AGRICULTURAL ENGINEERING RESEARCH

VIRGINIA

1933

AGRICULTURAL ENGINEERING RESEARCH IN VIRGINIA

(With Special Reference to the Tennessee Valley and Adjacent Territory)

VIRGINIA POLYTECHNIC INSTITUTE

DEPARTMENT OF AGRICULTURAL ENGINEERING

Blacksburg, Virginia

November 1933

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VIRGINIA POLYTECHNIC INSTITUTE
DEPARTMENT OF AGRICULTURAL ENGINEERING

Department Organization:

The Virginia Polytechnic Institute was one of the first state institutions in the East to recognize the field of agricultural engineering. It was the first Institution in the East to offer professional college training leading to a B. S. degree in agricultural engineering.

A separate department of agricultural engineering was established in 1920 and this department now has a staff of seven. The work of the department is organized under the three divisions of resident instruction, extension and research. The staff consists of six agricultural engineers and a secretary.

Resident Instruction Division:

Under this division of the department is conducted all agricultural engineering teaching activities at the College. These activities are divided into service courses and professional courses. Service courses in farm power and machinery, farm buildings, agricultural drawing, farm drainage and surveying are taught all agricultural students.

Professional courses in agricultural engineering are taught the students electing the four year course in agricultural engineering leading to the B. S. degree. In addition to the training in fundamental engineering, these students get specialized training in agricultural engineering in the fields of land reclamation, structures, rural electrification and farm power and machinery. They also secure training in the more fundamental agricultural subjects. Some eighty men have been graduated to date in agricultural engineering. Quite a large percentage of these men are in rural electrification work with electric utilities.

Extension Division:

Under the extension division of the department, three agricultural engineers are working directly in the field, carrying practical information right to the farmer on his farm. This extension work is carried on by means of correspondence, bulletins, blue prints, radio and articles for the press, short courses and meetings, and actual field demonstrations and consulting assistance. The principal extension projects in agricultural engineering are: farm structures, rural electrification, terracing (soil erosion control), drainage, irrigation, farm water supply, farm water power and farm operating equipment.

Research Division:

Under the research division is handled all investigations. These are organized into department research projects and Experiment Station research projects. All members of the staff are carrying on some line of investigation directly related to their specialty. For example, one man who is employed on full time resident instruction is carrying on several investigations and the three extension engineers are carrying on studies in connection with their extension projects. Experiment station projects are being handled by two men who devote half time to resident instruction and half time to research for the Experiment Station.

The departmental research projects are of the more practical kind in which the studies are made in cooperation with the farmer on his farm. The results of such studies are immediately applicable to other farms. Such studies have proven of immense value in conducting our extension activities in agricultural engineering.

The Experiment Station research studies are primarily of the type that require considerable equipment and laboratory study and a longer period of time to complete before results can be secured and made applicable to the farm.

Opposite the title of the research projects listed on the following pages is indicated whether the project is Departmental or Experiment Station.

RURAL ELECTRIFICATION

Rural Electrification has been actively studied and promoted in Virginia by the Agricultural Engineering Department for the past nine years. In 1924 a State committee on the Relation of Electricity to Agriculture was organized which was composed of representatives from interested organizations. A two-year study was made on a rural line constructed for the purpose in the Richmond territory. Policies and practices determined in this study were used in formulating a plan for the extension of rural service in all sections of the state. A plan which has the endorsement of power companies and farm interests has been in practical operation for the past four years and as a direct result of this plan electric service has been made available to many farms and rural towns. In 1924 about 500 farms were connected to high line electric service while by 1932 there were 12,280 farms served. Much of the information and experience gained during this period has direct and practical application to the Southwest Virginia territory and to the Tennessee Valley area in general.

In the seven counties of Southwest Virginia which lie in the Tennessee Valley area there are (1930 census) 18,242 farms of which 682 have central station electric service. Most of the other 96% of these farms are widely scattered, making distribution costs high due to the few users per mile of distribution line. Some of these farms are in marginal territory and may be excluded from consideration in formulating any plan for extending distribution lines. Definite study and investigation of the territory should be made, however, before such plans are formulated.

Many of the problems of rural use of electricity take on a very different aspect when cheaper electric power is in prospect, but there are two major handicaps to the more rapid extension of electric power into rural territory, even with the prospect of cheaper power.

I. The first (and probably largest) problem involved is that of distribution. Distribution costs to serve widely separated, low consuming users, constitute the largest part of the total cost of serving such customers.

II. The high prices asked for electrical devices and equipment is a second and large handicap. This is particularly true among users where existing funds and prospective incomes are low, and is a serious difficulty to the more rapid introduction of uses and building of larger electrical loads on the lines.

There are two definite points of attack in the solution of the first problem, namely (a) less costly distribution systems, and (b) increased use of energy (so that distribution costs may be distributed over more units of energy delivered.)

The use of longer spans, higher distribution voltages and cheaper line construction materials should be thoroughly investigated. Also underground distribution systems which at once eliminate poles, pole hardware, tree and traffic hazards, and sleet and wind damage may well bear further study and trial. More attention should be directed to the complete development of each territory and the intelligent use of loop distribution. This will more effectually cover the territory and insure better voltage regulation, even with lighter built lines.

Increased use will be encouraged by (a) cheaper power, (b) load building campaigns, (c) studies to determine new, larger and profitable uses, and the introduction of home and local industrial enterprises.

At least two methods suggest themselves as partly meeting the high priced equipment problem. Some private companies may be induced to place on the market certain pieces of equipment designed exclusively from the standpoint of Farm Home Utility. High finishes, eye appeal, and automatic and control devices that are of doubtful value in the farm home will be eliminated. These utility pieces to be marketed at 50 to 75% under the present quoted list prices applying to the highly finished and beautifully appointed apparatus desired for city homes. A second partial solution lies in the plan service of the college. This service may well include plans for home or local shop assembled equipment. Such plans are not now available and any such equipment should be designed, built and thoroughly tested before plans are distributed.

It has been clearly demonstrated by the two Virginia companies cooperating with us in our study of rural electrification that the best progress in line extensions and load building can only be made by a sound program of education. These companies have organized rural service departments and employed trained agricultural engineers to handle the rural service educational work. These men are all graduates in agricultural engineering at V. P. I. They are farm reared and understand the farmer and his problems as well as the technical phases of rural electrification. They work directly with the farmer in a consulting capacity. The remarkable progress these companies have made in rural electrification they attribute largely to the splendid work of these agricultural engineers who are especially trained for their work.

If the Tennessee Valley Authority is to make sound progress in rural electrification experienced agricultural engineers should be employed to carry out sound educational and load building programs in the various counties. It is

believed that this procedure is fundamental to success of rural electrification in the Tennessee Valley area as elsewhere.

