent personnel in each county. A professional staff of Extension subject matter specialists at the University and four Experiment Stations around the State compiles information from research and translates it into data the people of South Carolina can use day-to-day.

From basic cooking demonstrations to irrigation field tours, Extension staff members are teachers carrying Clemson University educational programs to all areas of the State.

The Extension program is organized around six broad categories: agricultural programs, 4-H and youth development, home economics, community development, special programs for low income farmers and 1890 programs conducted by South Carolina State College in cooperation with the Clemson University Extension Service.

Agriculture and Natural Resources

The Cooperative Extension Service is a unique achievement in education. It is characterized by two-way communication between those who work for Extension and those who use it. It is what Extension has helped people do for themselves that has achieved the greatest results.

Whether the classroom is a tobacco field, a wood lot or a farm shop, Extension activities are directed toward solving problems. Extension education tends to be informal, tailored to individual needs and budget requirements.

The delivery system is designed to deal with continuing problems as well as the unexpected and the uncommon. Consequently, the system requires substantial planning. This planning process, which incorporates both grassroots and scientific input, has identified computer technology, marketing strategies, alternative crops and improving the public image of agriculture as high priority thrusts for Extension.

Agriculture and natural resource producers provide food and fiber for millions in this country and around the world. Through exceptional, efficient efforts on the part of American farmers, more people are released to help produce less basic needs. Highlights of Extension activities in the departments that deal with agriculture and natural resources at the University and in the State's 46 counties follow.

Agricultural Economics-Farm Management Marketing

The function of the Extension Farm Management-Marketing program is to provide educational information and training to farmers, Extension agents, agribusiness and consumers about agricultural marketing, farm and financial management, agricultural policy and international trade. Workshops, county meetings and publications were the main teaching and training activities.

The major thrust this year was to provide farmers with the economic training and tools of analysis to do a more effective job of managing and marketing. Following are highlights:

- Twenty-two marketing workshops and county meetings.
- Twenty farm and financial management workshops and county meetings.
- Fifteen outlook presentations, including the annual outlook conference.
- Twelve county meetings on farm policy, taxes and estate planning.
- Five tax schools that drew 835 participants.
- Twelve training sessions on microcomputers.
- International trade seminar on trade policy issues.
- A five-day Southeastern Agricultural Lenders School.
- Marketing information and check-off program for peach producers.
- Enterprise alternatives for crop and livestock farmers.
- Marketing and participation alternatives in PIK and dairy diversion programs.
- Computer farm records program for dairy producers.
- Completed placement of microcomputers in each county office. This project was supported with a \$360,000 Kellogg grant.
- With funding from the Chicago Board of Trade, 15 Extension agents received extensive training on the futures market.

Literature development received major educational emphasis. Economic issues influencing farming were updated in "Outlook Updates" and "Management Marketing Memos." Publications included "Extension Economic Reports," leaflets and circulars. A new international trade newsletter was begun.

Budgets for major crop and livestock enterprises were prepared and used extensively. Specific marketing reports also were prepared for peaches, cotton and commodity futures. Computer programs were written for vegetables, fruits, cotton, corn, soybeans, wheat, beef cattle, dairy, hogs, farm records, cash flow analysis and enterprise budgeting.

Many South Carolina farmers still have serious financial problems. Special emphasis was given to financial management and marketing programs to help producers and agricultural lenders improve net farm income and management skills.

Agricultural Engineering

New programs have been developed and initiated in safety and energy. Chain Saw Selection and Operation was directed toward reducing chain saw injuries and deaths. The program, conducted in 15 counties, was highlighted on radio and television and supported by Extension Circular #637.

A 4-H program on fire safety was developed and conducted on a pilot basis in six counties. The program will be offered through State schools in cooperation with State fire professional groups. It covers basic fire knowledge, fire prevention, personal protection and fire extinguishment. Program materials developed include leader's guide, visuals, member record book and certificates.

Continued emphasis on farm production energy management has been placed on alternate energy and continuous wood heating. Tobacco curing and heating of greenhouses are part of the wood heating demonstration programs. An energy auditing program was initiated for tobacco barns. This program checks the heating loss potential of a tobacco curing unit and gives instruction on methods of reducing the loss.

New work on sunflower harvesting was begun, and a publication on this subject was reprinted.

A new emphasis on erosion control is under way in Extension agricultural programs. A program on conservation tillage evaluation for corn and soybeans was started.

A method for controlling runoff from irrigation and rainfall was demonstrated in three sites in the State. The use of dikes in the furrows of row crops holds water on the fields and allows the water to soak in. This method of water control can greatly improve irrigation efficiency and prevent erosion.

A major effort has been made to reduce the stray voltage problems in many livestock facilities, particularly in dairies. A survey on stray voltage pointed out the imminent electrical wiring problems on most farms.

The Agricultural Weather Office has expanded its service to the State through the use of computer-based communications. Daily farm weather advisories are written and transmitted by 10 a.m. Monday through Friday. These reach the user over the weather wire and through county Extension offices. Weather summarizations are done weekly for the Crop Reporting Service and the National Weather Service.

Weather data from more than 50 sites in the Carolinas and Georgia are quality checked and stored on the University computer. These data sets are updated daily from weather wires. The data are used in pest and crop models.

The drought of 1983 emphasized the need for adequate water for irrigation. With more than 150,000 acres being irrigated, efficient use of water was the focal point of irrigation programs. Attention was given the new Water Use Reporting Act which became law.

One program encouraged electrical power suppliers to seek ways to reduce or eliminate peak load demand charges for irrigators. Some of the power suppliers now have an off-peak load rate for irrigators who agree to stop irrigating during critical periods.

A plan for a small house was developed for persons requiring less space at an affordable price. Increased interest in home building resulted in higher demand for services and programs in housing.

South Carolina 4-H'ers were able to advance their training in computers thanks to the new beginners project book. Due to increased demand, the Amp Camp electrical project was expanded to two camp sessions. More than 300 4-H'ers were reached with 20 computers.

