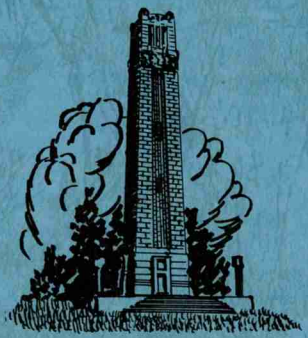
A PROPOSAL FOR
A DOCTORAL PROGRAM
IN
AGRICULTURAL ENGINEERING



NORTH CAROLINA STATE COLLEGE

A DOCTORAL PROGRAM

IN

AGRICULTURAL ENGINEERING

Submitted to the
Administrative Board of the Graduate School
North Carolina State College
Raleigh, North Carolina

March, 1957

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1. NEEDS, OBJECTIVES AND REQUIREMENTS FOR THE DOCTORATE

A. Needs

Agriculture's needs and demands for engineering service are matters of widespread recognition, and the present unparalleled requirements of drudgery type hand labor for agricultural operations in the Southeast amplify the inconsistencies in the agriculture of this area when compared with the general socio-economic conditions of the nation. While the gross income from farm production in North Carolina for 1955 was $1,135,400,000., giving a net income of $598,500,000., the income per agricultural worker amounted to $1,890. (1950 census). The corresponding figures for Iowa in 1955 were $2,289,400,000., $625,300,000. and $2,465. respectively. The primary reason for this difference in personal income so favorable to Iowa results from the greater mechanization of farm operations in the Mid-west; this is illustrated in part in Figure 1, which compares the operational statistics in the production of major crops for the two regions.

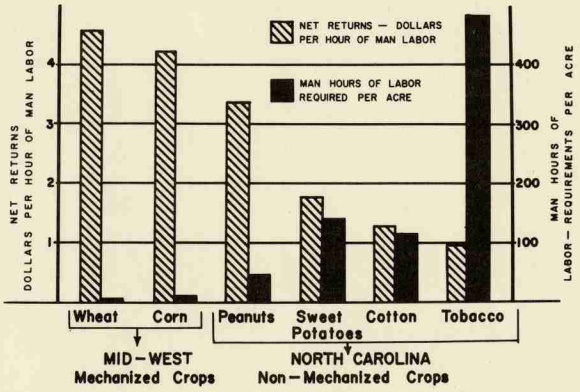

Figure 1. Need for Advancing Engineering Service to Agriculture in North Carolina.

The Southeast has unusual advantages in natural resources -- land, sunshine and water -- with which to produce the basic needs of mankind. Therefore, a real opportunity for this area lies in the placing of its agricultural industry on improved practices. This has particular significance in view of growing population pressures and the higher demands of a more

prosperous society. A major contribution in this endeavor will be advanced developments in the production and processing of food, fiber and other raw materials so as to place more productive power per operator at the disposal of the agricultural industry. The Agricultural Engineering profession has the responsibility of developing more powerful means of agricultural production by advancing technology in the operations of such production.

Professional leadership requires men of broad interests, sound judgment and clear perspective for unceasing appraisal of methods, developments, efforts and proposals, as well as for the responsibility to the contribution of worthy ideas to the total human enterprise. The training for both creative work and effective leadership is the responsibility of the academic phase of the Agricultural Engineering profession. Therefore, in order to contribute more competently to these objectives, the staff of the Department of Agricultural Engineering at North Carolina State College recommends that a program of study leading to the Doctor of Philosophy degree be established in Agricultural Engineering. No institution in the Southeast is presently offering the Ph. D. degree in Agricultural Engineering. Consequently, an advanced graduate program at this institution will serve both the State and region because presently this Department, more immediately than any others in the region, has the resources for administering a vital graduate program to the Doctor of Philosophy. Furthermore, the staff and resources of this Department compare favorably with the top Agricultural Engineering Departments in other regions that are offering this degree.

B. Objectives and Requirements

The productive activities of Agricultural Engineering are a complex of science, engineering and experience. Not only must the effective worker prevent gaps between the output of the scientific disciplines and engineering applications, but he must also formulate knowledge of nature pertinent to the engineering of systems in order to increase the ease of its transmission and thereby the utility of this knowledge. He must be an engineering scientist to the extent that he translates these data into idealized systems -- structures, machines, processes, circuits, etc. But because there are force fields and interactions that are either unknown or cannot be analyzed, scientific training supplemented by practical experience -- the art of engineering -- fills the gap between the results of analysis and the actual system. Extrapolations from analogies and a sense of the magnitude of variables are requirements in this endeavor. Therefore, effective problem analysis and efficient synthesis of solutions necessitate that the engineer has a clear understanding of the nature of the several forces, energies and materials; by this he can readily perceive alternatives and evaluate the significance of ideas.

The uniqueness of engineering problems in agriculture amplifies the demands placed on the professional engineer in this area. First, there is

the necessity of integrating the response characteristics of biological systems or a knowledge of the life sciences with the treatments interpreted by the physical sciences. Secondly, in many instances advancement in technology means the substitution of a mechanical device for the facility of the human hand. While this connotes complexity and refinement in design, such devices must be economically practical for enterprises that demand the use of this device even less than one week per year.

The scope of learning implied in the above requirements for forceful workers and leaders in this discipline is tantamount to the acceptance of the fact that only a part of this competence can be obtained by the student during the time allotted to graduate study. Accordingly, the primary concern of a graduate program in Agricultural Engineering must be to impart to the student (1) an appreciation of knowledge, of where it lies and sufficient confidence in his ability to seek it out for a critical study of the various problems as they arise, and (2) a direction to his interests and scholarly aspirations so that he may dedicate his life's work to advancing the effectiveness and dignity of this profession.

To achieve the first objective it will be necessary that the student obtain a real appreciation of the unity in scientific knowledge; that but a few basic concepts and mathematical principles serve as the common theoretical base for the interpretations of the many natural phenomena. This requires leading the student through an advanced level of physical theories in order that he may readily appreciate the analogies among the various formulations in field theory (dynamics, electromagnetism, thermodynamics) as well as a background in quantum physics. This is the more important because after leaving formal study seldom do men enter into higher levels of knowledge.

Because existing concepts are formulated mathematically and since the objective of science is to establish expanding knowledge on either old or new mathematical principles, it is quite by necessity that creative workers in Agricultural Engineering should obtain as early as practicable an understanding of advanced mathematics. Also, competence in advanced mathematics will encourage and permit the individual to read and comprehend as well as enhance his verbalizations in the various branches of science as befits his interests and needs.

Since the theories in the life sciences are based on concepts common to physical and chemical theories, it seems that in the perspective of professinal training formal study should be concerned primarily with the mathematical and physical disciplines; the acquisition of techniques and general knowledge in the biological sciences can in the main be relegated to the student's progressive and continual self-study.

Some engineering sciences are needed to provide training in the application of theory to idealized systems and apparatus. Theory of prob-

ability and statistical methods must be included for their interpretation of the nature of events and as the basis for formulating efficient experimental plans and valid inferences from experimental data. Technology courses should be relied upon only for their contribution to training in techniques and analysis of existing applications pertinent for a background of professional endeavors.

Research and training in research contribute greatly to the second objective stated above. Through instruction in the instrumental aspects of scientific research, the student acquires competence in the techniques peculiar to this profession; likewise, he becomes familiar with the problems and the methods of analysis and applied principles. Experience in research will be obtained from prosecution of individual researches pertaining to problems of professional interests. While a student, the individual will have the opportunity to enjoy some success in the solution of these problems and by association with men of common interests he will find that community of spirit sufficient for a dedication of his life's work.

