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ANNUAL REPORT

for the

Year Ending October 31, 1938

Connecticut
Agricultural Experiment Station
New Haven

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LETTER OF TRANSMITTAL

December 15, 1938

To His Excellency
Wilbur L. Cross,
Governor of Connecticut

Sir:

We have the honor to submit herewith the Annual Report of The Connecticut Agricultural Experiment Station for the year ended October 31, 1938. In accordance with instructions received, this is a brief statement consisting of three parts:

1. The Treasurer's Reports for the Fiscal Year Ended June 30, 1938.
2. A Report of Progress, which is in the form of the *Report of the Director* to the Board.
3. A statement concerning the appropriation needs of the Station for the biennium 1939-41, this being an explanation of the estimates already placed in your hands.

Because of their statistical nature, the Reports of the Treasurer concerning the several Station appropriations are placed at the end of this report; and for convenience the matter pertaining to the estimates for the new biennium is placed at the beginning.

Respectfully yours,

THE BOARD OF CONTROL
CONNECTICUT AGRICULTURAL EXPERIMENT STATION

E. C. Schneider, *Secretary*

ANNUAL REPORT

of the

Connecticut Agricultural Experiment Station

FOR THE YEAR ENDING OCTOBER 31, 1938

To the Board of Control of the Connecticut Agricultural Experiment Station:

TO THE FARMERS of Connecticut belongs a unique honor of being the first group to recognize the importance of research in modern life. Long before our great industries established their well equipped laboratories to improve their products and increase profits, the Connecticut Agricultural Society had induced the General Assembly to found this Station. After years of debate and effort, the legislative act was passed in 1875.

The purpose and functions were clearly defined in the act or "charter": "for the purpose of promoting agriculture by scientific investigation and experiment, there is hereby established an institution to be called and known as the Connecticut Agricultural Experiment Station." In general, then, the function of the Station is "to put science at work for agriculture." More particularly, its task is three-fold:

1. To "shoot trouble", or to render aid in emergencies. This often requires the most intensive research, the keenest minds and the best equipment possible to command.

2. To devise, through research, better methods, controls, devices, or varieties. In other words, to make possible improvement and advancement, resulting in greater profits and better living.

3. To increase our knowledge of the laws that govern the behavior of soils, plants and animals.

Research at best is an obscure business. We cannot in advance say definitely that certain results will come from a period of investigation. Inevitably some of the work must be negative, but the plusses far outbalance the minuses. For example, outstanding tangible results of this Station's research have been the method of producing hybrid corn; the discovery of vitamins; the methods of testing soils for fertilizer requirements.

What have these things alone meant to the farmers and to the public?

Hybrid corn today is a million-dollar industry. The methods first developed and demonstrated for commercial use here in 1917 are now used by seed-producers and experiment stations in all of the maize-growing countries of the world. Hybrid corn has meant dollars in the pockets of farmers and a better product for the consuming public.

Little need be said of the importance of the discoveries in nutrition to a vitamin-conscious public. Food habits, health, and demand for farm products have been revolutionized since the chemical studies of plants and foods started in our laboratory in 1890.

The soil tests, more recently devised and constantly improved, have already saved Connecticut farmers many thousands of dollars in fertilizer bills. The system developed here has been adopted by experiment stations and commercial concerns of more than 20 states.

The Present Crisis

Up to 1932, our research went forward steadily and with an efficiency of which we are all proud. Then came the call for economy. The Board voluntarily reduced its estimates each year, meeting the requests of the Governor at every point. We all thought each season would see an improvement in conditions.

At the 1937 session, we called attention to the inevitable result—a slowing down of the research work, to be followed surely by losses to the farms of the State.

Now we have reached a real crisis. Unless a small increase is made in the research funds, especially for supplies and equipment, our work will be sterile and our service to the State will become steadily poorer.

To add to the seriousness of the situation, new problems are upon us: the Japanese beetle, the corn borer, the peach moth, the Gypsy moth are now widely spread over the State. The Dutch elm disease has a foothold in Fairfield County. We must learn how to live with these pests. Research only can find the way.

All this takes no account of the fact that the number of service demands has steadily risen during the last eight years. Our records show an average increase of 25 percent in calls of all kinds.

HIGH POINTS IN THE STATION YEAR

As the Station was founded by the farmers of Connecticut, and is managed by a Board made up chiefly of farmers, it has tried through the years to be ready to meet emergencies of an agricultural nature. In the past year there have been several occasions when the experiences and training of the staff have been of inestimable value.

Outbreak of Downy Mildew of Tobacco

Downy mildew of tobacco, a disease very serious in the southern states and in Australia, made its first appearance in Connecticut seedbeds in May, 1937. The pathologist at the Windsor Substation was fully prepared to tell the growers about the disease and the then known methods of control. Meanwhile experiments were started in the greenhouse, and a bulletin with full information was published in October. The following spring the Station tried with success two new materials and these better methods were immediately broadcast among growers.

Japanese Beetle Increases

The Japanese beetle has been present in Connecticut for some time but it is spreading and there has been considerable injury during the past year. As a result the Station has published Bulletin 411. This contains all information pertinent to the beetle in this State, and has been in heavy demand.

Connecticut Squash Honored

Again a Station product of plant breeding has been honored by the vegetable trade. Last season we reported that an award of merit had been given the Windsor-A pepper in the All-American Seed Trade Selections. This year the Connecticut Straightneck Squash, a prolific early summer type with a straight neck, was awarded honorable mention.

Outbreaks of Forest Tree Pests

Unusual and in several cases unprecedented outbreaks of forest tree insects marked the past season. Gypsy moths defoliated more than 1000 acres in sections of Simsbury, Granby and Union in the worst outbreak in Connecticut history. Again unmatched was the outbreak of elm span worms that partially or wholly stripped 250 acres of woodland in Monroe. Sugar maples and aspens in a 400-acre tract in Litchfield County also suffered severely from the forest tent caterpillar.

Meetings at the Station

During the past year the Station has come into direct contact with a larger number of citizens than ever before. In addition to field day gatherings, groups from the several county farm bureaus have arranged to hold special meetings here.

In the winter of 1938 vegetable and fruit men more than once overcrowded the inadequate assembly room which has a maximum capacity of 100 persons. In one case late comers had to spend the morning visiting the laboratories as there was no room for them in the meeting room. The same overcrowding is experienced every autumn when the State Entomologist holds a conference of workers at the Station.

In spite of this handicap the meetings were successful from two viewpoints: They gave the growers an opportunity to see the work of the Station in progress and to meet the men who are carrying on projects in their particular problems. And they gave the Station staff other chances to get first-hand information about the outstanding problems of the farmers from different sections of the State.

Staff Activities

A few examples illustrate the increase in service demands of the past decade. Samples of soil sent to New Haven and Windsor for testing have

jumped from 2,000 to 6,000 in this period; the number of insects submitted for identification has increased 36 percent. In the Departments of Analytical Chemistry and Botany it has been necessary to employ emergency helpers to take care of the larger numbers of seeds to be tested.

At the same time the staff is called on to address more meetings than ever before, to inspect buildings for termite and other injury, and to do all manner of things that fall within the provisions of the Statutes governing Station activities. Although meetings are frequently held at night and require special preparation, the staff willingly gives many extra hours of work to this type of service.

Field Days at the Station Farms

Summer field days in 1937 numbered four, two at the vegetable farm at the Substation at Windsor and two at Mount Carmel. No need was felt for a Tobacco Field Day because there is a constant stream of farmers and tobacco growers bringing their problems to the Substation, situated as it is in the midst of the tobacco country. These men are in contact with the staff frequently and see what is going on at the farm.

Although a good many persons stop at the farm at Mount Carmel, vegetable and fruit growers are scattered all over the State. Field days are held as a clearing-house occasion when anyone may meet the members of the Station staff, and see the experiments. There is tremendous interest, not only in the field plots, but in exhibits set up by the various departments in the barn. The new method of treating native wood to make it durable for outdoor use, Japanese beetles, poison hazards on the farm, and mouse injury to orchards, excited a large number of querries at the Station day last August. A crowd was constantly found around these exhibits and around the publications table.

The Strawberry Field Day in June was also well attended by visitors who were anxious to see the trials of new and old berries, and the Station hybrids. Out of his original 10,000 seedling hybrids, Dr. Jones now reports several superior types of berries developed at the Station and particularly adapted to Connecticut growing conditions.

Pest Surveys

In addition to field days and meetings, the Station has other means of keeping in touch with problems. One of these is the vegetable disease and insect pest survey such as that made during the past summer by members of the Entomological and the Botanical Departments. Results of the work are given elsewhere in this report but one important finding should be noted here. The Station had conducted research and had offered control methods on all but three of the pests that were found damaging crops.

The Pomological and Vegetable Societies of the State appoint committees on research each year. These men meet at the Station with staff members interested in their problems, and go over the program of research for the coming season.

Staff Changes

Doctor Clinton's untimely death in August, 1937, shortly after he had retired as active head of the Botanical Department, was noted in the report last year.

Two other valuable men have left the Station to take positions outside Connecticut. Dr. A. A. Dunlap, for seven years assistant mycologist in the Botanical Department, was made chief of the Department of Plant Pathology and Physiology at the Texas Experiment Station on June 1. Dr. B. J. Kaston, for four years working on a special research project studying the elm bark beetle, carrier of the Dutch elm disease, left to accept a teaching position at Brenau College, Georgia. Dr. Kaston heads the Biology Department there.

In November, 1937, Mr. James S. Forbes, B. S., joined the staff as Assistant Treasurer. Increased bookkeeping resulting from the State Reorganization, the new purchasing system and the demands for personal conferences at Hartford regarding budget and personnel, made it necessary to have help in the business management of the Station.

A fellowship for a graduate student in genetics has been established by the Eastern States Farmers' Exchange. In June Mr. L. M. Roberts, formerly of Texas, came to take up the work of breeding hybrid field corn.

The Station at a Glance

General Information

1. This is the oldest Agricultural Station in the country, established in 1875 by the General Assembly, at the request of the State Agricultural Society.

2. The management of the Station is committed to a Board, strictly non-political in character, constituted as follows:

The Governor, *ex-officio*	Governor Baldwin
The Commissioner of Agriculture	Olcott F. King
Appointed by Sheffield Scientific School	J. W. Alsop
Appointed by Wesleyan University	Prof. E. C. Schneider
Appointed by Conn. Agr. College	A. B. Plant
Appointed by the Governor	Elijah Rogers
	Charles G. Morris
The Director, *ex-officio*	W. L. Slate

3. It is the State's Research Laboratory, its task being to "put Science at work" for the people, especially in relation to Agriculture.

Each year, the Station staff writes some 20 bulletins, besides many papers for scientific journals, answers thousands of inquiries, delivers many public lectures, confers with farmers individually and in groups, with the Extension workers, and holds meetings and field days at the Station and at the farms.

4. Staff

There are 53 members of the professional or scientific staff, and a total of 117 engaged in all phases of Station work. The scientific staff is drawn from all parts of the country, recruited in the same manner as a university faculty.

5. Plant and Equipment

a. **The main grounds**, laboratories and office at New Haven are located on 6 acres of land on Huntington Street, purchased from the estate of Eli Whitney in 1832.

b. The Experimental Farm at Mount Carmel—43 acres on Evergreen Avenue.

c. The Experimental Forest at Rainbow—110 acres.

d. The Tobacco Farm and Laboratory at Windsor—13 acres.

e. The Vegetable Field at Windsor (leased)—7 acres.

The total value of the Station's property, acquired through the State and by bequest, is in excess of $600,000.

6. Organization

The work is organized in eight departments listed below. For each is given a brief outline of the principal activities.

SOILS—Dr. M. F. Morgan, Chief

1. Mapping of Connecticut Soils and Land Types in relation to use.
2. Chemical and physical properties of Connecticut soils, including forest soils.
3. Fertilizer requirements of the crops of Connecticut, including trees, vegetables, and ornamentals.
4. Soil management in relation to these crops.
5. Soil analyses and "Testing".
6. Soil Erosion in Connecticut.

Note: 10,000 soil samples were tested last year in Connecticut alone by methods devised at the Station. These methods are now used by commercial companies and experiment stations in 20 other states. A Soil and Land Use Map of Connecticut has just been completed.

ANALYTICAL CHEMISTRY—Dr. E. M. Bailey, Chief

1. Official inspection (analysis) of Fertilizers, Feeding Stuffs, Foods, Drugs, Insecticides, Fungicides and miscellaneous materials, as provided by the several statutes relating thereto. This includes the biological assay of Vitamin D Milk and Cod Liver Oil for poultry.
2. General analytical work for the Station, for the Storrs Station, and for other State Agencies, such as the State Purchasing Department, the State Water Commission, and the State Veterinarian.
3. Calebration of Dairy and Creamery Glassware.
4. Analytical service for citizens, in special cases.
5. Research on analytical methods.

Note: Connecticut pioneered in this work, beginning with Fertilizers in 1875. Some 4,500 samples of all kinds are analyzed each year.

BIOCHEMISTRY—Dr. H. B. Vickery, Chief

1. Protein Chemistry: researches on the determination and properties of proteins and amino acids.
2. Plant Physiology: the chemical constituents of plants, especially tobacco, and the changes that occur during growth.
3. Nutrition: researches on the rate of growth and mineral requirements of growing animals.

Note: Much of present-day knowledge of human and animal nutrition, including Vitamins, is the result of work in this laboratory. Recently new light has been thrown on plant metabolism.

PLANT BREEDING (GENETICS)—Dr. D. F. Jones, Chief

1. Researches on the method of inheritance of various characters in plants, especially Corn.

2. The production of better strains of sweet and field corn through inbreeding and crossing.

3. Vegetable Breeding: The production of better strains of pepper, beet, squash, tomato, etc.

4. Fruit Breeding, especially strawberries.

NOTE: The method of producing Hybrid Corn, now used throughout the country, was developed at this Station. Several excellent new varieties have been bred here.

Windsor-A Pepper, Conn. Straightneck Squash and a new Strawberry are recent products of this work.

ENTOMOLOGY—Dr. W.E. Britton, Chief

1. Insect Survey of Connecticut: To keep informed of any outbreaks of new or old pests.

2. Fruit Insects: Research on the nature, habits and methods of control of Oriental Peach Moth, Japanese Beetle, Curculio, Red Mite, Aphids, Apple Maggot, Leaf Hoppers, etc., etc.

3. Vegetable Insects: The same for European Corn Borer, Corn Ear Worm, Squash Bugs, Bean Beetle, Cabbage Maggot, Flea Beetles, Thrips, etc., etc.