A "Prospectus on Rural Electrification in the Tennessee River Basin" prepared by George W. Kable, Rural Electrification Specialist of the Bureau of Agricultural Engineering of the U. S. D. A., is a splendid presentation of this entire problem and the suggestions in this prospectus should be given careful consideration.

RURAL ELECTRIFICATION PROJECTS

Project: Rural Electrification Development (Dept.)

Leaders: Chas. E. Seitz and V. R. Hillman

Object: A broad study to determine the best methods of promoting rural electrification in the state by means of existing agencies for supplying electric power.

Methods and Procedure: Rural service departments have been organized by the two leading power companies of the state. These two companies have employed eight agricultural engineers who are graduates of V. P. I. These men are in charge of the rural service work in the various divisions. They are following recommendations made by the agricultural engineering department of V. P. I. in conducting their work which is entirely educational and consulting advice. These men do no selling whatever.

Demonstration farms have been selected representing all types of farming. On these farms special uses of electricity are being investigated and complete figures kept of K. W. hr. consumption, costs, savings, etc.

Importance & Practical Application: As long as the private utility is the main source of securing electricity for rural use in this state, it was necessary to work out with these companies to determine the best methods of supplying electric service to the farmer. This cooperative arrangement to date has made possible the securing of a mass of information on farms, application of electricity, policies, etc. The work has been conducted under practical conditions right in the field and the individual farms. By demonstrating to the utility that a profitable load can be built up on the farm the officials have become more interested in rural service. At the same time it has been demonstrated that by the efficient and proper use of electricity the farmer can increase his income sufficiently to justify electric service.

Life & Cost of Project: This study has been under way for several years and will be continued indefinitely. The information is being collected through the extension division mainly as rural electrification is a recognized extension project.

When the Tennessee Valley Authority is ready to extend rural lines it would be advisable to devote additional funds to this project in the way of at least one additional agricultural engineer who could devote his entire time to such a study in cooperation with the Authority. About $4000 per year for salary and expenses should be sufficient.

RURAL ELECTRIFICATION PROJECTS

Project: Electric Domestic Water Heating (Exp. Sta.)

Leaders: P. B. Potter, V. R. Hillman

Objects: To test water heating equipment and installations to determine the best type of equipment and arrangement of units for the farm home.

To design, build, test and prepare plans for a home assembled water heater.

Methods and Procedure: This project is already under way and some definite recommendations may be made. A heater will be built using the ordinary range boiler, common insulation materials, and commercially obtainable heating elements and controls. Plans will be prepared whereby this unit can be assembled locally.

Importance and Practical Application: Commercial electric water heaters are high in price, while many homes already have a range boiler that could be readily equipped for service at a moderate cost.

Life and Cost: Two years to complete, but usuable information can be available within nine months.

Cost - $150.00 per year plus such commercial equipment as might be secured on loan.

RURAL ELECTRIFICATION PROJECTS

Project:	Dairy Water Heating and Sterilizing Equipment (Dept.)
Leader:	V. B. Hillman
Object:	To further study the problem of securing adequate quantities at moderate cost of hot water for washing and heat or steam for sterilizing of dairy equipment.
Methods and Procedure:	This project has been under way and much usuable information is at hand on the problem. The most effective results can be secured by cooperating with farmers in installing on farms various units of the most promising types and securing definite, detailed information on effectiveness, cost, and general characteristics of each installation.
Importance & Practical Application:	Equipment for this purpose is essential on every farm producing dairy products. It is a use readily adapted to electric power and offers splendid opportunities for load building.
Life and Cost:	Three years. $200.00 for purchase of equipment at start and $150.00 a year to continue if additional personnel not required.

RURAL ELECTRIFICATION PROJECTS

(Proposed Project)

Project: Electric Farm Oven

Leaders: P. B. Potter, V. R. Hillman

Objects: To design, build, test and prepare plans for an electric oven suitable for the farm kitchen, which may be assembled in the farm home or fabricated by a local tradesman from commercially obtainable materials and equipment.

Methods & Procedure: Such a device as described will be built and thoroughly tested. Plans will be prepared and instructions issued for assembling or building the equipment if investigations warrant.

Importance & Practical Application: Many farm homes can make ready use of such a device, when electric current is available at moderate cost, that would or could not purchase the present available types of electric ranges. It may be that a highly insulated, low wattage device, continuously connected to the line will prove more desirable than a higher wattage unit used but a relatively short time, but with which the oven is allowed to become completely cooled between use periods.

Life & Cost: Two years. Much information is already available that will prove usuable in this connection. Probable cost $600.00 including extra personnel and materials.

RURAL ELECTRIFICATION PROJECTS

(Proposed Projects)

Project:	Grain and Forage Processing
Leaders:	V. R. Hillman, J. W. Sjogren
Object:	A general project on the relation of electric power to the handling, grinding, drying and storage of grains and forage on the farm. To assemble the information already available on this general problem and to further study the application of electric power to these uses.
Methods & Procedure:	The best results will be obtained by cooperating with farmers in making installations for these various purposes and in studying costs and necessary or desirable changes in the equipment or operation of the equipment.
Importance & Practical Application:	Every dairy, livestock, grain or general farm handles and processes feeding materials. Most of these operations are readily adaptable to the use of electric power and in most instances furnishes a desirable type of load on the electric line.
Life and Cost:	A continuous project. If need arises for setting up of a definite project on some phase of the problem an approximate time and cost requirement can readily be established. Work at present contemplated can be carried on by existing personnel and with present equipment.

RURAL ELECTRIFICATION PROJECTS

(Proposed Projects)

Project: Electric Field Power Equipment

Leader:

Object: To determine the feasibility of, and necessary equipment for, applying electric power to field power operations.

Methods & Procedure: Types of possible field power machine.

(1) Battery operated tractor for field work. Battery to be charged during "off-peak" periods. Some work has been done on this by the Middle West Utilities Company. This is necessarily a heavy type machine due to the weight of batteries necessary to be transported.

(2) Motor driven tractor receiving power direct from the electric distribution system through suitably arranged wires, trolleys, take-up reels, etc. Size of machine and size of fields limited.

(3) Semi-portable power units at borders of the field. Field machines operated through cables and drum arrangements. Used in Europe to some extent. Has been tried out to limited extent at Iowa State College, Ames, Iowa.

Importance & Practical Application: More than half the power used on farms is in field operations. If electric power could be profitably applied to these operations the load characteristics on rural lines would be greatly improved.

Life and Cost: Would require several years of effort and several thousand dollars to fully develop and complete this project. Usuable results could be obtained in a shorter period and at less cost than for a fully completed study.

