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SKET

BULLETIN No. 80.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
A. C. TRUE, Director.

THE AGRICULTURAL EXPERIMENT STATIONS

IN

THE UNITED STATES.

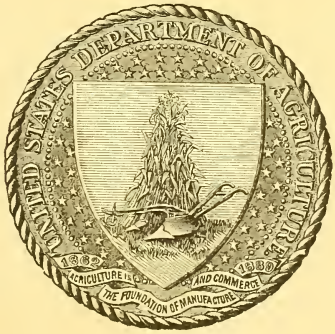
BY

A. C. TRUE AND V. A. CLARK.

THE PARIS EXPOSITION, 1900.

PREPARED TO ACCOMPANY THE EXPERIMENT STATION EXHIBIT

Contributed to by the Association of American Agricultural Colleges and Experiment Stations.



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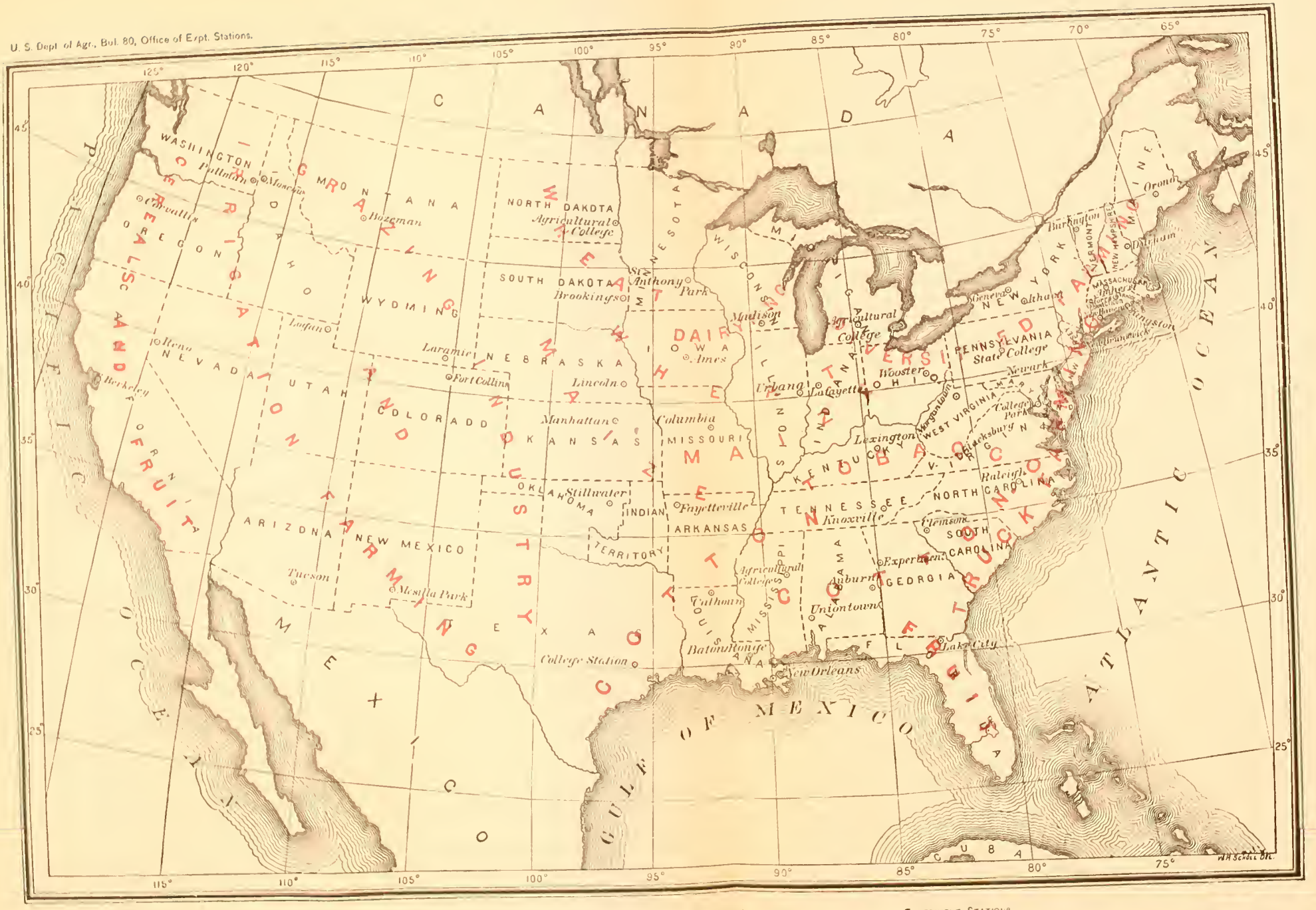

SKETCH MAP OF THE UNITED STATES, SHOWING GENERAL AGRICULTURAL REGIONS AND THE LOCATION OF THE AGRICULTURAL EXPERIMENT STATIONS.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., February 1, 1900.

Sir: I have the honor to transmit herewith a report on the history and present status of the agricultural experiment stations in the United States, prepared at the request of the Committee of the Association of American Agricultural Colleges and Experiment Stations on the Collective Station Exhibit at the Paris Exposition of 1900, and in accordance with your instructions governing the work of this Office on matters relating to that exposition. At the convention of the Association of American Agricultural Colleges and Experiment Stations held at Minneapolis, Minn., July 13–15, 1897, it was decided that the association would undertake the preparation of a Collective Station Exhibit for the Paris Exposition of 1900, provided the cooperation of the Department of Agriculture could be secured, and the following committee was appointed to have charge of this exhibit: H. P. Armsby, director of the Pennsylvania State College Agricultural Experiment Station; A. W. Harris, president of the University of Maine; W. H. Jordan, director of the New York State Agricultural Experiment Station; M. A. Scovell, director of the Kentucky Agricultural Experiment Station; and the Director of this Office. This committee decided to make this exhibit consist of objects illustrating the methods and results of the work of the stations, photographs, charts, publications, and a report on the history and present status of the stations. As a central agency for the stations this Office was requested to prepare this report, as is set forth in the letter of the committee herewith.

Washington, D. C., *October 30, 1897.*

Dr. A. C. True,
Director Office of Experiment Stations,
Department of Agriculture, Washington, D. C.

Dear Sir: We have the honor to inform you that the Committee on a Collective Station Exhibit at the Paris Exposition of 1900, appointed at the convention of the Association of American Agricultural Colleges and Experiment Stations, held at Minneapolis, Minn., July 13–15, 1897, has decided that the exhibit shall consist of—

(1) Contributions from the individual stations, illustrating by means of photographs, charts, models, or the objects themselves, special devices employed and notable results obtained in the various departments of station work.

(2) A complete set of the publications of the stations and of the Office of Experiment Stations, the card index, press bulletins, and other means of disseminating information, and a collection of photographs of the station staffs, buildings, and equipment, historical and statistical charts, etc.