The research activities of graduate students in Agricultural Engineering must of necessity be closely integrated with the overall research program within the Department. This is so not only because of considerations of efficiency and economics, but also because, by the nature of the problems, the time nominally allotted to thesis research is generally insufficient to effectively deal with more than a limited part of a problem. The Department's total research program offers opportunities for well defined thesis research and thorough investigation of some significant aspects of an overall problem currently under study. Such integration will avoid ineffective dissipation of the student's efforts and tend to give him confidence that his work will be a meaningful contribution to knowledge. Attention is directed to the fact that research in this Department demands the application of knowledge from the other disciplines especially plant and animal sciences, statistics and chemistry. Consequently, Agricultural Engineering research nurtures a scholar's ability and willingness for greater self-development in these disciplines.

While this discussion has been directed to the integrated objective of a total graduate program, administration will be in two parts. Based on the Bachelor of Science degree in Agricultural Engineering, which includes mathematics through a first course in differential equations, physics and engineering sciences, the following course listing will fulfill the requirements for strong Master of Science programs.

Courses for Master of Science Degree

Required Courses

			Semester Credits
AGE	651	Research in Agricultural Engineering	6 max.
AGE	652	Seminar	2 max.
MA	511, 512	Advanced Calculus	6
PY	401, 402	Intermediate Physics I, Mechanics & Heat	8
PY	403	Intermediate Physics II, Electricity & Magnetism	4

Appropriate Courses

			Semester Credits
AGE	551	Special Problems	
AGE	552	Instrumentation for Agricultural Research and Processing	1
SOI	511	Soil Physics	4
CH	531	532 Physical Chemistry	6
BO	421	Plant Physiology	4
ME	515	Experimental Stress Analysis	3
PY	407	Introduction to Modern Physics	3
PY	410	Nuclear Physics 1	4
ST	515,	516 Experimental Statistics for Engineers	6
CE	547	Fundamentals of Soil Mechanics	3
MA	522	Theory of Probability	3
MA	532	Advanced Differential Equations	3

In the main the selection of courses beyond those listed as required depends somewhat on the student's interests and the nature of his thesis research. However, the student should not be too concerned about specialization at this level of graduate study. Statistics would, with few exceptions, be a regular requirement and whenever possible an Introduction to Modern Physics would be included.

The course work and standard of competence suggested for the Master of Science degree will prepare the student well for more self-study and less formal classroom work. He will be prepared to read the literature and textbook material discriminately: will understand the mathematics employed, realize the pertinence of the subject and interpret properly the sequence of presentations. Therefore, with counselling, the student will learn more efficiently by greater reliance on his own ability, initiative and library resources than by following the routine of course work presentations. This suggests that a minimum of courses be required for the Ph. D. degree and that they be limited to those presentations which generalize the conceptual and theoretical forms of knowledge as conducted by a stimulating instructor. The student should be allowed maximum time for research and freedom for conscientious self-development. Again the final decision is to be based on that program of study having most meaning in a lifetime of work and learning.

The following list of courses are considered most appropriate to the total graduate program leading to the Ph. D. degree in Agricultural Engineering:

Required Courses

			Semester Credits
AGE	651	Research in Agricultural Engineering	
AGE	652	Seminar	
AGE	552	Instrumentation for Agricultural Research and Processing	1

Required Courses

			Semester Credits
MA	511, 512,	Advanced Calculus	6
PY	401, 402, 403	Intermediate Physics: Mechanics, Heat & Electromagnetism	12
PY	407	Introduction to Modern Physics	3
ST	515, 516	Experimental Statistics for Engineers	6
MA	611	Complex Variable Theory	3
PY	601, 602	Advanced General Physics	6
CH	531, 532	Physical Chemistry	6
MA	602	Partial Differential Equations	3

Options

AGE	654	Agricultural Process Engineering	3
AGE	661	Analysis of Function and Design of Farm Machinery	3
AGE	671	Theory of Drainage, Irrigation and Erosion Control	4
AGE	681	Analysis of Function and Design of Farm Buildings	4
SOI	511	Soil Physics	4
SOI	611	Advanced Soil Physics	4
MA	532	Advanced Differential Equations	3
MA	612	Complex Variable Theory	3
MA	622	Advanced Algebra	3
MA	632	Operational Mathematics	3

Appropriate Courses

AGE	551	Special Problems	
BO	421	Plant Physiology	4
ME	515	Experimental Stress Analysis	3
ME	601, 602	Advanced Engineering Thermodyamics 1, 11	6
PY	410	Nuclear Physics 1	4
PY	622	Statistical Mechanics	3
CE	547	Fundamentals of Soil Mechanics	3
MA	522	Theory of Probability	3
EE	516	Fundamentals of Servomechanisms	4

C. Sample Programs

Major: Agricultural Engineering Minor: Soils

Thesis Title: Micro-Environment of Planted Cotton Seed

Advancements in the design of cotton planting machinery and improvements in planting methods demand a definition of the proper physical environment to maximize seed germination and early growth of seedlings. The physical environment must be characterized by definite values for (1) temperature, (2) moisture, (3) oxygen, (4) carbon dioxide and (5) physical impedance. Instrumentation to simultaneously measure all important environmental factors in both laboratory and field are now available.

To formulate new knowledge will require, among other things, the development of a more complete understanding of the nature of the moisture transfer from soil to seed during cycling temperature periods, using the free energy concept of the science of thermodynamics.

The student will have the guidance of the following faculty members whose recognized specialties are pertinent to the research.

H. D. Bowen, Agricultural Engineering
J. van Schilfgaarde, Agricultural Engineering
J. F. Lutz, Soils
J. F. Lee, Mechanical Engineering (Thermodynamics)
R. C. Bullock, Mathematics

Courses (Beyond Conventional M. S. in Agricultural Engineering)

			Semester Credits
AGE	552	Instrumentation for Agricultural Research and Processing	1
AGE	661	Analysis of Function and Design of Farm Machinery	3
AGE	652	Seminar	
BO	421	Plant Physiology	4
CH	531, 532	Physical Chemistry	6
MA	602	Partial Differential Equations	3
MA	622	Advanced Algebra	3
MA	611	Complex Variable Theory and Applications	3
PY	601, 602	Advanced General Physics	6
PY	622	Statistical Mechanics	3
ME	601, 602	Advanced Engineering Thermodynamics I, II	6
SOI	511	Soil Physics	4
SOI	611	Advanced Soil Physics	4

Major: Agricultural Engineering

Minor: Mathematics
Physics

Thesis Title: Thermodynamics of Tobacco Leaf System During Curing Process.

In tobacco curing, supplemental heat is used primarily to regulate the moisture content of the tobacco leaf in order to establish the most favorable time interval-leaf temperature-moisture content relationships. Studies to date have revealed information about the responses of leaf material to environmental treatments: relationships between air conditions and moisture loss with discontinuities as a function of time x temperature; kinetics of certain physiological changes and enzymatic processes as dependent on leaf temperature and moisture content.

An adequate technology for tobacco curing awaits the formulation of these and other pertinent data into a unified body of knowledge. The science of thermodynamics offers a rational interpretation of the processes involved. Since the energy transformations are, in general, irreversible the challenge of this study lies in the necessity of defining thermodynamic functions in terms of parameters described in the operational sense.