Agronomy and Soils

Each of our major agronomic crops has an Extension program involving transfer of the most current research information to producers. This transfer takes place through the county system of agricultural agents maintained by the Extension Service.

Areas which received major program emphasis last year for the most valuable commodities were as follows:

Tobacco — proper use of nitrogen to maintain high quality and obtain maximum yields and profits.

Cotton — crop management for high yields and profits; emphasis on proper fertilization, pest management and harvest aids.

Soybeans — appropriate selection of varieties to minimize losses due to pests; the use of microcomputer programs to aid management decisions.

Grain sorghum — better management of this crop so producers may make profitable yields consistently in an effort to alleviate the feed grain deficit in the State.

Peanuts — integrated pest management to reduce costs of production and increase yields and profit.

Small grains — use of varieties and other management practices which will increase yields.

Forages — a program just starting is expected to have a major impact in the use of forages on soils more suitable for livestock than row crops. The program will be integrated into a major thrust to conserve soil and improve the economic status of the State's farmers.

Several Extension programs cut across commodity lines. These include activities in weed control, soil fertility and conservation, and the use of microcomputers to aid technology transfer.

Weeds account for more crop losses in South Carolina than any other pest group. Consequently, the Extension weed control program contributes to production of all crops. Chemicals developed for weed control are often very specific. Agribusinessmen need to know more about weed identification and weed ecology in order to use today's herbicides effectively. Special field training programs are offered to identify weeds and teach how to control them. Weed control will play a key role in further growth and expansion of conservation tillage methods in South Carolina.

Soil conservation practices including minimum and no-tillage methods combined with the increased use of forage systems encompasses a new thrust aimed at improving productivity for farmers growing row crops under marginal conditions. This program will be emphasized in the Piedmont and on the more erodible soils in the Coastal Plains.

The soil fertility programs, particularly the calibration of soil tests, benefit from the various fertilizer test/demonstrations conducted throughout the State. The feedback on response of crops to sulfur, micronutrients, lime, etc., is a good example of the benefits gained from the close cooperation between Extension and research at Clemson University.

As science and technology progress in agriculture, and as cost/benefit becomes more critical to producers, the extension of new, more complex knowledge becomes even more important. Clemson Extension specialists are applying microcomputer technology in extending knowledge to the county level. The result is the most rapid transfer of the most complex information in a form readily understandable to Extension agents and to producers. In the Agronomy and Soils area, the soybean program is being used as a prototype for computer-assisted activities that will be extended to all commodities.

Animal Science

Securing well-developed replacement heifers has been difficult for the State's commercial cattlemen. Recently the South Carolina Commercial Replacement Heifer Sale has received much recognition in the beef industry and is becoming a respected and established sale.

Heifers sold across the scales over the past two years were worth \$350-\$375 each. However, heifers sold through the S. C. Commercial Replacement Heifer Sale averaged \$622 in 1983 and \$583 in 1984. Buyers from outside the State have been present at these sales, but all heifers have remained in South Carolina.

During the past two years we have limited the number of heifers from various farms and sold additional heifers at private treaty off the farm following the sale. In 1985, additional heifers will be accepted and plans are to have as many as 200 heifers in the barn with about 200 to be sold at private treaty after the sale.

The beef industry looks to South Carolina for its leading role in beef records, testing bulls, marketing bulls and making available well-developed commercial heifers.

Community Development

The Extension Community Development program provides educational and technical assistance to communities to improve the quality of life in rural areas. Community Development emphasizes helping community leaders, local governments, organizations and professionals in other agencies solve problems and get maximum benefits from community resources.

Through the requests of city councils and elected officials, leadership surveys were conducted in rural towns to identify needed community services and local leaders. The results of these surveys have led to the development of recreation facilities, recruitment of new businesses and increased interaction between elected officials and local leaders.

Extension cooperates with the Governor's Office to conduct the annual Emphasis/South Carolina program through which outstanding community efforts in beautification and community improvement are recognized. This year's program attracted 300 people from 35 counties.

The Soil Conservation Service provides funding for a half-time Community Development specialist with the Lowcountry Resource Conservation and Development Program. Extension activities in Resource Conservation and Development are primarily in program planning and public education about the program through electronic and print media.

Community Development held educational programs for elected officials and fire chiefs to show how insurance premiums can be reduced when rural fire protection is provided. Assistance was given to six towns in organizing rural fire districts.

With the Governor's Office of Rural Improvement, a three-day leadership training session was presented for 75 council members, mayors and local leaders.

In many rural towns, downtown businesses are struggling to survive. As they lose sales, there is less tax revenue for local governments. In an effort to reverse this trend, Community Development held meetings with town councils and business owners in Allendale and Bishopville to help prepare comprehensive downtown revitalization studies and plans for those two cities.

Microcomputers offer small towns an inexpensive form of technology for word processing, accounting and data management. Microcomputer training was provided for several town managers and staffs.

Dairy Science

Extension Dairy Science personnel continue to work with dairy producers, dairy organizations and related businesses to provide information essential to the well being of the dairy farmer and the consumer.

The State's dairy industry has been depressed in 1983 and 1984. Cash flow on many dairy farms has been low, and the general financial situation has been bad. Some established producers filed for chapter 11 bankruptcy, and others were taken over by lending agencies. Extension dairy personnel worked with several producers on ways to cut costs and survive the current crises. Efforts with and through the Carolinas Milk Producers Federation have been directed at ways to review the dairy producer situation and establish an equitable price for milk sold on the farm.

Also, in an attempt to provide South Carolina dairymen information on the national marketing situation, a series of educational meetings was held at seven locations. More than 250 dairymen, lending agency personnel and Extension agents attended these meetings to evaluate the highlights of the 1983 Dairy Compromise Bill. In addition, the Dairy Science Department head and Extension dairy project leader presented promotional and educational programs on milk marketing at dozens of meetings of the S. C. Farm Bureau (dairy division), the American Dairy Association of South Carolina and the S. C. Dairy Association.