(3) A comprehensive illustrated report on the history and present status of experiment stations in the United States, together with a small illustrated pamphlet for distribution at the exposition, giving a brief summary of the main facts contained in the report.

As the Office of Experiment Stations already has a considerable portion of the material for the exhibit of the publications, photographs, charts, and for the preparation of a report on the stations, and can best undertake the preparation of these exhibits, the committee respectfully request that you take charge of this work. As the honorable Secretary of Agriculture has assured us of his hearty sympathy with the plans of the committee and his desire to aid them as far as he can in the carrying out of these plans, we feel confident that he will make such arrangements on behalf of your Office as will enable you to carry on this work in a satisfactory manner.

Respectfully,

H. P. Armsby,
A. W. Harris,
W. H. Jordan,
M. A. Scovell,
A. C. True,
Committee.

This report has therefore been prepared under my direction, with the assistance of Mr. V. A. Clark and other members of the staff of this Office. Mr. Clark has given special attention to the preparation of the reports on the individual stations, and has also done much work on other details connected with the report. The chapter on the inspection work of the stations was prepared by Dr. E. W. Allen, Mr. W. H. Beal, and Dr. E. V. Wilcox, of this Office. The introductory statement regarding the general agricultural conditions of the United States was prepared by Mr. C. B. Smith; the list of publications of the stations and this Office by Mr. G. A. Harlow; and the catalogue of the exhibit by Dr. Walter H. Evans, who also did a large amount of work connected with the preparation and installation of features of the exhibit other than those involved in this report. The statistics of the stations have been compiled by Miss J. A. Davis.

The accounts of the individual stations were prepared on the basis of data furnished by the directors of the stations, and were submitted to them for revision. The illustrations have been selected from a large number of photographs furnished by the stations for exhibit at Paris.

This report is submitted with the recommendation that it be published as Bulletin No. 80 of this Office.

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

HISTORY AND PRESENT STATUS.

GENERAL AGRICULTURAL CONDITIONS IN THE UNITED STATES AS RELATED TO THE WORK OF THE STATIONS.

The United States, exclusive of Alaska, Hawaii, Puerto Rico, and the Philippines, lies in the north temperate zone, between the twenty-fifth and forty-ninth parallels of latitude. Its surface varies in altitude from sea level to 15,000 feet above it, and is so broken up by mountain chains, plains, and valleys, that within its confines every variety of climate from subtropic to arctic and from very moist to arid is found. The range of vegetable production is equally wide. There are comparatively few agricultural products of importance to the world which are not cultivated within its borders, and from an agricultural standpoint the United States is probably more independent of the rest of the world than any other nation.

In 1890, the date of the last national census, 8½ million men were engaged in agricultural pursuits. There were 4,564,641 farms, each averaging 137 acres in extent, and nearly three-fourths of these farms were owned by the occupants. The work of the country was facilitated by the use of 14 million horses, 1½ million oxen, and 2⅓ million mules. There were 51 million head of cattle (16 million of which were milch cows), 44 million sheep, and 51 million swine. The total value of the farms of the United States,[1] including improvements, implements, and machinery, was estimated at 13,770 million dollars. In 1898, the value of the maize crop in the United States was, in round numbers, 552 million dollars; wheat crop, 392 million dollars; cotton, 319 million dollars (1897 crop); hay, 398 million dollars; and the combined value of oats, rye, barley, tobacco, and buckwheat about 330 million dollars. The estimated value of the dairy products of the

[1] Exclusive of Alaska, Hawaii, Puerto Rico, and the Philippines.

country for 1900 has been placed at over 500 million dollars. The annual value of the agricultural products of the United States is estimated to have now reached an aggregate of 3,000 million dollars.

For the purpose of showing the more salient features of the different agricultural portions of the United States, with reference to the work required of the agricultural experiment stations, the country may be grouped roughly into six sections: (1) The Northeastern States, extending from Wisconsin eastward to Maine and south to Maryland, where relatively small holdings and diversified farming prevail; (2) the Middle Eastern States, including Kentucky, the Virginias, portions of Ohio, Pennsylvania, Maryland, and North Carolina, which comprise the chief tobacco-growing districts of the Union; (3) the cotton States, extending from North Carolina to Texas, and including Arkansas and Tennessee; (4) the Central and Northern Mississippi Valley and Northwestern States, chiefly devoted to the culture of maize and wheat; (5) the arid and semiarid region lying west of the one hundredth meridian and extending to within 200 or 300 miles of the Pacific Ocean, largely concerned in grazing and irrigation farming; and (6) the Pacific States, devoted to the culture of cereals, fruits, etc.

It should be understood that in this classification no hard-and-fast lines can be drawn. All these sections overlap. The classification may be accepted in a general way as indicating the chief farming characteristics of the different sections of the country.

NORTHEASTERN STATES.

The agricultural soils of these States are in general composed of a more or less thick sheet of glacial débris. They are fairly rich and stable in character, and were originally covered with a dense forest growth. The climate is relatively hot in summer and cold in winter, and is generally suited only to the cultivation of hardy crops, as maize and other cereals, forage plants, roots, grasses, and certain orchard and small fruits. The rainfall is generally abundant throughout the whole region, the annual amount varying from 30 to 50 inches.

The agriculture of the New England States in the extreme northeast of this section began more than two hundred and fifty years ago. The crops grown by the first settlers were largely such as they had known in the mother country, the seeds of which they had brought with them. The native maize began to be grown at an early day. The later conversion of New England into a manufacturing center has greatly changed the character of New England agriculture. Intensive farming, as truck gardening and forcing-house operations, has become a profitable industry about the centers of urban population, the density of which from the New Hampshire seacoast to central New Jersey exceeds in recent years that of the most thickly settled portions of Europe. In Vermont and New Hampshire the dairy industry has grown into impor-

tance. The production in New England of wheat, maize, oats, barley, and other staple crops, except in a small way for home consumption on the farm, is to-day of practically no economic importance. The home supply does not begin to equal the home demand. The tobacco industry is developing in the Connecticut Valley; and along Lake Champlain and in Maine apple culture is coming into considerable importance.

Many of the soils of New England have been cultivated for more than two hundred years. Scientific agriculture is of recent origin, and farming according to the older methods has brought the usual results. On many soils fertilizers are required in relatively large amounts. The cheap virgin soils of the Western States have attracted many farmers away from New England, and the area under cultivation does not increase. The improvement of soils of diminished fertility; the value and use of commercial fertilizers on the farm and in intensive gardening operations; the dairy industry, with its many-sided features of cattle breeding, forage growing, stock feeding, and milk, butter, and cheese production; the cultivation and care of orchards; and tobacco growing and curing, are some of the more important problems on which the experiment stations in New England are working.