4. Forest and Shade Tree Insects: The same for Pine Shoot Moth, Elm Bark Beetles, Pine Weevil, Spruce Gall Aphid, etc., etc.

5. Household Insects: The same for Termites, Ants, Moths, etc., etc.

6. Parasites: Research on native and introduced species, with the object of use in control of pests, especially the Oriental Fruit Moth and Japanese Beetle.

7. Insecticides: Search for better materials and methods of application.

8. **Administration of the Plant Pest Laws:** In regard to Nursery Inspection, Gypsy Moth, Bee Diseases, Salt Marsh Mosquitoes, Japanese Beetle, Corn Borer.

(By law, the Station Entomologist is also the State Entomologist, who is charged with the above duties.)

NOTE: Dr. L. O. Howard once said that the last great struggle on earth will be between man and the insects. Perhaps this is the reason the Entomological Department is our largest group.

FORESTRY—Mr. W. O. Filley, Chief

1. Experiments on plantings of different species of trees at Rainbow—methods of management and studies of growth and habits.

2. The hundreds of Forest Plantations throughout the State are being observed for causes of success and failure.

3. Coöperative studies in the State Forests on methods of management.

4. Special studies on Red Pine.

5. Methods of treating Native Woods for use as fence posts.

6. Distribution of planting stock.

7. Control of White Pine Blister Rust, under the Statutes relating thereto.

8. Control of Dutch Elm Disease, under the Statutes relating thereto.

NOTE: The Experimental Plantations at Rainbow were started in 1901, the first of the kind in this country.

The post-treating work is proving that native woods can be used in place of chestnut.

BOTANY—Mr. E. M. Stoddard, Acting Chief

1. Plant Disease Survey of Connecticut: To keep informed of outbreaks of new and old diseases.

2. Life history studies of new diseases, and methods of control for Dutch Elm Disease, "X" Disease of Peach, etc., etc.

3. Tests of new fungicides and other controls for diseases of Vegetables, Fruits, Ornamentals, and the like.

4. Methods for growing greenhouse plants in sand.

5. Fruit Spray Service for County Agents.

6. Seed Testing, as provided by the Seed Law.

NOTE: The Station introduced spraying for disease control in Connecticut, 1888. Also, Seed Testing began here in 1880.

THE TOBACCO SUBSTATION— Dr. P. J. Anderson, Chief

(This is located at Windsor and is managed as a Station Department)

1. Fertilizer Experiments: Sources and rates of application.

2. The effect of nutrient elements on growth and quality—as potassium, calcium and boron.

3. Improvement of strains by selection and breeding.

4. Curing Experiments.

5. **Effect of harvesting** at different stages of plant development.

6. Survey and research on tobacco diseases: Downy Mildew or Blue Mold, Wildfire, etc., etc.

7. Control of tobacco insects (in coöperation with U.S.D.A.).

NOTE: Through the work on control of diseases and on fertilizers alone, the cost of upkeep has been returned many fold.

In addition to the research program, a large part of the Staff's time is spent in personal conferences with growers and packers.

PROGRESS OF THE STATION'S WORK

ANALYTICAL CHEMISTRY

ALTHOUGH the Station was not established until 1875, analyses of commercial fertilizers were made as early as 1854 by Professor Johnson under the auspices of the State Agricultural Society. Out of this work developed a realization of the need for a research institute, or Agricultural Experiment Station, that would put science at work for the farmer.

After the Station was established, the Analytical Laboratory began work on fertilizers, but very soon other analyses were added: feeding stuffs, milk and butter, vinegar; and later, foods and drugs in general. The State of Connecticut now has statutes regulating the sale of these and other agricultural products, under which the Station is assigned to act as an impartial, fact-finding agency. Corrective measures are usually the responsibility of the Commissioner. Results are reported in at least three bulletins published annually.

Commercial Fertilizers

The first annual Station report, dated 1876, includes analyses of 112 commercial fertilizers offered for sale to the farmers of Connecticut during that and the previous year, 1875. No guarantees were required, and some of the materials marketed were not suitable for improving the soil. Today the State requires the registration of all fertilizers sold in Connecticut, and a label on each package, declaring the contents. The most recent fertilizer report contains the analyses of 791 samples, representing 325 brands. The purpose of the inspection is primarily to determine whether the vendors have met the guarantees stated on the labels, but other useful tests are often made.

A new feature is the examination of samples to determine their relation to soil acidity. Connecticut soils have a natural tendency toward acidity. For that reason and because some crops are especially sensitive, liming is a common practice. In cases where soil is in the proper condition for a given crop, it is probably best to use a non-acid forming fertilizer. Manufacturers are now making up formulas to meet these requirements, and others that contain enough lime to offset acidity.

Commercial Feed Stuffs

Feeding stuffs to the number 1508 were examined. Although the law does not yet require the registration of dog foods, the number of brands marketed has increased enormously in recent years, and in 1936 a preliminary survey was made by the Station. During the past two years, 71 brands have been collected and analyzed and the results published.

In 1937 the Station began to make assays for vitamin D potency in oils offered as supplements in mixed feeds, especially for poultry. These oils are sold with a declared unitage of vitamin D, and the object of the tests or assays is to determine the accuracy of the declarations. For this purpose the Station has installed a laboratory in which chicks are used and the assays are conducted according to the procedure adopted by the Association

of Official Agricultural Chemists. During the year, 44 samples of oil were tested; 27 were satisfactory; 4 passed and 13 were below the potency claimed.

Foods and Drugs

In the latest bulletin on foods and drugs, the improvement in purity of samples tested in 1937 over those tested in 1896, when the first report was made, is noted. Connecticut pioneered in the chemical examination of foods, having published analyses as early as 1877. The General Assembly passed a general food law in 1895. This remained in effect until 1907 when it was revised to conform to the then newly enacted federal act of 1906. The latter has now been superseded by the Federal Food, Drug and Cosmetics Act of 1938.

In 1896, the Experiment Station examined 848 samples of foods and found 254 adulterated and 24 doubtful—a failure of 23 percent. In 1937, only 72, or 5 percent, of a total of 1,377 food samples were adulterated, below standard or questionable. When inspection first started, not only were substitute foods frequently sold as the genuine product, but materials hazardous to health might be included in the sophistication. Such gross adulterations as imitation coffee, ground soapstone in baking powder, and preservatives in milk, are rarely or never found at the present time. Most of the adulterants found in foods in the course of our inspections in recent years have been in the nature of economic frauds rather than health hazards.

Among the recently added duties of the Laboratory is the checking of samples of vitamin D milk sold by more than 40 dairies in the State which produce about 16,000 quarts per day. Using the Station colony of white rats, bio-assays are made of samples collected by agents of the Dairy and Food Commissioner. Results are reported to the Commissioner who takes corrective measures when necessary.

What has been said of the general improvement in foods applies also to drugs. The first report was made in 1908, when 60 percent of the samples of four different items of drugs examined were adulterated or below standard. In the period from 1934 to 1937, approximately 30 percent of the 1000 samples of a wide variety of drugs were substandard or objectionable. The last inspection shows only 7 percent of 277 samples analyzed in the substandard class.

Other Services

It falls to the lot of this department also to analyze miscellaneous samples for other state departments and for individuals. Among these are samples for the State Purchasing Department and for the Water Commission. Frequently the Commissioner of Domestic Animals or the Pathologist at the Storrs Station suggests that farmers submit the stomach contents of farm animals that have apparently died of poisoning; or individuals themselves send in fruits, vegetables and other products for determination of spray residue. Although this work is not required, it is considered helpful and important.

Members of the staff have served as referees or collaborators of the Association of Official Agricultural Chemists in studies of chemical and biological methods of analysis. The chemist in charge has served as a member of the Committee on Definitions and Standards for Foods of the U. S. Department of Agriculture and as a member of the Council on Foods and the Council on Pharmacy and Chemistry of the American Medical Association. He has served also as chairman of a Committee of the Association of Official Agricultural Chemists to prepare a revision of the chemical section for the seventh edition of "Standard Methods of Milk Analysis", published by the American Public Health Association. He, and members of his staff, have assisted the Dairy and Food Commissioner and the Director of this Station in revising to date the rules and regulations relating to the Food and Drugs Law of this State.

BIOCHEMISTRY

THE beginnings of biochemistry at this Station are linked with the names of Thomas B. Osborne and Lafayette B. Mendel. It was in 1888 that Dr. Osborne began his famous studies of the vegetable proteins. Twenty years later, in collaboration with Professor Mendel, came a series of classical studies of the nutritive value of these substances. In addition to these lines of investigation, the department is now making an intensive study of the chemical changes that take place in plants during growth.

Tobacco Leaf Studies

Station Bulletin 399, published during the past twelve months, gives a full report of the changes in chemical composition of tobacco leaves when these are kept with the bases in water either in light or in darkness. The data are of great value for the interpretation of the reactions that occur in the living plant, and bear particularly upon the conversion of the protein nitrogen into the amides asparagine and glutamine. The part taken in these reactions by the organic acids and the carbohydrates was also investigated and several reactions of fundamental importance were detected. Malic acid is largely converted into citric acid, and asparagine is produced in large amounts during culture in darkness. In light, on the other hand, malic acid and citric acid remain essentially unchanged, while glutamine is produced to a greater extent than asparagine. In his recent Silliman Lectures at Yale University, Professor C. A. Chibnall of London University made extensive use of these data in the development of a general theory of the relationships between the chief leaf constituents and their share in the fundamental reactions of the plant.

Analogous experiments have also been carried out with tobacco stalks. The results have significance for the interpretation of some of our work with tobacco leaves and particularly in connection with the work on rhubarb leaves Similarities and differences in behavior were discussed in Bulletin 407.

Rhubarb Leaf Studies

A full investigation of rhubarb leaves was undertaken in order to have material obtained from another species for comparison with the tobacco plant. Rhubarb was selected because there is reason to expect certain

differences in the behavior of a very acid tissue. The work involved culture of leaves in water in light and in darkness and in glucose solution in darkness. The results have confirmed certain conclusions drawn from our tobacco investigations and have shown in what way the amide metabolism of rhubarb differs from that of tobacco. The analytical work was completed during the year and the preparation of the results for publication is now going forward.

Beet Pigment Studies

The red pigment of the common beet was isolated in pure form as part of an investigation of the methods of analysis of beets. The Department of Genetics is interested in the development of strains of beets of high pigment content, because these are more desirable commercially than beets of pale color. A simple method was found to measure pigment, providing an essential tool for the beet breeding program.

A study of the chemical nature of the pigment itself gave reasons for believing that it is allied to such substances as the pigments of grapes and many other fruits and flowers. It differs, however, in that it contains nitrogen, being the most highly nitrogenous pigment of its type that has been found in nature.

Protein Studies

A new analysis of the basic amino acids of zein, the important protein of corn, has been made, and results conform closely to the predictions of physical chemists who have recently studied this protein in England and in the United States. The laboratory has had many conferences with protein specialists from abroad. Professor Astbury and Dr. Dorothy Wrinch have visited us from England, and we have had much correspondence on subjects of interest to protein chemists.

Nutrition Studies

Further investigations of the salt mixture (351) that was reported last year have indicated that it is well suited for studies of the inorganic salt requirements of young rapidly-growing albino rats. Studies on reproduction and on long-time growth are still in progress and cannot be summarized at this time.

To determine the exact daily requirements of the animals for calcium and phosphorus, a modification of salt mixture 351 has been prepared. The new mixture, 371, does not contain salts of calcium or phosphorus and thus it is possible to vary the amounts of these elements without altering the proportions of the other inorganic constituents of the food. Early work indicates that the requirements of the rat for skeletal development can be met more satisfactorily if the proportion of calcium and phosphorus of the food are varied with changes in the body weight.

The general investigation of calcium metabolism has been extended to include the utilization of calcium from green leaves. Preliminary results show that leaf tissues differ widely in their content of calcium and in the extent to which it is utilized by the animal body.

The study of the effect of intraperitoneal injection of thymus extract on the growth and development of the animals of our colony has been concluded. This work was first undertaken at the suggestion of Professor Mendel, in order to duplicate, if possible, results obtained by Dr. L. G. Rowntree of the Philadelphia Institute for Medical Research. Dr. Rowntree and his colleagues had demonstrated a marked acceleration in early growth and in the development of certain organs, when thymus extract was administered. The plan in this laboratory was to study the effect of this rapid growth and development on the skeletal system.

Briefly, there has been no confirmation of the results obtained in the Philadelphia laboratory. There has been no indication of precocity such as early eruption of the teeth and opening of the eyes. Inasmuch as the normal rate of growth of the animals of this colony is so much higher than in the colony at the Philadelphia Institute, a comparison has been made of the size of the thymus glands of animals from the main stock colony with those from offspring of thymus-injected animals, in an attempt to determine a cause for the failure of the animals of this colony to develop more rapidly when the thymus extract was administered. A small number of animals was available for this comparison and in most cases the thymus of untreated stock animals was much larger than in those animals born of thymus-injected parents.

BOTANY

There have been two major changes in the Botanical Department during the past year that have definitely affected the research program. On July 1, 1937, after 35 years of service, Dr. G. P. Clinton retired as active head of his department to devote his time to research. Previous to that time he had set his house in order but there was one piece of incompleted work that he was eager to accomplish. That was to discover how the tomato became infected with the late blight of potato, *phytophthora infestans*.

The blight appeared early in Connecticut in 1937. Dr. Clinton and his assistant made trips to many farms to look for the trouble. On one of the warmest days of mid-July, he visited a great many fields, working among the plants in the scorching sun. A few days later he suffered the stroke that ended in death on August 13.

Dr. A. A. Dunlap, one of Dr. Clinton's students in the graduate school at Yale University, and for seven years assistant mycologist at the Station, resigned on July 1, 1938, to become head of the Department of Plant Pathology and Physiology at the Texas Experiment Station. Dr. Dunlap had worked especially on vegetable diseases in Connecticut and had come to know the situation well. His method of controlling rootrot of seedlings by raising them in sand has been enthusiastically received by many growers. His departure curtailed plans of the Botanical Department to a certain extent last summer.

Fortunately the Station was able to obtain the services of a young man who had previously assisted in the department to carry out as far as possible Dr. Dunlap's plans for 1938.

Sand Culture of Seedling and Mature Plants

After the publication of a bulletin and circular on raising seedlings in sand, the method roused tremendous interest, and work continued in the greenhouse and, during the spring, in coldframes outdoors. Better systems of watering and feeding the plants in sand were worked out, and it was demonstrated that most kinds of sand could be used once, without the hot water washing advised in the publications. In addition to the seedling work, vegetables and flowers have been raised to maturity in sand in the greenhouse, and growers are eagerly watching the progress of experiments. The purpose now is to find the proper nutrient solutions for mature plants and a practical method of supplying this solution to large benches in commercial greenhouses.