Dispensing information on feeding dairy cattle continues to be an important role of the total Extension dairy effort. Because of its economic importance (nearly 60 percent of the cost of producing milk), nutrition programs are critical. During the past year South Carolina dairymen submitted about 1,200 feed and forage samples for chemical analysis at the Clemson University Agricultural Service Laboratory. The results of these samples are serving as an important educational tool for improving forage quality and dairy cattle feeding programs.

Due to the severe heat and drought during summer 1983, a special program on feeding dairy cows after the severe weather was developed and presented to 200 producers, Extension workers and industry representatives at eight meetings.

Use of computers on dairy farms was emphasized during the year. In an attempt to reach more dairymen with feeding analyses, a least-cost dairy ration program was put together for use with the Radio Shack microcomputer. This program was initiated in 10 county Extension offices. Through it about 75 percent of the dairy producers in the State can be reached by Extension agents.

A reproductive management program involving 22 dairymen in 10 counties outlines an intensified farm visitation approach with emphasis on using dairy herd improvement reproductive information on which to base management decisions. Preliminary results indicate an improvement in reproductive efficiency. A seminar on milking management was presented to producers and employees at 10 locations. About 125 people attended.

This was the second year of the Residue Avoidance Program. The Delvotest is gaining acceptance among dairymen as a screening test for milk from treated cows. However, there is a continued threat of antibiotics getting into milk, and constant screening for antibiotics is needed.

A visual display on residue avoidance has been prepared and is being used at various places where dairymen gather. We are planning an on-farm survey of antibiotic use.

Interest is developing in the use of microcomputers in conjunction with the Dairy Herd Improvement program. We have been working to become familiar with available programs and to develop new programs for dairies.

Entomology, Fisheries and Wildlife

This was an exciting year for this department in several areas. The results in from the Boll Weevil Eradication program indicate excellent suppression of boll weevils from the diapause treatments last fall. This, combined with the high mortality of weevils from the cold winter, gives the program an excellent chance of success. Successful eradication/suppression of the boll weevil in South Carolina is the key to this program being expanded to the rest of the Southeastern cotton belt.

Extension entomology received federal Integrated Pest Management funds to develop programs to control fly breeding at poultry farms. To date, the program has been successful. Fly control is extremely important in light of State regulations which can close poultry operations that fail to control them.

The decision to form a new Department of Aquaculture, Fisheries and Wildlife was a significant event for our department. The new department

will focus attention on Extension to serve the public demand for information in this growing discipline. In cooperation with the S. C. Wildlife and Marine Resources Department, two jointly funded Extension specialists are now employed. One works with wildlife programs and the other in aquaculture and fisheries. As part of this program, a Cooperative Extension Fish Disease Laboratory has been established at Clemson to serve this growing industry.

Food Science

Extension Food Science program activities emphasized commercial food processing demonstrations to assist entrepreneurs. Accomplishments included the adoption of improved processing schedules for three canned hash products and a new canned mechanical deboned poultry meat product now marketed by a South Carolina processor. Another new venture, one that will commercially process frozen apple cider, was based upon our program recommendations. This facility is now under construction.

Other work included initial coordination of investigative demonstrations to evaluate a continuous cold pasteurization process to manufacture clear apple juice using metallic membrane hyperfiltration technology. If successful, this technology will eliminate several expensive processing steps now being used by the industry.

Extension Food Science Technology transfer activities included assistance in the development of a process to preserve fried chicken by canning, preparation of a processing line layout to reopen a peach canning facility, adoption of procedures to dehydrate red chili peppers commercially, conducting two two-day food handler sanitation workshops at a meat processing facility, and developing the processing procedures necessary to introduce a new product line of bottled teriyaki and sweet-sour sauces by a South Carolina restaurateur.

In addition, processing equipment checks and installation advisories were provided to four companies processing meats, vegetables and fruit products and to another 12 community canneries sponsored by high school/low-income agencies.

More than 3,000 notices of proposals, changes and new federal and State regulations were distributed to 1,050 South Carolina food industry companies by the Extension Food Science Food Regulation Information Filter Center. This enabled processors to participate in the promulgation of responsible regulations and avoid possible citations, fines or adverse publicity by having lead time to implement necessary regulatory compliance changes.

Another 110 educational advisories were developed in response to requests from food processors (in addition to 71 plant visits), citizens and other agencies dealing with food safety, preservation and processing.

Educational public service information on food additives, food storage, chocolates and food labeling was developed for the news media and incorporated into newsprint and radio features reaching an estimated 750,000 persons. Other program activities provided leadership in several food processing, trade and professional associations and serving as the Institute of Food Technologist regional communications representative for South Carolina.

Continuation of budget cuts for 1983-1984 caused a 50 percent manpower cut, leaving only one Extension food scientist to develop and deliver the Extension Food Science programs.

Forestry

Integrated Pest Management activities have resulted in publication of eight leaflets for landowners and foresters. In addition, a computer information center has been programmed and is now operational. It is currently being tested and evaluated and will be available for public use in the near future. Three computer-assisted decision-making models also are being incorporated into the pest management program. Other activities include the development of public service announcements for local television stations and numerous demonstrations on the harvesting and use of pest-infected or killed timber. The integration of pest management practices with timber management by landowners could result in growth savings as high as 5 percent of the annual growth.

A Forest Productivity Task Force currently is operating in South Carolina. The Cooperative Extension Service has one agent from each county working with this effort as well as many of the specialists at the State level. The goal of the program this year is the reforestation of an additional 10,000 acres of private land. This is the first time governmental agencies, industries and landowners have cooperated this closely on a forestry project.

The matrix management concept being used with area Extension agents in forestry is working well. Two agents were employed in the past year with Renewable Resources Extension Act funds. One has helped establish three county landowner associations. Forestry newsletters are being mailed to landowners in nine counties. Forestry field days and a six-session training program have been conducted. Landowners have responded positively and are requesting assistance weekly.

The Forestry as an Investment brochure is still popular. Three Extension groups, three industrial associations and three agencies outside the State have bought reprints of this publication.