The States of New York, Pennsylvania, New Jersey, Maryland, Delaware, Michigan, Wisconsin, and portions of Ohio have been classed with the New England States on the basis of diversified farming. The farming portions of New York, Pennsylvania, and parts of western New Jersey and Maryland are in a large measure at a considerable elevation above sea level. Exceptionally rich soils make farming operations in these regions generally profitable, and place these States among the most substantial agricultural districts in the Union. The Atlantic coast plain in Delaware, eastern New Jersey, and Maryland has a low contour, and the soil is relatively light in character and of medium productiveness. Favorable climatic conditions have conduced to make this plain one of the most important fruit-growing districts of the eastern United States. The contour of the agriculturally developed portions of Michigan and Wisconsin is devoid of mountains, and the climate is somewhat modified by close proximity to the Great Lakes. Maize and other cereals and hay are the principal crops of the region, and fruit growing and truck farming are very important industries. The dairy industry finds its greatest development in Wisconsin and New York, but is also an industry of great commercial importance in southern Michigan, Ohio, and Pennsylvania. Michigan, Ohio, New York, and Pennsylvania constitute the chief wool-growing States of the Union. Hop culture is one of the special crops of New York. Important grape-growing districts are found in western New York, northern Ohio, and western Michigan. Light white wines,

similar in character to some of the German Rhine wines, are made from the New York vineyards. The grapes of Ohio and Michigan are largely used for dessert purposes.

Under a system of diversified farming, the naturally rich soils of nearly all these States are still in a good state of productiveness. The competition of Western wholesale machine-produced crops and nearness to large markets have greatly stimulated the diversification of farming operations. The older methods of agriculture which neglect to take into account modern development in farming practices and the necessity of supplementing grain and hay growing with stock breeding, dairying, fruit culture, and garden and special crops have been found unprofitable. The experiment stations in this region are necessarily engaged in promoting the further diversification of agriculture, the use of more intensive methods of culture, and the development of dairying and other special agricultural industries.

MIDDLE EASTERN STATES.

As we pass from this northern group of States to those lying farther south, a marked change in soils, climate, and methods of farming is met with. A series of States is presented in which the growing of one or two staple crops has been fostered year after year on the same soils with little attempt at rotation. The climate becomes milder and negro labor is largely employed.

Virginia is grouped with Kentucky because of the common crop, tobacco, which has found extensive development in each State. Tobacco was the first American agricultural crop to be exported from the colonies. It is an exhaustive crop. In the early development of this industry in Virginia extensive fields of newly cleared land were cropped year after year with tobacco until the returns from the exhausted soil barely reached the cost of production. The fields were then abandoned and new areas sought. All over Virginia to-day may be found these abandoned lands, growing up to pines and underbrush, and one of the prominent problems of the experiment station of the State is to bring these soils back again to a state of fertility suitable for the culture of general farm crops.

The early Virginians, emigrating westward into Kentucky, carried with them a knowledge of tobacco culture. The naturally rich Kentucky soils and genial climate favored the growth of the plant, and to-day Kentucky heads the list of tobacco-producing States in America, with an average annual production of more than 200,000,000 pounds.

While tobacco historically and at the present time is a crop of much importance in these States, it is by no means the only crop grown. The blue-grass region of Kentucky is one of the most famous grazing and stock-breeding districts in America. In 1898 the State produced

85,000,000 bushels of maize, 14,000,000 bushels of wheat, and large amounts of other cereals, hays, etc. Kentucky heads the list of hemp-growing States, and produces more than 93 per cent of all the hemp grown in the United States. The peanut crop finds its greatest development in Virginia. Nearly one-third of the total crop grown in the country is produced in this State. Maize and other cereals and potatoes are also staple crops of Virginia, and in the Piedmont portions of the State apple production promises to become an industry of great commercial importance. In those portions of Ohio, Pennsylvania, Maryland, and North Carolina included in this section considerable tobacco is grown, but other crops are largely produced and the tendency is now strongly in the direction of greater diversification of agriculture.

The restoration of worn soils, the prevention of washing of lands due to improper culture, and the development of more careful and scientific methods of farming are the chief general problems on which the experiment stations in this region are called upon to work.

COTTON-GROWING STATES.

From the beginning of the nineteenth century, when the cotton gin was invented, cotton culture was developed in this region with the aid of the labor of negro slaves, and the area of cotton growing was pushed northward and westward as the population of the region increased. Land was so abundant that old fields were abandoned for new ones when the yield of cotton diminished, and this crop was so profitable that almost exclusive attention was paid to it. Since the abolition of slavery, though the price of cotton has greatly declined, the amount grown has been very much increased, and the farmers have depended almost entirely on this as their money crop. Careless methods of culture and the leaching of lands left bare of vegetation during the winter depleted the soils and rendered the use of large amounts of fertilizers necessary to successful agriculture. Recently, however, and largely through the efforts of the experiment stations, much has been done to develop truck farming, fruit growing, animal industry, and dairying in the South. More careful methods of culture and the more discriminating use of commercial fertilizers have been widely taught.

If we consider some of the geographical and special features of these States, we find the sea and Gulf coast country a rather low plain, gradually increasing in altitude toward the interior of the continent. The Florida peninsula is peculiar in being a vast ridge which rises from the floor of the Gulf of Mexico. Less than one-tenth of the total surface of Florida lies above the coast plain of the ocean and its greatest elevation does not exceed 300 feet. The soil is light, but the

subtropical climate, with an abundance of moisture and sunshine, makes the response to fertilizers on these soils quick and remunerative. West of Florida the soils are generally richer than along the Atlantic coast plain, being in general largely made up of soil brought down from the interior of the country. The rainfall is also considerably heavier. It is about 90 inches in Louisiana and decreases gradually in amount both east and west until in western Texas it is not sufficient for the support of the forests so generally prevalent over the whole eastern United States.

Texas leads all these States in the production of cotton. Its production in 1897–98 exceeded $2\frac{4}{5}$ million bales, or nearly double the amount produced by either Mississippi, Georgia, Alabama, or South Carolina, where cotton is the main crop grown. The total production of cotton in the cotton section during the season of 1897–98 was about 11 million bales.

Some of the special crops of the different portions of this section of country may be noted. The lower half of Louisiana produces nearly 300 million pounds of cane sugar annually. Small amounts of sugar, varying from 1 to 5 million pounds, are also produced in Texas, Florida, and Georgia. Louisiana is also a rice-growing State of considerable importance. Cuban leaf and Sumatra wrapper leaf tobaccos of excellent quality are successfully grown in Florida, and Louisiana has long been famous for the culture of the variety of tobacco known as perique. Oranges, lemons, bananas, almonds, and other subtropical fruits and nuts are grown to a considerable extent in Florida and some of the adjoining States. North Carolina is an apple-growing State of considerable importance, and peaches are grown in Georgia and Alabama on a large scale. Texas produced 105 million bushels of maize in 1898, and this crop was quite generally grown in all the other States. Wheat is a minor crop. Live stock and dairy interests are still in the early stages of their development, but promise to become of great commercial importance. Along the Atlantic coast from Florida north into New England, commercial truck farming constitutes one of the main agricultural features of the different States and is yearly growing in importance.