Environmental control chambers and techniques for observing leaf temperature and other physical characteristics have been developed for research in tobacco curing.

The student will have the guidance of the following faculty members whose recognized specialties are pertinent to this research.

F. J. Hassler, Agricultural Engineering
W. E. Splinter, Agricultural Engineering
J. A. Weybrew, Biochemistry
J. F. Lee, Mechanical Engineering (Thermodynamics)
J. W. Cell, Mathematics

Courses (Beyond Conventional M. S. in Agricultural Engineering)

			Semester Credits
AGE	552	Instrumentation for Agricultural Research and Processing	1
AGE	654	Agricultural Process Engineering	3
AGE	652	Seminar	
BO	421	Plant Physiology	4
CH	551	General Biological Chemistry	5
CH	531, 532	Physical Chemistry	6
MA	602	Partial Differential Equations	3

MA	611	Complex Variable Theory	3
MA	622	Advanced Algebra	3
PY	601, 602	Advanced General Physics	6
PY	622	Statistical Mechanics	3
ME	601, 602	Advanced Engineering Thermodynamics 1, 11	6

Major: Agricultural Engineering Minor: Mathematics

Thesis Title: Evaluation of Human Effort Through Physiological Response.

The complexity and seasonal characteristics of agricultural tasks require measurement techniques of a higher degree of refinement than time and motion studies to evaluate work efficiences. In addition to the physical effort required to perform a task, other factors such as temperature, relative humidity, eye strain, noise, mental effort and vibration also contribute to the gross fatigue experienced by the individual.

It is known that heart rate, oxygen consumption and body temperature vary with effort as well as with temperature and humidity. The definition of these physiological responses, which will require the development of instrumentation to augment existing equipment, would contribute background knowledge upon which a more comprehensive task analysis could be built.

The student will have the guidance of the following faculty members whose recognized specialties are pertinent to this research.

F. J. Hassler, Agricultural Engineering
W. E. Splinter, Agricultural Engineering
R. J. Monroe, Statistics
R. C. Bullock, Mathematics
A. T. Miller, Physiologist, UNC

Courses (Beyond Conventional M. S. in Agricultural Engineering)

			Semester Credits
AGE	552	Instrumentation for Agricultural Research and Processing	1
AGE	654	Agricultural Process Engineering	3
MA	602	Partial Differential Equations	3
MA	611	Theory of Complex Variables	3
MA	622	Advanced Algebra	3
MA	632	Operational Mathematics	3
MA	635	Mathematics of Computers	3
PY	601, 602	Advanced General Physics	6
CH	531, 532	Physical Chemistry	6

In addition to these specific course areas some competence in statistics and in electronics would be required as well as familiarity with the contents of Zoology 213. These are assumed to have been gained at the M. S. level.

Major: Agricultural Engineering Minor: Soils

Thesis Title: Plant Tolerance to Excessive Soil Water.

The rational design of adequate drainage systems requires a knowledge of the probability of occurrence of any given weather conditions as well as an understanding of the effect of such weather on soil conditions and plant development. The second of these problem areas can be studied through the use of a growth chamber.

By using adequate statistical design and existing measuring techniques, a relation can be developed among the following variables: soil moisture level, soil aeration, climatic conditions, stage of crop growth and rate of crop growth. Interpretation of such a relation in terms of fundamental physiological processes and physical laws would be an important contribution.

The student will have the guidance of the following faculty members whose recognized specialties are pertinent to this research.

J. van Schilfgaarde, Agricultural Engineering
H. D. Bowen, Agricultural Engineering
C. H. M. van Bavel, Soils
R. J. Monroe, Statistics
H. T. Scofield, Plant Physiology

Courses (Beyond Conventional M. S. in Agricultural Engineering)

			Semester Credits
AGE	522	Instrumentation for Agricultural Research and Processing	1
AGE	671	Theory of Drainage, Irrigation and Erosion Control	3
AGE	652	Seminar	
SOI	511	Soil Physics	4
SOI	611	Advanced Soil Physics	4
BO	532, 533	Advanced Plant Physiology	4
UNC	Stat 134	Introduction to Statistical Theory	5
MA	611	Complex Variable Theory	3
MA	602	Partial Differential Equations	3
MA	622	Advanced Algebra	3
PY	601, 602	Advanced General Physics	6
CH	531, 532	Physical Chemistry	6

Note: The above course listing assumes that St 515 and 516 have been included in the M. S. program.

11. AGRICULTURAL ENGINEERING FACULTY

Since the success of any graduate program rests primarily with the faculty, this request for permission to grant the Doctor of Philosophy degree is predicated on the competence of the Agricultural Engineering staff to initiate and promote excellence in a program of instruction at this level. Substantial evidence of mastery of methods and materials of knowledge, appropriate to the institution of advanced graduate instruction, is found in past performances of the Departmental faculty; the soundness of individual schoolings and of background experiences indicates faculty qualifications that connote progressive development and greater productivity.

Professionally speaking, this Department has gained faculty recognition equal to that accorded Agricultural Engineering Departments of leading universities throughout the country.

While our faculty has obtained a healthy consensus on educational and research standards for the products of our recommended program, there exists a mutuality of willingness to discuss issues and policies pertaining to the means for accomplishing these ends. The absence of vigorously defended prejudices provides a favorable climate in which to challenge existing policies, to cultivate improvements and to implement desirable changes--a favorable condition for continual self-evaluation.

The important attribute of enthusiasm for graduate instruction and students, as well as interest and activity in research, is well expressed by our faculty.

The following biographies give a fair portrayal of faculty qualifications. Much information pertinent to the evaluation of present and potential competences has been omitted in deference to conciseness of presentation and in acknowledgement of the many intangibles involved.

Henry D. Bowen, B.S., M.S., Ph.D.
Research Associate Professor of
Agricultural Engineering

Educational Record

School	Dates Attended	Degree Received	Field of Specialization
Michigan State College	1946-49	B.S.	Agricultural Engineering
Michigan State College	1950-51	M.S.	Agricultural Engineering
Michigan State College	1951-53	Ph. D.	Agricultural Engineering

Henry D. Bowen (Continued)

Professional Record

1. Positions Held

Institution	Address	Dates of Employment	Title
Michigan State College	E. Lansing, Mich.	1951-52	Grad. Research Asst.
Michigan State College	E. Lansing, Mich.	1952-53	Instructor-Research
N. C. State College	Raleigh, N. C.	1953-56	Research Asst. Prof.
N. C. State College	Raleigh, N. C.	1956-	Research Assoc. Prof.

2. Publications

Year	Author	Title	Place
1951	H. D. Bowen	"Electrostatic Precipitation of Dusts for Agricultural Purposes"	M. S. Thesis, Mich. State College
1952	H. D. Bowen	"Application of Electrostatic Charging in Dusting Plant Surfaces"	Agricultural Engineering, Vol. 33, No. 6, p. 347
1953	H. D. Bowen	"Electric and Inertial Forces in Pesticide Application"	Ph. D. Thesis, Mich. State College
1956	H. D. Bowen J. C. Ferguson W. H. Pierce	"Costs of Applying Nitrogen Fertilizer"	Agricultural and Food Chemistry, Vol. 4, 316
1956	H. D. Bowen C. W. Gantt, Jr. W. C. Hulburt	"Hose Pump for Applying Nitrogen Solutions"	U. S. D. A., Farmers' Bulletin No. 2096

3. Experience in Supervision of Graduate Study

(a) Advisory Committee Assignments: Co-Chairman once, member twice.
(b) Title of Thesis: "Design and Development of a Gravity Flow Unit for Metering Liquid Nitrogen Solutions", M. S., James H. Anderson, 1954.

