

TEN YEARS OF AGRICULTURAL ENGINEERING SERVICE

By

THE AGRICULTURAL ENGINEERING DEPARTMENT

Of the

Virginia Polytechnic Institute

(1925 to 1934 Incl.)

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HISTORICAL:

A curriculum in agricultural engineering was adopted in 1913 at V. P. I. but as no provision was made for a department or professor of agricultural engineering only three men were enrolled in this course from 1913 to 1919 when this curriculum was dropped from the catalogue.

With the passage by Congress of the Federal Smith-Lever Act in 1914 Extension work in agriculture was started in Virginia. A specialist in agricultural engineering was employed that year to instruct farmers of the state in proper methods of land drainage. This man was the second extension specialist employed. The first specialist who was employed a few weeks previously to instruct farmers in animal husbandry is now director of the Extension Division and the same agricultural engineering specialist is now head of the Agricultural Engineering Department and agricultural engineer for the Extension Division. This extension work in drainage proved so valuable and popular that the farmers of the state demanded assistance and instruction on other farm engineering subjects so that by 1917 the extension work on agricultural engineering was broadened to handle instruction in farm buildings, water supply and related engineering projects.

Largely as a result of the extension work done there was created a demand for resident instruction in agricultural engineering and in 1920 a department of agricultural engineering was established at the college with classes in farm power and machinery, farm buildings and agricultural drawing and farm surveying and drainage started which were required of all students registered in agriculture. In order to meet a demand for specialized training in agricultural engineering a four-year curriculum was offered in 1922 leading to the degree of Bachelor of Science in agricultural engineering. Provision was also made the same year to start research work in this field in a small way.

It is important to note that V. P. I. has been the leader in this field of education in the East and was the first Land Grant College east of the Mississippi river to offer a four-year professional course in agricultural engineering. A number of other Eastern colleges now offer such training. This whole development has all come from an actual demand from the people of the state for such work.

SCOPE:

Agricultural engineering may be defined as the art and science of engineering as applied to agriculture. It embraces the four following general fields:

1. Land Conservation and Development. Land is the first requirement for agricultural production. Land conservation and development has to do with the drainage, irrigation, erosion control, flood control, and any other mechanical means by which the land is brought into better condition for the economical production of crops.

2. Power and Machinery. Agriculture requires a large amount of power and mechanical equipment. This branch of agricultural engineering deals with the design, construction, operation, repair and management of this equipment to the end that crop production may be carried on at the best time, and in a way that will be both convenient and economical.

3. Rural Electrification. Due to the rather recent application of electric power in any quantity to farm operations, this has come to be recognized as a branch of agricultural engineering and deals with electrical machines and other electrical uses on farms. It is in reality but a more modern source of power and may be considered under the previous heading. This is a most interesting and important phase of agricultural engineering and has great possibilities in the bringing of many conveniences and better living conditions into farm homes, and a suitable type of power to many farm operations.

4. Farm Buildings and Structural Equipment. More than a quarter of the total investment in the farming enterprise in this country is represented in buildings and the equipment in these buildings for lighting, heating, ventilation, refrigeration, water supply and sewage disposal. The design, location, construction and maintenance of these buildings and their equipment in a way that will make the most convenience and profit is a broad and interesting field of agricultural engineering.

Household engineering, though not always considered a definite branch of agricultural engineering, nevertheless is closely associated with it and comes in for considerable attention. It deals with the equipment and processes that are used by the farm women. Sewing machines, cooking equipment, washers and other cleaning devices and materials, ironing machines, water heating equipment and many other devices that are found in the modern kitchen and household are considered.

ORGANIZATION:

The work of the agricultural engineering department is organized under three main divisions of activity, (1) resident instruction, (2) research, and (3) extension.

Resident Instruction Division:

Under this division of the department is conducted all agricultural engineering resident teaching activities. These activities are divided into service courses for agricultural students and professional courses for the

students enrolled in the four year course in agricultural engineering. Service courses in farm power and machinery, farm structures, agricultural drawing and farm surveying and drainage 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 training in fundamental engineering and agricultural subjects these students get specialized training in a variety of agricultural engineering courses which fall under the main fields of Land Conservation and Development, Power and Machinery, Farm Structures and Rural Electrification.