In the agricultural changes now taking place in this group of States the agricultural experiment stations have played a prominent part. Not unmindful of the need of a more thorough knowledge of the principles underlying the culture, fertilization, and improvement by selection and cross-breeding of the great staple, cotton, and the utilization of its by-products in feeding and as a fertilizer, the experiment stations have yet taken the lead in introducing and cultivating those leguminous forage plants which play so important a rôle in the restoration of impoverished soils on a rational basis. They have furthered the spread of mixed husbandry, in which the keeping of stock suffi-

cient to consume most of the products of the farm is urged, fostered the development of the dairy industry, insisted on the observance of the principle of rotation of crops, and pointed out the adaptation of the South for fruit and trucking crops.

THE CENTRAL AND NORTHERN MISSISSIPPI VALLEY AND NORTHWESTERN STATES.

A characteristic feature of nearly all the States of this group and one of the elements which contributed most largely to their rapid development is the treeless prairie lands. In Illinois and all the States west of the Mississippi River vast prairies, sometimes as level as the sea and again more or less rolling, exist. The rich, black, prairie soil, sometimes 20 feet in thickness, is almost inexhaustible; and this group of States with reference to the whole area involved is more generally suited to agriculture than any other portion of the United States. West of the Mississippi River forest areas are limited and are usually confined to river bottoms.

The climate of these States is largely controlled by the warm, rain-laden winds coming up the Mississippi River from the Gulf of Mexico and by the cold dry winds from the northwest. The rainfall is sufficient for the development of all crops, except in the western parts of North Dakota, South Dakota, Nebraska, and Kansas, where the semi-arid region begins and where seasons of drought often make farming operations precarious.

The crops of the more southern of this group of States include a wider range than is produced in any other section of the United States. All the American grains are grown except rice. Hardy orchard and small fruits flourish and stock feeding and dairy industries are in a high state of development. These States are, however, preeminently maize States. In the Northwest the wheat crop stands out above all others. Commercial fertilizers are not used except in a few limited areas in the more eastern portions of this section and rotations of crops and farm manures are relied upon to keep up the fertility of the soil.

The States most largely devoted to maize culture are Ohio, Indiana, Illinois, Iowa, Kansas, Missouri, and Nebraska. In 1898 these States produced more than 1,133 million bushels of maize. During the same year they produced 236 million bushels of wheat, 370 million bushels of oats, and hay in proportion. This enormous production of staple crops, taken in connection with selling prices nearly on a level with the cost of production, has strongly tended toward the development of stock-feeding industries and the conversion of these bulky crops into condensed products, as meat, butter, milk, and cheese. Many farmers in these States are large feeders of western range sheep and cattle, and nearly all the large slaughterhouses are located in this section of the country.

The three States of Minnesota, North Dakota, and South Dakota are essentially wheat States. It is in these States that "bonanza" wheat farming finds its greatest development. Thousands of acres of this grain are frequently under one management, and from horizon to horizon the eye sees but one vast wheat field. On these farms wholesale operations prevail and modern farm machinery finds its greatest application. In 1898 Minnesota alone produced 78 million bushels of wheat. The average yield per acre was 15.8 bushels. North and South Dakota produced 55 million and 42 million bushels, respectively. No fertilizers are used on these farms. Large profits have been realized, but it is an exhaustive system of farming. Unprofitable yields on some of the older wheat soils of Minnesota have already conduced to the introduction of rotative methods and the keeping of live stock, and generally in Minnesota, as well as the Dakotas and States farther south, reckless systems of tillage are rapidly giving way to more considerate and legitimate agriculture.

The experiment stations in this section of States are directing their energies toward the solving of problems which most directly affect their respective States. Alternate seasons of rainfall and drought along the western borders of several States have led to special studies in the conservation of soil moisture by tillage, subsoil plowing, and cultivation at different seasons. Irrigation farming from artesian wells has found a limited development. Improvement of wheat by selection, crossing, and breeding is going on in Minnesota and the Dakotas. Suitable hardy fruits for the colder northern States are being introduced and older varieties improved. The principles of stock feeding and dairy farming are being studied in nearly every State, and these problems are among the most important features of the work of the experiment stations in this region.

THE ARID AND SEMIARID REGION.

This great region lies between British America on the north and Mexico on the south, and extends from the one hundredth meridian on the east westward to within 200 or 300 miles of the Pacific Ocean. It is a high plateau of scant rainfall and completely separates the agriculture of the East from that of the Pacific States. Cattle and sheep grazing is at present the only agricultural industry except where irrigation farming is practiced. The vegetation of the larger portion of the arid plains, though scant, originally supported millions of buffaloes. The buffaloes have disappeared, but from Montana to Texas herds of cattle and sheep have come to take their place, and cattle and sheep ranches have become characteristic institutions of these Western States. The State most largely engaged in cattle grazing is Texas. The whole western part of the State is one great cattle ranch, where more than 5 million cattle are grazed annually.

The cattle ranch of the open ranges is an institution peculiar to the grazing States. On these ranges vast herds of cattle, branded with the mark of the owner, roam at will over territory often thousands of square miles in extent. Once a year, usually in May or June, occurs the annual round-up. At this round-up men on horseback systematically scour the whole territory and drive the cattle into corrals. Here they are separated; newly born calves are branded with the marks of their mothers; and beef cattle are selected for shipment north and east to be fattened and slaughtered. In the more northern States some provision in the way of sheds and fodder for the herds is necessary to tide over the winter months, and frequently great losses occur from heavy snowstorms; but in the South the cattle run out all winter and find sufficient nourishment in the nutritious grasses of the plains.

Texas, Montana, California, and Oregon are the States most prominently concerned in sheep grazing. A sheep ranch differs from a cattle ranch in that the sheep are grazed in smaller bunches and are constantly watched by a shepherd and his dogs. Sheep on ranches are destined largely for mutton rather than wool.

Ranching is a pastoral and retrogressive kind of farming, but it is the only kind suitable to the unirrigated portions of this great region. The number of sheep and cattle which the natural herbage is capable of supporting is already near the maximum limit, but it seems likely that the food-yielding power of these plains can be greatly increased by the introduction of new species of suitable plants from the arid regions of Australia, South America, Asia, and elsewhere.