RURAL ELECTRIFICATION PROJECTS

(Proposed Projects)

Project:	Refrigeration and Reversed Refrigeration Cycle Applications
Leader:	
Object:	To study the application of refrigeration and the so-called reversed refrigeration cycle to house heating, air conditioning, water heating, refrigeration and ice making, or other heating, refrigeration, and storage problems.
Methods & Procedure:	The immediate interest in this problem is in home heating and present indications are that wide application may be made of the principles. Either all or any part of the functions listed above might be secured through the proper arrangement of one set of equipment.
Importance & Practical Application:	All farms and farm homes have heating, refrigeration, and storage needs in varying degrees. If combined apparatus can be developed it furnishes great load building possibilities and will add to health, comfort and convenience of farm work and farm living, and with a minimum of mechanical and electrical units. A central heating and refrigeration plant for the farm is not beyond the reach of the imagination and may be much nearer actual accomplishment than at present realized.
Life and Cost:	A long time and costly project but one with very great possibilities.

RURAL ELECTRIFICATION PROJECTS

(Proposed Projects)

Project: Rural Lines and Distribution Systems

Leader:

Objects: To study means of securing cheaper rural distribution facilities.

To determine the feasibility of higher primary and secondary voltages.

To completely develop certain suitable areas for the application of loop distribution systems.

To determine the feasibility of underground primary and secondary systems.

Methods and Procedure: In constructing the necessary lines to serve rural territory suitable areas will be selected in which to thoroughly test out any system of distribution that shows promise of giving adequate service at a lower cost. First cost, adequacy, service and maintenance costs, safety and permanence will be considered.

Importance & Practical Application: Distribution costs to serve relatively few consumers are high. A 6900 volt, 3 phase line has more than 5 times the capacity of a 2300 volt single phase line of same size copper. The cost usually would be less than 50% higher. Higher voltages may partly solve the problem.

Loop net works will more completely serve a territory and may be reasonably expected to give better line regulation. With underground systems are associated certain problems and difficulties but if they can be made workable will eliminate many hazards to which aerial systems are subject.

Life & Cost: A long time problem. Not a particularly costly problem since some kind of lines will of necessity have to be constructed. These may well be of several types offering opportunity for unbiased judgment of each on its merits. A very worth while project.

RESEARCH IN HOUSEHOLD ENGINEERING

The Field of Household Engineering

This line of endeavor is comparatively new and perhaps not well understood so that a word of explanation may be appropriate at the beginning.

Household Engineering has to do with the mechanics and utility of the equipment of the home, the principles of physics involved, and a general application of engineering to the home, all for the purpose of saving time and human energy and of bringing about a higher efficiency in the processes of the home.

Because of the rather recent and rapid development of all kinds of mechanical equipment for the home and a general lack of knowledge on the part of the housewife who uses this equipment a great deal of research and investigation has become necessary. It is the aim and purpose of this research to establish facts and standards of performance for this equipment, to evaluate the factors of home processes, and determine the general utility of equipment for homes with different living standards. Since the farm home has been found trailing behind in utilizing these new advantages extra emphasis has been applied in that direction.

It can be shown that the standard of living maintained in a home is closely associated with the efficient use of equipment and mechanical energy in that home. The high cost of this new equipment has been a considerable handicap to thousands of farm homes which otherwise might take advantage of it. Research should show that much simpler and cheaper equipment can be assembled that will give practically as good results.

Since a high proportion of home equipment is electrical in one way or another any program involving the use or sale of electricity must necessarily give important consideration to this field.

HOUSEHOLD ENGINEERING AT VIRGINIA POLYTECHNIC INSTITUTE

Research work in this field was organized in the Agricultural Engineering Department in 1930 with funds furnished by the Agricultural Experiment Station. These funds are from the Federal (Purnell) appropriation entirely and amount to approximately $3000 annually.

The work has been carried on under a half-time arrangement in which one man divides his time between research and teaching. Additional help has been had in the form of student labor and a girl assistant working part time. The work would be greatly enhanced if it could go under a full-time arrangement with more funds and equipment and personnel.

The work has developed along the lines of laundry investigations and studies of heat and temperatures used in cooking. A generous sized laboratory is available and it is fairly well equipped for measuring the factors involved in the washing process and the factors of the cooking process. In addition there are ample electrical services and instruments for studying the electrical applications of home equipment. A very extensive program of future research has been worked out and is available whenever facilities can be extended into other phases of the work. It might also be mentioned that the project leader has had more than ordinary experience in this field and is well trained in engineering and physics.

Should the Tennessee Valley Authority desire to use these facilities on any problem in Household Engineering the Department could promise almost immediate action upon receipt of additional aid toward the work.

HOUSEHOLD ENGINEERING PROJECTS

Project Name No. 1: Home Laundry Investigations

Leader: P. B. Potter

Objects: The objectives sought in this project are (1) the evaluation of the factors of machine, loading, time, temperature, water and soap in the washing process; (2) the determination of correct factors for ironing such as the electric iron, moisture content of clothes for ironing, temperature for different fabrics, and time and energy requirements; and (3) development of "standards of performance" for the equipment used.

Methods and Procedure: Hundreds of washings are being done in machines of different makes and types with each of the various factors under control except a single factor which is varied through practical ranges. Each washing is measured by means of standard dirt samples placed in the machine and washed under varying conditions. The amount of cleaning obtained is indicated by a "whiteness coefficient" obtained by reading the light reflection from each sample in a Bunsen photometer set-up in dark room. Data thus obtained is tabulated and trends of each factor studied.

Repeated ironings have been done on cotton, linen and rayon fabrics while varying moisture contents and different irons and temperatures have been used. Temperature of the iron is constantly recorded, time and energy measured, and the quality of work observed. Tests have been made on 15 different irons on the market and performance records tabulated. Determinations of best factors for ironing are determined.

Experimental batches of sheets are being sent to four different local laundries and results measured and scored with a batch done under home conditions. Hundreds of tensile tests are being made on samples cut from the sheets after each washing.

From all data obtained it is possible to formulate performance standards for each kind of equipment, these to be a contribution toward the work of the American Standards Association for all manufactured products.

Importance and Practical Application:

Sanitation is one of the basic factors in a proper living standard for families at home. The washing of clothes is most essential to such sanitation as well as to pride in appearance of individuals. Washing and ironing are chores that can hardly be eliminated from home operations. Moreover they are tiring tasks requiring much time and human energy. It is logical to assume that any discoveries made in investigating this subject would benefit millions of families, not once, but continually.

Results of tests already completed show that it is possible to wash too long, that 15 to 20 minutes is sufficient and longer washing puts the dirt back into the clothes. Soft water saves a half, or more, of the soap bill. Hot water is highly important for rapid cleaning and sanitation. Some "best" soaps cost no more and give better results than cheap soaps. The machines can be over-loaded and it is really faster to wash less clothes per batch. Ironing economy depends on a powerful iron with temperature control and upon correct moisture application to the clothes. Correct moisture content saves time and electrical energy and gives quality in ironing. There is a difference in the performance of irons and the one put out by the best companies is not always the best iron.