Research Division:

Under the research division of the department is handled all investigations. These studies are organized into two classes, (1) studies made by department members, not on the Experiment Station staff, and (2) studies made by Experiment Station staff members. It is the policy of the department to have each member conduct some research studies in his speciality even if he is on the resident instruction or extension division staff.

The Experiment Station research studies are primarily of the more fundamental type that require equipment and laboratory study and a longer period of time to complete before results can be secured and made applicable to the teaching staff or to the farmers. Studies are now under way in the fields of household engineering and farm machinery. There is need also for engineering studies in the field of soil erosion control, rural electrification and farm structures.

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

Extension Division:

Under the extension division of the department, extension specialists in engineering carry the results of research and teaching direct to the farmer on his farms. This extension work is conducted by means of correspondence, bulletins and circulars, blue prints, radio talks, articles for the press, short courses, farmers' meetings and actual field demonstrations, surveys and consulting assistance on the individual farms.

The major extension subject matter projects in agricultural engineering are: farm structures, rural electrification, soil erosion control (terracing), drainage, irrigation, farm water supply, farm water power, and farm operating equipment. Quite a variety of miscellaneous engineering problems are also handled in answer to direct requests from the farmer.

SERVICES RENDERED IN AGRICULTURAL ENGINEERING

The following is a condensed statement of the more important services rendered by the agricultural engineering department during the last ten years, 1925 to 1934 inclusive. It is impractical to list all the miscellaneous services rendered as they are so varied. This report will, therefore, deal with what is thought to be the major services during this period in the three divisions of resident instruction, research and extension, and the emergency work done for the various new deal agencies during the past two years.

Services Rendered by Resident Instruction Division:

During the ten year period service courses in agricultural engineering making 12 credit hours of instruction were taught for other curricula of the agricultural division to approximately 480 sophomores and 600 freshmen or an average of about 660 student hours per session. Special courses were also taught for home economics, agricultural education and engineering students such as household mechanics, automobile engineering, and farm shop. During the summer session regular courses, short courses and special courses have been taught for vocational teachers, 4-H club boys and girls and regular students. Approximately 1200 students have been instructed at these summer courses during the ten year period.

In the professional four year course in agricultural engineering the total composite enrollment in all agricultural engineering classes for the ten year period was 411 or an average of 41.1 students per session, distributed through the four undergraduate and one graduate year. Teaching work for these students involved approximately 42 credit hours of instruction in the sophomore, junior and senior years, distributed through an average of twelve courses.

A total of 84 students have been graduated with a B. S. degree in agricultural engineering in the ten year period. During this period eight men were granted M. S. degrees in agricultural engineering. All 84 of these graduates are employed. At a time when thousands of college graduates are still seeking employment it is significant that not only is there practically 100 per cent employment but also a probable dearth of agricultural engineers. The actual fields of employment of these 84 graduates as shown below indicate the valuable and worth while public service that they are rendering to the state and nation and is ample proof of the service rendered by this department of the college in training these men.

26 - employed as agricultural engineers by the Federal Government in this and other southern states in soil erosion control activities.

13 - employed in rural electrification work. Eleven (11) of these are employed in this state by electric power companies, devoting their entire time to

the promotion of the use of electricity on the farm. Two (2) of these are employed in research work in rural electrification with the Tennessee Valley Authority.

14 - employed as county agents or assistant county agents. Eight of these men are in charge of erosion control programs in their counties, four are in charge of soil conservation programs in cooperation with the F. V. A. One is a boys' club agent for several counties and one is a full fledged county agent in charge of all work in the county.

7 - employed by state colleges in teaching, extension and research work in agricultural engineering and related subjects.

4 - employed as teachers in high schools of the state. Two of whom are teaching agriculture, one teaching automotive engineering in a city high school, and one is principal of a county high school.

3 - employed as agricultural or automotive engineers with large corporations. One is agricultural engineer for a leading gasoline fuel company. One is an automotive engineer for a large oil company and one is a research engineer for a large steel corporation.

6 - employed as salesmen with commercial companies handling mechanical equipment or agricultural products.

2 - employed by Federal Government in flood control engineering work on the Mississippi river.

3 - employed by U. S. Army as lieutenants in C. O. C. camp work.

1 - employed by Virginia Agricultural Experiment Station as superintendent of a sub-experiment station farm.

1 - employed as landscape architect by large firm of landscape gardeners.