The tillable soils of this whole district are abundantly supplied with all the elements of plant growth and the climate, with its clear skies and days of sunshine, is well suited to the growth of all common grains, roots, forage plants, and fruits of the United States. The chief obstacles to agriculture are lack of moisture and the presence of large amounts of alkali in the soils. In the river valleys and wherever water for irrigation can be had this intensive system of farming is in a high state of development. Beginning with the utilization of the small mountain streams for the irrigation of the gardens of the early settlers in Utah, this method of farming has grown until at present more than three million acres are irrigated, and a system of reservoirs, dams, and canals has sprung up rivaling in extent and in engineering features the imperial systems of India. The total area which can be irrigated is many times larger than that now watered, but after all the water resources have been made available for irrigation purposes the amount of land reclaimed will form but a small percentage of the whole.

Irrigation farming requires a high grade of intelligence for its successful management. The economic use of water for the growing of a great variety of crops involves problems requiring years of patient

study for their solution. The conservation by tillage of the irrigation water applied, the effects of seepage, and the rise of alkali consequent upon irrigation are related problems which the experiment stations of the arid States are investigating. Though the actual area cultivated in these arid States is limited, the amount of farm produce yielded is considerable and nowhere in the world can more ideal farming conditions be found than in some of the irrigated valleys of these grazing States.

THE PACIFIC STATES.

These include California, Oregon, and Washington. The agriculture of California is at present largely confined to the Sacramento and San Joaquin River Valley systems, constituting the great California Basin, and to a belt of coast lands south of San Francisco. In the southern and central portions of the State irrigation is necessary in the production of crops. The rainfall gradually increases northward. It is periodic in the Great Basin, and is regularly followed each year by a six-months' season of drought. The climate of the California Basin and of the tillable seacoast lands is nearly subtropic, and especially suited to the culture of small grains, fruits, vegetables, and nuts. On some of the thinly forested lands in and about the valleys cattle and sheep ranches are numerous.

In recent years the fruit industry has been greatly developed in California. Oranges, lemons, prunes, olives, peaches, pears, and raisin grapes are being extensively grown. Fresh California fruits are widely sold throughout the United States and the dried and canned fruits are found in nearly all the cities of northern Europe and in the Asiatic coast towns. The wines from California vineyards compete in the markets of the world with the wines of Europe. In the variety and development of her fruit industries California stands first of all the States of the Union, and in 1890 this State stood second in the production of wheat.

The coast belt north of San Francisco and along the western slopes of the Sierra Nevada is densely forested with conifers. The forests extend northward through Oregon and Washington, where they form the densest and noblest wooded districts of America. The tillable valley soils of all the Pacific States are deep and very fertile and promise to be unusually enduring to the tax of tillage.

Washington and Oregon, like California, seem especially adapted to the growth of small grains, the yields per acre being nearly double those obtained in the Mississippi Valley. The climate is mild and more closely resembles that of Great Britain than does any other portion of America. Deciduous fruits grow luxuriantly, as in California, but the climate seems too moist for the successful culture of the grape.

The agriculture of the Pacific States has been developed for the

most part during the second half of the nineteenth century. The problems with which the experiment stations have to deal in that region relate, therefore, to the determination of the natural conditions with reference to the development of agriculture in the manner most suitable to the local environment. Studies of the soil and its management, the testing of varieties of grain, forage plants, vegetables, and fruits, and investigations regarding the utilization of native grasses and forage plants for the development of animal industry have thus far chiefly engaged their attention.

HISTORY OF THE STATIONS.

In the first agricultural societies which were formed in this country near the close of the eighteenth century we find the beginnings of a recognition of the desirability of experimental inquiries for the advancement of agriculture. The society organized in South Carolina in 1785 had among its objects the establishment of an experiment farm. President Washington, who was a member of the first society for promoting agriculture organized in the United States, which was formed at Philadelphia, then the seat of the General Government, March 1, 1785, in pleading for the establishment of a national board of agriculture in his annual message to Congress in 1796, says that one of the functions of such a board is "to encourage and assist a spirit of discovery and improvement * * * by stimulating to enterprise and experiment." The distribution of seeds and plants begun in 1839 through a Congressional appropriation secured by Hon. Henry L. Ellsworth, Commissioner of Patents, which afterwards resulted in the establishment of the United States Department of Agriculture, was primarily an experimental enterprise with a view to testing the adaptation of new varieties of agricultural plants to different parts of the country.

In 1849 the New York Agricultural Society established at Albany a chemical laboratory for the analysis of soils, manures, etc., and an elaborate examination of maize was made there by Dr. Salisbury. In 1855 a special agent was employed by the Patent Office "to investigate and report upon the habits of insects injurious and beneficial to vegetation, especially those infesting the cotton plant." The same office also employed a chemist and botanist, laid out a propagating garden, and arranged with the Smithsonian Institution for procuring and publishing records of meteorological observations. After the establishment of the United States Department of Agriculture in 1862 as a branch of the Government distinct from the Patent Office the land on which its buildings now stand was for several years chiefly used as an experiment farm. As soon as agricultural colleges were established in this country experimental investigations in field and

laboratory were undertaken, but for a number of years these were carried on with small means and for the most part by the voluntary labor of professors outside of their regular duties as instructors.

EARLY EXPERIMENTAL WORK BY AGRICULTURAL COLLEGES.

The act to establish and endow an agricultural college passed by the legislature of Maryland in 1856 contains the following section:

SEC. 6. It shall be the duty of the said board of trustees to order and direct to be made and instituted on said model farm, annually, a series of experiments upon the cultivation of cereal and other plants adapted to the latitude and climate of the State of Maryland, and cause to be carefully noticed upon the records of said institution the character of said experiments, the kind of soil upon which they were undertaken, the system of cultivation adopted, the state of the atmosphere, and all other particulars which may be necessary to a fair and complete understanding of the result of said experiments.

The records of the college show that in 1858, immediately after the college was located, and before building began, field experiments with corn, oats, and potatoes, "to test the relative value of the different manures offered for sale in the cities of Baltimore and Washington," were commenced on the college farm. This work continued for two or three years, but was interrupted by the financial distress which soon affected the whole country and by the disturbed political condition of the State and nation.