Life and Cost:

This project was begun in 1930 and will require about two more years to complete. It is using about two-thirds of the appropriation or $1800 - $2000 a year for salary, labor, supplies and equipment. Present funds are ample to complete the work under present arrangements. Several phases of the project are practically finished but have not been reported. The washing tests make up the greater part of that yet to be finished.

HOUSEHOLD ENGINEERING PROJECTS

Name of Project - No. 2: Reliability of Oven Regulators

Leader: P. B. Potter

Objects: The objects of this project were (1) to test oven regulators supplied with the different makes of household ovens and determine their accuracy and reliability; (2) to determine just what range (variation) is permissible in temperatures for baking different products; (3) to formulate standards of performance for these.

Methods and Procedure: Test methods were set up in which continuous oven temperatures were taken in five places in the oven by means of thermo-couples and pyrometer. Ovens were secured wherever available and tested as found. The regulators were set at seven different points over the scale (50° apart) and a one-hour test of temperatures conducted on each setting to observe action of regulator. Curves were plotted to show action and characteristics of regulator.

Extensive bakings of five different products were carried on under different controlled temperatures and the products judged for different qualities to determine the best or optimum temperature and also the range or zone of temperatures that will give products with desirable qualities. These determined zones served as standards of temperature control that regulators should meet.

None of the regulators tested met the baking requirements in all respects although some gave general results that would be satisfactory in homes.

Importance and Practical Application: Baking is an important method of preparing food and regulators for controlling temperature are highly advocated. But manufacturers are adding heavily to the cost of ovens when equipped with regulators. If these are not reliable then money is spent without adequate returns. If these regulators are sold at high prices then they should give good performance. Unbiased tests are necessary to find out. The results observed should eventually produce better regulators and give the housewife the results she expects. It is a part of the movement to have better equipment and to make that equipment worth what is paid for it.

Life and Cost of Project:

This project was begun two years ago and completed in part as a Master's Thesis in Home Economics. Certain definite answers have been obtained. It is to be continued another year to obtain data on more regulators than have been tested so far.

It is planned to revise the project into one entitled "Heat in Cooking" so that other factors of cooking may be studied, such as oven design and efficiency, radiant and convective heat, burner efficiency, cost of fuels, etc.

This project consumed about one-third of the funds allotted to household engineering, or about $1000 per year, most of which is spent for salary, help and instruments. Few supplies are needed and ovens tested are borrowed without expense. The project can be continued to completion under present allotment of funds.

HOUSEHOLD ENGINEERING PROJECTS

(Proposed New Projects)

Project Name: Domestic Housing Studies

Leader: P. B. Potter and others

Objects: This project would have as its objectives (1) the determination of minimum housing requirements of farm families with reference to their living standards; (2) development of types of construction to utilize native and local materials with maximum shelter at minimum cost; (3) production of plans and designs suitable to each section of the country.

Methods and Procedure: The first objective would be a detail survey of hundreds of homes and families to determine what they have now in the way of a home; adequacy of this housing; approximate living standards as measured by income and possessions; proportionate cost of the home compared to expenditure for other property. Each section or condition would be surveyed. Plans of present desirable houses and features would be recorded for study.

Object (2) would be developed by listing all local materials and recording present types of construction with their advantages and defects. Every possible way of utilizing and combining materials would be tried out and sample structures subjected to all kinds of tests of wind, weather, water and fire resistance as well as to comfort producing ability.

Finally plans and designs of new homes would be worked out after an intensive study of present designs in use and ingenious application of inventive ability to new features such as adjustable rooms, movable partitions, built-in furniture with multiple uses, etc.

Importance and Practical Application: No one thing is of more vital importance to family life and stability than the security obtained by possessing a home, adequate and comfortable, yet within the range of the family income.

While there are thousands of house plans of homes designed for middle and wealthy classes, homes for the poorer classes simply have not been architected or designed. They have been thrown together and are too often little more than shacks or windbreaks. The climate of this section of the country necessitates more rugged protection from cold in winter and from heat in summer, that is, more comfort.

The high cost of homes has prevented home ownership. There ought to be cheaper ways of making good houses. The use of local materials and common labor with elimination of excessive transportation charges and high priced skilled tradesmen should reduce costs fully 50%.

Local materials have important possibilities in many sections. For instance, why is it not possible to make insulating board from woodlot lumber, marsh grass, and various crop residues. Small local industries would be set up, electrical energy consumed, and valuable building material produced for cheaper, more comfortable homes.

Lastly, it cannot be said that any section of a State or country is "developed" until the greatest possible perfection is attained in housing its families.

Life and Cost of Such a Project:

A project of this kind would require a minimum expenditure of $6000 per year for five years. Full time of a project leader and an assistant would be required for two years to cover object. (1) two more years would be required for objective (2) and the recommended plans could be drawn up in the fifth year. About $4500 would be spent on salaries each year and $1500 on expenses. During the period for testing materials and construction additional amounts would likely be needed.

The Virginia Agricultural Experiment Station has already approved portions of such a project whenever other projects are completed so that personnel can work on this. A start has been made on the study of Virginia Farm Homes and materials in the form of a Master's Thesis this year. In addition the Station has a project leader with talent and experience to carry on such a project.

HOUSEHOLD ENGINEERING PROJECTS

(Proposed New Project)

Project Name: The Utility of Home Equipment

Leader: P. B. Potter

Objects: The objectives to be sought in this project would be: (1) to test all equipment used in the home for efficiency and utility; (2) to determine requirements for equipment in homes with probable return on the investment; (3) formulate standards of performance.

Methods and Procedure: This project is concerned largely with testing and a determination of performance for the different pieces of home equipment. All possible makes of equipment would be tested and the results tabulated so that any one interested in purchase of equipment could learn of the performance record. The tests would consist of efficiency determinations and durability over a certain life test.

From the results obtained could be written a code or standard of performance which might start as an average performance for all makes but which would be made more rigid as improvements came along.

The second part would consist of a study of the use of all this equipment in the home to find out how useful it is, how much it is used and whether it is effective at all over certain hand methods. Perhaps some equipment could not be recommended at all for families of certain living conditions.

Importance and Practical Application: There is organized action now being put forth by the American Home Economics Association and American Standards Association and other institutions for better performance of the high priced equipment that the public buys. Many more agencies are needed to do this testing. The Agricultural Experiment Stations are logical agencies to take a part in this work because the welfare of agricultural families is concerned with use of mechanical equipment and saving of human energy and drudgery.