Horticulture

Clemson University's Cooperative Extension Service receives its greatest number of questions about home lawns and gardens. To better serve

this large clientele, parts of two more faculty assignments have been directed toward this area. A course has been developed to present Master Gardeners training for interested citizens who then volunteer their time to help others with basic gardening questions. Television and radio programming on this topic has been developed.

Grower demonstrations are still a principal method of Extension education. During the past year, county and area horticulture agents received training on strawberries, vegetables, turf and fruit production practices that will make them more effective in establishing grower demonstrations. Clemson also hosted national and regional short courses in peaches, nursery crops, integrated pest management and turf.

Electronic communication with microcomputers has developed to the point that messages from county Extension offices and data from branch Experiment Stations can be transmitted to and from the Horticulture Department for use in Extension programs. This network soon will tie every county office and College of Agricultural Sciences department together. This is an improvement over telephone communications because printed information and graphs can be readily transmitted.

Plant Pathology

Extension plant pathologists continue educational programs to encourage early recognition of disease problems so proper remedial action can be taken. Emphasis in 1983 was on grower meetings, field demonstrations and written material.

Three major diseases were of particular concern last year. Stem canker of soybeans has the potential for killing large acreages in a short time. Serious losses were sustained in 1982. Through interdisciplinary Extension efforts, tolerant varieties were found, rotations for particular situations were suggested and losses were kept to a minimum in 1983.

Use of ethylene dibromide (EDB), a widely used nematicide, was banned in 1983. Since plant-parasitic nematodes are a major cause of reduced yields and quality of field, vegetable and fruit crops, Extension plant pathologists developed new control strategies for most crops. Educational activities were directed toward helping growers recognize nematode problem areas. Greater emphasis was put on using the nematology services of the Agricultural Services Laboratory. New nematode threshold guidelines are being developed. Rotation of crops to control nematodes on soybeans and tobacco was stressed.

A new label was obtained for a nematicide that helps reduce the numbers of ring and root-knot nematodes on peach trees. Nematicide plots were established on several crops to demonstrate nematode control measures.

Black streak of peaches was found to be due to a high pH in the wash and cooling water. There was a special educational effort to make all

packing operations aware of the cause of the problem and provide technical help where the problem was not easily solved. More than 80 percent of the packing operations now have testing equipment and know the procedures for maintaining proper pH.

Rapid communication is important in solving plant pathology and physiology problems. Additional equipment for enhancing electronic mail and processing plant problem diagnoses has been installed, and personnel are being trained to develop and use the system.

Poultry Science

With the outbreak of highly pathogenic avian influenza in North-eastern states, poultry health received State and national attention. In response, Extension specialists helped establish an Emergency Poultry Disease Task Force. Procedures were developed to respond to outbreaks of highly pathogenic poultry diseases. Avian influenza has not been reported in South Carolina, but the threat has helped Extension emphasize the need for farm security and good management.

Poultry and egg price levels responded to supply and demand, creating a positive economic position. This has created a demand for help and advice on entering or expanding poultry farms in South Carolina. 4-H poultry teams and individuals represented the State well in regional and national competition.

An industry-initiated nutrition experiment plus broiler and egg handling seminars planned by Extension served the industry educationally and improved public relations with industry leaders.

Sea Grant Marine Extension Program

The Sea Grant Marine Extension program is a marine outreach of the Sea Grant Consortium and the Clemson Extension Service. The consortium is a partnership of six universities and one State resource agency. By tapping into the facilities of these member institutions and the Sea Grant programs in other states, The Marine Extension Program (MEP) is able to address the coastal public's questions on how best to use their marine resources. The MEP works with a broad range of marine users including commercial and recreational fishermen, marina operators, scuba divers, marine businesses as well as the average user who goes to parks and beaches for recreation.

The following are examples of how the MEP functions:

- Because there are more boats trawling for the same amount of shrimp, the MEP is showing fishermen how to use new species to supplement their income. A recent workshop on squid introduced 100 fishermen to a potential South Carolina fishery.

- When a local fish dealer was asked to supply sun-dried whelk (conch) to a Japanese market, the MEP helped locate a tobacco dryer to speed the drying and eliminate problems associated with outdoor drying.
- More than 80,000 copies of a Recreation Guide to the Low Country that the MEP helped produce have been distributed. One map in this guide helps the coastal user locate what he wants quickly and easily. The MEP, in cooperation with the Charleston County Parks, Recreation and Tourism Department, has instituted a docent program. Volunteers are made available to local groups that want more information on the coastal environment. In four months it has had an audience of 500.
- South Carolina landowners now grow crawfish in more than 500 acres of ponds, thanks to technical support of the MEP's aquaculture/mariculture specialist. The MEP has helped others grow and harvest other species such as marine shrimp. One landowner produced 850 pounds from 15 acres, using naturally available shrimp to stock his ponds.
- The MEP helped organize the South Carolina Marina Association, which now represents fresh and saltwater marinas and associated marine trades. Through the association, marinas have access to an insurance program that saved two marinas \$25,000.

Extension Home Economics

Scope of Activity

Home economics is a body of knowledge that prevents rather than cures problems related to the basic necessities of life. This helps families make decisions based on their needs, resources and value systems. Information is delivered through county agents in each county.

Extension Home Economics programs center on five major areas: family economic stability and security, energy and environment, food and health, family strengths and social environment, and leadership development. At the same time, Extension Home Economics seeks to make families visible in legislative deliberations through public policy education and awareness.

A brief overview of each subject area follows.

Family Life and Human Development

An educational program, Helping South Carolina Families Gain Coping Skills, was carried out in all counties. Program materials were shared with other agencies that view Extension as a source of practical family information.

The Parent-Child Interaction (PCI) program was expanded to 20 counties. Statewide, about 200 parents were involved in programs de-

signed to help them gain competency in parenting. PCI has been well accepted in South Carolina, and the governor has launched a campaign to implement a program to teach the same concepts to other children.

Clothing and Textiles

About a third of the counties reported clothing programs as a major emphasis in helping families cope with today's economic problems. The methods used to present the materials were special interest meetings, workshops, Lunch 'N Learn groups for working homemakers, exhibits and individualized instruction. During the past year 12 publications, three videotapes, five slide sets and four teaching kits were developed to help the counties with clothing and textile presentations.