1 - employed as assistant agricultural editor and director of radio broadcasting by State Extension Division.

1 - employed as general manager of large cemetery corporation.

1 - employed as general manager of large retail farm machinery business.

1 - employed as agricultural engineering advisor to Arabian government.

1 - employed as manager of large farming enterprise.

This department has secured through donation or loan from manufacturing companies over \$20,000 worth of mechanical farm operating equipment which is used in the laboratories for instruction and research purposes. The loaned equipment is kept up to date by the manufacturers, being replaced each year or so with newer equipment.

Members of the department staff have contributed to the advancement of the agricultural engineering profession by taking an active part in the work of the American Society of Agricultural Engineers. Members have been chairmen of important committees and divisions of this society such as the college division, student committee, household engineering research committee, rural electrification committee, and members of various other committees of the society. One member of the department was elected and served for one year as National president of the American Society of Agricultural Engineers.

SERVICES RENDERED UNDER RESEARCH DIVISION

Experiment Station Research:

The two main fields in which experiment station research studies have been made are farm power and machinery and household engineering. The equivalent of the full time of one man has been employed for 8 years by the Experiment Station for these studies.

Farm Power and Machinery Studies:

The 1930 U. S. Census gave the value of machinery on farms of Virginia at \$44,487,650. There is need for research to improve the equipment being purchased by farmers. We have been serving the farmers in this field by pointing out to the manufacturers the improvements needed in the equipment to make it better suited to Virginia conditions.

1. Farm Water Power Development. This was a study in cooperation with the U. S. Bureau of Agricultural Engineering made in Montgomery, Wythe and Washington counties to determine the possibilities of economical utilization of the flow of water in typical farm streams for the generation of electrical power for farm use. The data secured from this study were compiled and published in U. S. Department of Agriculture Farmers' Bulletin No. 1430 entitled, "Power on the Farm from Small Streams". This bulletin has proven very popular and thousands were supplied to farmers throughout the United States, resulting in the installation of many farm water power plants. There is still a popular demand for this bulletin which has recently been revised.

2. Survey of Machinery Used on Virginia Farms. This was a survey made in the state to determine methods of reducing power and labor costs in the production of field crops. The results of this study indicated the type of research work most needed and enabled the department to start on some of the following needed studies.

3. Study of All-Purpose Type Tractor. This study was made to determine the basic requirements for the most efficient use of this type of tractor and its place in Virginia farming, especially for cultivation. As a direct result of this

study eight basic requirements were determined and the manufacturers of this type of tractor incorporated most of the improvements recommended by the station. With these improvements this type tractor has proven very satisfactory for cultivation and general farm work. Several thousand have been sold to Virginia farmers which have resulted in a reduction of tractor operation costs on these farms and more efficient power.

4. Study of Combine Harvester-Thresher. This study was made in cooperation with the Bureau of Agricultural Engineering of the U. S. D. A., to determine the use of the combine for harvesting small grains and soybeans. As a result of this study needed improvements were determined to meet Virginia conditions. The combine manufacturers incorporated the suggested improvements and as a result some 75 such machines have been sold in the state and have proven exceptionally satisfactory.

5. Study of Soybean Harvesters. This is a study to determine the most efficient machines and methods of harvesting soybeans and methods of improving the existing types of machines. The results of this study indicate that the combine is the most efficient machine for harvesting soybeans when available. This study also shows that the one-row harvester will save from 45 to 75 per cent of the beans. As a result of this study plans have been developed and made available whereby the machine can be made in the farm shop. Further studies are now being made to improve the efficiency of the one-row harvester.

6. Study of Methods of Harvesting Lespedeza. This is a study to determine the efficiency of different machines and methods of harvesting lespedeza seed. From this study proper adjustments of the grain separator for threshing lespedeza have been developed and made available to farmers. Results obtained from this project indicate that about 25 per cent of lespedeza seed can be saved by the pan method and because of this waste a study is being made of the possibility of improving the efficiency of the seed pan by adding a reel to the mower above the pan. Results from this study also show that the windrower attached to the mower will reduce the loss of seed when the crop is to be cut and threshed.

7. Study of Seed Cleaning Equipment. A study of the equipment used in separating noxious weed seed from grass seed. Results of this study indicate that the ordinary farm fanning mill can be used for this work if proper screen combinations are used and the fan operated at proper speeds. Such screen combinations have been worked out for lespedeza seed and clover seed and this information is now available.