Much of the equipment sold to the public is ill-designed and inefficient and too high priced. Millions of dollars could be saved present purchasers and many more families could have equipment if facts were known and published about it.

Many families spend money for equipment with only half-knowledge as to whether they can make any use of it. Unbiased recommendations are needed as to the utility of each piece of equipment. These utility studies should not only determine how useful equipment is but should produce new designs and suggestions to manufacturers for improvements.

Finally, to combat high prices and make equipment available to more families, research agencies should develop designs for simple equipment that can be assembled by local mechanics or families themselves. This assembled equipment to have the essential units but would dispense with fancy enameled surfaces and accessories. For instance there should be no need of a family paying $75 to $150 for an electric range when one could be assembled at home from plans devised by a practical research laboratory for about $15 to $25. The latter might be less efficient, but with low priced electric current it would make possible the having of equipment and the use of electricity for cooking.

The above idea would develop small local industries out of tin shops and electric shops and could be carried out with many other pieces of equipment.

Cost and Life of Such a Project:

A piece of work of this kind would have an indefinite life and such a testing laboratory should be maintained continuously so as to try out new equipment as it came along. However, much of value could be accomplished in the next three years.

With an initial appropriation of $5000 to set up a laboratory and an annual budget of $4000 for salary and labor and supplies the project could be established.

FARM STRUCTURES PROJECT

Project: Farm Development (Dept.)

Leaders: H. H. Gordon and C. E. Seitz

Object: A study of the possibility of improving agricultural conditions on typical farms in Virginia by better crop rotations, etc., by improved physical layout, and by means of better machinery and equipment.

Methods and Procedure: In cooperation with the Agricultural Economics, Agronomy and other related departments and the Bureau of Agricultural Engineering of the U. S. Department of Agriculture, twenty-five typical farms in different areas of the state have been selected for study. Eight of these farms are in the Tennessee Valley area.

Complete field surveys of the selected farms are first made by the Bureau of Agricultural Engineering. This bureau prepares and provides maps of these farms and cooperates in the preparation of plans for the development of these farms.

Soil surveys are made by the Agronomy Department and the Agricultural Economics Department makes a farm record study of the farm operations over the previous year. When all this information is assembled a conference is held with all parties interested, such as Dairy, Animal Husbandry, Poultry, etc., depending on the type of farming practiced by the farm cooperators. At this conference complete plans for the development of these farms are mapped out, such as recommended rotations, size of flocks or herds, physical improvements, etc. In other words a complete farming program that is best suited for the land, section and individual farmer is recommended.

A conference is next held on the farm with the local county agent present. The farm program is explained in detail to the farmer and such revisions made as are found desirable.

The Department of Agricultural Economics keeps a complete farm income and cost record throughout the life of the investigation.

The Department of Agricultural Engineering makes detailed estimates of plans for and supervises construction of such improvements as may be recommended when or if they are constructed by the farm owner.

Importance and Practical Applications: After two years experience on this project all cooperating parties agree that it has great possibilities. Several of the farmers cooperating have already shown substantial increased incomes as a result of following the recommendations made. This project offers the best method of doing extension work with individual farmers as all facts are made available and all sources of information and technical advice is utilized in mapping out a farming program for the farmer.

Life and Annual Cost of Project: This project was started in 1931 and will continue over a period of years.

This study is now being handled as a project of the Extension Division. The present personnel limits the expansion of the project to any great extent.

From results already secured we are convinced that this study merits the attention of at least one full time man. ($3600 for salary and expenses should be sufficient to handle this project.) Ten or more farms should be selected in each of the counties in the Tennessee Valley area. With such a set-up real progress could be made and definite results secured.

In addition to securing valuable information in such a study to pass on to other farmers of the area, these farms could be used as experimental and demonstration farms on which to try out and demonstrate various electrical applications when electricity is made available. (See recommendations under rural electrification.)

FARM STRUCTURES PROJECT

Project: Dairy Refrigeration (Dept.)

Leaders: H. H. Gordon and C. W. Pegram

Objects: A study of all types and makes of dairy refrigeration equipment in use on the principal markets of the state to determine best methods, best type of equipment and costs, together with a cost comparison with ice.

Methods & Procedure: This project has been carried on over a period of three years and a preliminary report prepared and published. Final report to be made in near future.

A field study was made on a large number of farms, checking actual farm practise and comparison with ice cooling. Dry versus wet storage, ammonia versus CO_2 refrigerants also studied. Cost records so far as available collected and studied. Laboratory tests and check at college barns made as check on field results.

Importance & Practical Application: The principal city markets are requiring cooling of milk to below 50 degrees. Ice is expensive and mean to handle. Many makes of mechanical refrigeration are available. Many requests for information on this subject made a study, and a bulletin on the subject of great importance.

Life and Cost: Now in process of being written up. All equipment loaned either by manufacturers or power companies, the latter helping in keeping record of current consumption and costs.

FARM STRUCTURES PROJECT

Project: Common Storage for Fruits and Vegetables (Dept.)

Leaders: H. H. Gordon and A. H. Teske

Objects: Study of existing houses, checking on ventilation, temperatures obtainable and operating practises.

Design of storage based on results obtained above and practise in other states, with complete check on efficiency and best operating methods.

Methods and Procedure: This project has been carried on over a period of three years and is now ready to be written up. Designs have been worked out and have been successfully used on several farms for a period of two to three years. Careful checks have been made with equipment loaned by the U. S. D. A.

Importance and Practical Application: Low grade fruits if dumped upon the market have a tendency to break the prices of #1 fruit. Yet if held and marketed over a period of months may prove as profitable, handling costs considered, as the #1 fruit and supply a market which otherwise would not buy fruit. It also makes possible roadside marketing and peddling for the small grower giving a profitable business over a period of months. The same is true of vegetables. Its success where tried is proof of its practicability.

Life and Cost: Now in the writing up stage. All equipment loaned (about $1000.00 worth) by the U. S. D. A. No other costs. Project could very profitably be continued.

FARM STRUCTURES PROJECT

Project: Stationary Spray Plants for Orchards (Dept.)

Leaders: Chas. E. Seitz and H. H. Gordon

Object: A study to determine the cost, effectiveness, economy, mechanics, design and arrangement of stationary spray plants for Virginia orchards.

Methods & Procedure: A number of installations of stationary spray plants have been made in orchards throughout the state under the direction of the agricultural engineering department. Some of these installations are in the Tennessee Valley area.

After a survey of the orchard, plans and specifications, together with cost estimates, are prepared for the owner. Complete records of installation and operation costs are kept. Effectiveness of control are also noted and comparisons made with portable equipment.