4. Membership in Learned and Professional Societies

American Society of Agricultural Engineers
Tau Beta Pi (Engineering Honorary)
Sigma Xi (Science Research)
Phi Kappa Phi (General Scholastic)

5. Recognized Assignments

Faculty Advisor, Student Branch A. S. A. E., 1955, 1956
Member, Department Committee on Undergraduate Curriculum and Program, 1955-
Member, Special Committee to Study Cotton Situation in North Carolina, 1955
Member, Committee on Planning Machinery Shed and Use of Grounds at New Agricultural Engineering Building.

George Wallace Giles, B.S., M.S.
Professor and Head of Department
Agricultural Engineering

Educational Record

School	Dates Attended	Degree Received	Field of Specialization
University of Nebraska	1927-33	B.S.	Agricultural Engineering
University of Missouri	1933-35	M.S.	Agricultural Engineering

Professional Record

1. Positions Held

Institution	Address	Dates of Employment	Title
University of Missouri	Columbia, Mo.	1935-36	Research Assistant
N.C. State College	Raleigh, N. C.	1936-38	Assistant Professor
N.C. State College	Raleigh, N. C.	1938-42	Associate Professor
N.C. State College	Raleigh, N. C.	1942-48	Professor
N.C. State College	Raleigh, N. C.	1948-	Professor and Head of Department

2. Publications

Year	Author	Title	Place
1935	G. W. Giles	"A Drawbar Dynamometer and Its Use in Soil Tillage"	University of Missouri Research Bulletin No. 226
1935	G. W. Giles	"A Drawbar Dynamometer Adapted to Farm Implements"	Agricultural Engineering, Vol. 16, No. 6, 215-218
1940	G. W. Giles	"The Electric Ultramometer Circuit as a Drawbar Dynamometer"	Agricultural Engineering, Vol. 21, No. 12, 469-471
1945	G. W. Giles	"A New Fertilizer Distributor & Planter for the Southern Farmer"	Agricultural Engineering, Vol. 26, No. 3, 109-110
1947	G. W. Giles	"The Vine-Row Sweet Potato Vine Harvester"	N.C. Agr. Exp. Station Bulletin No. 358
1951	G. W. Giles C. A. Routh	"Design Data on Hay Rakes"	N.C. State College, Dept. of Agricultural Engineering Mimeographed Circular (Unpublished)
1951	G. W. Giles C. A. Routh	"The Finger Wheel Rake"	Agricultural Engineering, Vol. 32, No. 10, 537-540, 544
1951	G. W. Giles	"A Progress Report on the Finger Wheel Rake"	N.C. State College, Inf. Circular No. 4, Dept. of Agricultural Engineering

3. Patents

Year	Author	Patent No.	Subject
1947	G. W. Giles	U.S. Patent Application No. 747, 895, (Reissued Nov. 6, 1950 as No. 194,222)	Vine-Row Harvester
1952	G. W. Giles R. E. Wicker	U.S. Patent No. 2,619,260	Fertilizer Distributor

George Wallace Giles (Continued)

Year	Author	Patent No.	Subject
1952	G. W. Giles C. A. Routh J. P. Dail G. C. Wood	U. S. Patent Application No. 301,512	Harvester
1952	G. W. Giles J. P. Dail, Jr. A. M. Daniel C. A. Routh G. C. Wood	U. S. Patent Application No. 294,186	Hay Rake

4. Experience in Supervision of Graduate Study

(a) Advisory Committee Assignments: Co-Chairman twice
Member twice

(b) Titles of Theses

"Leaf and Moisture Loss from Alfalfa Caused by Certain Field Handling Methods", M.S., C. A. Routh, 1952.

"A Machine for Use in Evaluating Agricultural Field Tools", M.A.E., E. J. Matthews, 1955

5. Membership in Learned and Professional Societies

American Society of Agricultural Engineers
Sigma Xi (Science Research)
Gamma Sigma Delta (Agricultural Research Honorary)
Alpha Zeta (Agricultural Honorary)
Listed in "Who's Who in South and Southwest", 1956 Edition, p. 341
Listed in "Who Knows--And What--Among Experts and the Specially Informed", 1954, p. 251.

6. Recognized Assignments

Member, A.S.A.E. Committee on Relations with Vocational Education, 1946.
Member, Committee on Patent Policy, N.C. State College, 1946-1947.
Member, A.S.A.E. Committee on Fertilizer Application, 1949-1952.
Organizational Chairman Engineering Section of Tobacco Workers' Conf., 1950
Member, State Advisory Committee for S.A.A.E. and V.A.E., 1951-1952.
Member, Advisory Committee, Div. of Farm Machinery, U.S.D.A., 1951-1952.
Vice-Chairman, S.E. Section of A.S.A.E., 1952.
Secretary, S.A.A.E. and V.A.E., 1953-1954.
Chairman, N.C. Section of A.S.A.E., 1954
Chairman, 1954 Industry-Research Conference, Sponsored by Farm Equip. Inst.
Chairman, Committee on Professional Registration, N.C. Section A.S.A.E., 1953-55.
Co-Chairman, Joint Committee (Schools of Agriculture and Engineering) on Agricultural Engineering, 1953-1955.
Member, Technical Committee, Regional Cotton Mechanization Project S-2, 1948-56.

George Wallace Giles (Continued)

Member, A. S. A. E. Committee on Research, 1955.
Chairman, Building Steering Committee for Constructing new Agricultural Engineering Building, 1954-1956.
President, S. A. A. E. and V. A. E., 1955-1956.
Member, National Joint Committee on Fertilizer Application (A. S. A, A. S. H. S., N. C. A., N. F. A., F. E. I. and A. S. A. E. cooperating), 1952-1956. Subcommittee on Machinery for Research.
Chairman, S. E. Section of A. S. A. E., 1956.
Member, Nominating Committee A. S. A. E. for 1956-1957.
General Chairman, Tobacco Workers' Conference, Canada, 1956.
Member, Committee on Sprayer Nozzle Standardization, Farm Equipment Institute, 1956.
Member, Steering Committee on Peanut Research Conference, A. S. A. E. and National Peanut Council, 1956.

F. J. Hassler, B. S., M. S., Ph. D.
Professor and In-Charge Graduate
Studies in Agricultural Engineering

Educational Record

School	Dates Attended	Degree Received	Field of Specialization
University of Missouri	1940-44 1946	B. S.	Agricultural Engineering
Michigan State College	1946-48	M. S.	Agricultural Engineering
Michigan State College	1948-50	Ph. D.	Agricultural Engineering

Professional Record

1. Positions Held

Institution	Address	Dates of Employment	Title
U. S. Army		1943-46	Personnel Officer
Michigan State College	E. Lansing, Mich.	1946-47	Graduate Assistant-Teaching and Research
Michigan State College	E. Lansing, Mich.	1947-48	Instructor-Research
Michigan State College	E. Lansing, Mich.	1948-50	Grad. Asst. -Research
N. C. State College	Raleigh, N. C.	1950-52	Research Asst. Prof,
N. C. State College	Raleigh, N. C.	1952-53	Research Assoc. Prof.
N. C. State College	Raleigh, N. C.	1953-54	Research Assoc. Prof. & In-charge Grad. Studies
N. C. State College	Raleigh, N. C.	1954-	Professor and In-charge Graduate Studies