8. Study of Small Garden Tractor. The results of this study indicate that the small garden tractor gives satisfactory service under Virginia conditions. The results show that the cost for operation, including fuel and lubricating oil, is about 40 cents for ten hours of actual operation. Recommendations and suggestions for the purchaser of the garden tractor were obtained from this study and have been made available to the farmer in a mimeographed form.

Household Engineering Research:

The chief objectives sought in this division of department activities are to determine and disseminate practical information on the use of mechanical and electrical equipment in the home, together with such investigations as will show its utility, efficiency and adaptability to the needs of the household. The steadily increasing expenditures for and use of such equipment and the general lack of knowledge concerning the many types and makes has caused a demand for this service which justifies more effort than is now actually given to it. Dependable information coming from an independent research agency is needed more than ever by consumers as claims and propaganda are broadcasted by manufacturers in extravagant advertising.

Research in this field is concerned with consumption to the end that the consumer may get the most and the best for his money and to the end that those with limited funds may obtain something in the way of equipment to facilitate a better mode of living.

Procedure in this kind of research is done largely by investigations and testing that will evaluate the factors concerned with a household problem and by showing the importance of each related thing to aid in improving the living and the well-being of each family. Limited development work that aims at producing cheaper equipment is also a phase of this work.

Home Laundry Investigations:

This is a project which attempts to evaluate the factors of the home laundry problem and extensive tests are being conducted to determine the importance of time of washing, temperature of water, type of machine, loading of machine, amount of soap to use and the value of soft water. Tests of all kinds of soap, comparison of home laundry work with commercial work, the trying of methods of washing, exact data on washing machines, all furnish practical information to the housewife that aids her in saving energy, time and expense.

Reliability of Oven Regulators:

This project was concerned with the requirements of oven temperature regulation and was preceded by extensive baking experiments to determine temperature limitations. Tests were then run on electric ovens to determine their ability to meet these requirements. A considerable deficiency in regulator performance was found to exist, even in the so-called best makes. From this work housewives are learning how to check their regulators and obtain the best results to give the performance shown to be necessary.

Electric Iron Tests:

This problem belonging to the home laundry investigations and carried out on some 25 electric irons of all makes and types has furnished complete information on electric irons and their operation. Complete tests on the irons when new and

after a life test of 1000 hours and comparisons of high wattage and low wattage capacity, ironing on different kinds of cloth with different dampening, energy consumption, records of thermostat performance, etc., has furnished a complete story about this most used appliance. It aids the housewife in buying and using irons and criticisms furnished manufacturers help to improve the irons.

Moisture Content of Clothes for Ironing:

This small problem worked out in connection with ironing tests was to determine the importance of correct dampening of clothes. Results showed big differences in per cent of moisture used by different laundresses and consequently the energy necessary to iron, but this was not so important as the extra time required to iron real damp clothes. Such information aids the housewife in better and faster work.

Economy of Soft Water:

A study in connection with laundry investigations to show cost of getting soft water by four methods and the extra expenditure in soap when using hard water. Simple home methods are devised that will enable the families of the hard water section of Virginia to have soft water at very low cost. An important problem to a large portion of the state.

Effect of Frost on Refrigerator Operation:

The beginning of studies on the household refrigerator to evaluate factors affecting operation. This household appliance is leading all others in sales at this time and reliable information is still needed to furnish consumers with assistance and advice in buying. Results obtained so far indicate that some factors of frost and temperature may not be so important as has been stated in the past.

Soap Economy in Washing:

A complete set of tests on all makes of soaps to determine their value to the housewife. Results on quantities required and costs and utility of each soap placed in tabular form gives the housewife practical information on which to make purchase. This study in connection with soft water study is important to the hard water sections of the state.

Study of Heat in Cooking:

A new project designed to furnish reliable information about the process of cooking and involves studies of time, temperature, the oven, and source of heat. An increasing desire to use electric energy brings the need of increased efficiency and better regulation of the oven. An exact determination of the factors involved will save money and worry for the housewife by improving the equipment and the use of electricity. It should also aid manufacturers in producing very much better stoves and ovens.