In 1870 the president and fellows of Harvard College began to organize the school of agriculture and horticulture which had been provided for in the will of Mr. Benjamin Bussey, of Roxbury, Mass. This interesting document was signed July 30, 1835, and was proved soon after the death of the testator, in 1842. It bequeathed half of the income of about $300,000 and 200 acres of land in Roxbury to the president and fellows of Harvard College, on condition that they establish on the farm "a course of instruction in practical agriculture, in useful and ornamental gardening, in botany, and in such other branches of natural science as may tend to promote a knowledge of practical agriculture and the various arts subservient thereto." Owing to other provisions of the will, it was not deemed advisable to begin the formation of the Bussey institution earlier than 1870. In the same year the trustees of the Massachusetts Society for Promoting Agriculture granted to the corporation of Harvard College a considerable sum "for the support of a laboratory and for experiments in agricultural chemistry, to be conducted on the Bussey estate." The laboratory of the new institution was not ready for occupation until the last week in 1871. As soon as it was completed, however, agricultural researches were begun by F. H. Storer, the professor of agricultural chemistry, and his assistants. The first report of this work was presented to a committee of the trustees of the Massachusetts Society for

Promoting Agriculture, December 3, 1871. The earliest experiments consisted of field tests of fertilizers upon the farm of the institution, and chemical analyses of commercial fertilizers. A number of bulletins were published, including reports of field experiments and investigations on hybridizing plants, the composition of feeding stuffs and fertilizers, injurious fungi, and physiology. The great fire in Boston in 1872 and the commercial crisis of 1873 combined to cripple the institution financially, and for a number of years little was done in the way of original investigations. Recently, however, the financial status of the institution has improved, and investigations have been undertaken in several lines. Several bulletins have been published within the past three years, among which are those on the white pine (*Pinus strobus*), basket willow, systematic destruction of marmots and other vermin, and chemical substances in the trunks of trees. An extensive arboretum of indigenous and exotic trees, shrubs, and herbaceous plants has been developed on the grounds of the institution through a bequest made to Harvard University in 1872 by James Arnold, of New Bedford, Mass.

When the College of Agriculture of the University of California was organized it was understood that a part of its work would consist of experimental inquiries. In 1870 Prof. E. S. Carr, in an address at the State Fair, made the following specific allusion: "The University proposes to furnish the facilities for all needful experiments; to be the station where tests can be made of whatever claims attention." A later report contains the following statements regarding the development of experimental inquiries in agriculture at the University:

Ex-President Gilman, in his report dated December 1, 1873, alludes to progress in this work, as follows:

The University domain is being developed with a view to illustrate the capability of the State for special cultures, whether of forests, fruits, or field crops, and the most economical methods of production. It will be the station where new plants and processes will be tested and the results made known to the public. * * * A fine estate has been provided, well adapted to the establishment of an experiment station in agriculture, a botanic garden, an arboretum, etc.

As is usual in the history of new undertakings, progress at first was slow and hesitating. The report for the years 1873–1875, by R. E. C. Stearns, at that time secretary of the board of regents, shows that 40 acres were prepared for planting with a view to agricultural experiments in 1874, and that during the winter following there were planted 584 named varieties of tree fruits, 73 of grapevines, and 95 of various small fruits. * * *

In 1874 buildings were erected on the grounds set apart for agricultural experiments, viz: A barn 36 by 44 feet; a tool house 64 by 12 feet; two propagating houses, one 64 by 15 feet, the other 30 by 24 feet; a house for hatching fish eggs; and in addition to these larger structures a complement of sheds and outbuildings, hot beds, and cold frames were provided. Propagation of shrubs and trees from seed obtained abroad, and especially from other arid regions of the world, was first undertaken.

In 1874 E. W. Hilgard was chosen professor of agriculture. [Professor Hilgard had previously been engaged for a number of years in conducting an agricultural and geological survey in Mississippi, in connection with which chemical examinations of

soils, field experiments, and other agricultural investigations had been incidentally carried on in accordance with a plan inaugurated as early as 1857 and afterwards made the basis for the highly successful work of the California Experiment Station under his direction.] In the winter of 1875–76 the first field experiments were undertaken to determine the effects of deep culture and of the application of various fertilizers.

In 1875 the laboratory branch of the experiment station work was inaugurated, the regents making provision for the expenses thereof for the first two years; and at the end of this time the legislature opened the way for the continuation and extension of the work by liberal special appropriations from year to year.

After the fund which had been established by the sale of the land scrip donated to Connecticut under the act of Congress of July 2, 1862, had been given to the Sheffield Scientific School of Yale College in 1863, a professor of agriculture was added to the working force of that institution. Samuel W. Johnson, M. A., professor of theoretical and agricultural chemistry, and William H. Brewer, Ph. D., the professor of agriculture, have for many years taken an active interest in all work for the promotion of agricultural science in Connecticut and elsewhere in the United States. Under their direction experimental work for the benefit of agriculture was carried on to a limited extent at New Haven more than thirty years ago, and it is doubtless safe to say that "through the influence of the professors and pupils trained in this school, more than to any other single cause, is due the recognition of the importance of the establishment of agricultural experiment stations, first in Connecticut and subsequently throughout the whole country." Prof. W. O. Atwater, the first director of the first regularly organized State experiment station in this country, received a part of his training in this school.

ESTABLISHMENT OF EXPERIMENT STATIONS BY THE STATES.

The reports of the successful and beneficial work done in the European experiment stations excited more and more attention on this side of the Atlantic, and the more advanced leaders in agricultural progress in this country began to ask for the establishment of similar institutions in the United States. In 1872, at a convention of representatives of agricultural colleges held in Washington in response to a call issued by the United States Commissioner of Agriculture, the question of the establishment of experiment stations was discussed, and the report of a committee in favor of such institutions was adopted by the convention. On the 17th of December, 1873, at the winter meeting of the State board of agriculture, at Meriden, Conn., Professor Johnson, of the Sheffield Scientific School, and Professor Atwater, of Wesleyan University, urged the establishment of an agricultural experiment station in that State after the European pattern. A committee was appointed to consider the expediency of such a movement, and reported two days later that it was their "unanimous opinion that the State of

Connecticut ought to have an experiment station as good as can be found anywhere, and that the legislature of the State ought to furnish the means for its establishment." A permanent committee was then appointed by the board to bring this matter to the attention of the public and the legislature. This committee held meetings in different parts of the State, and the following winter secured the introduction of a bill for an experiment station, which, however, was laid over until the next session of the legislature. Another year of agitation of the matter ensued. The project had many warm and enthusiastic friends, but, as might have been expected, the great mass of the farmers took little interest in the enterprise. When it had become apparent that it could not otherwise succeed, Mr. Orange Judd, then editor and proprietor of the American Agriculturist, offered on his own part $1,000 to begin the undertaking, and on the part of the trustees of Wesleyan University, at Middletown, the free use of the chemical laboratory in the Orange Judd Hall of Natural Science.

These offers were made on condition that the legislature should appropriate $2,800 per annum for two years for the work of the station. It was thought that if by these means the work of agricultural experimentation could actually be begun, the usefulness of the enterprise would be so clearly demonstrated that it would speedily receive more generous and permanent support. An act making the appropriation thus proposed was unanimously passed, and approved July 2, 1875. Early in October of the same year a chemist was on the ground, and as soon as practicable two assistants were secured. Professor Atwater was made director, and thus the first State agricultural experiment station in America was an accomplished fact. Notwithstanding the severe financial depression of 1877, which caused serious reduction in old appropriations and utter refusal of new ones by the legislature of that year, a bill prepared by the director of the station and making a permanent annual appropriation of $5,000 "to promote agriculture by scientific investigation and experiment" was passed unanimously. At the end of the two years provided for in the original bill the station was reorganized under the direct control of the State and permanently located in New Haven, where it has since been in successful operation, until 1882 in the laboratory of the Sheffield Scientific School, and thereafter in buildings and on grounds provided by the State in the suburbs of the city.