Copper Sprays on Muskmelons

Muskmelons are an uncertain crop in Connecticut. There is a good market, but there are diseases and insects that may ruin the yield in a bad season. Moreover, the treatments ordinarily used to check downy mildew and the striped cucumber beetle are likely to injure the melon foliage, and vigorous vines are essential to the development of good fruits.

After several years of trials with different copper sprays, results during the 1937 season were encouraging. Eight copper sprays were compared for control of disease and toxicity to the plants themselves. Downy mildew did not appear until late in the season and an unprecedented crop of four tons of melons on one-fifth acre of land was harvested. The two sprays that seemed to be most promising were copper oxychloride and copocil.

In the 1938 season, experiments were extended, using 21 different fungicides, most of them commercial preparations. Downy mildew appeared early and was so severe that vines on check plots died before fruit was full grown. Coposil did not retain first place as a control measure. The following materials gave good or fair control: Oxo-Bordeaux, Grasselli Copper Compound A, Coposil, Copper-Hydro "40", Basi Cop, and Cupro-K. Bordeaux mixture gave good control of the blight but injured the melon foliage and reduced the set of fruit. Other materials were not satisfactory and one was actually harmful. Treatments began on July 20 and were continued at seven- or ten-day intervals until mid-September. Unfortunately, there was no comparative yield data in 1938 because the hurricane destroyed the crop before the final harvest.

Vegetable Sprays

Similar disease-control experiments were also carried out for downy mildew blight on cucumbers, late blight on tomatoes, leaf blight on carrots and Cercospora leaf spot on beets. At present no definite statement can be made regarding the best fungicide to use in each of these cases. Conclusive results can only be reached through repetition of the experiments for one or two more seasons under different weather conditions.

"X Disease" of Peach

The Station has now been working on the "X Disease" of peach for six seasons. Although there are still many things to be found out in regard to the mysterious trouble, the results of certain lines of investigations are most encouraging. For example, it can probably be demonstrated that satisfactory control may be obtained and maintained by destroying choke cherries in the vicinity of a peach orchard, provided clean stock is used for planting.

The results of budding and grafting experiments, started in 1937, have been quite satisfactory. A much higher percentage of peach trees budded with infected choke cherry showed definite symptoms of disease than in previous years. Also a higher percentage of infection from peach to peach was obtained. Nearly all grafts made in that summer of 1937 took, and made some growth the same season, but every one died during the winter. Evidently the short time they were alive was sufficient to produce the disease in the grafted tree.

Peach trees budded in 1937 with patches of root bark from diseased peach showed infection in 1938, which corroborates our previous findings that the disease is systematic and not localized in the branches where it is visible. Healthy peach trees root-grafted with diseased root scions showed as high a percentage of infection as did the budding with root bark. Patches of bark from diseased peach twigs budded into healthy peach gave nearly as high a percentage of infection as was obtained by the use of diseased buds. Similar results were obtained from the use of diseased choke cherry twig bark patches, although cherry root bark failed to produce evident infection in the first season. A few peach trees budded with diseased peach or choke cherry buds in 1936 showed infection in 1938 for the first time, demonstrating that the disease may carry over one season without evident effect on the tree.

While it is still too soon to draw final conclusions from our field experiments for the control of "X Disease" by the destruction of immediately adjacent choke cherry, the conditions to date are quite satisfactory. About 2 percent of infection appeared in orchards around which choke cherry was removed, contrasted with 10 percent in those not cleaned up. All seven orchards treated were in the southern part of Connecticut where trees have been blasted by disease. Orchards where the infected trees have been removed are not far from other sources of infection.

During the summer of 1938, considerable work was done on the relation of insects to the spread of the disease, the results of which, if any, will not be available until the summer of 1939.

In some of the orchards where records of the behavior of individual trees have been kept for several years, it was found that a few trees remained healthy, even when surrounded by infection. With the thought that perhaps these trees have a natural immunity to the disease, we have budded some healthy seedling stocks from them, hoping that a resistant strain of these varieties may be developed.

In regard to the known distribution of the "X Disease", diseased choke cherry is present throughout Connecticut, eastern Massachusetts and the eastern part of New York, extending somewhat into Vermont. The spread on peach in Connecticut has not been so rapid but nevertheless is surely increasing each year.

Apple Sprays

The apple spraying experiments at the Mount Carmel Farm have been continued in coöperation with the Entomology Department. These experiments are conducted for the comparison of various spray materials and schedules of application, with the object of finding as cheap and simple a schedule as possible, consistent with good commercial control of pests. From this study has been evolved the use of a combination of arsenate of lead, hydrated lime and fish oil, which has proved to be a satisfactory spray for the control of fungi and insects on varieties not susceptible to scab. As a result of the use of this material in comparison with sulfur, it was found that sulfur sprays killed the natural enemies of the European red mite and militated against satisfactory summer control. In an effort to find a suitable fungicide other than sulfur for scab-susceptible varieties, various copper compounds have been tried but so far they have been unsatisfactory because of the injury to foliage and fruit. None of them has shown any outstanding value as a fungicide for scab control.

Chestnut Blight

For a great many years Dr. Clinton was deeply interested in the chestnut blight. He and the Station Forester obtained about a bushel of nuts of the American species from Virginia and planted the resulting seedlings at six points in the State. These plantations are at Southport, Orange, New Haven, Hamden, Portland and Windsor, on different types of land, but in the natural chestnut country of Connecticut. Dr. Clinton's object was to keep records of the progress of these trees, to determine whether *Endothia parasitica*, the fatal blight, is gradually declining in virulence in nature.

There are plenty of spores in Connecticut woodlands to infect chestnuts, because the fungus is kept alive on shoots springing from stumps of dead trees. These sprouts sometimes grow to considerable height and bear nuts before they succumb to disease. The records of the seedlings show that a number of trees in each locality have been lost as a result of winter injury, drought, and the blight. A few reached a height of 12 to 14 feet before infection set in. In some cases replacements have been made.

The Botanical Department also has kept growing artificially in the laboratory some cultures of *Endothia parasitica* that were collected during the height of the scourge 20 or more years ago. From time to time Dr. Clinton compared the virulence of this material with fresh spores taken in the woods, by using both kinds to inoculate healthy chestnuts growing on the Station grounds. There has been a definite decline in the virulence of the blight in culture, but none in nature.

Tree Diseases Studied

Several tree diseases have been subjects of study in 1938. These included Dutch elm disease, Cephalosporium of elm, Verticillium wilt of maple, and a disease of the needles of evergreens found here for the first time.

Verticillium seems to be more widespread and increasing, and has been discovered on new hosts: coleus, pepper and smoke tree. The disease sometimes causes the death of maple. Inoculation experiments have been

conducted to determine the manner of infection and spread of the disease in the tree from a given point and time of infection.

Verticillium also occurs on elm but not so frequently as the Cephalosporium, the visible symptoms of which are often confused with Dutch elm disease.

Control of Nematodes on Chrysanthemums

The chrysanthemum bud and leaf nematode has continued to cause some trouble in florists' stocks. Infestations range from slight to severe and occur on outdoor types of chrysanthemums.

Experimental control work was undertaken at Bristol and Wallingford in coöperation with growers, and in the Station greenhouses at New Haven. These experiments might roughly be divided into three groups, namely: plant treatments, soil treatments, and combinations of these two. Biweekly observations of experiments were made from April to October.

As a result of this season's work one of the larger growers has offered to supply space and plants for further experimenting with the more promising control treatments developed this year.

Seed Testing

One of the regular services of the Station is seed testing. This work has three subdivisions: Purity and germination tests of samples submitted by growers, dealers and others, for the information of the sender; purity and germination tests of samples collected by the Commissioner of Agriculture in the administration of the seed law; and experimental work on methods, carried on as time and opportunity permit.

The analyses of samples collected by the Commissioner of Agriculture regularly constitute the largest part of the work, and this was greatly increased in 1938 by an amendment to the seed law, requiring the labelling of vegetable seeds as to germination, and by the establishment of voluntary grades of lawn mixtures.

In the past season 2,000 samples of vegetable seeds were tested for germination; 300 samples of field seeds and 36 samples of graded lawn mixtures were tested for both germination and purity; and 84 samples of ungraded lawn mixtures were tested for purity. Extra equipment and additions to the personnel of the department were required to accomplish this work.

Pest Survey

Surveys

At the request of vegetable men in the State, members of the Departments of Entomology and Botany working with vegetables made up a vegetable pest schedule in the spring of 1938. This circular in calendar form described briefly the chief disease and insect pests of farm crops in Connecticut, and outlined the controls that have been discovered or tried at the Station farms. Methods and time of applying sprays and dusts were included.

The same departments conducted a survey of insects and diseases attacking vegetables during the summer of 1938. The purposes were: (1) to obtain accurate information on the occurrence of vegetable diseases and insects, and (2) to determine the effectiveness of control measures actually used by growers. Twenty-two trips were made and 54 farms visited, with a total of 90 separate observations. Most calls were made in Fairfield, New Haven, Middlesex and Hartford counties, with some work in Litchfield, Tolland and New London counties.

Forty-six diseases and 26 species of injurious insects were found in commercial market gardens. Of these the following were causing serious losses: (1) diseases—carrot leaf blight, celery late blight, drop rot of lettuce, downy mildew of melons and cucumbers, downy mildew and black mold of onions, downy mildew of spinach and leaf spot of tomatoes; and (2) insects—Mexican bean beetle, cabbage maggot and cabbage worms, European corn borer, striped cucumber beetle, potato flea beetle and squash vine borer.

A similar survey of orchards was attempted but time was not found to collect as much data as is needed. However, it is felt that a fairly accurate picture of conditions has been made.

Results of both surveys will be presented and discussed with vegetable and fruit men.

ENTOMOLOGY

PREVIOUS to 1901, investigations and control of insect pests had been the province of the Botanical Department at the Station. Dr. W. E. Britton came here as horticulturist in 1894, but he had been interested in insects and had started collecting before attending college. That early group of insects is now the foundation on which the extensive Station collection has been built.

It was one of Dr. Britton's duties to write insect notes in the Station's annual reports. Then came the San José scale, and fruit growers of the State were instrumental in having the legislature create the office of State Entomologist in 1901. Since that time the studies of insect pests and their suppression, and certain control services required by statute, have gone ahead steadily under Dr. Britton's direction.

Each year a detailed account of this phase of the Station work is published and the reader is referred to the reports for 1937 and 1938 for further information.

Insect Survey of Connecticut

Including two gifts, amounting to 500 specimens, and collections made by the staff, there were about 5,000 additions to the insect collection last year. The Station now has well over 100,000 mounted insects.

The additions to the Check-List of Insects of Connecticut are now on the press as Bulletin No. 60 of the State Geological and Natural History Survey. This bulletin also includes a check-list of the spiders of Connecticut, prepared by Dr. B. J. Kaston. Reports on various economic insects are sent each month to Washington, D. C., and are included in the Insect Pest Survey Bulletin.

Termites in Connecticut

A large number of calls for inspection of buildings thought to be infested by termites has continued to come to the Station. Examinations were made only in cases that presented special problems, and Bulletin 382, *Termite Control in Connecticut Buildings*, was sent in response to other inquiries. Of the 104 calls made, 67 were cases of termites, 7 powder post beetles, 12 ants, and 18 of miscellaneous pests.

Studies of the effectiveness of various methods of control have shown that metal termite shields, when properly installed, have provided complete protection. Chemical treatments have been less satisfactory than metal termite shields, but are apparently effective in a large number of cases.

A series of case studies is included in the Thirty-seventh Report of the State Entomologist, Bulletin 408.

Fruit Pests

The seven outstanding pests of the fruit orchard in New England are the curculio, rosy aphid, pear psylla, Oriental fruit moth, apple maggot, European red mite and white apple leafhopper.

Oriental Fruit Moth

One of the worst is the Oriental fruit moth, on whose control the Station has been working for many years. In its larval stage the moth kills the tips of twigs, causing the shoot to branch, and later it enters the fruit. In the past year plots were dusted with all-sulfur-talc combinations and sprayed with nicotine bentonite and also a special spray designed for codling moth control. Results with dusts and the codling moth spray were discouraging but further work is needed to bring them to a practical status.

Parasite work has consisted of continued breeding of *Phaeogenes haeussleri* and studies of *Dioctes molestae*, with a view to finding some practical means of overcoming the unfavorable sex ratio.

Band and tip collections during late summer and early fall showed that *Macrocentrus* and other parasites were increasing, and band collections indicate that *Bassus diversus* went into hibernation along with the fruit moth in several places. This species was also recovered in several orchards during the summer. Continued studies of several other phases are in progress, and stocks of *Dioctes molestae* and *Macrocentrus Ancylivorus* are on hand for summer distribution to growers in 1939. Larval parasitism continues to show some correlation with the amount of infestation.

The total larval parasites distributed to growers in 1938 was 23,290 or considerably less than in 1937. This reduction was due in large part to trouble in our breeding rooms from a predator mite which caused considerable losses in our breeding stocks. This year the Massachusetts Station took care of their own supply of Macrocentrus for which purpose

one of our experienced men was loaned for a period of about one month. Massachusetts was able to supply several thousand Macrocentrus towards the end of the season in order to help us meet requests for parasites in Connecticut. A percentage of the Trichogramma egg parasites was used for much needed field experiments. Following is a list of parasites produced for liberation in Connecticut orchards during 1938.

Trichogramma sp.	5,300,000
Dioctes molestae	6,974
Orgilus longiceps	6,900
Macrocentrus ancylivorus	4,670
Bassus diversus	835
Phaeogenes haeussleri	3,911

White Apple Leafhopper

Another of the seven pests is the white apple leafhopper that causes an unsightly spotting of fruit at harvest time. Observations on the white apple leafhopper in 1938 showed relatively low populations, and destruction of adult hoppers by the hurricane before winter eggs were laid. This *may* mean less trouble from this insect in 1939.

European Red Mite

In the season just passed (1938) the European red mite was moderately abundant. The red mite is another of the deadly seven. It injures trees by browning the foliage, sometimes early in June. A heavy infestation gives undersized and poorly colored fruit one season and affects the vitality and set of fruit the following year. Even a moderate infestation leaves the tree with sickly foliage, preventing development of the fruit the latter part of the summer.