Extension home economists reported working with 1,124 individuals in clothing concerns. They presented 118 programs. A total of 866 participated in construction-related programs, making 723 garments. The savings for these items was put at \$40,000.

Today's young people want to know how to use their resources wisely. Fashion clinics, local clothing workshops and fashion reviews have provided basic skills and self-confidence for this audience.

Family Resource Management

Financial management is cited as the number one problem of most South Carolina families. Programs offered by county agents in five counties were directed toward producing more knowledgeable consumers. Using groups such as Extension Homemakers, 4-H, college audiences, military and civilian personnel on an air base, the general public and the media, agents offered information via computers, videotapes, individual counseling, newspapers, radio and workshops.

In one county, a follow-up survey of 410 persons who had received training showed 102 had improved management skills, 152 had learned to plan and budget income, 50 learned planning skills and the participants estimated cost savings of \$2,460.

Through the efforts of Extension home economics, people in five counties are using skills gained to supplement their family incomes. These skills include upholstering, furniture refinishing, quilting, soft sculpturing dolls, candlewicking home accessories and stenciling on fabric and wood.

Foods and Nutrition

The Food and Nutrition program has concentrated programs in two areas: nutrition as it relates to good health, and wise use of food resources.

More than 35 percent of South Carolina's adults are obese, and weight control through proper food habits and exercise has been a major educational program. The Eating Slim program reached 270 persons in nine

counties. Nearly all of the participants were from rural areas where typically no other weight control program was available. Those who took part lost an average of 14 pounds during the 16-week program. Informal evaluations have shown improved nutrition knowledge, reduced hypertension and weight loss by other family members.

According to a new survey, more than 60 percent of all South Carolina households preserve food at home. The value of this food is estimated at \$78 million. The survey found about a fourth of this home-preserved food is processed by unreliable methods. For these reasons, an Extension food preservation program is conducted in every county. In addition to providing information, home economists also check the accuracy of pressure canner gauges and judge canned goods at county and state fairs. Every major health and education agency in South Carolina refers questions on home food preservation to Extension.

Last year Extension home economists:

- presented workshops that resulted in thousands of participants changing to food preservation practices recommended by the USDA.
- as part of a pilot program informed 500 fair participants of deficiencies in food products they were entering in competition.
- answered more than 15,000 questions about food preservation and food safety in a five-month period.

Expanded Food and Nutrition Education Program

The Expanded Food and Nutrition Education Program (EFNEP) reaches limited resource families, especially those with children, with information to help them improve their diets and nutrition. The program operated in 34 counties in 1983, reaching 5,705 homemakers. Many of those taking part have improved their diets (in one county the figure was 97 percent) and are producing and preserving some of their food.

The 4-H EFNEP program, which also operated in 34 counties in 1983, reached 5,511 youngsters.

Interior Design and Home Furnishings

Persons were trained by Extension agents and volunteer leaders in home furnishings skills. This training stressed alternative methods for making homes more livable without heavy cash expenditures.

In 1983:

- 496 persons took the Interior Design by Correspondence course.
- home furnishings classes conducted in four counties drew more than 200 participants.
- 23 participants in a chair caning and furniture restoration workshop reclaimed 22 pieces of furniture.
- many people took part in pillow-making and picture framing workshops.

Residential Housing Mission

Housing requires a major part of the income of each family, and all 46 counties in South Carolina offer Extension Home Economics programs on housing. Five counties provided a detailed evaluation of the results of home repair and remodeling education efforts.

Accomplishments include 1,573 program participants and 93 families doing their own repairs and remodeling. Home economists helped prepare 12 television shows and one long article for a metropolitan newspaper.

The results of Extension energy conservation information were demonstrated in a Greenville housing project. Conservation workshops and follow-up activities were held in area housing projects in one city.

Leadership Development

The South Carolina Extension Homemakers Council has 409 clubs with 6,493 members in 43 counties. Last year the State Council voted to finance trips for nine members to the Southern Leadership Training Workshop in Mississippi. Since their return, they have trained 170 additional leaders at a series of in-state workshops. They plan to continue this program, eventually training 1,000 leaders in the State.

Another highlight of the year was the Citizenship Caravan which drew 1,052 Extension Homemakers to Columbia March 9, 1983, for a visit to the State Capitol and to attend a luncheon with legislators. Every Homemakers Council in the State was represented as three resolutions were presented to more than 100 legislators. The resolutions emphasized the need for home economics research and the importance of the Cooperative Extension Service to South Carolina.

4-H and Youth Development

The mission of the 4-H and Youth Development program is to help youths in South Carolina become self-directed, productive individuals who make a positive contribution to our State and nation.

The learn-by-doing approach to the 62 4-H educational projects and activities enables youths to participate in programs of interest, acquire relevant experiences and evaluate these experiences in terms of potential careers.

Participation

The most successful 4-H programs are accomplished through organized community 4-H groups with an adult volunteer and/or teen leader to provide guidance. In South Carolina, 3,377 adult volunteer and teen leaders gave leadership to 4-H programs in 1983. There were 30,944 youths aged 9-19 enrolled in 1,373 4-H clubs, and 29,792 youths enrolled in special interest programs.

In 1983, 5,744 youths participated in the 4-H camping programs conducted at Camp Bob Cooper and Camp Long, and 5,815 were enrolled in the Expanded Food and Nutrition Education Program. The most popular 4-H projects in 1983 were Exploring 4-H, Food Nutrition, Personal Development, Electric Energy and Safety.

More than 7,584 4-H youths lived on farms; 33,826 lived in towns with populations under 10,000 and rural non-farm; 9,079 lived in towns and cities with populations of 10,000-50,000; 7,940 lived in suburbs or cities with populations greater than 50,000; and 2,307 lived in cities with populations exceeding 50,000.