The success which attended this attempt to establish a State experiment station in the United States was sufficient to attract the attention of advanced agriculturists throughout the country, and the example set by Connecticut was soon followed in other States. March 12, 1877, the State of North Carolina established an agricultural experiment and fertilizer-control station at Chapel Hill in connection with the State University in accordance with an act of the legislature

creating a Department of Agriculture, Immigration, and Statistics. The Cornell University experiment station was organized in February, 1879, by the faculty of agriculture of the university, as a voluntary organization. From that time until the passage of the act of Congress of March 2, 1887, the work was carried on by the different professors in such time as could be spared from other studies. For a part of that time the trustees of the university appropriated money from the university funds to pay for the services of an analyst and for the purchase of supplies. All the other work was done without compensation.

The New Jersey State Station at New Brunswick, N. J., was established March 18, 1880, by an act of the State legislature and connected with the scientific school of Rutgers College.

The movement grew in favor with the people with each succeeding year, and in 1886 the Committee on Agiculture in reporting the Hatch bill to the House was able to make the following statements:

> Since 1881 the legislatures of several States have either recognized or reorganized the departments of agriculture in the land-grant colleges as "experiment stations," thus following substantially the course adopted by New Jersey. Such stations have been established in Maine, Massachusetts, Ohio, Tennessee, and Wisconsin. In three other States (probably more), without legislative action, the college authorities have organized their agricultural work as experiment stations. This has been done in California, Missouri, and New York. But in addition to the twelve experiment stations specifically designated by that name a very large number of the colleges established under the act of 1862 are doing important work of a precisely similar kind. Many of them began such work immediately upon their establishment, and have since maintained it continuously; others have entered upon it more recently. The colleges in Colorado, Indiana, Kansas, Michigan, and Pennsylvania are carrying on what is strictly experiment-station work as a part of their ordinary duty.

HOUGHTON FARM.

The only attempt in America to establish an agricultural experiment station through the munificence of one man deserves recognition in this article, although it was short-lived. In the year 1876 Mr. Lawson Valentine, a philanthropic and public-spirited native of Massachusetts, conducting a prosperous business in New York City, purchased a tract of several hundred acres in the township of Cornwall, Orange County, New York, to which he gave the name of Houghton Farm. Soon afterwards he conceived the idea of establishing at this place a series of systematic agricultural experiments. Mr. Valentine naturally took for his model the work of Lawes and Gilbert at Rothamsted, England, but with modifications suited to American conditions.

In the summer of 1879 Dr. Manly Miles, of Michigan, was engaged as director of experiments, and during the next eighteen months he laid out suitable fields, constructed a system of drainage, and visited the principal stations of Europe for the purpose of studying plans and methods of investigation. Early in 1881 the scheme was reorganized,

and Maj. Henry E. Alvord, of Massachusetts, was placed in charge as general manager, with these instructions from the proprietor:

> First, conduct the farming operations in accordance with the best known methods and under the best possible organization and management, with a view of educating and enlightening others by furnishing valuable examples and results in practical agriculture. Second, organize and operate a scientific department devoted to agricultural investigation and experiment, to be of the highest order, and such as to command the respect, interest, and cooperation of leading scientists of this and other countries.

Upon this basis Houghton Farm was conducted for about five years. The experiment department, with its own organization, assignment of real estate, and equipment, was maintained at an expense to the proprietor approaching $20,000 per annum. The experimental work inaugurated was grouped under four heads: (1) Agricultural physics; (2) plant growth; (3) diseases of plants; and (4) animal growth and production. The scheme included four corresponding series of publications, issued at irregular intervals. Papers were published and distributed during 1882, 1883, and 1884 in the three series first named. The main work consisted of field experiments in growing maize; 36 plats of an area of one-fifth acre each were continuously cultivated for several years, and part of the records were published. Extensive provisions were made for work in breeding and feeding dairy cattle and mutton sheep, and in dairy products, but no pamphlet publications were issued on this line.

The death of Mr. Valentine in 1888 put an end to this enterprise.

MOVEMENT TO SECURE FEDERAL AID FOR EXPERIMENT STATIONS.

The convention of delegates of agricultural colleges which met at Washington in 1883 discussed and indorsed the project for the establishment of stations in connection with the colleges by appropriations from the National Treasury, in accordance with the terms of a bill already introduced in the House of Representatives by C. C. Carpenter, of Iowa. Congress, however, was not yet quite ready to undertake so large a scientific enterprise in this direction, and the bill was not put upon its passage. Meanwhile the number of stations was steadily increasing, and the interest of practical farmers, as well as men of science, was more and more excited by the reports of the results of the experiments which the stations had completed. On July 8, 1885, a convention of agricultural colleges and experiment stations met at the Department of Agriculture at Washington, in response to a call issued by the Commissioner of Agriculture. Almost the first thing which this convention did was to adopt a resolution "that the condition and progress of American agriculture require national aid for investigation and

experimentation in the several States and Territories; and that therefore this convention approves the principle and general provisions of what is known as the Cullen bill of the last Congress, and urges upon the next Congress the passage of this or a similar act." (The Cullen bill was in its general provisions similar to the bill afterwards passed by Congress and now popularly known as the Hatch Act.) So earnest was the convention in this matter that it appointed a committee on legislation, which was very efficient in securing the passage of the amended bill.

In a later session the convention adopted resolutions urging the creation of a branch of the Department of Agriculture at Washington which should be a special medium of intercommunication and exchange between the colleges and stations, and which should publish a periodical bulletin of agricultural progress, containing in a popular form the latest results in the progress of agricultural education, investigation, and experimentation in this and in all other countries. Provision was also made for a permanent organization by the appointment of a committee to cooperate with the United States Commissioner of Agriculture in determining the time of meeting and the business of the next convention, and in forming a plan for a permanent organization.

At the next session of Congress the experiment station enterprise was again called to the attention of the House of Representatives, by the bill which was introduced by William H. Hatch, of Missouri, and referred to the Committee on Agriculture. This committee made a favorable report March 3, 1886, and nearly a year later the bill was passed by Congress, and was approved by President Cleveland March 2, 1887.

THE HATCH ACT.

The Hatch Act (see Appendix) provides that $15,000 a year shall be given out of the funds proceeding from the sale of public lands to each State and Territory for the establishment of an agricultural experiment station, which must be a department of the land-grant college established under the act of Congress of July 2, 1862, except in the case of those States which had established experiment stations as separate institutions prior to the passage of the former act.