The natural enemies of the red mite are an important control and considerable time has been spent in following the different enemies throughout the season and determining the effect of certain sprays on them. In the case of summer sprays, it is probably the sulfur ingredient that kills some of the most important predators, mites of the genus *Seius*. For this reason a reduced amount of sulfur has been tried in comparison with the usual sprays. The work in commercial orchards has gone far enough to justify certain conclusions. There seems to be need of dormant oils in many cases, but the lime, lead arsenate and fish oil schedule may be all that is needed for non-scabbing varieties of apples in dry seasons in favorable locations. It was not a success in 1939 because of heavy rains. Plots receiving the sulfur sprays in 1937 experiments showed a marked reduction in predators in six out of eight orchards examined, and control of the European red mite has been marked wherever "no-sulfur" schedules have been tried.

A bulletin, number 418, on control of the red mite is now on the press.

Adhesives for Standard Spray Mixtures

Work has been continued with materials designed to increase the adhesion of standard spray mixtures, including dry lime sulfur as the fungicide. So far improvement in adhesion of the arsenate portion has been so small

that they are probably of little practical value with this insecticide. Casco waterproof glue apparently increased the spread and adhesion slightly over other materials tried. These experiments involved careful spray tests in field and laboratory and analyses for arsenic by the Chemistry Department. Laboratory work consisted of spraying and washing glass slides and careful weighing with an accurate analytical balance. Work during the summer of 1938 consisted of field tests of oil and other stickers for the lime-lead arsenate spray. Fish oils were superior to fish oil soaps in these tests.

Oil Sprays for Control of Rosy Aphid

The rosy aphid is an insect that assumes importance every two or three years. At times it may ruin 50 percent of the apples on a given tree. In other seasons the amount of fruit stunted by its feeding amounts to little more than that discarded in thinning operations. The Station has continued comparing three oils considered most efficient for control of rosy aphid, and has made a special study of one containing di-nitro-hexylphenol to control aphids and red mite. Plots in four different orchards were sprayed on an experimental basis, and careful counts of the mortality recorded. It appears at the present time that oils with di-nitro-hexylphenol are effective against aphids, and fairly so against European red mite. The oil nicotine seems to vary and was not satisfactory at dilutions less than one pint to 100 gallons. Bud counts of aphids shortly after the applications showed tar oils and *dinochp* oils were somewhat more effective. A circular, number 126, on the control of the rosy aphid is now ready for press.

Substitutes for Lead Arsenate in Orchard Sprays

Although lead or arsenic residue above the tolerance is seldom found at harvest on Connecticut fruit, the search for a reliable substitute for this spray material continues. The Station confined operations during 1937 to a field and laboratory study of derris or cubé dusts. Plots were used in two different orchards, each dusted with .5 percent rotenone dust with clay filler. In both orchards there was a marked reduction in maggotty fruit as compared with check trees, but work is being continued. Unusual rainfall during July interfered with the work. Investigations are now under way to test the possibility of increasing the life of rotenone dusts on the trees under conditions such as obtained in 1938.

Tobacco Pests

Work on tobacco insects at the Windsor Substation is supervised by this department. A review of the research of the past year is included in the report of the Tobacco Substation.

Insect Pests of Forest Trees

The summer just passed was marked by unusual outbreaks of insects of forest trees in Connecticut and climaxed with severe losses resulting from the hurricane. The outbreaks of gypsy moth, lime tree looper and forest tent caterpillar were reported when they occurred and special

measures will be necessary to curb the spread of gypsy moth. The hurricane left much down timber which will favor the increase of elm bark beetles, carriers of Dutch elm disease, unless debris is cleared up before spring.

Research on forest tree insect pests in the past year included the pales weevil, the elm bark beetle and the European pine shoot moth.

Pales Weevil

For three years some attention has been given to the control of the pales weevil, a serious pest of young pines planted on land from which pine trees have recently been cut. It is customary to wait until the third spring after cutting before replanting in order to avoid heavy losses. The Station has made several small plantings of white pines and has determined the extent of pales weevil injury and the period during which it occurs. Our observations to date indicate that the maximum injury occurs during the first spring and fall after cutting, and that it is practicable to plant white pine the second spring after cutting in regions where some pine is cut every year. This decreases the interval between cutting and planting one year.

Dutch Elm Disease

Work on the Dutch elm disease is a coöperative project of the Botanical, Entomological and Forestry Departments. A review of the Station's activities is presented under Forestry. The studies of the native elm bark beetle, a carrier of the disease, have been completed and a Station bulletin, number 387, gives an account of the findings. Two other reports are now ready for press.

Investigations show the relation between the hibernating tunnels and feeding tunnels of the adults, and their importance in dissemination of the Dutch elm disease. Experiments have been carried out on the freezing and supercooling points of the various stages of beetle development. Additional data have been obtained on parasitism, especially the finding of a new parasite of the adult beetle, and further work has been done on digestive enzymes. In this field we have also made population studies in silvicided trees and have observed the relative abundance of the two bark beetles, European and American, in various localities, particularly where the elm disease is present. Bulletin 420, *The Native Elm Bark Beetle in Connecticut*, is ready for press.

Efforts are now being made to develop methods of controlling the Dutch elm disease locally.

European Pine Shoot Moth

This enemy of red, mugho and Scotch pines, infests the tips deforming the trees. Infestations are not so severe in the northern counties of the State where colder winter weather keeps the shoot moth in check. But in 1937 in Fairfield County 50 percent, and in New Haven County 28 percent, of the young pine stands examined were severely infested.

Experiments with sprays show that ground cubé root with powdered skim milk as a spreader and adhesive is superior to lead arsenate, giving a better and more uniform control.

Population studies of this species of red pine in relation to its injuriousness have shown that the tops of the trees, regardless of their height, are more heavily infested than the lower branches. This is the reason that a small number of larvae can severely injure a tree. The larval population necessary to cause injury is 50 to 80 per tree in the fall, or 25 reaching maturity in the spring, for all red pines from 6 to 25 feet in height. The shoot moth population in a stand increases rapidly at first and then more slowly. Whether or not a saturation point is reached depends on the height of the trees.

Control of this forest pest is a joint project of the Forestry and Entomological Departments. Each year scouts examine young pine stands in northern Connecticut and the amount of control work depends upon findings. C.C.C. labor is used and work is restricted to stands where a serious infestation impends. Thus in 1937, in Tolland and Windham counties, 90 percent of the young red pine stands were apparently free of infestation. In Litchfield and Hartford counties the proportion of infested stands was also low. In the southern part of the State, particularly in Fairfield and New Haven counties, the insect is more abundant because of favorable environmental conditions. Control in southern Connecticut is carried on by the W.P.A., and again the extent of this work is determined by Station examination of the stands. The object of this control work has been to keep heavy infestations out of the stands until the trees have reached a height of about 10 feet. If this is done, there is little danger thereafter. It is also believed that a general reduction of the abundance of this insect in the southern part of the State is essential to the successful growing of red pine in this region.

Other Long-time Projects

In coöperation with the U. S. Department of Agriculture, the Station is continuing measurements of pine trees to determine the relation between rate of growth and pruning methods, to recovery from weevil attack. The pine stands are in widely separated locations providing a variety of soil types and range in weevil abundance.

During examination of nurseries, it has been observed that certain spruces are resistant to the gall-forming aphid. Work on the spruce gall aphid has been confined to propagating these immune trees for further experiment.

Insect Pests of Vegetables

In another section of this report there is a brief review of the survey of farms to determine the insect and disease pests of vegetables on Connecticut crops. The Station had investigated a number of these more serious pests in the past. Research on others is a part of the present program.

Onion Thrips

Spraying controlled onion thrips in the 1937 experiments when applications were made before the plants had been seriously injured. Materials

used were pure ground cubé (4 percent rotenone) at the rate of 2 pounds in 50 gallons of water with 4 ounces of the petroleum sulfonate spreader *Ultrawet*. The addition of wettable sulfur improved the spray if the weather was hot, but was of no value in cool weather. Sulfur burned the leaves of seed onions slightly. The "standard" nicotine sulfate spray was not effective. The tests indicated that two to four applications at weekly intervals controlled the thrips and increased the yield markedly.

In 1938, rainfall was heavy and thrips were not very destructive. No tests were made.

The European Corn Borer

In coöperation with the U. S. Department of Agriculture tests on control of the European corn borer in both early and late market sweet corn were continued. Further trials using dual-fixed nicotine dust (4 percent nicotine) and pure ground cubé root (4 percent rotenone), one pound in 25 gallons of water with a suitable spreader, indicated the continued effectiveness of these materials. Sprays applied during August to control the second generation larvae were especially effective.

Commercially prepared dual-fixed nicotine dust was as effective as the laboratory material used in previous tests.

In 1938 the insecticide tests were continued in an effort to reduce the cost of application: (1) by use of fewer applications and (2) by use of mechanical equipment.

On early corn it was found that three applications at weekly intervals were almost as effective as four applications at intervals of five days. But further tests must be made before definite conclusions can be drawn.

On late corn five applications at intervals of five days were more effective than four applications at weekly intervals. However, even four applications greatly increased the yield of borer-free corn.

The experiments on date of planting corn in relation to corn borer infestation have been completed. They showed that corn maturing during August was relatively free from infestation. July and September maturing sweet corn was moderately to heavily infested.

The increased injury to dahlias has led to efforts to develop suitable insecticides to protect these plants. In 1937 the following sprays and dusts were applied seven times at weekly intervals during August and September:

1. Dual-fixed nicotine dust (4 percent nicotine)
2. Rotenone dust (1 percent rotenone in pure ground cubé)
3. Quebracho fixed nicotine spray
4. Pure ground cubé root (4 percent rotenone) 1 pound in 25 gallons with a suitable spreader.

All of these materials protected the dahlias, but the cubé spray was somewhat less effective than the others.

Tests of mechanical equipment were carried out by the members of the U. S. Department of Agriculture in New Haven. They developed

and used a wheelbarrow type of power duster and obtained excellent results with it. A similar duster is now on the market. Such equipment saves much work in dusting sweet corn and can be used for other vegetables as well.

The Squash Bug

Work on the squash bug includes control and a study of natural factors influencing abundance. Application of special pyrethrum dusts killed the nymphs and increased the yield by prolonging the life of the plant. However, the cost of the treatment is at present too high to permit its use by commercial growers and work will be continued to find ways to reduce the expense.

Studies of the effect of climate and of the parasite *Trichopeda pennipes* on the abundance of squash bugs are in progress.

Potato Flea Beetle

The potato flea beetle is one of the expensive insect enemies of crops in Connecticut. It not only injures the foliage of potatoes and tomatoes, but is found on many vegetables and flowers. It is also one of the worst insect pests of tobacco. The Station project on control of this elusive black beetle has been completed. On Irish cobbler potatoes during the past year cubé dust containing .75 percent rotenone plus the petroleum sulfonate spreader *ultrawet* was the most effective insecticide. Applications May 27 and June 3 reduced the number of beetles and decreased feeding injury. Cubé dust (.75 percent rotenone) and pure ground cubé root (4 percent rotenone) in a spray at the rate of 3 pounds in 100 gallons were less effective. The standard barium fluosilicate dust, 1 pound with 4 pounds hydrated lime, was less effective than cubé sprays or dusts.

Corn Ear Worm

Research on this insect that occasionally is an important pest of corn grown in southern Connecticut has been carried out by Dr. G. W. Barber of the U. S. Department of Agriculture. The Station will publish results of one phase of this work as Bulletin 419, now ready for press.

The most practical control measure was the application of a highly refined mineral oil, such as Nujol, on the silks. The oil was sprayed in a fine mist as soon as the silks wilted. In Florida tests, this treatment provided about 75 percent control and cost about one cent a dozen ears.

Control and Inspection

The Japanese Beetle

The Japanese beetle has continued to increase in Connecticut, and during the past season the Station published Bulletin 411 to give information on its habits, injury and control.

In addition the Station has coöperated with the U. S. Department of Agriculture in scouting for grub infestation and in placing colonies of parasites. So far *Tiphia vernalis*, *T. popilliavora* and *Centeter cinerea*

have been colonized in strategic locations. Recoveries of *T. vernalis* have been made at four different points. A careful watch is being maintained for parasite development in the different locations with a view to recolonization from parasites obtained at these centers.

The use of traps has also been continued, lawns have been inspected, and information given on lead arsenate treatment. Diggings have been made to determine degree of grub infestation.

Mosquitoes

With the aid of the Federal Government and relief labor Connecticut has completed the ditching of the 22,000 acres of salt marsh land along the shore of Long Island Sound. State-wide W.P.A. projects now include building of dikes, tide gates and improving outlets, structures that will be of a permanent nature. In addition several towns in the State have their own W.P.A. projects, some working on fresh water mosquito elimination. The State has not taken the responsibility for draining fresh water swamps. Insofar as the State appropriation permits, ditches that have been approved and accepted for maintenance by the Station have been maintained on salt marsh areas.

Corn Borer Clean-up (In coöperation with the U. S. Department of Agriculture)

During the past season control of the European corn borer included only the enforcement of the compulsory clean-up as provided in Section 2125 of the General Statutes of Connecticut. By that act all corn must be cut flush with the ground, or the stalks, stubble or other debris plowed under cleanly by April 25. Provisions are also made for the proper disposal of corn cobs and fodder and of fleshy stemmed garden plants and weeds. Inspection did not cover the entire State, but was restricted to areas where the insect has done severe damage on sweet corn.

Ten inspectors were employed from April 25 to June 1, 1938. They covered 83 towns.

The names of many growers, who had not met the law requirements, were turned over for legal action to the prosecuting officers. Usually the farmers were given more time to clean or plow their fields and nearly all made an honest effort to comply with the regulations. Altogether, eight cases came before the courts and fines and costs were assessed. For the most part prosecuting attorneys and grand jurors were very willing to coöperate in the clean-up.

The Gypsy Moth

As in former years trained scouts employed by the Station have scouted roadsides and the open country in eastern Connecticut, and the Federal Bureau of Entomology and Plant Quarantine covered the western portion of the State. Also considerable gypsy moth work was done by men from the C.C.C. camps, and the Resettlement Administration has carried on similar work on its own properties in Griswold and Sterling. A Federal W.P.A. brown-tail moth project was conducted in the eastern end of the State and, although 37 towns were covered, no nests of the brown-tail moth were found in Connecticut.

These several agencies worked in 109 towns. Altogether 536 infestations were found, 386,402 egg-clusters creosoted, 36 colonies sprayed, 42 tons of lead arsenate used, 1,192,069 caterpillars crushed by hand, 848,419 burlap bands applied, 3,494 miles of roadway and 698,772 acres of woodland scouted, and 2,348 acres cleaned. The figures for 1937-38 are not yet available, but the most important infestations are now being sprayed.

The picture now has a completely new aspect with the finding of more than 1000 acres heavily infested in Granby and Union in 1938, and with the further hazard of spread as a result of the September hurricane. It is generally agreed that drastic measures will be necessary to control the gypsy moth in Connecticut.