Development of Low-Cost Electric Cooking Equipment:

The need of the rural consumer of electricity for cheaper equipment with which to use his electricity was the motive for working on this project in cooperation with T. V. A. Results of development work along this line have been successful in producing electric stoves that local mechanics can assemble at costs approximately 20% of the usual electric range price. This lower cost of equipment enables the rural consumer to begin obtaining the benefits of electricity where before he was just waiting until he had the money to buy the higher priced stoves. This activity has stirred the manufacturers to produce very attractive new stoves at one-half the usual prices for electric ranges. Where practical other equipment will be studied from this angle.

Department Research Studies:

Members of the department have conducted a variety of studies during the ten-year period the results of which have given us valuable information to use in our resident instruction and extension work. Brief descriptions of these studies are contained in the several V. P. I. bulletins on Research and Publications.

The following are the more important of these studies:

The Status of Rural Electrification in Virginia - Published in Bulletin
The Use of Explosives on the Farm - Published in Bulletin
A Study of the Isolated Farm Electric Plant - Published in Agr. Engr. Journal
An Investigation of Spray Equipment
The Application of Electricity to Agriculture
Electricity on the Farm and in Rural Communities - Published in Bulletin
Electricity on Virginia Farms
Overhead Irrigation in Virginia
Surface Irrigation of Potatoes in Virginia
Surface Irrigation of Apple Orchards
Dairy Electric Refrigeration Systems
Controlling Insect Pests with Electricity
A Study of the Virginia Farm Home
Feed Grinding Studies
The Design of the Farm Dairy Plant
Common Storage for Apples
Mechanical Refrigeration for Small Dairies - Published in Bulletin
Stationary Spray Plants for Orchards
Dairy Sterilizers
Depth and Spacing of Drain Tile
Agricultural Engineering Curriculum Standards
Rural Electrification in Virginia - Published in Bulletin
Farm Use of Electricity
Sprinkler Irrigation of Orchards
The Hydraulic Ram as a Farm Pumping Unit
Agricultural Engineering Department Organization
Rural Service Organization
Curing Sweet Potatoes by Electricity

SERVICES RENDERED UNDER EXTENSION DIVISION

It is impossible to list all the miscellaneous services being rendered the state by the extension work in agricultural engineering. The demands made on the department from many sources are extremely heavy and varied. This department does a great deal of technical engineering work for all agricultural departments of the college as well as for farmers. The following are some of the major extension projects and activities in which valuable service is being rendered.

Farm Structures Project:

One of the most valuable services rendered the farmers of the state is the furnishing of free plans for all types of farm structures. The department has developed over a period of years a large assortment of well designed plans for practically all types and kinds of buildings needed on Virginia farms. This plan service is constantly being improved by the preparation of new designs which incorporate the latest and most efficient ideas in farm building construction. Field assistance is also given in building construction, especially in cases of community building projects such as storage and packing houses, county fair buildings, milk plants, etc.

During the ten year period 17,718 farm building plans were sent to farmers requesting them. Any observant person traveling over the state can note the great improvement in the type of buildings being constructed on the farms of the state as a result of this service. U. S. Census figures show that in 1925 the value of all buildings on farms in Virginia totaled \$256,136,184 while in 1930 this total was \$321,941,879. These figures show that even though farm land decreased in value by over \$50,000,000 the value of buildings alone increased over 25 million in the five-year period or an average of over 5 million dollars per year. It is safe to assume that most of this increase in value was due to the construction of new buildings. From information given in county agents annual reports and the number of plans sent out from this office it is estimated that farm buildings constructed from our plans have averaged at least (\$1,500,000) in value per year during the ten-year period.

Rural Electrification Project:

The progress made in rural electrification in Virginia in the past ten years has been largely the result of the extension work done by this department. This department initiated and organized the rural electrification movement in Virginia in 1924. In that year a member of the extension staff organized the Virginia Committee on the Relation of Electricity to Agriculture and was chairman of this committee during the years of its existence. This committee was composed of representatives of the various farm organizations, agricultural agencies and power companies. The cooperation of electrical equipment and electric utility companies was secured for a field study of the application of electricity in agriculture. These studies were conducted by members of this department and as a result plans were worked out for the promotion of rural line extensions and the development of uses of electricity in farming.