Importance & Practical Application: Spraying for insect and pest control in the orchard is one of the large items of expense in fruit growing and has an important bearing on the successful operation of any orchard. Results secured in several of our cooperative orchard projects indicate that spraying costs can be cut almost in half by the use of stationary spray equipment as compared to the portable outfits. For example, one of our cooperators reports that with his stationary system in a 35 acre orchard, each of his six spray applications cost him $14.60 while with the portable rigs the cost was $25.50 per spray application. In other words by using the stationary system he saved $65.40 for the six spray applications. This grower also reported that the application with the stationary system was more thorough which was proven by the absence of scab or worms in his orchard while adjoining orchards where the portable method was used were heavily infected.

The stationary spray plant costs on the average about the same as portable rigs necessary for efficient application. It does not require numerous replacements like portable systems and is ideal for hilly or mountainous orchards. This system is especially well suited to conditions in the Tennessee Valley area.

Life and Cost of Project: This project has been underway for several years and will continue indefinitely. It is now being handled through the Extension Division. There is much research data that should be collected in connection with this project. This research data could very well be collected by the same man handling the farm development and irrigation project if a full time man were available for such work.

FARM STRUCTURES PROJECT

Project: Farm Building Plans (Dept.)

Leader: H. H. Gordon and V. R. Hillman

Object: A Study to determine the requirements for all types of farm structures to best meet Virginia conditions.

Methods and Procedure: After careful study of actual farm conditions, consultation with the various departments and specialists concerned, such as the dairy specialist or poultry specialist when the subject of a dairy barn or poultry house is being considered, and with the various farm organizations concerned detailed building plans are prepared entailing the recommendations of these authorities. The buildings are constructed on the farms of the state according to the plans or blue prints furnished. Construction cost records are kept and a check-up made from time to time to determine the adaptability of that particular structure to the whole farm program.

A large assortment of several hundred plans covering practically every type of building found on Virginia farms has been prepared. These plans consisting of blue prints, bill of material and specifications are available through the extension division for use by the farmers of the state. The plans are furnished free to state farmers. Several thousand plans are sent to farmers annually. It is estimated that buildings constructed from these plans on the farms of the state each year will total at least two million dollars in value.

Importance and Practical Application: The value of buildings on farms of the state in 1930 was $321,941,879 or about 60% of the total land value in the state. This value increased at the rate of about $7,000,000 per year since 1925. Buildings constitute a large part of the farm investment and consequently represent a large item in production costs. Better designed, economical, serviceable, efficient and well arranged buildings are essential to maximum success on most farms. Changing conditions give rise to changed requirements, health regulations call for improved equipment and practices and there is need for continual study and investigation to make these plans meet the service requirements and conform to economical practice. Studies should be made to determine to what extent local materials may be utilized both for structural members and for insulation, and how the increased needs may be met at the same or lower cost.

Life and Cost: This project has been going on from the beginning of agricultural engineering work at V. P. I. It is conducted through the extension division as part of the extension project in farm buildings. It is

necessary that we continue to study the whole question of farm building in order to keep our plan service up to date.

A special study of farm building requirements could very profitably be made for the Tennessee Valley area. If such a study were made an additional man would be necessary. About $3600 per year for salary and expenses should be sufficient for conducting such a study.

LAND RECLAMATION PROJECTS

Project: Irrigation (Dept.)

Leader: Chas. E. Seitz

Objects: A study to determine the economy and effect of irrigation on crop yields, quality, insurance against drouth, etc.

Methods and Procedure: A number of irrigation installations have been made in orchards and on truck and general farms in various sections of the state. Observations are being made and data collected on these farms to determine the practicability of surface and overhead irrigation in Virginia.

Surveys are made on the farms selected and detailed plans and specifications prepared for pumping plants and distribution systems. Construction and operation cost records as well as quantity of water applied and resulting increased yields, etc. are kept.

Importance & Practical Application: A study of climatological data indicates that in one year out of three the amount of rainfall is below that necessary for even average yields. Also during practically every year there is a prolonged period with a deficiency of rainfall some part of the growing season. Irrigation at such times insures maximum yields and prevents loss of crops from drouths.

Results of several years of orchard irrigation in the state have demonstrated that sufficient water applied during the growing season will result in increased size, color and quality of fruit. Water applied during the latter part of the season will very definitely increase the size of fruit and greatly improve the color. In several instances, one in the Tennessee Valley area, the increased yield of apples from irrigation has been sufficient to pay for the entire installation and operation cost in one season.

Overhead or spray irrigation of truck crops has been demonstrated as practical and a splendid investment. Three years observations of a 22 acre overhead irrigation system on one of our cooperative farm development project farms have shown that increased returns and frost protection resulting from irrigation has more than paid for the entire cost of installation of the irrigation system. The past two seasons this truck farmer has made a good income while other truck farmers in his section, not having irrigation, have lost money.

Water is the controlling factor in the production of any crop. Fertilizers are not made fully available without sufficient moisture. When ample cheap power is made available in the Tennessee Valley there will be promising possibilities for irrigation throughout the area.

Life and Cost: This project has been under way for several years and will be continued indefinitely. It is now being handled through the Extension Division. It merits the full attention of one man. However, this study could very well be handled by the same man who would handle the farm development project if a full time man were placed in charge of that project.

LAND RECLAMATION PROJECTS

Project: Land Drainage (Dept.)

Leader: Chas. E. Seitz

Object: A general study of farm underdrainage and district drainage to determine the economy, best spacing and depth, size of tile mains, etc.

Methods and Procedure: A large number of tile drainage surveys and installations have been made on farms of the state. Cost records, yields before and after drainage, etc. have been kept on a number of these installations. Records are being kept at the present time on several tile drainage installations in the state. When a tile drainage survey is made for a farmer he agrees to keep cost and result records for us. Observations are also made on the effect of different depth and spacing of tile. Considerable information has been collected and published on this project to date.

Importance & Practical Application: Drainage is one of the most important problems in much of Tidewater Virginia. Thousands of acres of cultivated farm lands in this area are in need of proper drainage for maximum crop yields. Other thousands of acres of rich bottom land in all sections of the state have been forced out of production due to the stream channels clogging up and overflowing the land. Much of this land could be reclaimed to advantage. It seems good policy to reclaim good rich bottom land and take some of the poorer hillside lands out of production.

Results of studies already made prove that tile drainage is a good investment and necessary for successful cultivation of much of our farm areas, especially in Eastern Virginia.

Results of drainage studies have been published on the Influence of Drainage on Plant Growth; Actual Cost of Tile Installation on a Virginia Farm; Economic Study of Tile Drainage on the Eastern Shore; Economic Study of the Sunray Drainage District. A bulletin entitled Farm Drainage in Virginia was published several years ago.