Program Emphasis

The primary emphasis of the South Carolina 4-H and Youth Development program is for county Extension professionals to recruit, train and support adult and teen leaders. This emphasis is essential to expand and enhance educational learning experiences for more youths and to make the best use of tax dollars allocated to the 4-H program.

Curriculum areas in 4-H include production, processing and distribution of food and fiber; human and animal nutrition; conservation of natural resources; citizenship/community service; leadership development; health; and family living.

Three years ago, the South Carolina 4-H Foundation was formed as a component of the Clemson University Foundation system. One of the goals of the Foundation continues to be to increase support of 4-H from the private sector. A \$1.25 million campaign has been launched to secure additional funds for 4-H in the next five years. Plans are being completed to identify 4-H alumni across the State.

County Extension professionals who recruited, trained and supported adult and teen leaders enabled more youths to receive positive learning experiences through 4-H. The leadership skills developed by adult and teen leaders also helped them prepare for other leadership positions in their counties and the State.

Special Programs

The Extension Service has been charged with the responsibility of translating scientific knowledge from university and experiment station research into useful application on farms, in homes and communities. Despite the trend toward large, sophisticated farm operations, small family farms with limited resources still make up a substantial portion of the State's rural population. The Special Programs area assists those with low incomes and limited resources. Extension personnel are used to identify problems and establish objectives in crop and livestock production, marketing, nutrition, housing, youth development and family life.

Small Farms Program

The small farm is defined as a farm operated by a family that provides most of the labor and management, depends on that operation for a significant portion of its income and has a total income below the median non-metropolitan family income for the State.

Today Extension relies heavily on videotapes, computers and other forms of mass communication to reach large audiences. But on-farm demonstrations are still very much a part of Extension work with small farmers. Tours and field trips with groups also are being used as more effort is being made to reach the small scale farmer with educational information.

The Integrated Pest Management program involved the small farmer and home gardener during the year. Trained scouts scouted insect activity in selected areas. Their findings were reported and published so other producers would know what insects were a problem from week to week. Demonstrations on the control of parasites in livestock also were carried out for small farmers under the Integrated Pest Management program.

Marketing

Selling the farm product is a serious problem for the small farmer. Low volume and lack of product quality work against marketing efficiency. Considerable time and effort is being given to help growers of horticultural crops to increase quantities by assembling products at a designated place for sale direct to customers. Most counties now have such markets, and it is estimated these markets bring in more than \$2 million annually to more than 1,000 small farmers.

Small Farm Project Management Team

Many small farmers in the State were reached through Extension Special Programs cooperating with the Governor's Council on Rural Development and other agencies through demonstration of drip/trickle irrigation. This is a method of applying irrigation water directly to the root zone of plants. It operates with low water pressure, low volume and uses less than half the water and energy of overhead sprinkler irrigation systems. These demonstrations showed primarily the benefit of a well-oriented approach to managing small acreages of high value cash crops.

DIVISION OF REGULATORY AND PUBLIC SERVICE PROGRAMS

L. H. Senn, Director

This division of Clemson University operates several consumer protection-type programs closely related to the agricultural sector. The philosophy for having regulatory programs at Clemson is that certain regulations can be enforced more effectively when strong educational approaches are used. Regulatory and Public Service Division personnel use this technique as a normal procedure.

The division maintains close coordination with the Cooperative Extension Service and the S. C. Agricultural Experiment Station and solicits their aid when additional educational research efforts are needed. Strict enforcement is used only against recalcitrant offenders.

The major objective of this division is to ensure that consumers buying lime, fertilizers, pesticides and seed get the qualities indicated on tags or labels. It also enforces regulations of the Crop Pest, Boll Weevil Eradication, Bee Disease and Abandoned Orchards Acts and imposes quarantines when needed.

The division also was given the responsibility for enforcing the S. C. Pesticide Control Act and the S. C. Agricultural Liming Materials Act of 1976.

Following are highlights of division activities for 1983-84.

Department of Agricultural Chemical Services

This department performs the chemical analyses reported by the Department of Fertilizer Inspection and Analysis and the Plant Pest Regulatory Service. Most samples analyzed were multi-component, with more than 25,000 individual analyses made. The laboratory has concentrated on improved methodology, instrumentation and organization to analyze all samples quickly and accurately.

The department performed more than 30,000 analyses for the S. C. Agricultural Experiment Station. In addition, the Agricultural Service Laboratory processed more than 89,000 soil samples, 3,900 plant and feed samples, and 4,200 samples for nematodes.

Department of Seed Certification

Seed certification is a program of standards imposed on seed and plant production that ensures varietal purity, good germination and freedom from noxious weed seeds. Participation in the program is voluntary.

Clemson University was designated by law in 1945 as the agency for inaugurating and carrying out a program of certification of pure seed and plants in South Carolina. The Seed Certification Department of Clemson

and other seed certification agencies in the United States must comply with standards for certification of seed in Federal Seed Act Regulations.

Departmental field work in 1983-84 involved inspections of 60,521 acres of crops for certified seed production. Inspections included 75 varieties of 12 crops for 338 farmer/growers and 28 seed-producing firms. Each field was inspected to determine that the crop was true to variety and free of noxious weeds.

Major acreages of crops inspected were soybeans, 38,232; small grains, 17,951; and cotton, 2,542. In addition, other field work involved grow-out plantings of 332 samples of South Carolina certified soybeans and small grains for comparison to producer or processor's samples of the same seed lots. Only three of the samples were found to have varietal purity or labeling problems. This work, in effect for three years, indicates the excellent job certified seed producers and processors are doing in obtaining representative samples of their seed.

During 1983-84, 1,123,695 certified seed tags were issued to growers whose seed met standards both in the field and the laboratory. Thirty-eight facilities were inspected and approved during the year for custom processing of South Carolina certified seed.

Plant Pest Regulatory Service

The Crop Pest Act

Nursery Inspections: Five hundred fifty-four nurseries, greenhouses and vegetable transplant growers and 932 nursery dealers were licensed to sell plant material, including 22 dealers outside the State. An additional 206 establishments were visited on routine inspections to determine compliance with quarantines and regulations to provide assistance with pest problems. Twelve other nurseries were not certified on the initial inspection because of pests and/or weed problems.