Substantial progress has been made in rural electrification as a result of the extension work done by this department. According to the Saville report recently made for the State Corporation Commission, there were approximately 500 miles of rural electric lines throughout the state ten years ago. Today there are 5809.6 miles, or a growth of more than one thousand per cent for this period. The number of rural customers now served is 38,092. This growth has been accomplished by real cooperative effort on the part of State officials, the agricultural engineering department of V. P. I. and the utility companies. At the suggestion of this department the larger power companies have employed some thirteen graduate agricultural engineers trained at V. P. I. These men devote their entire time to work with the farmer, in the promotion of the use of electricity on the farm. They have rendered and are rendering a service of inestimable value to the cause of rural electrification in Virginia.

Soil Erosion Control (Terracing Project):

It has been stated by Federal authorities that Virginia farmers are suffering an estimated annual loss of \$66,000,000 from soil erosion. The department of agricultural engineering has recognized the seriousness of this loss for years and has been serving the farmers of the state by instructing them on methods of preventing losses of their soils from erosion. By means of short courses, field demonstrations, meetings and actual field assistance in laying out terraces and organizing erosion control associations valuable service has been rendered in this field of activity.

During the ten year period 6026 farmers have terraced 45,962 acres as a result of extension work. An increased value of at least \$10.00 per acre as a result of terracing is a conservative estimate or a total of \$459,620 as increased value to the land terraced not to mention the value of this work in actually saving the soil itself and the improvement of the land. Some 4,197 farmers attended terracing schools and demonstrations given by the department.

Drainage Project:

The department gives assistance to farmers in planning drainage systems for their farms. Surveys and maps are made of lands needing drainage and recommendations made for the installation of tile systems. During the ten year period 135 drainage surveys were made and maps prepared for the drainage of 6,644 acres. Preliminary surveys were made and advice given on several hundred additional farms. The county agents report 1298 farmers installing drainage systems on 15,759 acres during this period. A conservative estimate as to the increased value of this land after drainage is \$20 per acre or \$315,180 increased value of land as a result of this project. Thousands of dollars have been saved from loss on this land during wet years and the production on the land has been greatly increased.

Irrigation Project:

Largely due to the demonstrations and investigations conducted on irrigation by the department there has been a constantly growing interest in irrigation in Virginia. Overhead irrigation for truck crops and surface irrigation for

orchards has gained in popularity in the last few years. The department has been of real service to the state in instructing farmers on irrigation methods. Eighty-five irrigation surveys have been made for the irrigation of 4,330 acres. Many farmers report a big saving and increased income as a result of irrigation. County agents report 137 farmers adopting irrigation practices during this period.

Farm Water Power Project:

Numerous requests are received from farmers wishing to develop power from their small streams. Considerable valuable service has been rendered farmers and communities in the development of hydro-electric power plants. Several large community installations have been made and 232 surveys have been made for small individual water power plants during this period.

Farm Water Supply Project:

Running water in the home is considered the most essential convenience on the farm to improve the health, happiness and standard of living of the farm family. The department has rendered a real service to the farmers of the state in giving advice on water systems. Thousands of letters have been answered on this subject and 1808 actual farm water supply surveys have been made for farmers. The county agents report 2790 farmers installing systems as a result of this work. With less than 15% of Virginia farm homes having running water, there is yet a great deal to be done on this project in the state.

Farm Operating Equipment Project:

Farmers are constantly calling on the department for advice on mechanical equipment. Most of this advice is given by correspondence and bulletins. However, much field work has been done in demonstrating improved equipment and instructing through field meetings and schools. Especially valuable service has been rendered under this project to the fruit growers in the installation of stationary spray plants for orchards, irrigation pumping plants, and cold storage plants for the storage of fruit. Thousands of dollars have been invested by fruit growers in improved operating equipment under the direction of this department, which has resulted in great savings and increased incomes. The dairy industry has been rendered valuable service by advice on modern milking systems, sterilization plants, refrigeration systems and the equipment of dairy processing plants. The truck farming industry has been rendered service in the matter of overhead irrigation systems, refrigeration, vegetable cleaning equipment and general labor saving equipment. The poultry industry has been rendered assistance with incubation and brooding and general electrical equipment. The general farming industry has been assisted with improved operating equipment such as gas engines, tractors, general farm machinery, combine harvesters, seed cleaning equipment and small grain harvesters and threshers. Several thousand farmers attended the school and demonstrations for improved equipment.