Life and Cost of Project: Land drainage has been an extension project in Virginia since 1914. Drainage studies in connection with this extension project have been made during this time and will be continued. A comprehensive study could very well be made in the Tennessee area for the purpose of classifying the land that could be profitably drained.

LAND RECLAMATION PROJECT

Project: Terracing to Control Erosion (Dept.)

Leader: J. A. Waller, Jr.

Object: A study to determine the proper grade, width, spacing, best method of construction and effectiveness of terraces to control soil erosion on different soil types in Piedmont Virginia.

Methods and Procedure: Observations are made on the many terraces that are constructed through the extension project in terracing. Terracing has been an important extension project for many years and much practical information has been collected that is being put in use on this project.

Importance and Practical Application: Soil erosion is a serious problem in a large area of the state. In about 25 counties in Southern Piedmont and Southeastern Virginia it is perhaps the most serious of any land problem.

A study was made of Charlotte County, Virginia, several years ago for the purpose of determining the amount of farm land that is being washed away or is subject to erosion. This study indicated that 89% of the farm land in that county is subject to erosion, while 71.5% is actually eroding to a more or less extent. As a result of erosion approximately 3.9% or nearly 4,000 acres were abandoned to farming in one year. This condition is typical of many of our Piedmont counties. It has been clearly demonstrated that properly constructed and maintained terraces are an effective first step in erosion control on slopes under 15%.

Life and Cost: Application has been made to the Public Works Board for funds to conduct terracing in some thirty counties of the state. When these funds are made available much additional information can be collected on erosion control during the progress of this terracing program.

Erosion demonstration areas could very profitably be established in the Tennessee Valley Area for the purpose of studying and demonstrating methods of erosion control in this area.

FARM POWER AND MACHINERY

Research work in farm power and machinery at the Virginia Agricultural Experiment Station was started in 1926. Since that time work has been carried on, the results of which have been of considerable value to the farmers of the state. Much attention has been given to the adaptation of modern "muscle saving" farm equipment to Virginia conditions, thus aiding the farmer in decreasing his costs of production and in reducing the amount of disagreeable work and drudgery to a minimum. The following is a short summary of the work that has been carried on in farm power and machinery.

In the study of harvesting small grains it was found that the combine harvester-thresher is a satisfactory machine for Virginia conditions. It also proved to be the best soy bean harvester now available with an average loss of less than 12 per cent as compared with a 25% to 40% loss with other methods of harvesting. A summary of the results of the combine study has been worked up which gives valuable suggestions to operators of combines, especially in soy bean areas.

Another important study that has been carried on in connection with the farm power and machinery work was the project on the requirements of the general purpose tractor. Many weaknesses and deficiencies were brought out in the work with the general purpose tractor and these results were put in the hands of the designers. As a result many improvements have been made in the design of the general purpose tractor and in the design of

the implements used on these machines. The results have been summarized and arranged into practical suggestions, which are available to users and prospective purchasers of tractors.

Some work has been carried on to determine the efficiency of some of the modern tools among which were: the disc, the pulverator, the "wheat-land" plow and the moldboard plow. The cost of operating these implements on stony and hilly ground was also studied. These data are available.

Corn production studies have been made with the general purpose tractor as the source of power. If the side hills are not too steep a very good job of planting and cultivating corn can be done with the modern tractor equipment. The rotary hoe, for example, has proven to be a very efficient tool for early cultivation of corn if operated between three and four miles an hour. This speed is possible with tractors. Under such conditions the operation of the rotary hoe has taken the place of one and sometimes two cultivations.

Seed cleaning studies have been made the results of which will assist seed growers to clean their seed to better advantage and thus receive better prices because of the higher quality.

FARM POWER AND MACHINERY PROJECTS

Project Name: A Study of the Influence of Topography on Stability of Traction Machinery unier Standard Loads and Given Soil Conditions. (Exp. Sta.)

Leader: John W. Sjogren

Object: To determine the influence of the following factors on traction machinery stability:

(a) The position of the center of gravity on lateral grades.
(b) Variations in positive, negative, and lateral grades and combinations thereof.
(c) Change in grade and angle of approach thereto.
(d) Character of soil as indicated by skidding and lateral movements.

Method and Procedure: The technique and equipment for this project must be developed as the work progresses since we have no precedent to guide us. The following procedure is being followed:

(1) Controlled laboratory studies with small scale models accompanied with mathematical and kinematical analyses of each case. These laboratory studies are conducted with a small model garden tractor operated in a soil box which can be placed to represent different lateral slopes varying from 0 to 30 per cent grades. The center of gravity of the tractor can be changed and each setting will be run at the different slopes and the lateral pull on the front and rear wheels of the tractor recorded. These tests will be run both with and without lugs. The tests will be run with the angle of approach of the soil box changed to represent up-hill and down-hill as well as side slope.

(2) Tests with actual machines, both in laboratory and in the field, applying and checking the results obtained in the controlled laboratory studies. Since this is an original project the above procedure may need revision as the work progresses.

Importance and Practical Application: The success of tractor operation in the mountainous sections of this state depends upon the ease with which it will operate on side slopes without injury to growing crops. This is especially true in the cultivation of row crops like corn. The basic principles underlying tractor operation on side slopes, therefore, is of considerable practical importance to the tractor operator as well as to the designer.

Life and Cost: The annual cost of this project is estimated at approximately $800 exclusive of the salary of the project leader. This work should be finished in two years.

FARM POWER AND MACHINERY PROJECTS

Name of Project: A Study of Grain Cleaning, Grading and Separating Equipment. (Exp. Sta.)

Leader: John W. Sjogren

Objects: There are many cleaning and separating devices on the market designed to separate the weed seed from other seed. The object of this project is to determine the relative efficiencies of these cleaning and separating devices when used under farm conditions, also to determine by trials the combinations of screens that can be used for separating noxious weed seeds from grains and grass seeds.

Method and Procedure: Tests will be run on different types of machines and with different grains and grass seed. These tests will be run in the laboratory on equipment obtained from manufacturers of such equipment. Purity tests will be run on samples and careful records kept.

Corn graders will also be tested.

Importance and Practical Application: One method of reducing or eliminating weeds on the land is by sowing weed free seed. This can be accomplished only through careful cleaning of the seed. Many farms have cleaning equipment available but it is not in use because of the lack of proper screen combinations. The results of this project should make such data available to seed growers. The quality of the seed crop of many farmers can thus be improved and higher prices obtained. The spread of noxious weeds can also be reduced.

Life and Cost: This project is now in progress and has another year to run. The annual cost is estimated at about $650.00. This project can be continued without any additional equipment.

FARM POWER AND MACHINERY PROJECTS

Name of Project: Methods and Equipment for Harvesting Soy Beans. (Exp. Sta.)