Miscellaneous Inspections: We issued 152 phytosanitary export certificates (45 State and 107 federal) for various agricultural planting seed, flue-cured tobacco and plant material, primarily orchids and chrysanthemum and rhododendron cuttings destined to other states, Canada and other foreign countries. Twenty-six regular certificates of plant inspection were issued for assorted house plants being moved or shipped within the United States.

Sweet Potato Inspections: Sixty-four inspections, including storage, plant bed and field inspections, were conducted for about 23 growers in the Pee Dee, Sandhill and Coastal Plains areas of the State.

Sweet Potato Weevil: Plant Pest Regulatory Service personnel continued to monitor the sweet potato weevil problem at the USDA Vegetable Breeding Laboratory at Charleston. Following an evaluation, appropriate measures were taken to prevent spread.

Phony Peach: The 1983 survey for phony peach disease was conducted in 14 counties. Six temporary inspectors were hired. Approximately 1.7 million trees were surveyed with 417 (.02 percent) found diseased. Several cases of rosette also were found.

Bee Disease Act

Bee Inspections: Of the 2,795 bee colonies inspected, 11 were infected with disease. Three hundred three other beekeeper contacts were made regarding various bee problems. Certification was issued to move 1,932 colonies to North Carolina, Georgia, Virginia, Ohio and New York.

Cooperative State-Federal Programs

The department and USDA entered into a cooperative agreement in 1983 whereby the State would hire seasonal employees. Forty-eight employees were hired to survey and perform control activities in areas known to be infested.

Witchweed: Statistics for 1983 show that 23 new farms with 615 acres were infested with witchweed. More than 5,000 actual and about 1,000 aggregate acres were treated. A total of 133 farms and 4,006 acres have been released from quarantine. Remaining infested farms and acres are 1,292 and 33,821 respectively.

Imported Fire Ant: Regulatory activities are continuing with nurserymen to keep fire ants in a certifiable status. Small, isolated infestations exist in three counties, and control measures are being applied. Since there is not a good, economical, efficacious material available for comprehensive programs, all treatment is on a small scale. Amdro, a product offered by Stauffer Chemical Co., is a good material. But it is very costly, and the results in a large scale program do not justify the cost for a cooperative State/federal eradication program.

Gypsy Moth: In 1983 177 adult male moths were caught in South Carolina. This compared with 312 in 1982. Of these, 138 were caught in Horry County. Numerous inspections were conducted of outdoor household articles moving into the State from high risk moth areas.

Boll Weevil: The Boll Weevil Eradication program was active in 1983 and, as with any other program of this nature, opposition was encountered. A lawsuit was filed by six growers who objected to the fees on the basis that the regulations had not been promulgated. The regulations were filed as soon as possible after public hearings. However, the legislature adjourned without taking action, stating there was not enough time to get them through both houses. Thus, we filed them as "emergency regulations" and carried out the program under them. In August a judge ruled against the State. The spraying of the cotton fields of those who brought the legal action continued because the growers were objecting only to paying the fees, not to having the fields treated.

Another group of growers also objected to the fees. The State sought an injunction allowing the program to continue. The judge ruled in our favor until the case could be heard on its merits at a later date.

National Plant Pest Survey and Detection Program

Cereal Leaf Beetle: This year's survey was conducted in Cherokee, Chester, Dillon and Marlboro counties, and beetles were found in all four counties.

Japanese Beetle: Trapping was conducted in Saluda, Edgefield, Orangeburg and Sumter counties with catches in each.

South Carolina Pesticide Control Act

In an effort to improve its education and enforcement capabilities, this agency has pursued external sources of funds where possible without decreasing the flexibility of the pesticide program. These efforts have resulted in two grants totaling \$108,872 from the EPA. The department also has made a concerted effort to increase efficiency and data management by obtaining a computer system.

Registration: In 1984 803 companies registered 7,148 pesticide products for sale in South Carolina. We collected and analyzed 2,078 pesticide samples with 22 found deficient in the guaranteed percentage of one or more ingredients. Stop-sale notices were issued on all deficient products. Registration fees totaling \$116,710.25 were deposited.

Using provisions of the Federal Pesticide Control Act, the department issued 17 Section 24 (C) special local need registrations. One Section 18 emergency exemption to allow use of Larvadex to control fly larvae in poultry houses was sought, but denied by the EPA.

Certification: Pesticide dealers and applicators must be certified and licensed to buy, sell or apply pesticides classified for restricted use. Last year 13,090 private applicators licenses, 1,584 commercial applicators licenses, 748 non-commercial licenses and 420 pesticide dealers licenses were issued. Certification fees totaling \$47,642 were collected.

Education and Enforcement: Pesticide personnel made frequent contact with pesticide dealers, Extension agents and various applicators and pest control operators. Numerous structural pest inspections were conducted. The promulgation of structural pest control regulations in 1980 and mandatory licensing in 1983 has significantly increased the workload in this area, but this provides a valuable service to both the industry and consumers. Although strong enforcement measures were required in a few instances, most pest control companies are voluntarily correcting violations and refunding charges for unnecessary pest control activities.

Twenty-six penalties ranging from \$50 to \$400 (total \$3,550) were assessed and seven criminal prosecutions resulted in convictions. Forty-five investigations of potential pesticide misuse were conducted. Numer-

ous stop-sale notices were issued for unregistered products, sale of restricted products by unlicensed dealers and other violations. Seventy-two warning letters were issued.

An excellent working relationship has been established between the agency and the Consumer Fraud and Consumer Affairs sections of the Attorney General's office. Overall, compliance with the act by members of the agribusiness industry has been excellent.

Department of Fertilizer Inspection and Analysis

The Department of Fertilizer Inspection and Analysis is responsible for enforcing the provisions of the South Carolina Fertilizer Law, 1954, 1970 and 1978 and the South Carolina Agricultural Liming Materials Act, 1975.