Land Clearing Project:

The department rendered valuable service to the farmers of the state during 1925-26 and 27 by distributing the surplus war explosive which was made available to the farmers of the state at cost. One hundred and thirty-three explosive demonstrations were held throughout the state to instruct on the proper handling of this explosive. These demonstrations were attended by 2707 farmers.

In the three years during which "pyrotol", the surplus war explosive, was distributed by this department eighteen hundred and fifty-three (1853) farmers purchased approximately one-half million pounds of this explosive for which they paid \$49,000. From reports received from 300 of these farmers, it is estimated that the 1853 farmers saved approximately \$57,000 on the purchase price as compared to the cost of the same amount of commercial explosive of equivalent strength. Basing estimates on the Reports received, the 1853 farmers removed stumps from 6788 acres of new land and 14,017 $\frac{1}{2}$ acres of cultivated land. By removing stumps from the cultivated land, yields were increased 21.4%. The new land increased in value \$250,479 and the cultivated land \$277,501. Taking the state average per acre value of all crops for 1927, which was \$43.20, the increased yield reported as a result of removing stumps from the cultivated land would amount to \$9.42 per acre or \$129,521, not to mention the returns from the new land cleared of stumps.

Miscellaneous Services:

In addition to the extension projects briefly discussed the department has handled a great variety of miscellaneous services of all kinds, too numerous to mention in this report. Engineering services have been rendered to practically all the agricultural departments of the college, all the farm organizations in the state, to the various state agencies such as the State Dairy & Food Division, State Health Department, State Corporation Commission, rural community organizations, county schools and county fair associations and various commercial agencies such as electric power companies, farm machinery companies, dealers of mechanical equipment, etc.

In carrying on the extension work of the department during this period approximately 40,000 letters have been written and 26,000 circular letters sent out dealing with agricultural engineering projects. About 3200 farmers and farm boys were given instruction at short courses outside of Blacksburg. Some 52,000 bulletins on agricultural engineering subjects were mailed out, and 21,590 farmers actually contacted. Talks on agricultural engineering were given at meetings attended by over 29,000 farmers and 144 radio talks were delivered on agricultural engineering subjects.

A large number of technical and popular articles for professional, trade and farm journals were written by members of the department and the following bulletins and circulars were published:

- Power for the Farm from Small Streams - U.S.D.A. Bulletin
- The Use of Explosives on the Farm - Virginia Extension Division Bulletin
- The Present Status of Rural Electrification in Virginia - C.R.E.A. Bulletin

Electricity on the Farm and in Rural Communities - C. R. E. A. Bulletin
Mechanical Refrigeration for Dairies - Virginia Extension Circular
Rural Electrification in Virginia - Virginia Extension Bulletin
Rural Electrification Handbook - Cooperative Bulletin
The Homestead Brick Brooder - Virginia Extension Division Circular
Farm Storage for Fruits and Vegetables - Virginia Extension Division Circ.

EMERGENCY SERVICES

The various emergency projects undertaken by the Federal Government in the past two years have made heavy demands upon the department but it is felt that outstanding service has been rendered the state in cooperating with the emergency and other Federal agencies. The following is a brief statement of the most important of the services rendered in this connection.

Soil Erosion Area (P. W. A.) (S. E. S.)

As a direct result of a request made by this department for Public Works funds to conduct soil erosion control work in some 20 counties of the state, the U. S. Department of Interior allotted approximately 1/2 million dollars for a soil erosion demonstration area in Pittsylvania county, Virginia. This department assisted in organizing this project and selecting the personnel which consists of a large staff of technical men. Plans are now under way to greatly extend this soil erosion work in the state.

Rural Housing Survey (C. E. A.)

Members of the department assisted the U. S. Department of Agriculture in working out details for the National rural housing survey which was made under C. E. A. funds in ten per cent of the counties of the Nation. Members of the department also directed the survey for ten counties in Virginia. As part of this project five architects and draftsmen were employed for several months to prepare plans for small farm homes. Several hundred of these plans have already been furnished farmers. The department also cooperated with the Bureau of Agricultural Engineering of the U. S. D. A. in preparing Farmers' Bulletin No. 1738 entitled, "Farmhouse Plans", containing 40 selected plans prepared in various states as part of the rural housing survey.