F. J. Hassler (Continued)

2. Publications

Year	Author	Title	Place
1947	F. J. Hassler C. M. Hanson A. W. Farrall	"Protection of Crops from Frost Damage by Use of Radiant Energy - Part II"	Michigan Agr. Exp. Sta. Qtly. Bul. 30: 21-28.
1948	F. J. Hassler C. M. Hanson A. W. Farrall	"Protection of Vegetation from Frost Damage by Use of Radiant Energy - Part III"	Michigan Agr. Exp. Sta. Qtly. Bul. 30: 339-360
1946	F. J. Hassler	"Utilization of Radiant Energy for the Protection of Vegetation from Frost Damage"	M. S. Thesis, Michigan State College
1950	F. J. Hassler	"Petroleum Fuel Burners for the Generation of Radiant Energy for Frost Control"	University Microfilm Inc., Ann Arbor, Michigan, Vol. #X, No. 4, 1950
1953	F. J. Hassler J. A. Waybrew N. W. Weldon H. B. Pucket	"Curing Tobacco with Anthracite"	Technical Bul. No. 102, N. C. Agr. Exp. Sta., 16 pgs.
1953	F. J. Hassler H. B. Puckett	"Supersensitive Thermostat"	Agricultural Engineering, Vol. 34, No. 12, 841-842.
1957	F. J. Hassler	"Leaf Temperature Measurement in Tobacco Curing Research"	Submitted to Tobacco Science, Paper No. 784 of Journal Series.

3. Experience in Supervision of Graduate Study

(a) Advisory Committee Assignments: Chairman 18 times
Member twice

(Representative for Graduate School on two final examinations for the degree of Doctor of Philosophy.)

(b) Titles of Theses Completed and in Preparation (not listed under co-chairman)

"Time and Effort Analysis of Seating Conditions for Tobacco Primers", M. S., Charles W. Suggs, 1955.

"Sampling Techniques for Evaluating the Picking Efficiency and Peanut Damage for the Carding and the Cylinder Type of Peanut Pickers", M. S., William T. Mills, 1955.

"Deuterium Oxide Equilibration with Tobaccos", M. S., Antony Markantonatos, 1956.

"Effect of Air Velocity on the Rate of Drying and Temperature of Yellowed Tobacco Leaves", M. S., William Dickens, 1956.

"Some Determinations Pertinent to the Removal of Midrib from Tobacco Leaf During Curing Operations", M. S., William Hugh Johnson, 1956.

F. J. Hassler (Continued)

"Yellowing Flue-Cured Tobacco in the Bulk", M. S., Wiley H. Henson, 1956.

"Determinations in the Design of Picking Cylinders for a Peanut Harvester", M. S., Thomas H. Garner, 1956.

"Relationship Between Quality of Tobacco Leaf and its Fluorescence under Ultra-Violet Radiation", M. S., Ora B. Morgan

"Dielectric Properties of Mature Tobacco Leaf as Criteria of Quality", M. S., William S. Thompson.

4. Membership in Learned and Professional Societies

American Society of Agricultural Engineers
American Association for the Advancement of Science
Sigma Xi (Science Research)
Tau Beta Pi (Engineering Honorary)
Sigma Pi Sigma (Physics Honorary)
Pi Mu Epsilon (Mathematics Honorary)

5. Recognized Assignments

Chairman, Interdepartmental Cooperation in Tobacco Curing Research, 1952
Member, All College Committee on Programs for Master of Science Degree, Oct. 1953 - April, 1954.
Member, Departmental Building Plan Sub-Committee, Nov. 1953.
Member, Arrangements Committee for Tobacco Chemists' Conference, Jan. 1955 - Oct. 1955.
Participant, 1955 University Conference, Oct. 1954 - March, 1955.
Secretary, N. C. Section of American Society of Agricultural Engineers, Jan. 1953 - Jan. 1954.
Member, Committee on Graduate Instruction, American Society of Agricultural Engineers.
Member, Committee on Student Branches, American Society of Agricultural Engineers.
Member, Departmental Committee on Undergraduate Curriculum and Program.

Blaine Frank Parker, B.S., M.S., Ph.D.
Assistant Professor in
Agricultural Engineering

Educational Record

School	Dates Attended	Degree Received	Field of Specialization
Brevard Jr. College	1942-43		
Virginia Polytechnic Inst.	1946-50	B.S.	Agricultural Engineering
George Peabody College	1950		
Virginia Polytechnic Inst.	1950-52	M.S.	Agricultural Engineering
Michigan State College	1952-54	Ph.D.	Agricultural Engineering

Professional Record

1. Positions Held

Institution	Address	Dates of Employment	Title
U.S. Air Force		1943-46	Aerial Gunnery Instructor
U.S.D.A., B.P.I.S.A.E.	Beltsville, Md.	1947-48	Agricultural Engineering Aide on Research Project at Blacksburg, Virginia.
T.V.A., Elec. Dev. Branch	Chattanooga, Tenn.	1948-49	Agricultural Engineering Aide on extension type work.
V.P.I.	Blacksburg, Va.	1950-52	Instructor
Michigan State	E. Lansing, Mich.	1952-54	Grad. Research Asst.
N.C. State College	Raleigh, N. C.	1954-	Assistant Professor

2. Publications

Year	Author	Title	Place
1952	B.F. Parker	"An Analysis of Winter Ventilation for Poultry Laying Houses"	M.S. Thesis, Virginia Polytechnic Institute, Blacksburg.
1953	B.F. Parker	"Nomographs and Date for Determining Winter Ventilating Rates for Poultry Laying Houses"	Agricultural Engineering, Vol. 34, No. 10, 689-692, 708.
1954	B.F. Parker	"Some Effects of Chromatic Illumination, Reflectance, and Product Rotation on Sorting Efficiency of Cherries and Tomatoes"	Ph.D. Thesis, Michigan State College
1954	B.F. Parker D.F. Wiant	"Use of Chromatic Illumination and Methods of Product Rotation for Sorting Red Tart Cherries"	Mich. Agr. Exp. Station Quarterly Bulletin, Vol. 36, No. 4, 435-447.

Blaine F. Parker (Continued)

1955	B. F. Parker	"Efficiency of Visual-Manual Sorting--The Use Made of Spectral Distribution of Illumination for the Visual Detection of Defective Red Cherries"	Agricultural Engineering, Vol. 36, No. 2, 100-105.

3. Experience in Supervision of Graduate Study

(a) Advisory Committee Assignments: Co-Chairman twice

(b) Title of Thesis Completed:

"A Manual for Vocational Instruction in Farm Structures Design", M.A.E., George M. Blum, Jr., 1955

4. Membership in Learned and Professional Societies

American Society of Agricultural Engineers
Registered Professional Engineer, Commonwealth of Virginia
Alpha Zeta (Agricultural Honorary - President 4th year)
Phi Kappa Phi (General Scholastic)
Omicron Delta Kappa (National Leadership)
Sigma Pi Sigma (Physics Honorary)
Sigma Xi (Science Research)

5. Recognized Assignments

Member, Committee on Farm Structures Research, A.S.A.E., 1954-55.
Faculty Advisor, Student Branch A.S.A.E., 1954-55.
Chairman, Special Committee for Studying the Status of Farm Structures in the Southeast, S. E. Section A.S.A.E., 1955-56.
Member, Farm Structures Program Committee, S.E. Section A.S.A.E., 1956.
Secretary-Treasurer, N. C. Section A.S.A.E., 1956.
Member, School of Agriculture Curriculum Committee, 1956.
Chairman, Departmental Committee on Undergraduate Curriculum and Program.
Charman, Committee on Planning Machinery Shed and Use of Grounds at New Agricultural Engineering Building.