Some of the major activities of the department for the July 1, 1983-June 30, 1984 period follow:°

Fertilizer usage data — tons	702,725
No. of fertilizer samples procured and analyzed ...	6,320
No. of fertilizer samples not meeting guarantee ...	1,146
Percent of fertilizer samples not meeting guarantee	18.7
No. of liming material samples procured and analyzed	233
Total number of liming material samples not meeting guarantee	2
Percent of liming material samples deficient8
Total number of individual deficiencies in liming material samples	2
Number of irregularities other than underweight ...	2
Weight irregularities	6
Fines collected, payable to state treasurer	\$ 585.00
Penalties collected, payable to state treasurer	\$ 23,804.10
(Deficiencies where consumers not identifiable)	
Fertilizer registration fees collected, payable to state treasurer°°	7,370.00
Lime registration fees collected, payable to state treasurer°°	390.00
Soil amendment registration fees	50.00
Lime permit fees collected, payable to state treasurer	1,350.00
Fertilizer taxes turned over to state treasurer	<u>154,233.38</u>
Total monies sent to state treasurer	\$187,782.48

° This is a first report. Final report may vary slightly.

°° Actually recorded by state treasurer July 1, 1983-June 30, 1984 but may not correspond to final fees paid for the fiscal year.

Fertilizer Movement in 1983-84

The tonnage sold in 1983-84 was 13 percent more than during 1982-83, the lowest fertilizer tonnage year since 1936. Total tonnage of mixed fertilizer and materials sold in 1983-84 was 702,725.

Fertilizer and Agricultural Liming Material Quality Control

The quality of fertilizer bought by South Carolina consumers was the highest in eight years. Of the 6,319 samples taken by fertilizer inspectors, 18.7 percent were found to be deficient beyond the allowance. This was the best record by the fertilizer industry since 1976. There has been a decline in the percent deficiency since reaching a high of 28.2 percent in 1978-79.

The improvement has not been by accident, but by efforts of the industry and a firm, but fair, enforcement of the South Carolina Fertilizer Law. An educational effort by the department through meetings, visits to plants and supplying written material has contributed to higher quality fertilizer in the State. Samples of bagged fertilizer were 15.66 percent deficient while samples of fertilizer sold in bulk were 19.70 percent deficient. Samples of dry blended fertilizer were 23.94 percent deficient compared to 9.60 percent deficiency for samples of granular, mixed fertilizer and materials.

Of 233 samples of agricultural liming materials sold to South Carolina consumers, only two (.8 percent) were below the investigational allowances for the various guarantees. Permits for distributing agricultural liming materials were issued to 280 dealers.

Contamination of Fertilizer

Tobacco is extremely sensitive to certain types of herbicides. Fertilizer formulated for tobacco by one company was found to contain slight amounts of an herbicide suspected to be dicamba. Where this fertilizer was used, herbicide damage ranged from none to substantial. Fertilizer samples from lots suspected to be contaminated were taken by inspectors. Due to the extremely low amounts of contamination, the laboratory was unable to verify contamination in many of the samples. The department cooperated with farmers, Extension tobacco specialists and agents, the fertilizer company and insurance companies in supplying portions of samples and exchanging information.

LIVESTOCK-POULTRY HEALTH DIVISION

C. E. Boyd, Director

The Livestock-Poultry Health Division conducts a number of regulatory programs in consumer protection and animal health and the diagnosis of various disease problems in South Carolina livestock.

The division's three main areas of responsibility are the South Carolina Meat and Poultry Inspection programs, the Livestock Regulatory programs, and the Diagnostic Laboratory.

The Animal and Plant Health Inspection Service, USDA, cooperates with the Livestock-Poultry Division in carrying out certain animal disease eradication programs conducted on a national basis. It also provides 50 percent of the funds for administering the South Carolina Meat and Poultry Inspection program.

Following are highlights of the division during 1983-84.

Meat and Poultry Inspection

This department's responsibilities cover the wholesomeness of meat and poultry slaughtered and the food products processed at all processing plants in the State except for a small number of plants that operate under federal jurisdiction.

One hundred fifteen meat and poultry plants are under State inspection. The full-time staff consists of six veterinarians, 55 inspectors, a compliance-evaluation officer and two administrative personnel. More than 100 million pounds of red meat and poultry are inspected annually in State plants.

South Carolina's programs continue to meet the standards to be classified as "equal to" the Federal Meat and Poultry Inspection programs.

Cooperative Disease Eradication Programs

National disease eradication programs have been established in this country to eradicate certain livestock diseases that cause great economic losses to the livestock industry.

The eradication of brucellosis in cattle and pseudorabies in swine are our major programs. The federal government cooperates by furnishing approximately one-half the personnel, equipment and indemnity funds to help carry out those programs.

During the year, the U. S. Department of Agriculture approved the shipment of two stallions and four mares under quarantine into South Carolina for intensive testing. These horses came from foreign countries where contagious equine metritis is known to exist. All were found to be free of the disease and were released from quarantine.

In June 1984, South Carolina was officially advanced to the status of "free state" under the U. S. Department of Agriculture brucellosis classi-

fication which confirms that no brucellosis has been diagnosed in cattle within the past year.

Animal Diagnostic Laboratory

The laboratory is staffed by six veterinarians and 11 technicians. It provides diagnostic services in animal pathology, bacteriology, virology and serology for the regulatory programs as well as diagnostic help to practicing veterinarians and livestock and poultry owners in the State.

The laboratory is in a position to isolate and identify many animal diseases impossible to differentiate clinically. During the year the laboratory handled more than 3,000 cases and conducted more than 200,000 laboratory tests and examinations.

Livestock Auction Market Inspection

All livestock going through auction markets are inspected for contagious and infectious diseases.

From 94 to 108 livestock auction sales are held each month at the 18 livestock markets in the State, and this division furnishes a veterinarian and a livestock inspector at each sale to ensure compliance with all animal health requirements. In addition, a veterinarian is present at all dispersal and consignment sales for cattle and swine.

Five permits were issued during the year to operate new auction markets, and two permits were issued for new buying stations.