National Survey of Rural Electrification (C. E. A.)

The department cooperated with federal representatives in making a state and national survey of rural electrification which was conducted as a continuation of the farm housing survey. A 68 page report was published by the government containing the information collected in this survey.

Electric Stove Study (E. W. A.) and (T. V. A.)

This study was started on C. E. A. funds in cooperation with the U. S. Bureau of Home Economics as part of the farm housing survey. The T. V. A. became interested and are now supporting the study which has as an object the development of low cost electric stoves suitable for farm use.

Agricultural Engineering Research (T. V. A.)

At the request of the T. V. A. a report was prepared on research work in agricultural engineering at V. P. I. and recommendations made for additional research projects that might be of value to the work of T. V. A.

Contact Work (T. V. A.)

A member of the department was selected to represent the college and state in all planning activities in connection with the T. V. A. program. As contact man for Virginia this representative helped work out a number of agricultural activities of T. V. A. and secured the cooperation of this agency in development work for Virginia.

Agricultural and Industrial Survey (T. V. A.) and C. W. A.)

The department cooperated with T. V. A. in selecting the personnel and directing the work of an industrial and agricultural survey of the S. W. Virginia counties in the Valley. This survey was made with C. W. A. funds.

Soil Erosion Control and Farm Development (T. V. A.)

As contact man for T. V. A. the representative of the department served on a committee which worked out plans for an erosion control and farm development program for the entire Tennessee Valley water shed. A program that was already in operation in Virginia was adopted and put into effect in all states in the Valley with assistant county agents employed to handle these projects.

Compliance Work (A. A. A.)

This department was called on to train field supervisors and surveyors in the various counties in proper methods of land surveying for the crop reduction campaigns for U. S. Department of Agriculture. Several hundred men were trained for this survey work.

Rural Electrification Report: (F. P. C.) and (F. P. P. Com.)

A report on rural electrification for the state of Virginia was prepared by members of the department at the request of the Federal Power Commission for the National Power Survey. A special report on rural electrification was also made for the President's Power Policy Committee.

Residential Electric Appliance Survey (F. P. C.) and (F. E. R. A.)

An electric appliance survey of the town of Blacksburg was made by members of the department with F. E. R. A. students as part of the National Electric Rate Survey for the Federal Power Commission.

Preliminary Survey of Rural Electrification (State Corp. Com.)

The department cooperated with Allen Saville, Inc. in making a statewide rural electrification survey for the State Corporation Commission to secure infor-

mation on which to base requests for Public Works funds for the extension of rural electric lines in the state.

County Terracing Project (F. E. B. A.)

The department is cooperating with the F. E. B. A. in organizing terracing associations in Virginia counties for the purpose of controlling erosion. Ten counties have been organized to date with agricultural engineers employed as assistant county agents in charge of the program.

Rural Rehabilitation (F. E. B. A.)

The department is cooperating with the rural rehabilitation division of the Emergency Relief Agency in preparing plans for subsistence homesteads and for rural rehabilitation clients. A member of the department was granted a leave of absence to serve as director of the rural rehabilitation division of the Y. S. B. A. A pamphlet entitled "Pest Storage for Fruits and Vegetables" was written for the emergency garden work.

Farm Housing (F. E. A.)

A member of the department served for three months as field representative of the Federal Housing Administration for Virginia and Maryland in charge of farm housing promotional work.

Marginal Land Committee (A. A. A.)

A member of the department is serving on the Marginal Land Committee of the College. This committee has the responsibility of selecting and passing on all marginal land purchased by the government to be taken out of cultivation. This member of the department is chairman of a committee of the State Planning Board which is to decide the proper use of this land after purchase.

Blacksburg P. W. A. and C. W. A. Projects

A member of the department assisted in planning the new high school building which is being constructed with Public Works funds. He also designed a culvert for the school grounds built with C. W. A. funds and gave advice on general C. W. A. projects for the Town of Blacksburg and the County Transient Camp.

State Planning Board (P. W. A.)

A member of the department was appointed by the governor as a member of the State Planning Board. He is serving as chairman of two important committees of this board and has been called into consultation as often as for advice on public works and planning projects for the state. Several projects and reports have been prepared by him for the Planning Board. This board has the extremely important function of advising on Public Works projects and coordinating the work of all agencies handling public works funds.