William E. Splinter, B.S., M.S., Ph.D.
Research Associate Professor of
Agricultural Engineering

Educational Record

School	Dates Attended	Degree Received	Field of Specialization
University of Nebraska	1945-50	B.S.	Agricultural Engineering
Michigan State College	1950-51	M.S.	Agricultural Engineering
Michigan State College	1951-54		Agricultural Engineering
Michigan State University	1954-55	Ph.D.	Agricultural Engineering

Professional Record

1. Positions Held

Institution	Address	Dates of Employment	Title
U. S. Navy		1946	S-1/c Clerical
Michigan State College	E. Lansing, Mich.	1950	Graduate fellow
U. S. Navy	E. Lansing, Mich.	1951	RDSN Radar Operator
Michigan State College	E. Lansing, Mich.	1951-52	Grad. Research Assistant
Michigan State College	E. Lansing, Mich.	1952-53	Instructor, Research
Michigan State College	E. Lansing, Mich.	1953	Grad. Research Assistant
Michigan State College	E. Lansing, Mich.	1953-54	Instructor
N.C. State College	Raleigh, N.C.	1954-	Research Assoc. Prof.

2. Publications

Year	Author	Title	Place
1951	W.E. Splinter	"A Consideration of Weed Control Through Physical Properties of Seeds"	M.S. Thesis, Michigan State College
1953	W.E. Splinter G.W. French	"Dirt Removal Devices on Sugar Beet Harvesters"	Proceedings of the American Society of Sugar Beet Technologists, 7th Regional Meeting, p. 63-71.
1953	W.E. Splinter J.F. Davis D.B. Eldridge L.G. Merrill	"A Fertilizer Placement Drill with Attachment for Placement of Insecticides and Fungicides for Organic Soils"	Michigan Agr. Exp. Station Quarterly Bulletin, Vol. 36, No. 2, 219-225.
1955	W.E. Splinter	"Deposition of Aerial Suspensions of Pesticides"	University Microfilm Inc., Ann Arbor, Mich., No. 12957.
1956	W.E. Splinter R.L. Rabb F.E. Guthrie C.W. Suggs	"The Effect of Placement of Insecticidally Treated Transplanting Water on the Control of Wireworms in Tobacco"	Journal of Economic Entomology, Vol. 49, No. 2, 256-259.

William E. Splinter (Continued)

1956	W. E. Splinter C. W. Suggs	"Instrument for Recording Heart Rate for Energy Studies"	Agricultural Engineering Vol. 37, No. 9, 618-619.
1956	W. E. Splinter C. W. Suggs	"Time and Energy Analysis of Agricultural Tasks"	Agricultural Engineering, In Press

3. Experience in Supervision of Graduate Study

(a) Advisory Committee Assignments: Co-chairman once
Member twice

(b) Title of Thesis in Preparation:
"Some Environmental Factors Affecting Tobacco Seed Germination", M.S., Joe M. Bunn.

4. Membership in Learned and Professional Societies

American Society of Agricultural Engineers
Society of Automotive Engineers
Sigma Tau (Engineering Honorary)
Pi Mu Epsilon (Mathematics Honorary)
Sigma Pi Sigma (Physics Honorary)
Sigma Xi (Science Research)

5. Recognized Assignments

Editor, "Nebraska Blueprint", 1949-50 (Student Engineering Magazine, University of Nebraska.)
Member, A. S. A. E. Committee on Fertilizer Application, 1952.

Jan van Schilfgaarde, B.S., M.S., Ph.D.
Research Assistant Professor of
Agricultural Engineering

Educational Record

School	Dates Attended	Degree Received	Field of Specialization
Hope College	1946-47		
Iowa State College	1947-49	B.S.	Agricultural Engineering
Iowa State College	1949-50	M.S.	Agricultural Engineering
Iowa State College	1950-54	Ph.D.	Agricultural Engineering and Soil Physics

Jan van Schilfgaarde (Continued)

Professional Record

1. Positions Held

Institution	Address	Dates of Employment	Title
Iowa State College	Ames, Iowa	1949-50	Research Fellow
Iowa State College	Ames, Iowa	1950-51	Instructor
Hansen Brothers Construction	Sumner, Iowa	1951-summer	Drainage Engineer
Iowa State College	Ames, Iowa	1951-54	Instructor and Associate, part-time.
N. C. State College	Raleigh, N.C.	1954	Research Asst. Professor

2. Publications

Year	Author	Title	Place
1950	J. van Schilfgaarde	"Effect of Present Installation Practices on Drain Tile Loading"	M.S. Thesis, Iowa State College
1951	J. van Schilfgaarde R. K. Frevert W. J. Schlick	"Effect of Present Installation Practices on Drain-tile Loading"	Agricultural Engineering Vol. 32, 371-378.
1954	J. van Schilfgaarde R. K. Frevert Don Kirkham	"A Tile Drainage Field Laboratory"	Agricultural Engineering Vol. 35, 474-478.
1954	J. van Schilfgaarde	"Analytical and Empirical Evaluation of Water Table Behavior as Affected by Drainage Systems"	Ph.D. Thesis, Iowa State College
1956	J. van Schilfgaarde Don Kirkham R. K. Frevert	"Physical and Mathematical Theories of Tile and Ditch Drainage and Their Usefulness in Design"	Iowa Agr. Exp. Sta., Research Bul. No. 436.
1956	J. van Schilfgaarde	"Approximate Solutions to Drainage Flow Problems"	Section in "Drainage of Agricultural Lands", J. N. Luthin, Editor Agronomy Monograph, Vol. 7 (In press).

3. Experience in Supervision of Graduate Study

(a) Advisory Committee Assignments: Co-chairman twice
Member twice

(b) Titles of Theses:

Titles to the two co-chairman assignments referred to above have not been selected.

Jan van Schilfgaarde (Continued)

4. Membership in Learned and Professional Societies

American Geophysical Union
American Society of Agricultural Engineers
Soil Science Society of America
Gamma Sigma Delta (Agricultural Research Honorary)
Sigma Xi (Science Honorary)
Phi Kappa Phi (General Scholastic)
Listed in American Men of Science, Vol 1, 9th Edition, 1955.
Pi Mu Epsilon (Mathematics Honorary)
Registered Professional Engineer, State of Iowa

5. Recognized Assignments

Secretary, Drainage Research Committee, A.S.A.E., 1954-55
Chairman, Departmental Library Committee, 1954-
Vice Chairman, Drainage Research Committee, A.S.A.E., 1955-
Member, Water Resources Committee, N.C. Section A.S.A.E., 1955
Member, Soil and Water Program Committee, S.E. Section A.S.A.E., 1956

David S. Weaver, B.S., M.S.
Director, North Carolina Agricultural
Extension Service

Educational Record

School	Dates Attended	Degree Received	Field of Specialization
Ohio State University	1915-20	B.S.	Agriculture
N. C. State College	1923-25	M.S.	Agricultural Engineering

Professional Record

1. Positions Held

Institution	Address	Dates of Employment	Title
U. S. Army		1918-19	Sgt. in Infantry
Ohio State University	Columbia, Ohio	1919-20	Instructor
Miss. A & M College	State College, Miss.	1920-23	Instructor
N.C. State College	Raleigh, N.C.	1923-26	Asst. Professor
N.C. State College	Raleigh, N.C.	1927-32	Assoc. Professor
N.C. State College	Raleigh, N.C.	1932-36	Professor
Federal Rural Ecectrification Administration	Washington, D.C.	1936-37	Principal Engineer