Leader: John W. Sjogren

Objects: To develop a more efficient method of harvesting soy beans adaptable to small acreages and to soy beans planted in rows.

Method and Procedure: The first step in this study is to secure information from farmers and from actual field trials on the causes of the waste. Some of this information is already available, although more is needed.

The next step in carrying on the project will be to secure a harvester of the one-row type. (Such a machine has now been procured.) Field trials and tests will then be run with the machine with different designs and changes. Some of the preliminary trials will be run on soy bean plots at Blacksburg. Other field tests should be run in the soy bean districts of the state. A study of the effect of cultural methods and their effect on the efficiency of the harvester should also be made.

Importance and Practical Application: The combine-thresher method is the most efficient in harvesting soy beans for the seed. This method, however, is not adaptable to small acreages or to irregular fields. The one-row harvester is used almost entirely on smaller acreages where the seed is to be saved. This method is very wasteful of seed. Information on methods of combating this waste would be worth much to the small farmer who is growing soy beans as a part of his cropping system. If the harvester can be improved it will be worth much to the agricultural industry of this state especially to the farmer with a small acreage.

Life and Cost: This project is in progress at the present time. It should be finished in two years. The annual cost is estimated as about $650.00. This project can be carried with our present funds.

FARM POWER AND MACHINERY PROJECTS

(Proposed Project)

Name of Project: Orchard Tillage Machinery

Leader: John W. Sjogren

Object: To determine the requirements which orchard tillage machinery must meet for orchard work to prevent damage to trees as a basis for the design of such equipment.

To determine and study the limitations produced by physical controlling factors such as topography and type of trees with the object of obtaining basic information required for the design of orchard machines and the adaptation of existing machines.

Methods & Procedure: Many of our present day tillage machines, although used for orchard work are not adapted to such work and as a result injure fruit trees and fruit on the lower branches. The first step in this project, therefore, should be a preliminary study of the requirements of orchard machinery, and to determine the factors that limit the design of machines to meet those requirements.

Field studies should be made to determine the possibilities of adapting existing machinery to do satisfactory work in orchards.

Field studies should be made with different types of machines to determine the ones best adapted for orchard work.

Importance and Practical Application: Many of the machines used in the tillage and in the seeding of cover crops in orchards are not adapted to such work. The tillage machinery such as the disc and the plow cannot be used for moving and stirring the soil close to the trees because of levers and other protruding parts that are likely to cause damage to the trees. The same is true with seeding machinery.

This project will give to the manufacturer information on requirements of orchard machinery and the limitations of such machines. The results should make information available to the farmer whereby he can adapt his present machines to the use of orchard work with the least amount of injury to trees and fruits.

The work on this project should be carried on in the field during the growing season.

Life and Cost: This project should be started during the spring of 1934 and finished in three years. The annual cost as outlined will require an annual expenditure of $2,000.

We have no equipment for such work but will have to depend on loaned equipment or on equipment already available in other departments. An additional annual sum of $1500 would be required to carry on a project as outlined above.

FARM POWER AND MACHINERY PROJECTS

(Proposed Projects)

Name of Project: A Study of Fertilizer Distributing Machinery

Leader: John W. Sjogren

Objects: To determine the basic requirements of fertilizer distributors for applying the fertilizer in certain locations relative to the seed or plant without injury under various climatic conditions.

To study fertilizer distributors attached to planters and drills to determine the accuracy of placing the fertilizer in certain positions relative to the seed without injury.

To study the requirements of machines for distributing fertilizers to meadows and pastures.

Methods and Procedure: Carefully outlined field tests should be carried on to determine the desirable location of fertilizers with respect to the plant itself, and a careful study be made of the requirements of a machine to distribute the fertilizer where it is desired. The following characteristics of a machine should be determined during this study: Most desirable hopper capacity and shape; efficient cleaning, agitator, and delivery devices; minimum and maximum rates of fertilizer application for best results; the feed, adjustment and timing of spreader mechanism; and the uniformity of fertilizer delivery in the hill. The effect of weather conditions and of type of fertilizer on the accuracy of the distributing mechanism should receive considerable study in this project.

Importance and Practical Application: A large amount of commercial fertilizer is used annually on the farms in all sections of Virginia. Some of this material is distributed at planting time by means of distributors attached to the planters and drills. The mechanism of these machines is inaccurate and is affected by climatic conditions and by the type of fertilizer used. The devices used for placing the material in the ground are not dependable. More information is needed on the placement of fertilizers with respect to the crop that is being planted. It is of considerable importance to our corn and potato growers, as well as to other farmers, that information be secured on the fertilizer distributors in order that the very best use may be made of the fertilizer by the crop. This is possible only when the fertilizer is properly placed in the soil.

Life and Cost: A project as described above will require at least three years of intensive work. It is estimated that it would cost about $2500 a year. It would require the part time services of another man. Our present funds are not adequate to carry on this work. It is estimated that an additional $2000 would be needed to carry on this project.

FARM POWER AND MACHINERY PROJECTS

(Proposed Project)

Project Name: The influence of wheel equipment on the stability of traction machinery.

Leader: John W. Sjogren

Objects: To determine the fundamental requirements of wheel equipment for the efficient use of traction machinery on rolling land.

To determine the effect of various types of wheel equipment on the stability and ease of handling the tractor on rolling and hilly land.

To study the relative efficiency of the rubber tire equipment compared with the regular wheel and lug equipment on traction machinery.

Methods and Procedure: A study of factors affecting the stability of traction machinery is now in progress and a part of the laboratory equipment can be used for a portion of the study dealing with wheel equipment. The results obtained from the laboratory equipment will be checked with machines operating under field conditions to determine the actual effect of wheel equipment on the stability of the tractor. Efficiency tests will be run in connection with the field work comparing rubber tired equipment with standard equipment on rolling and hilly land.

Importance and Practical Application: A large part of the land in southwest Virginia is rolling and some of the fields have steep slopes, making the operation of tractors difficult because of their tendency to creep down-hill on lateral slopes and because of the difficulty of steering under such conditions. A knowledge of the effect of various types of wheel and lug equipment on the stability of a tractor on lateral slopes will be of value to designers of such equipment and of practical value to the farmers in choosing the equipment most adaptable to their conditions. Rubber tire equipment for tractors are proving very successful in the corn belt and information on their adaptability to hilly lands will be of much value. The information on efficiency is also of direct importance to the farmer and such data are not available for our conditions.

Life and Cost: This work can be started at once in connection with the work on Stability of Traction Machinery. A part of the equipment now on hand is adaptable to this work. Some additional equipment will be necessary. The work should be finished in two years.

The annual cost of the project is estimated at $3,000. Our present funds are not sufficient to carry on this work as outlined. An additional $1500 will be needed for equipment and extra help.