Inspection of Orchards and Nurseries

Altogether, 133 orchards and gardens were inspected in 1937. The regular nursery inspection included 388 nurseries covering 5,000 acres. The number of nurseries in Connecticut is now above 400. The Station is also responsible for examination of imported stock and inspected 14 shipments, containing 67 cases, and 542,975 plants of nursery stock imported from foreign countries last year.

Apiaries

In 1937 the two apiary inspectors visited 149 of the 169 towns of Connecticut and inspected 1,437 apiaries, containing 10,253 colonies. They found 222 colonies in 107 apiaries, infested with American foul brood. Of the infested colonies, 37 were treated and 185 destroyed. The average number of colonies per apiary was 7.1, and the average cost of inspection was $1.28 per apiary, and 18 cents per colony.

FORESTRY

THIS STATION was one of the first in the United States to see the need for research in forestry. Beginning in 1900, land for this purpose has been acquired in different parts of the State from time to time, and nursery stock is grown at the Tobacco Substation at Windsor. The first experimental plots were laid out at Rainbow Forest, near Windsor, in 1902. A second plantation was once part of the Communistic Shaker farm at Enfield, but experiments on this land have been practically wiped out by the hurricane of 1938. These forests were not only used as a laboratory of the Forestry Department, but by other departments whose research projects include forest soils, insects and diseases.

The work of the Forestry Department may be classed as research, and control or service, although the latter often includes research problems. The research program has suffered during recent years. Budgets have been reduced and forestry, because of slow returns, has not held the limelight. Also, there were many emergency problems that permitted the use of relief labor. These absorbed most of our time. Recently, however, some reorganization and added personnel have resulted in placing the experimental work on a better basis. A series of studies on "Red Pine in

Connecticut Plantations" is being pushed rapidly to completion. The first report, "Volume Tables for Red Pine", has already appeared as Bulletin 413.

The Rainbow Experimental Forest

For 35 years these 110 acres of sandy land in Windsor and East Granby have been managed as a laboratory of forest practice. Beginning in 1902, plantations of many forest species, mostly coniferous, were established in various combinations, spacings and methods of planting. Many silvicultural experiments have been added as the years passed and progress reports have been published at intervals, the last in 1924.

A new report was in preparation and final measurements were almost completed when the hurricane struck Connecticut on September 21. While the younger plantations at Rainbow were not destroyed, many of the older ones were, and the damage was heavy on 10 of the 75 plots.

The immediate task was to secure final measurements on all down trees, and to salvage as much as possible of the experiments terminated by the storm. This work is in progress. The report planned for publication in 1938 will be delayed but the data needed are not irrevocably lost. About 70 percent of the plots were unharmed and this unique experimental project will go forward.

Studies of Forest Plantations

Connecticut was a pioneer in coniferous forest planting and offers excellent material for study. Prior to 1933, a good beginning had been made on red pine and some results were published. Since 1932, when the staff was reduced as a measure of economy, this work has been continued in coöperation with the State Forester and the Civilian Conservation Corps with very satisfactory results. As previously stated we plan to push these studies more rapidly and, although the hurricane has destroyed many of the more mature plantations, there are enough left in the western half of the State to furnish the necessary material. Volume Tables for planted white pine are nearing completion.

Preservative Treatment of Fence Posts

For several years the State Forester and the Highway Department have coöperated on these experiments with most encouraging results. The purpose has been to make possible the use of other native woods in place of the chestnut, by devising treatments that will increase their durability when used in the ground. This involves the testing of methods and materials, testing the strength of the posts, as well as ways of seasoning and handling the posts before treatment.

One result has been to bring about the use by the State Highway Department of native species treated with creosote. As yet only one plant is in operation, but at least a quarter of a million posts have been thus utilized during the past five years.

During the past year, the so-called "tire tube method" of treating posts with zinc chloride has been tested and demonstrated as a practicable

way of handling fence posts for use on the farm. Circular 123 on this subject was published recently.

While the project has dragged for lack of funds, it is still an active one which offers opportunity for service to woodland owners. This opportunity was enlarged and emphasized by the hurricane, since much of the wind-felled material can be used best for posts.

Control of White Pine Blister Rust

Since 1917, the Station has coöperated with the U. S. Department of Agriculture in the control of blister rust, which spreads from pine to pine only through current and gooseberry bushes (Ribes) that serve as alternate hosts for the fungus. Spores may be carried by wind or insects over great distances but the practical control distance is 900 feet. Removal of such bushes from the vicinity of white pines is therefore an effective means of protection. Similar work is carried on in all the states where white pine is an important timber tree. Federal expenditures in Connecticut have greatly exceeded those by the State in recent years, and will probably be continued on the same basis in 1938-39.

For the past season, blister rust control activities included four main projects: wild Ribes eradication, nursery sanitation, mapping pine areas and painting of control area bounds. The work was done with W.P.A. and C.C.C. labor under the supervision of the Station.

The wild Ribes eradication was conducted in 31 towns on 76,805 acres of land and gave protection to 10,678 acres of pine. Two nursery sanitation zones were rechecked and Ribes eradicated.

Pine mapping was done in 73 towns; 122,174 acres of pine and control area were mapped in detail.

Painting of control area bounds was done for the purpose of identifying these areas in the field. They outline 900-foot zones surrounding pine types, and 1,336 miles of such bounds were painted.

The ultimate object of this program is to establish blister rust control as an item of forest management which will be carried on by local pine owners coöperatively or by means of town appropriations. However, it will still be necessary for the State, and probably the Federal Government, to continue the work of education, organization and supervision. Consequently, the present state appropriation will continue to be needed.

The hurricane has made control work more necessary than ever since the rehabilitation of forest lands in eastern Connecticut will be secured partly through natural white pine reproduction already present. This young growth, and any plantations of white pine, must be protected against blister rust if they are to be of any future value to the owners or to the community.

Control of the Dutch Elm Disease

Work on the Dutch elm disease began in 1935 in coöperation with the departments of Botany and Entomology. At about the same time the U. S. Department of Agriculture undertook to eradicate the disease from the region around New York City and sought the coöperation of this Sta-

tion in the enterprise. As a result, the U. S. Department of Agriculture has had state authority for the removal of condemned trees, and the State of Connecticut has joined New York and New Jersey in determining the federal policy.

In the fall of 1934, with the approval of the Governor, the Station began scouting for Dutch elm disease in portions of the State not covered by federal agents, who were then working only in Fairfield County. One infected tree was located in Old Lyme. As a result, the U. S. Department made an attempt to eradicate the disease in that town and has apparently been successful.

The General Assembly of 1935 appropriated $25,000 for Dutch elm disease control and the 1937 session duplicated this appropriation. These sums, with a deficiency appropriation of $2,500 granted the Experiment Station in 1935, make a total of $52,500 available for Dutch elm disease control over a period of four years.

State funds have been used for two seasons of extensive scouting. The second scouting in the summer of 1937 yielded no positive results.

Since 1935, the Station has sponsored and supervised an elm sanitation project which was begun under the Emergency Relief Administration and continued under the Works Progress Administration. The purpose has been to get rid of elmwood suitable for the breeding of elm bark beetles (carriers of the disease) by the pruning of healthy elms and removal of dead and dying elms on the streets, highways and other public property. This work has been done in coöperation with State Highway and municipal authorities, with contributions from such sources in the form of transportation and equipment.

Sanitation work is an essential part of the control program and in the past year it was carried on in 145 towns, in 83 of which work was completed before the hurricane. Reports show that 44,679 trees were pruned and 5,496 trees and stumps were removed.

There have been many inquiries from property owners which have necessitated at least 100 inspections of elm trees during the year. In many cases, the trees had to be climbed and sampled. Samples thus secured, as well as those sent in by scouts and others, have been cultured by the Botany Department. In cases where property owners were not satisfied with the diagnosis made by the federal laboratory, trees had to be resampled and cultures made in our laboratory as a check.

With the hope that new methods of control for the disease may be developed, the Entomology Department has been carrying on scientific investigations which are described elsewhere in this report. They are considered a highly important part of the project and should be continued.

The results of five years' work by the U. S. Department of Agriculture are encouraging in that the total number of Dutch elm disease trees found in Connecticut to June 30, 1938, was only 424. During the following summer, however, this total was increased to 887 as of October 31, 1938. It should be noted that 91 percent of the trees were in the towns of Greenwich, Stamford, Darien, Norwalk and New Canaan. There are only 11 other towns in Fairfield County in which one or more diseased trees have been found.

The isolated infection in Old Lyme appears to have been eradicated. Another isolated infection area seems to exist in Branford, North Branford and Guilford. Two trees were found in Branford and Guilford in 1936 and six in Branford and North Branford in 1938. None was found in Guilford this year. Repeated scouting has failed to locate any infected trees between Branford and Stratford, or north of Danbury. The rest of the State seems to be free as yet from any trace of the disease. In New York and New Jersey, the disease has been found in new territory this season but it has practically disappeared from New York City and the immediate vicinity.

It seems evident that the next two years will be crucial ones. There is ample evidence that, by active and efficient effort, the disease can be eradicated from isolated areas such as Old Lyme and the rate of spread definitely retarded. It is not yet possible to say that it can be completely eradicated from the generally infected area around New York City but, if the attempt should be given up now, there would never be any hope of such eradication. It is expected that the federal work will be continued with increased vigor and efficiency and Connecticut should certainly continue to coöperate as during the past five years. The requested appropriation of $12,500 per year is considered necessary for this purpose.

Distribution of Forest Planting Stock

For more than 30 years, this project of the Forestry Department has been managed as nearly as possible on a self-supporting basis. In recent years, seedling stock has been purchased and transplanted for one or two years at the Tobacco Experiment Station in Windsor. Then it has been sold to Connecticut landowners for forestry purposes, in lots of 500 or more, at a price sufficient to cover the cost. Since 1935, the stock has been sold to farmers at a discount, for which reimbursement has been received from the U. S. Department of Agriculture under the Clarke-McNary Act.

During the past fiscal year, a total of 489,000 trees was sold to landowners, of which 160,000 went to farmers, and 75,000 additional trees were grown for the State Forester on an exchange basis. Most of the trees sold were conifers, more than half being three-year transplants of white and red pine. Norway and white spruce were also much used.

As a result of the hurricane which destroyed much standing timber in the eastern half of the State, it is anticipated that the demand for forest planting stock in the spring of 1939, and for several years after, will greatly exceed the supply. It is probable that some other means of handling this project will be proposed in order to meet the emergency needs. A state appropriation may be necessary to assure adequate financial support. In that case, it may prove advisable for the Station to surrender this project to some other state agency within a year or two.

PLANT BREEDING

MAN'S EFFORT to improve plants and animals is about as old as farming itself. We know when we compare modern types with their originals that great strides had been made long before the modern tools of genetics were placed in the plant breeder's hands. The breeder is no longer searching blindly among thousands of types and crosses for a superior line for propagation. The modern geneticist is discovering how desirable characters are inherited, and much of his time is most profitably spent in studying inheritance in the plants he seeks to improve. His goal is plants that yield larger and better crops, that are disease resistant, or that are better suited to our climate, soils, and markets than those commonly grown.

Among the achievements for which this Station is recognized was the application of the principles of inbreeding and crossing to produce hybrid corn. On August 21, 1938, the New York *Times* stated that 15,000,000 acres of hybrid field corn were grown this year in the Corn Belt, and that the estimated increase in yield from the use of this new kind of seed amounted to 120,000,000 bushels. From 60 to 70 percent of the entire sweet corn acreage in this country, which is normally 550,000 acres, was also planted to seed produced by the crossing of inbreds.

This method of obtaining hybrid seed is the outcome of investigations in inheritance started at the New Haven Station in 1906. The first demonstration that the same method could be used commercially came in 1917 and since that time it has not only been the basis of new methods used in corn breeding here, but has been applied in the improvement of other vegetables and fruits.

Improvement in Early Sweet Corn

The outstanding development in the 1937 season was the performance of the new early sweet corn hybrid, Marcross C6.13. This is a cross of Connecticut Inbred Number 6 out of Whipple Early Yellow, and Connecticut 13 inbred out of Golden Early Market. The combination has been tested as far south as southern Pennsylvania and as far west as Nebraska with favorable reports in nearly every section. It is an early maturing sweet corn with large ears. In a trial in New Jersey it was completely free from bacterial wilt injury, a serious corn disease, while many other varieties were badly damaged. Other combinations that have shown up well and have proved useful are Whipcross C6.2, Gemcross C13 and Gemcross C6. Hybrid sweet corn is now rapidly replacing the open-pollinated early market garden varieties as it formerly replaced the mid-season canning and market garden types.

Hybrid Field Corn

The Canada Leaming and Burr-Leaming hybrid field corns have been used by farmers in this region for many years. Recently there has been an increased interest in field corn because of the widespread use of hybrid corn in the West. The Eastern States Farmers' Exchange has made available a fellowship in corn breeding which may be used by a graduate student, and an extensive study of a large number of western inbreds has been started. The best of these will be tried in combination with native types for the purpose of producing high yielding combinations adapted to different locations in the northeastern territory.

Supplies of stock seed selected for trueness to type of both sweet and field corn inbreds have been made available to seed producers. The Station has also tested commercial samples of many varieties of field corn, sweet corn and other vegetables. The results of all tests are made available to the growers.

Beets

Garden beet improvement has lagged behind other vegetable crop improvement for three reasons. First, beets are highly self-sterile so that it is difficult to get inbred lines that are uniform for any particular character or group of characters. In some sections of the country bag isolation has been a fairly good means of obtaining selfed seed. At New Haven this method has not been very successful although we have 95 lines which have come down through 23 original roots. To get these 23, which were able to reproduce themselves, more than 1200 roots were originally used.

The second reason for slow improvement with this crop is that we have known nothing about the chemistry or physical properties of the beet pigment. Thirdly, we have had no adequate quantitative measure of this pigment and the amount of color is an important factor in marketing beets. In collaboration with the Department of Biochemistry we have now isolated in pure form the red pigment in beets and at the same time perfected a reliable quantitative method of determining pigment in individual roots. As a result, we can select roots of known pigment content for propagation. Although some of our inbred lines contain a large amount of pigment, (.75 to 1.50 percent) none has yet been released.

Peppers

The market demands an early productive pepper of the California Wonder type. In Connecticut, California Wonder is not early, and it does not yield a satisfactory crop every year. Crosses were made in 1930 between California Wonder and Bountiful, a very early, productive, yellow, thin-walled, rough type. We hoped that an early, productive, California Wonder type could be selected from the hybrid.