David S. Weaver (Continued)

N. C. State College	Raleigh, N.C.	1937-40	Ext. Agri. Engineer
N. C. State College	Raleigh, N.C.	1940-48	Head of Department of Agricultural Engineering
N. C. State College	Raleigh, N.C.	1948-50	Asst. Director, Agri. Ext. Service
N. C. State College	Raleigh, N.C.	1950	Director, Agricultural Extension Service

2. Publications

Year	Author	Title	Place
1925	D. S. Weaver	"Methods of Obtaining Maximum Sunlight in Farrowing Houses"	M.S. Thesis, N.C. State College

3. Membership in Learned and Professional Societies

American Society of Agricultural Engineers
Phi Kappa Phi (General Scholastic)
Alpha Zeta (Agricultural Honorary) - served four years as National President and twelve years on National Council.
Delta Theta Sigma (Agricultural Honorary)
Secretary of Southern Section A.S.A.E., 1928
Member, National Advisory Commission of Better Homes, 1928
Vice Chairman, Southern Section A.S.A.E., 1935-36
Secretary, N. C. Rural Electrification Authority, since 1936
Chairman, Southern Section A.S.A.E., 1937-38
Chairman, College Division A.S.A.E., 1938-39
Member, N. C. Advisory Commission on Public Works Planning, 1944
Member, N. C. Advisory Commission on Rural Industries, 1949
Chairman, Governor's Committee on Water Legislation, 1953
Member, Executive Board, N. C. Resource-Use Commission, 1948 to date
Member, National Food Conservation Board, 1951 to date
Chairman, State Soil Conservation Commission, 1951 to date
Member, Soil Conservation Committee, Chairman since 1952
Member, State Cotton Promotion Committee, Chairman since 1953
Member, N. C. Board Farm Organizations and Agencies, Vice Chairman since '55
Vice Chairman, N. C. Board of Farm Organization and Agricultural Agencies, '56
Member, State Rural Development Committee, Chairman 1956
Member, N. C. Water Board Advisory Commission
Member, N. C. State Agricultural Stabilization Commission
Member, National Garden & Home Food Preservation Advisory Commission
Member, State A.S.C. Committee
Member, N.C. Rural Rehabilitation Committee
Member, American Society of Agricultural Engineers, Past Chairman of Southern Section and of several national committees.

111. FINANCIAL SUPPORT AND PHYSICAL FACILITIES

A. Financial Support

Out of a present budget of over $233,000 in Agricultural Engineering, over 75% is directed to research. This includes, in addition to monies appropriated from public funds, commercial and foundation grants. That the administration is responsive to the needs of financial support for graduate instruction, even at the Master's level, is readily ascertainable from the amount of money presently allocated to graduate student stipends listed in Table 1.

Table 1. Funds for Graduate Assistantships in Agricultural Engineering (1956-57)

Project Name	Grants-in-Aid	Appropriated Funds	Total
Irrigation		1800	1800
Tobacco Curing	1800	3600	5400
Tobacco Mechanization	1800	1800	3600
Peanut Harvesting	1800		1800
Farm Structures	1800		1800
Total	7200	7200	14400

Instead of offering budgets as introductory justifications only, it is the more important to consider them in the prospectus of continuing and increased financial support. Since graduate instruction compliments academic research, and both are mutually supplementary, it is very appropriate to relate future resources for graduate programs to expectations in the total research program.

Current thinking about agricultural problems manifests the needs for new or expanded programs of engineering research in the following major areas: cotton mechanization; hay and silage mechanization; pesticide control; structures for livestock and poultry production; poultry equipment and facilities; operations in fruit, nut and vegetable production; small grain and corn harvesting, drying and handling; fertilizer application; seedbed and tillage; and soil and water engineering. Administrative recognition of these needs is reflected in the Department's research budgets for the past five years. Figure 2 gives the amounts and regular increases in annual allocations since 1952.

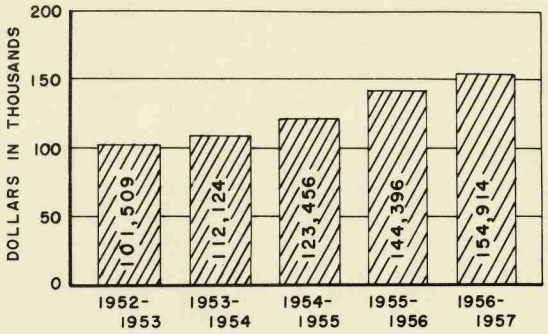

Figure 2. Total Funds (Experiment Station Budget) For Agricultural Engineering for 1952-57

The obvious indications are that, in the face of increasing appropriations for research and teaching, an advanced graduate program will serve to nurture self-support through the development of ideas and effective engineering scientists with which to confront engineering problems in agriculture.

B. Physical Facilities

Office space and facilities are adequate to the institution of the doctoral program. General laboratory space and equipment are likewise available in the following subject areas: farm power units and machines, crop processing, rural electrification, farm conveniences, structures and soil and water conservation.

A research shop (5862 square feet area) well equipped to perform essential research tasks of construction, fabrication, and maintenance is established in this Department. The shop features metal forming equipment: welders, metal cutting and forging equipment; special equipment for machining, drilling, and surfacing metals; woodwork machinery; and a complete stock and tool room for supplying research needs.

Exceptional laboratory space (over 3000 square feet) is available for special experimentation. One laboratory of 1590 square feet provides environmental control throughout a limited range of air conditions in which to conduct fundamental studies on the response of crops to processing treatments. Four separate test rooms, each having approximately 300 square feet, are designed to accommodate particular research projects that require regimented environments. These rooms provide a wide range of air conditions throughout 45°F to 150°F. Of further interest is the development of a laboratory (600 square feet) in which to perform tests for correlating fatigue with mental and

physical effort in the performance of operations peculiar to the agricultural industry. This space includes an instrumentation room in conjunction with a controlled temperature and humidity chamber for providing arbitrary working environments.

C. Equipment and Instruments

The departmental laboratories are well supplied with both general and specialized equipment. Since Agricultural Engineering research is concerned with measurement and control of numerous variables (force, acceleration, energy, temperature pressure, moisture, air and water flow, etc.), a wide variety of instruments find application in practically all phases of the Department's instructional and research programs. To afford graduate instruction in instrumentation principles, techniques and methods, the Department has an increasing inventory of quality instruments, which include recent developments in electronic apparatus. Many of the more prominent types are included in the following list:

Electronic Instruments for Indication, Recording and/or Controlling in Millivolt Ranges:

Single point adjustable span recorder for force transducer or temperature (thermocouple) sensing.
16-point adjustable span recorder for millivolt or temperature sensing.
Three 16-point standard recorders for temperature sensing.
20-point bridge-type recorder for pressure transducer sensing.
Recording-controller by temperature sensing.
Single point standard recorder for multiple sensings.
Narrow-span recording for millivolt sensing.
Two 48-point indicators for temperature sensing.
144-point temperature or millivolt transducer sensing.

Oscilloscopes:

Tektronix high-gain oscilloscope for characterizing small D-C and transient potentials.
Three regular laboratory oscilloscopes.