Windsor-A is the first line to be released from this cross. It is not ideal in every way but it is early, productive and it has a thick wall. This pepper was the winner of an award of merit in the All-American Seed Trade Selections last year. Windsor-B, the next most promising line, has much better shape than Windsor-A but its yield is not so high.

A new series of pepper hybrids has been made between the Windsor types and Oshkosh, an unrelated line with good color and yield. The crossing of unrelated lines results in vigorous offspring. The new hybrids will be put in a picking trial next year for preliminary selection.

Tomatoes

Almost every seedsman and Experiment Station in the country has a tomato breeding project under way. With the long list of varieties, strains

and stocks that seedsmen offer for sale, the question is often asked: Just what kind of tomato is wanted? We can get early, mid-season, and late varieties of good to inferior quality.

Tomatoes are very sensitive to the environmental conditions under which they are grown. A strain may do particularly well on one farm but responds in an altogether different manner a few miles away, where there is another type of soil, or where the land slopes in a different direction.

In the small State of Connecticut there are three distinct biological zones. Within each of these there are hundreds of different combinations of soil, temperature, elevation, drainage and rainfall. Each farm has a distinctive set of environmental conditions which will probably not be duplicated on many others in the State.

Under these circumstances it is to be expected that no one strain or variety of tomatoes will do equally well in all parts of the State or on every farm. Necessarily the breeding of tomatoes must be carried on in every locality where this vegetable is grown to any extent, if locally adaptable strains are to be had by all growers.

At the New Haven Station we have hybrid tomatoes in which Alacrity, Bonny Best, Break O'Day, and John Baer have been used as parents. When these hybrids were grown at Windsor in comparison with Pritchard, Bonny Best and other standard varieties, no appreciable difference between the hybrids and standard varieties was observed. At Mount Carmel, however, some were superior to others in yield and quality of fruit. The best of these new hybrids will be distributed to market gardeners in various parts of the State for further trial.

Squash

For the past 12 years a summer squash breeding project has been under way for the purpose of producing an acceptable variety that would be earlier than the standard straightneck strains. Last year we released Connecticut Straightneck summer squash to fill that need. This squash was earlier by a week than any strain with which it was compared. It has lately received honorable mention in the All-American Seed Trade Selections.

Hybrids between Connecticut Straightneck and other inbred lines are in the process of development.

Strawberries

The strawberry is one of Connecticut's well known crops. For several years a breeding project has been carried on for the purpose of producing a more attractive berry of better quality than the varieties commonly grown. During the past two years extensive testing of a number of selected seedlings in comparison with the standard commercial varieties and the new productions from other states has shown that three of our new strawberries have sufficient merit to justify a more extensive use.

Principles of Genetics

Investigations in the field of heredity and variation have been actively prosecuted. Dr. L. J. Stadler of the University of Missouri and the

Department of Agriculture spent the summer of 1937 at the Mount Carmel farm growing corn material that could not be raised so satisfactorily in Missouri. With his coöperation, studies in the mechanism of cell division and chromosome behavior are being carried forward. The large collection of genetic material in the department has been unusually favorable for a study of abnormal tissue growth and important findings relating to the problem have resulted. These were reported in *Genetics*, *Science* and the Proceedings of the Association for the Advancement of Science.

SOILS

Although the Department of Soil Science was the last one set up at the Station, this important study had not been entirely neglected in Connecticut previously. In 1899 the first survey of the United States Bureau of Soils was made in the Connecticut Valley. Other departments were interested in soil and fertilizer problems in this field, but not until 1923 did the Station begin to make rapid advances. The work carried on in many parts of the State, as well as in greenhouse and laboratory at New Haven, includes a classification of the different soil types; constant refinement of the rapid system of testing soils for chemical constituents, originally devised here; soil and fertilizer requirements of crops, forest and shade trees; and special researches on forest soils.

Recently the Station has worked closely with the Federal Soil Conservation Service in furthering the soil erosion control projects now being developed in the Scantic River Watershed in Hartford and Tolland counties. Coöperation from this agency has also provided detailed soil-erosion-slope-land cover maps of several large orchards in the State.

The soils of the Scantic River Watershed have been grouped with respect to various factors and are being studied in relation to type of farming data assembled by the Economics Department of the Storrs Agricultural Experiment Station.

Pasture Soil Studies

A group of 15 representative pasture soils has been subjected to intensive study by laboratory methods and pot culture in the greenhouse. These soils represented a considerable range in productivity, as judged by the condition of the pasture sod and the farmer's report of carrying capacity. Good, fair and poor pastures were each represented by five soils.

The results show pasture areas of low productivity need all three of the common fertilizer elements and that good production is associated with increased chemical fertility. Phosphorus is relatively most deficient on the poor pasture soils, with nitrogen and potash less so in the order named. With the exception of naturally calcareous soils, low pH values, indicating high acidity, are commonly associated with low fertility and poor productivity. The results of the greenhouse pot trials are fully supported by both the rapid chemical tests of the Universal Soil Testing System developed at this laboratory and by the more refined laboratory analyses.

Soil Management for Vegetable Crops

Trials of various fertilizer combinations, manure, lime and organic amendments have been in progress at Windsor for several years. Abundant rainfall and severe leaching during the summer months of 1937 resulted in increased response to the heavier applications of nitrogen and to stable manure. Early crops in 1938 have again indicated the superiority of quickly available chemical fertilizers for crops making rapid growth during May and June, and the poor availability of nitrogen from manure during this early part of the growing season.

Sweet potatoes in 1937 continued to do best on a fertilizer relatively low in nitrogen and high in potash.

Irish potatoes grown for the fifth season in succession on old tobacco land showed a further decline in yield, in line with previous trends. Responses to potash have continued steadily upward, while the considerable available phosphorus residual from long continued fertilization for tobacco is still sufficient to prevent any significant response to phosphorus in the fertilizer. The use of lime in sufficient amounts to counteract the acid tendency of the fertilizer materials has been consistently beneficial.

Losses from the Soil by Leaching

The series of drainage tanks (lysimeters) at Windsor has continued to yield valuable information as to the nature and extent of the removal of necessary constituents from the soil by the leaching action of excess water. This excess comes from rains and melted snow which percolates through the soil, especially during the late fall and early spring months in most years. The rainfall during the past year has been above normal, resulting in an earlier removal of nitrates and other soluble constituents not taken up by crops. The early fall rains of 1937 made cover crops less effective than usual since the losses had already occurred before these had begun active growth. As in previous years, grass sod permitted a minimum of leaching.

Rapid Chemical Soil Tests

Studies of rapid methods for testing the nutritional status of the soil have been continued. Additional calibration of the tests was provided by the series of pasture soils previously discussed. Special attention has been given to methods for determining "minor element" constituents. Approximately 6000 soil samples per year now come to the Station from farmers and gardeners. The methods developed at this Station are now being used by at least 20 states as a guide in soil management practices.

FOREST SOILS

Liberation of Plant Nutrients under the Forest Floor

A set of 18 lysimeters, formerly under red pine, have now been installed in a hardwood stand, and data are being collected on the nutrient changes that take place in the upper portion of the soil profile.

Soil Conditions Affecting the Quality of Forest Sites

A study of the soil in relation to the site index of Connecticut oak forests has been completed. Soil studies under mixed hardwoods are to be conducted in the future on plots being laid out for growth study by the State Department of Forestry.

Improving Unproductive Forest Soils

The soils of two forest areas of especially low productivity, one in the Meshomasic State Forest at Portland and the other in the Pachaug State Forest at Voluntown, are being intensively studied. A series of plots at each location receiving various fertilizer and silvicultural treatment is supplemented by pot cultures and laboratory studies. Experiments with slow-growing forest trees must be conducted over a long period before conclusive evidence can be expected.

Soil Treatments in the Forest Nursery

A number of experiments with fertilizers and other soil treatments in forest nursery seedbeds and transplant beds have been conducted during the past ten years. The results have been assembled for publication. Briefly the data indicate that larger and stronger plants result from the proper use of fertilizer in seedling and transplant beds.

The Soil and Land Use

The significant qualities of the numerous soil types that have been identified in Connecticut are being analyzed in terms of land use characteristics and their relationships to the development of various types of farming. Basic information pertaining to this project is being summarized for publication as a Station bulletin entitled, "The Soil Characteristics of Connecticut Land Types".

TOBACCO SUBSTATION AT WINDSOR

THE STATION began investigations on tobacco in 1890, when Dr. Jenkins laid out the fertilizer plots at Poquonock. However, it was not until 1921 that the Tobacco Substation was established. The previous year the wildfire disease broke out in the tobacco fields, threatening to destroy the industry. The Station set up a temporary laboratory in Hartford, and in 1921 the growers obtained a small appropriation for a special substation at Windsor, the center of the Connecticut tobacco country. This amount was augmented by the growers and packers who made a generous contribution.

The 14-acre farm was purchased in that year, and later a small laboratory was built. Since then the demands of the tobacco growers and packers for research and direct service have steadily increased. In addition, research on vegetables has become an important project at Windsor because of the growing acreage devoted to diversified farming in the Connecticut Valley, and the unique growing conditions found there. The original wooden building that has been used for offices, laboratory and library has long since been outgrown, and there is need for a simple brick laboratory to house this important phase of the Station's work.

Direct Service

Last year growers brought 4000 soil samples to the Substation, requiring in some cases six or eight determinations each. The results of these analyses are used as a guide to fertilization practices, or in the selection of new fields for growing tobacco. This is one of the services that has increased tremendously in recent years. In addition, annually more than 100 samples of tobacco seed are tested for germination and the Station also has a cleaner which blows out the light seed. Other direct and time-consuming services include personal conferences with the farmers who come to the Substation to discuss tobacco problems, and visits to individual farms to investigate difficulties. During the past year members of the Station staff addressed many meetings most of which were arranged by the county agents.

Investigations

Altogether, the Tobacco Substation is carrying 23 projects or scientific investigations. These may be grouped under the following heads: fertilizer experiments, soil studies, physiological and chemical investigations, curing experiments, improvement of strains by breeding, tobacco diseases, time of harvesting, fermentation or sweating, and tobacco insects.

Fertilizer Experiments

Most of the land on the Station farm is divided into plots on which fertilizers are being tested. The purpose of the experiments is to find the optimum quantity of each of the essential food elements that should be applied in the fertilizer and to compare the effects of different carriers of the same element. This involves not only computation and comparison of the weight and of the grade of tobacco from each treatment, but tests of combustion, taste, aroma and the other factors which make up quality. Also chemical analyses are frequently necessary.

Since the fertilizer experiments have been pushed more vigorously than the other lines of investigation, we now have rather definite answers to many of the most urgent questions about the nutrient requirements of the crop. As long as new materials continue to come into the market, there will be need for investigations.

Soil Studies

Fertilizer investigations inevitably lead to studies of the soils to which the fertilizers are added. By means of lysimeters, the leaching of different nutrients as affected by the type of soil, by the material in which they are supplied, by the season, or by cover crops, is being studied. Soil reaction as affected by change of season and by different fertilizers is a constant subject of study. The effects of added humus, manure, lime and other soil amendments are also receiving attention.

Improvement of Strains

In both Shade and Havana Seed tobacco, strains that are resistant to black rootrot have been developed. Some of these are as good in quality as the ordinary strains and yield more. They are being tested and further

selections made each year at the Station. A new strain of Shade tobacco with higher quality and more good leaves to the plant has been developed, and growers are planting it on a large scale this year.

Along the same line of investigation is the breeding of a Broadleaf variety of tobacco resistant to the mosaic disease ("calico"). We now have some strains that are satisfactory as far as resistance is concerned, but further selection and possibly back-crossing will be necessary to make them more like the original Broadleaf in appearance and other characteristics.

Curing Experiments

The effect of environmental factors on the cure and resultant characters of the leaf has long been a subject of study at Windsor. Various fuels for raising the temperature of the shed have also been compared. Studies by the Biochemical Laboratory of the Station on the chemical changes that occur during curing are adding much to our understanding of this process.

Insect Investigations

As a result of insect studies at the Substation, we have practical methods for controlling nearly all insect pests of tobacco. In this field the Station has had the active help of the U. S. Bureau of Entomology, which has stationed an entomologist at Windsor. Three insects that do the most damage to tobacco are the flea-beetle, the wireworm, and thrips. During the past year studies were continued on the ecology and control of of these insects, and the usual survey of tobacco insects was made.

Good control of the flea-beetle on Shade tobacco has been obtained by the use of cubé and barium fluosilicate dusts at the rate of 10 pounds per acre. It has been found that although a few beetles breed in the soil under the tents, most of those found on the leaves migrate in from other fields, particularly from potatoes.

Tests with nicotine sulfate sprays and cubé sprays and dusts gave inconclusive results against the tobacco thrips.

Several materials were used for wireworm control. Dichloroethyl ether added to the setting water gave promising results but injured the young plants in warm weather. Crude flake naphthalene applied to the soil before setting the plants reduced the wireworm population significantly. There was slight injury to the plants.

Tobacco Diseases

Great progress has been made in combatting tobacco disease in the 15 years since our first report was published. At that time there were three all-important and destructive diseases of tobacco: wildfire, black rootrot and pole sweat. The disease picture is now very different. Wildfire has been practically eliminated. Black rootrot is kept satisfactorily under control by regulation of acidity of the soil and by substitution of resistant strains of tobacco for susceptible kinds. Methods of controlling pole sweat by firing the curing sheds with charcoal have been standardized.

There is still need for more work on pole sweat and the related curing disorders and these investigations are active at present. A constant watch is kept for the first appearance of any diseases that are destructive in other tobacco sections but have not yet appeared here.

Downy Mildew

The most alarming disease outbreak since wildfire has been downy mildew or blue mold of tobacco which made its first appearance in Connecticut in May, 1937. The disease had been known in the southern United States and in Australia for many years, and the pathologist at Windsor was familiar with all phases of the trouble including what had been done toward control. Immediately careful surveys were made and best-known control methods were suggested. In the meantime, research on the disease was started. Many materials were tried, but only two were found practical and successful. Either benzol or paradichlorobenzine used in the beds kills the fungus without injuring the plants.

Other diseases which are either new or rare but which have caused considerable alarm and some damage are black fire, smudge, blackleg and a new type of bedrot. All of these have been under investigation during the year.

Time of Harvesting Tobacco

Since there still exist great differences of opinion among growers as to the proper time to cut stalk tobacco, or to pick the leaves from Shade tobacco, carefully controlled and replicated experiments have been in progress for several years on both types and were continued in 1938. The results indicate that many farmers have been harvesting crops before they were sufficiently mature, with consequent loss.