Several Sensitive Potentiometers and Wheatstone Bridges (Manual)

Boonton Q-meter

Meters for Evaluating Circuits and Components

Electronic null indicator
Audio analyzer
Impedance bridge
Five volt-ohm-ampere meters
Recording microammeter
Capacitance meter

Two inductance meters
Two variable frequency signal generators
Two regulated D.C. power supplies

Stress Analysis Equipment

"Brush" twin-channel recording oscillograph
Two "Brush" strain gage amplifiers

Telemetering Equipment

Four miniature transmitters
Hallicrafter receiver
Standard receiver

General

Scaler Radiation Counter and Sample Holder
"Photovolt" Microlumen Light Meter
High-Speed Motion Picture Camera Plus Accessories for Studying Dynamics of Machine Components available from the Mechanical Engineering Department
Pneumotachograph to Measure Oxygen Consumption
Cardiotachometer
Nine Air Conditioned Growth and Processing Chambers
Three analytical balances, vacuum dryer and other ovens, force and pressure transducers
Cathetometer
Bicycle-ergometer

IV. ADDITIONAL INSTITUTIONAL AND INDUSTRIAL SUPPORT

The research and teaching activities of the Department of Agricultural Engineering receive considerable assistance through cooperative use of physical equipment and consulting services of other disciplines on the North Carolina State College campus, as well as on the University of North Carolina campus at Chapel Hill, and the Duke University campus at Durham. Additional support to research efforts on engineering problems in the field of agriculture is received through cooperative arrangements with various industries and the U.S.D.A.

Probably the most utilized source of support comes from the Department of Experimental Statistics, for Agricultural Engineering relies on statistics as a tool perhaps more than any other branch of engineering in order to interpret and evaluate the reliability of data obtained from biological systems. The research programs of all graduate students and staff members are set up in conference with members of the Statistics staff and the experimental results are analyzed with the aid of the Statistics laboratory and the IBM Digital Computer Laboratory.

A second source of considerable support comes from the Chemistry laboratories. Here, for example, analyses for sugar, calcium, proteins, nicotine, etc., are run to determine the effects of physical treatments on tobacco leaves. Analyses are also run regularly on peanuts, hay, and other field crops to evaluate their responses to cultural processing operations.

A third important facility available to the Department of Agricultural Engineering is the 16 North Carolina Department of Agriculture and North Carolina State College Research Stations located throughout the State. Of these, 10 stations have been or are being used in researches currently under way. Their favorable distribution throughout the State's climatic conditions and crop types afford excellent opportunities for studying experimental systems and operations of concern to North Carolina agriculture.

The Agricultural Engineering Division of the U.S.D.A. cooperates not only in physical facilities, but also stations several of its personnel in the Agricultural Engineering Department.

That mathematicians and physicists are consulted is immediately evident if one considers the number of departmental graduate committees on which they serve. In addition to these, staff members in plant physiology, botany, entomology, soils, field crops, animal industries, and agricultural economics from North Carolina State College as well as physiologists from the University of North Carolina and plant physiologists from Duke University give valuable aid in the various research programs.

Industry too has given considerable assistance to the research activities of the Department. A representative listing of industries loaning or contributing equipment - ranging from "Q" meters to tractors - includes:

American Machine and Foundry
Bolens and John Bean Divisions of Food Machinery and Chemical Corporation
Ford Tractor and Implement Division of Ford Motor Co.
Powell Manufacturing Company
Holland Transplanter Company
R. H. Bouligny Manufacturing Company
Scott Viner Company
Lilliston Equipment Company
Various manufactures of tobacco curing equipment

Industries which are making available graduate assistantships and operating funds for research include:

Portland Cement Association
New Holland Machine Company
Scott Viner Company
Lilliston Equipment Company
Several tobacco manufacturing companies

Through the Research Triangle arrangements, a wealth of expensive technical and precision equipment will become available for application to engineering phases of agriculture. Since this is still in the embryonic stage, full advantage of this opportunity has not yet been realized. The past cooperative efforts with other individuals and the increasing trend toward the application of engineering principles to biological systems indicates that utilization of these facilities toward a more competent solution of operational problems in agriculture is an opportunity of moment.

V. LIBRARY FACILITIES FOR GRADUATE STUDENTS

Available to graduate students in Agricultural Engineering, as well as to undergraduates, are the majority of recent texts and reference works in the field of Agricultural Engineering. The D. H. Hill Library has most of these works, and the Departmental Library, while quite small and incomplete, also contains copies of the more important texts.

The nature of Agricultural Engineering - the application of engineering principles to agricultural problems - implies the importance of reference material in allied fields such as civil, mechanical and electrical engineering, engineering physics, agronomy, plant physiology and animal industry, as well as in the fundamental sciences of mathematics, physics and chemistry. In all of these fields, considerable numbers of references are available through the services of the D. H. Hill Library and/or the departmental libraries.

The books and journals in Agricultural Engineering and related fields mentioned above are supplemented by a nearly complete file of publications of Federal and State agencies. This source of information on the activities of research workers at other locations is of utmost value to the agricultural engineering student.

The proper use of the above sources of information should provide the graduate student in Agricultural Engineering with a sufficiently complete body of reference material for him to survey the problem at hand adequately to initiate his studies.

For more thorough library investigations, the Agricultural Engineering student, as does any researcher on this campus, has at his disposal the full range of indexing journals and lists of publications available in the D. H. Hill Library. Having located the desired material through the use of these reference works, inter-library loan service enables him to inspect almost any reference imaginable whether or not it is available on this campus.

To claim that the library facilities at North Carolina State College are exceptionally good would not be justified. That they furnish an adequate

source of material for the study of most problems in Agricultural Engineering is, however, our considered opinion. Furthermore, the libraries of Duke University and the University of North Carolina provide valuable supplementary facilities.

The Department maintains a Library Committee which, among other things, takes an active interest in having the D. H. Hill Library secure such new publications as are pertinent in the study of Agricultural Engineering problems.

In order to illustrate the scope of the reference material pertinent to Agricultural Engineering research, and to indicate the type of subject matter considered to make up Agricultural Engineering, there are appended hereto two lists of publications. The first lists the recently published textbooks in Agricultural Engineering written with the aid of grants from the Ferguson Foundation. The second is a selected list of those periodicals considered of great importance in relation to research projects presently active in this Department.

Ferguson Foundation texts in Agricultural Engineering:

Barre, H. J. and L. L. Sammet
FARM STRUCTURES
John Wiley and Sons, Inc., New York, 1950

Barger, E. L., W. M. Carleton, E. G. McKibben, and Roy Bainer
TRACTORS AND THEIR POWER UNITS
John Wiley and Sons, Inc., New York, 1952

Henderson, S. M. and R. L. Perry
AGRICULTURAL PROCESS ENGINEERING
John Wiley and Sons, Inc., New York, 1955

Frevert, Richard K., Glenn O. Schwab, Talcott W. Edminster, and Kenneth K. Barnes
SOIL AND WATER CONSERVATION ENGINEERING
John Wiley and Sons, Inc., New York, 1955

The most important journals pertinent to research work presently being conducted in Agricultural Engineering at North Carolina State College:

Agricultural Engineering
American Geophysical Union Transactions
Society of Automotive Engineers Journal
Plant Physiology
American Journal of Physiology
Journal of Economic Entomology
Machine Design
Soil Science
Soil Science Society of America Proceedings
Industrial and Engineering Chemistry
Chemical Abstracts
American Society for Testing Materials Proceedings
American Concrete Institute Journal
Food Technology