Role of Yeasts in the Fermentation of Tobacco

The Station physiologist has devoted considerable time to this investigation during the last two years. He has found that the addition of yeasts accelerates and intensifies the fermentive activity and greatly improves the quality of the finished product.

Publications

Further detail on the progress of the work of the Tobacco Substation may be found in the reports published annually during the winter months. The Station also issues circulars and bulletins on individual investigations, or information that must reach the farmer before the annual report comes out. Other papers are published in scientific journals.

THE LIBRARY

During the year ended October 31, 1937, the Station Library has had approximately the following number of additions:

U. S. Department of Agriculture publications	885
State Agricultural Experiment Station publications	968
Scientific and agricultural domestic and foreign journals (separates)	2,795
Single books purchased	60
Total	4,708

The library subscribes to 80 sets of scientific journals. It receives in return for the publications of this Station about 24 sets of domestic farm journals and 26 sets of foreign agricultural journals.

The total number of cloth and paper bound volumes on hand is now about 24,500. Most of the United States Department of Agriculture and State Experiment Stations publications, as well as scientific journals, are received in pamphlet form and are not included in the volume count until bound.

PUBLICATIONS

BULLETINS OF THE STATION

July 1937, to July 1938

THE COMPOSITION OF SOME COMMERCIAL INSECTICIDES, FUNGICIDES, BACTERICIDES, RODENTICIDES AND WEED KILLERS. (Superseding Bulletins 300 and 346.) H. J. Fisher and E. M. Bailey. No. **398**.

CHEMICAL INVESTIGATIONS OF THE TOBACCO PLANT. VI. CHEMICAL CHANGES THAT OCCUR IN LEAVES DURING CULTURE IN LIGHT AND IN DARKNESS. H. B. Vickery, G. W. Pucher, A. J. Wakeman, and C. S. Leavenworth. No. **399**.

SOME COMMON HOUSEHOLD INSECTS AND THEIR CONTROL. Neely Turner and B. H. Walden. No. **400**.

REPORT ON FOOD PRODUCTS AND DRUGS FOR 1936. E. M. Bailey. No. **401**.

A STUDY OF THE BULB MITE (*Rhizoglyphus hyacinthi* Banks.) Philip Garman. No. **402**.

THE CONTROL OF CARPENTER ANTS IN TELEPHONE POLES. R. B. Friend and A. B. Carlson. No. **403**.

REPORT OF COMMERCIAL FERTILIZERS FOR 1937. E. M. Bailey. No. **404**.

DOWNY MILDEW OF TOBACCO. P. J. Anderson. No. **405**.

A STUDY OF THE INFLUENCE OF THE INTERVAL BETWEEN MATINGS UPON THE REPRODUCTIVE PERFORMANCE OF THE ALBINO RAT. A. H. Smith, W. E. Anderson, and R. B. Hubbell. No. **406**.

CHEMICAL INVESTIGATIONS OF THE TOBACCO PLANT. VII. CHEMICAL CHANGES THAT OCCUR IN STALKS DURING CULTURE IN LIGHT AND IN DARKNESS. H. B. Vickery, G. W. Pucher, A. J. Wakeman, and C. S. Leavenworth. No. **407**.

CONNECTICUT STATE ENTOMOLOGIST. 37th REPORT, 1937. W. E. Britton. No. **408**.

REPORT OF THE DIRECTOR FOR THE YEAR ENDING OCTOBER 31, 1937. No. **409**.

TOBACCO SUBSTATION AT WINDSOR. REPORT FOR 1937. P. J. Anderson, T. R. Swanback, and O. E. Street. No. **410**.

THE JAPANESE BEETLE IN CONNECTICUT. W. E. Britton and J. P. Johnson. No. **411**.

CIRCULARS OF THE STATION

CONNECTICUT STRAIGHTNECK: A NEW, EARLY, PRODUCTIVE SUMMER SQUASH. L. C. Curtis. No. **119**.

REQUIREMENTS FOR TREE WORKERS IN CONNECTICUT. Tree Protection Examining Board. No. **120**.

VEGETABLE PEST CONTROL SCHEDULE. A. A. Dunlap and Neely Turner. No. **121**.

THE "X DISEASE" OF PEACH. E. M. Stoddard. No. **122**.

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PUCHER, G. W., CURTIS, L. C., and VICKERY, H. B. The red pigment of the root of the beet (beta vulgaris). II. A method to determine betanin. Jour. Biol. Chem., **123**: 71-75. 1938.

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LIST OF PROJECTS

1938-39

Analytical Chemistry

1. Inspection of fertilizers.
2. Inspection of feeding stuffs. (Including biological assays of fortified poultry feeds.)
3. Inspection of food and drugs. (Including biological assays of vitamin D milk.)
4. Calibration of Babcock glassware and thermometers.
5. Analyses of insecticides and fungicides.
7. Analyses of special and miscellaneous foods.
8. Collaborative studies on analytical methods.

Biochemistry

1. Cell chemistry.
   a. A detailed examination of the constituents of plant cells, in particular those of leaf tissues. The further development of methods for the determination of the different forms of nitrogen in such tissues.
   b. Chemical investigations of the constituents of the tobacco and other plants with special reference to the changes that occur during culture under various conditions.
   e. The metabolism of the organic acids in plants.

2. Protein chemistry.
   a. The methods for the determination of the basic amino acids yielded by proteins with the object of increasing their accuracy and convenience.
   b. The methods for the separation of other amino acids yielded by proteins.
   c. The properties of certain of the amino acids and their derivatives.
   d. Methods for the preparation of pure proteins.

3. Nutrition investigations.
   a. The relation of diet to the rate of growth with special attention to certain factors that appear to determine rapid growth.
   b. The investigation of the relation of certain constituents of the diet, in particular the mineral salts, to growth.

Botany

2. The nature and cause of mosaic diseases of plants. (Inactive.)
5. Plant disease survey of Connecticut.
8. Spraying and dusting experiments on apples and peaches. (See also Entomology, No. 3.)
15. A study of the virulence of the chestnut blight.
20. Diseases of shade trees.
27. Special investigations of elm diseases.
28. Studies on the identification of apple varieties by seed characters.
30. Investigations of the disease of vegetable crops and their control.
   a. The control of downy mildew of muskmelons and cucumbers.
   b. Downy mildew of onions—comparison of fungicides as to control and to injury to the plant.
   c. Beets—tests of copper compounds for the control of leaf spot.
   d. Tomatoes—tests of copper compounds for the control of early blight and Septoria leaf spot.
31. Investigation of a new peach trouble ("X disease").
32. Sand and other artificial culture methods for growing seedlings and plants.

Control and Service

12. Seed testing. (In coöperation with the Commissioner of Agriculture.)
25. Spray service. (With the Extension Service, Connecticut State College.)

Entomology

3. Spraying and dusting experiments on apples and peaches. (See also Botany, No. 8.)
9. Insect survey of Connecticut.
17. Studies on the control of the Oriental fruit moth, including parasites. (In coöperation with the U. S. Dept. Agr.)
28. Investigations on oil sprays.
30. A study of insects that attack the tobacco plant. (In coöperation with the U. S. Dept. Agr.) (See also Tobacco Substation, No. 20.)
31. Studies on the biology and control of the European pine shoot moth. (See also Forestry, No. 13.)
32. The biology and control of the potato flea beetle.
34. Tests of methods to control clothes moths.
35. The biology and control of the white apple leafhopper.
36. Methods for the control of onion thrips.
37. Substitutes for lead arsenate in orchard sprays.
38. The relation of rate of growth and pruning methods to the recovery of white pine to weevil injury.
40. Studies of sprays and parasites for the control of the European corn borer. (In coöperation with the U. S. Dept. Agr.)
41. Studies on the corn ear worm. (In coöperation with the U. S. Dept. Agr.)
42. The biology and control of termites.
43. The spruce gall aphid.
44. Bark beetles of the elm.
45. Investigation of parasites of the Japanese beetle.
46. Study of the parasite, *Trichopoda pennipes* Fabr., of the squash bug.
47. Value of derris dusts in the control of aphids.
48. Study of predators affecting the European red mite.
49. Adhesives for standard spray mixtures.

Control and Service

10. Inspection of orchards and nurseries.
11. Control of the gypsy moth. (In coöperation with the U. S. Dept. Agr.)
12. Elimination of the mosquito nuisance.
13. Inspection of apiaries.
19. Control of European corn borer. (In coöperation with the U. S. Dept. Agr.)
24. Control of the Asiatic beetle.
25. Control of the Japanese beetle. (In cooperation with the U. S. Dept. Agr.)
27. Rearing and distributing parasites of the Oriental fruit moth. (In coöperation with the Conn. Pomological Society.)

Forestry

1. Experimental plantations on a sandy tract at Rainbow.
   a. Comparison of many species of conifers and hardwoods, in pure stands and in combinations.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
6. Studies of forest plantations throughout the State.
   a. Studies of growth and yield of the several species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. An investigation of the distribution and growth of forest trees as influenced by soil conditions and other site factors.
12. A study of preservative treatments of native woods.

Control and Service

5. Distribution of forest planting stock. (In coöperation with the U. S. Dept. Agr.)
7. Control of white pine blister rust. (In coöperation with the U. S. Dept. Agr.)
15. Control of Dutch elm disease. (In coöperation with the U. S. Dept. Agr.)

Genetics

1. A genetic study of hereditary characters in corn involving their linkage relations and variability.
2. The effects of inbreeding and crossing upon corn.
3. Methods for the improvement of naturally cross-fertilized plants by selection in self-fertilized lines, with particular attention to field corn for grain and ensilage; alfalfa; and to some of the more important vegetable crops such as sweet corn for market gardening and canning, beets, cabbage, carrots, cucumbers, melons, onions, radishes, rutabagas, squash; and some fruits such as bush fruits and strawberries.
4. Methods for the improvement of naturally self-fertilized plants, with particular attention to tobacco, and vegetable crops such as lettuce, lima beans and tomatoes.
5. A study of variation and the effects of selection in strains of cross-fertilized and self-fertilized vegetables.

Soils

2. The physical and chemical characteristics of important soil types in relation to the nutritive response of tobacco and other crops when these soils are variously treated in the greenhouse.
3. Nutrient requirements of vegetable crops on important soil types used for market gardening in Connecticut.
4. A study of the physical, chemical and biological conditions of several soil types in natural mixed hardwoods and in planted coniferous forests.
5. Lysimeter studies of the drainage losses and other changes that occur in several soils under heavy fertilization as practiced for tobacco and vegetables.
6. Lysimeter studies of the composition of drainage water as affected by the forest floor.
7. The improvement of the nutritional status of unproductive forest soils.
8. The agronomic application of rapid chemical tests for estimating the nutritional factors of soil fertility.
9. The evaluation of various soil factors in terms of land use and types of farming.

Tobacco Substation

1. Fertilizer experiments—various sources and rates of nitrogen, phosphoric acid, potash, lime and magnesia.
4. Tobacco nutrition studies—the role of nitrogen, sulfur, potassium, phosphorus, calcium, manganese, boron, magnesium and other elements.
5. Improvement of Havana seed tobacco by selection. (In coöperation with the U. S. Dept. Agr.)
6. Improvement of Broadleaf tobacco.
7. Improvement of Cuban shade tobacco.
13. Preservative treatment of shade tent poles. (See Forestry, No. 12.)
17. Investigations in the curing of tobacco.
19. Diseases of tobacco.
20. A study of insects that attack the tobacco plant. (In coöperation with the U. S. Dept. Agr.) (See also Entomology, No. 30.)
22. Experiments on the irrigation of tobacco.
23. Studies on the rate of growth of tobacco.
24. The effect of harvesting tobacco at different stages of maturity.

All of which is respectfully submitted.

WILLIAM L. SLATE,

Director.

REPORT OF THE TREASURER

W. L. Slate, Treasurer, in account with the **Connecticut Agricultural Experiment Station.**

GENERAL STATION FUND

(Chapter 111 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

Balance on hand July 1, 1937		.....
State Appropriation	$63,394.00	
Transferred from Mosquito Appropriation	3,404.00	
Reimbursements:		
Clarke-NcNary Fund	303.56	
State Park and Forest Commission	1,200.00	
Tree Protection Examining Board	15.00	
Miscellaneous Receipts	27.15	68,343.71
		$68,343.71
Miscellaneous Receipts:		
Balance on hand July 1, 1937	.....	
Sale of bulletins	27.15	
	27.15	
Less miscellaneous receipts deposited with State Treasurer	27.15	
Balance in hands of Station Treasurer, June 30, 1938		
		$68,343.71

DISBURSEMENTS

Personal Services:		
Salaries	$46,563.27	
Labor	6,448.42	
		$53,011.69
Contractual Services:		
Telegraph and telephone	563.17	
Travel (outlying investigations)	958.50	
" (meetings, conferences, etc.)	486.60	
Freight, express and parcel post	29.73	
Publications (reprints, etc.)	135.24	
" (bulletins, envelopes, etc.)	8.77	
" (other expenses)	209.95	
Gas and electricity	1,109.55	
Water	207.47	
Insurance (fire, boiler, burglary, and automobile)	314.48	
Miscellaneous contingent expenses	683.89	
Repairs to furniture and fixtures	51.08	
" " automobiles	287.76	
" " scientific equipment	44.24	
" " tools, machinery and appliances	177.62	
" " buildings	863.48	
Library (binding)	233.55	
Nonstructural improvements	1.66	
		6,366.74
Supplies and Materials:		
Stationery and office supplies	565.10	
Chemicals and laboratory supplies	189.26	
Spraying and dusting materials	33.09	
Photographic supplies	22.31	
Feeding stuffs	140.61	
Fertilizers	45.00	
Miscellaneous supplies	496.57	
Automobile oil	44.14	
Postage	779.04	
Gasoline for automobiles	480.88	
Coal	1,685.49	
		4,481.49
Capital Outlay:		
Furniture, furnishings and fixtures	999.36	
Library (books and periodicals)	703.33	
Scientific equipment	716.09	
Tools, machinery and appliances	240.23	2,659.01
Total disbursements		$66,518.93
Balance on hand, June 30, 1938		1,824.78*
		$68,343.71

*Reverted to State Treasury.

FOOD AND DRUG APPROPRIATION

(Section 2438 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

State Appropriation	$10,650.00

DISBURSEMENTS

Personal Services:		
Salaries	$9,535.00	
		$9,535.00
Contractual Services:		
Telegraph and telephone	.10	
Travel (meetings, conferences, etc.)	89.82	
Freight, express and parcel post	6.27	
Gas and electricity	79.80	
Miscellaneous contingent expenses	14.33	
Repairs to tools, machinery, and appliances	6.05	
		196.37
Supplies and Materials:		
Stationery and office supplies	27.45	
Chemicals and laboratory supplies	193.45	
Photographic supplies	14.31	
Feeding stuffs	165.18	
Miscellaneous supplies	29.08	
Food and drug samples	.20	
		429.67
Capital Outlay:		
Library (books and periodicals)	48.29	
Scientific equipment	84.31	
Tools, machinery and appliances	2.89	135.49
Total disbursements		$10,296.53
Balance on hand, June 30, 1938		353.47*
		$10,650.00

*Reverted to State Treasury.

FEED FUND

July 1, 1937 to June 30, 1938

RECEIPTS

Feed Fees collected by the Station and deposited with the State Treasurer	$16,845.00

DISBURSEMENTS

Personal Services:		
Salaries	$13,899.50	
Labor	364.14	
		$14,263.64
Contractual Services:		
Telegraph and telephone	8.46	
Travel (outlying investigations)	81.55	
" (meetings, conferences, etc.)	69.71	
Freight, express and parcel post	7.81	
Publications (reprints, etc.)	5.25	
Gas and electricity	438.40	
Water	54.78	
Insurance (burglary)	18.56	
Repairs to automobiles	42.97	
" " tools, machinery and appliances	35.62	
" " buildings	6.60	
		769.71
Supplies and Materials:		
Stationery and office supplies	86.35	
Chemicals and laboratory supplies	144.84	
Feeding stuffs	152.37	
Miscellaneous supplies	15.42	
Food and drug samples	1.35	
Postage	45.00	
Gasoline for automobiles	26.20	
Livestock	269.40	
		740.93
Capital Outlay:		
Library (books and periodicals)	96.91	
Tools, machinery and appliances	10 32	107.23
Total disbursements		$15,881.51
Balance on hand June 30, 1938		963.49
		$16,845.00

FERTILIZER FUND

July 1, 1937 to June 30, 1938

RECEIPTS

Fertilizer Fees collected by the Station and deposited with the State Treasurer		$12,424.23

DISBURSEMENTS

Personal Services:		
Salaries	$10,066.05	
Labor	578.34	
		$10,644.39
Contractual Services:		
Telegraph and telephone	8.72	
Travel (outlying investigations)	55.70	
" (meetings, conferences, etc)	48.20	
Publications (reprints, etc.)	5.25	
Gas and electricity	443.54	
Water	53.81	
Miscellaneous contingent expenses	10.18	
Repairs to automobiles	48.88	
" " tools, machinery and appliances	25.00	
" " buildings	9.30	
		708.58
Supplies and Materials:		
Stationery and office supplies	20.41	
Chemicals and laboratory supplies	327.67	
Miscellaneous supplies	.35	
Automobile oil	3.60	
Postage	22.00	
Gasoline for automobiles	31.28	
		405.31
Capital Outlay:		
Library (books and periodicals)	62.00	
Scientific equipment	129.70	
Tools, machinery and appliances	5.00	196.70
Total disbursements		$11,954.98
Balance on hand, June 30, 1938		469.25
		$12,424.23

GYPSY MOTH SUPPRESSION APPROPRIATION

(Sections 2131 and 2132 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

Balance on hand July 1, 1937		.....
State Appropriation		44,880.00
		$44,880.00

DISBURSEMENTS

Personal Services:		
Salaries	$25,888.50	
Labor	13,073.25	
		$38,961.75
Contractual Services:		
Telegraph and telephone	52.05	
Travel (outlying investigations)	211.30	
Freight, express and parcel post	8.48	
Electricity	17.28	
Insurance (automobile)	408.56	
Medical services	23.00	
Repairs to automobiles	252.68	
" " tools, machinery and appliances	75.64	
Rent of storehouse, office space and garages	512.00	
		1,560.99
Supplies and Materials:		
Stationery and office supplies	26.31	
Chemicals	4.50	
Insecticides	918.80	
Lumber and small hardware	4.13	
Miscellaneous supplies	291.42	
Automobile oil	122.13	
Postage	15.00	
Gasoline for automobiles	1,012.71	
Fuel	30.15	
		2,425.15
Capital Outlay:		
Tools, machinery and appliances	16.52	16.52
Total disbursements		$42,964.41
Balance on hand June 30, 1938		1,915.59*
		$44,880.00

*Reverted to State Treasury.

BEE DISEASES

(Section 2130 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

State Appropriation		$2,110.00

DISBURSEMENTS

Personal Services:		
Salaries	$1,031.25	
Contractual Services:		
Travel (outlying investigations)	945.58	
Total disbursements		$1,976.83
Balance on hand, June 30, 1938		133.17*
		$2,110.00

WHITE PINE BLISTER RUST APPROPRIATION

(Section 2126 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

Balance on hand July 1, 1937		.....
State Appropriation	$4,900.00	
Reimbursement: Tree Protection Examining Board	15.00	
		$4,915.00

DISBURSEMENTS

Personal Services:		
Salaries	$2,245.00	
Labor	1,050.00	
		$3,295.00
Contractual Services:		
Telegraph and telephone	123.05	
Travel (outlying investigations)	435.96	
" (meetings, conferences, etc.)	19.75	
Insurance (automobile)	67.30	
Repairs to furniture and fixtures	1.40	
" " tools, machinery and appliances	1.50	
" " automobiles	23.67	
		672.63
Supplies and Materials:		
Stationery and office supplies	107.07	
Lumber and small hardware	30.56	
Miscellaneous supplies	28.70	
Gasoline for automobiles	79.51	245.84
Total disbursements		$4,213.47
Balance on hand June 30, 1938		701.53*
		$4,915.00

*Reverted to State Treasury.

MOSQUITO ELIMINATION APPROPRIATION

(Section 2415 and 2416 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

Balance on hand July 1, 1937		.....
State Appropriation	$19,700.00	
Less amount transferred to Current Expense	3,404.00	16,296.00
		$16,296.00

DISBURSEMENTS

Personal Services:		
Salaries	$8,163.75	
Labor	4,741.17	
		$12,904.92
Contractual Services:		
Telegraph and telephone	9.40	
Travel (outlying investigations)	1,035.65	
" (meetings, conferences, etc.)	45.77	
Rent of equipment	21.00	
Insurance (automobile)	44.22	
Repairs to automobiles	200.39	
" " tidegates	288.52	
		1,644.95
Supplies and Materials:		
Stationery and office supplies	15.24	
Photographic supplies	35.41	
Miscellaneous supplies	59.50	
Automobile oil	19.89	
Postage	11.00	
Gasoline for automobiles	160.88	
		301.92
Capital Outlay:		
Tools, machinery and appliances	307.18	307.18
Total disbursements		$15,158.97
Balance on hand, June 30, 1938		1,137.03*
		$16,296.00

*Reverted to State Treasury.

INSECT PEST APPROPRIATION

(Section 2124 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

Balance on hand July 1, 1937			.....
Insect Pest Appropriation		$48,910.00	
Connecticut Pomological Society		400.00	
Receipts from nurserymen (penalty for failure to register)		45.00	
Miscellaneous receipts:			
Mileage for use of automobile	$2.80		
Sale of anabasine	2.00	4.80	$49,359.80
			$49,359.80

DISBURSEMENTS

Personal Services:			
Salaries		$37,656.25	
Labor		4,039.54	
			$41,695.79
Contractual Services:			
Telegraph and telephone		246.71	
Travel (outlying investigations)		2,697.50	
" (meetings, conferences, etc.)		187.18	
Freight, express and parcel post		12.72	
Publications (reprints, etc.)		5.00	
Storage of apples		81.24	
Gas and electricity		243.84	
Water		73.41	
Insurance (automobile)		132.66	
Miscellaneous contingent expenses		25.25	
Repairs to furniture and fixtures		6.00	
" " scientific equipment		38.59	
" " automobiles		270.45	
" " tools, machinery and appliances		20.51	
" " buildings		7.28	
			4.048.34
Supplies and Materials:			
Stationery and office supplies		96.39	
Chemicals and laboratory supplies		109.42	
Spraying and dusting materials		289.51	
Photographic supplies		52.07	
Miscellaneous supplies		157.65	
Automobile oil		24.08	
Postage		141.75	
Gasoline for automobiles		542.52	
			1,413.39
Capital Outlay:			
Furniture, furnishings and fixtures		107.81	
Library (books and periodicals)		225.22	
Scientific equipment		134.79	
Automobiles		578.00	
Tools, machinery and appliances		87.85	1,133.67
Total disbursements			$48,291.19
Balance on hand June 30, 1938			1,068.61*
			$49,359.80

*Reverted to State Treasury.

TOBACCO RESEARCH APPROPRIATION

(Section 2123 of General Statutes, Revision of 1930)

July 1, 1937 to June 30, 1938

RECEIPTS

Balance on hand July 1, 1937		.....
State Appropriation		18,208.00
		$18,208.00

DISBURSEMENTS

Personal Services:			
Salaries	$13,570.00		
Labor	1,744.74		
			$15.314.74
Contractual Services:			
Telegraph and telephone		161.14	
Travel (outlying investigations)		237.66	
" (meetings, conferences, etc.)		181.75	
Freight, express and parcel post		2.64	
Gas and electricity		249.63	
Water		36.65	
Insurance (automobile and hail)		57.50	
Repairs to furniture and fixtures		16.37	
" " scientific equipment		20.48	
" " automobile		44.04	
" " tools, machinery and appliances		60.27	
" " buildings		224.54	
			1,292.67
Supplies and Materials:			
Stationery and office supplies		71.10	
Chemicals and laboratory supplies		150.71	
Spraying and dusting materials		4.75	
Photographic supplies		70.41	
Fertilizers		223.06	
Miscellaneous supplies		116.39	
Automobile oil		13.60	
Postage		90.00	
Gasoline for automobiles		135.31	
Fuel		447.58	
			1,322.91
Capital Outlay:			
Library (books and periodicals)		20.65	
Scientific equipment		12.93	
Tools, machinery and appliances		193.49	227.07
Total disbursements			$18,157.39
Balance on hand, June 30, 1938			50.61*
			$18,208.00

*Reverted to State Treasury.

DUTCH ELM DISEASE

(Special Act 498, 1937)

July 1, 1937 to June 30, 1938

RECEIPTS

Two-year Appropriation under Special Act		$25,000.00

DISBURSEMENTS

Personal Services:		
Salaries	$4,943.50	
Labor	3,523.54	
		$8,467.04
Contractual Services:		
Telegraph and telephone	15.30	
Travel (outlying investigations)	2,212.88	
" (meetings, conferences, etc.)	14.74	
Freight, express and parcel post	.94	
Publications (reprints, etc.)	20.00	
		2,263.86
Supplies and Materials:		
Stationery and office supplies	7.47	
Chemicals and laboratory supplies	1.62	
Photographic supplies	3.83	
Miscellaneous supplies	6.72	
Postage	6.96	26.60
Total disbursements		$10,757.50
Balance on hand June 30, 1938		14,242.50
		$25,000.00

LOCKWOOD TRUST FUND

July 1, 1937 to June 30, 1938

Received from the Trustee and deposited with the State Treasurer		$6,000.00

DISBURSEMENTS

Personal Services:		
Salaries	$700.00	
Labor	2,287.58	
		$2,987.58
Contractual Services:		
Shoeing horses	6.00	
Telegraph and telephone	39.03	
Travel (outlying investigations)	3.50	
Freight, express and parcel post	3.24	
Other transportation expenses	5.00	
Gas and electricity	91.97	
Water	40.18	
Rent of equipment	20.00	
Insurance (automobile)	67.30	
Miscellaneous contingent expenses	79.10	
Repairs to furniture and fixtures	.90	
" " automobiles	70.64	
" " tools, machinery and appliances	150.99	
" " buildings	36.82	
Nonstructural improvements	76.44	
		691.11
Supplies and Materials:		
Stationery and office supplies	43.25	
Chemicals and laboratory supplies	25.22	
Spraying and dusting materials	5.60	
Feeding stuffs	95.45	
Fertilizers	999.62	
Lumber and small hardware	5.75	
Miscellaneous supplies	661.49	
Automobile oil	18.15	
Gasoline for automobiles	157.74	
Coal	4.50	
		2,016.77
Capital Outlay:		
Tools, machinery and appliances	255.85	255.85
Total disbursements		$5,951.31
Balance held in Trust Fund by the State Treasurer		48.69
		$6,000.00

FEDERAL FUNDS

July 1, 1937 to June 30, 1938

Total Federal Funds received and deposited with the State Treasurer	$52,746.78

DISBURSEMENTS

	Hatch	*Adams*	*Purnell*	*Bankhead-Jones*
Personal services	$7,500.00	$7,500.00	$25,438.39	$5,984.83
Contractual services	.....	.....	1,447.21	668.24
Supplies and materials	.....	.....	1,950.53	623.36
Capital outlay	.....	.....	1,163.87	470.35
	$7,500.00	$7,500.00	$30,000.00	$7,746.78

Total disbursements	$52,746.78

WHAT THE STATION CAN DO

Each mail brings to the Station requests for information and service, the range of subjects being almost without limit. Every effort is made to comply with these requests, even though they are outside the fields under investigation. This is one of the purposes for which the library is maintained. However, some of the letters request help that requires an intimate knowledge of live stock management and the like, and others ask us to make laboratory determinations for which we do not have the equipment or staff. Therefore it is helpful to publish from time to time a list of the subjects on which we are best equipped to furnish information and the kinds of samples we can accept.

The Station can furnish information on:

Fertilizers and fertilization.
Soils and their management.
The chemical composition of foods, drugs, insecticides and fungicides.
Insect pests of plants and their control.
Fungous and other diseases of plants and their control.
Sprays and spraying.
Fruits and fruit management.
Weeds and their control.
Forestry—all phases.
Care of shade trees, all phases.
Plant breeding.
Lawns, establishment and care.
Bees.
Mosquito elimination.
Tobacco.
Vegetables, especially varieties and strains.

Samples and specimens that can be analyzed, tested or identified:

Fertilizers.
Feeding stuffs.
Foods and drugs.
Milk—except for bacterial count.
Seeds.
Weeds and other plants.
Insects.
Diseased and injured plants.
Soils.

The Station does not furnish information on.

Live stock feeding and management, including poultry.
Animal diseases.
Household management.
Clothing.
Farm management.
Markets and marketing.

Requests for information on these subjects should be sent to the Connecticut State College, Storrs.

The Station cannot make analyses and examinations of:

Drinking water—apply to the State Board of Health, Hartford.
Milk for bacterial content—apply to the Dairy and Food Commissioner, Hartford.
Sick or dead poultry should be sent to the Animal Diseases Laboratory, Agricultural Experiment Station, Storrs.