The duties of the stations are thus defined:

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic

questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

In order that the funds from the National Treasury might be for the most part devoted to agricultural investigations, only $3,000 of the first year's appropriation for each station was to be expended for buildings, and thereafter only $750 a year could be so expended.

That the farmers of the country may receive prompt information regarding the work of the stations, it is provided that, in addition to "full and detailed" annual reports of their operations and expenditures, "bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit." The franking privilege is also given for the station publications. Financial and other reports of the stations are to be sent to the Secretaries of Agriculture and the Treasury, but no provision is made for auditing the accounts by officers of the United States or for any supervision of their work by the Federal authorities. It is, however, made the duty of the Secretary of Agriculture "to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purpose of this act."

DEVELOPMENT OF THE EXPERIMENT STATIONS UNDER THE HATCH ACT.

Owing to the failure of Congress to make a specific appropriation to meet expenditures under the Hatch Act during the fiscal year in which it was passed, the Treasury Department ruled that no money could be paid to the stations during that year. It was therefore necessary to wait until the following session of Congress before active operations could be begun under that act. Meanwhile the State legislatures one after another gave their assent to the provisions of the act and designated the institutions which were to receive its benefits. Boards of management were organized, working staffs were appointed, buildings were located and planned, land was selected for field experiments, and in general the equipment of the stations was provided for. When the appropriation was made by Congress in 1888 it was included in the general appropriation act of the Department of Agriculture, though the head of that Department was at that time in no way responsible for the expenditure of this fund, and this precedent has uniformly been followed in succeeding years.

During 1888 experiment stations in all the States (then 38 in number) and the Territory of Dakota received the national funds, making a total appropriation of $585,000, to which must be added about $125,000 derived from State appropriations, fees for fertilizer analyses, sales of farm products, etc., and $10,000 appropriated by Congress for the Office of Experiment Stations. The whole amount used for experiment station purposes in the United States in 1888 was, therefore, about $720,000. At that time there were two stations in Alabama, Connecticut, Massachusetts, New Jersey, and New York, and three in Louisiana. The total number which had been organized by the close of 1888 in the United States was 46.

The following year the Territory of Dakota was divided and became the States of North and South Dakota, and the station located in the latter State was continued. Branch or sub stations were established in a number of States. If these are excluded the whole number of stations in 1889 was the same as before, 46; if the substations are included, it was 63. These stations employed 393 officers, and, with this Office, expended in all about $725,000, of which $600,000 came from the National Treasury. They published that year 45 annual reports and 237 bulletins. A partial organization of new stations was also effected in the Territories of Arizona, New Mexico, and Utah.

In 1890 stations were established in these Territories and in the State of North Dakota. An attempt was also made to establish two small State stations in north and southeast Alabama, which, however, were only temporary. Counting these, the number of stations in the United States that year was 52. The total revenues were $988,146, of which $652,500 came from the National Treasury. The Report of the Director of the Office of Experiment Stations for 1890 gives more complete statistics of the stations than it had been possible to obtain previously, and these are summed up as follows:

The stations employ 429 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors 66, chemists 101, agriculturists 63, horticulturists 47, botanists 42, entomologists 33, veterinarians 19, meteorologists 11, biologists 4, viticulturists 2, physicists 3, geologists 1, mycologists 2, microscopists 4, irrigation engineer 1, in charge of substations 16, secretaries and treasurers 21, librarians 5, clerks 18. There are also 42 persons classified under the head of miscellaneous, including superintendents of gardens, grounds, and buildings, foremen of farms and gardens, apiarists, herdsmen, etc.

During 1890 the stations have published 36 annual reports and 225 bulletins. The mailing list of the stations now aggregates about 340,000 names. At a low estimate, a total of 35 millions of pages, containing information on agricultural topics, have been disseminated among the people during the past year; furthermore, the results and processes of experiments are described in thousands of newspapers and other periodicals. The mailing lists of the stations have largely increased during the year. The calls upon station officers to make public addresses are numerous and increasing. The number of such addresses reported to this office as delivered during the past year is about 750. The station correspondence with farmers is now very large and touches nearly every topic connected with farm theory and practice.

In 1891 stations were organized in the States of Washington and Wyoming and the Territory of Oklahoma. The number of stations that year was 55, receiving funds aggregating about $925,000, of which $682,500 came from the National Treasury. They employed 481 persons in the work of administration and inquiry and published 51 annual reports and 255 bulletins.

In 1892 a new station was established in the State of Idaho, but the stations in north and southeast Alabama were no longer in operation, so that the total number of stations fell to 54. The total revenues were $1,017,144, of which $709,542 was from the General Government. They employed 491 officers and issued 50 annual reports and 298 bulletins.

In 1893 a new station was established in the State of Montana, making the total number of stations 55. Their total income was $975,073, of which $730,000 was received from the National Treasury. They employed 532 officers and issued 48 annual reports and 298 bulletins. During that year the stations made a collective exhibit at the World's Columbian Exposition at Chicago. This was made by the Office of Experiment Stations and the Association of American Agricultural Colleges and Experiment Stations acting in cooperation. The Director of this office, Prof. A. W. Harris, represented the office, and the association was represented by a committee of which Dr. H. P. Armsby, director of the Pennsylvania State College Experiment Station, was chairman. The station work was exhibited in nine sections: Botany, soils, fertilizers, crops, horticulture, entomology, feeding stuffs, animal nutrition, and dairying. There were also botanical, biological, and chemical laboratories, in which some of the simpler station operations were carried on by way of illustration. The publications of the stations and of this office were shown, together with a large number of photographs and charts illustrating the buildings, equipment, and work of the stations. The exhibit was in general of a popular character and was installed in the Agricultural building. In connection with this exhibit a popular digest of the publications of the stations was made by this office and published as Bulletin No. 15, entitled Handbook of Experiment Station Work. At the same exposition a very extensive test of the different breeds of dairy cows was made under the direction of a committee of station officers. In this test a daily record was kept of the food, milk, fat in the milk, and butter or cheese yield of each cow. (For a more extended account of this test see p. 84.)

In 1894 Congress adopted the recommendation of the Secretary of Agriculture and gave this Department authority to examine the expenditures of the stations under the Hatch Act and report on their legality. This led to much closer relations between the Department and the stations than had hitherto existed. As soon as practicable after the passage of this act the required schedules were prepared on the basis of

those already in use at the stations, and distributed. In order that the Department might have accurate and complete information regarding the work and expenditures of the stations as the basis for the required reports to Congress, it was decided that the stations should be regularly visited by representatives of the Office of Experiment Stations, and this has been done each year since. In connection with these visits inquiries are made regarding the management and work of the stations and their relations to the land-grant colleges. Their methods of keeping accounts are also examined. Conferences are held with the station officers and members of the governing boards, in which not only financial policy but also lines and methods of work are discussed. The first report on the work and expenditures of the stations was made by the Secretary of Agriculture to Congress early in 1896. This showed that while some difficulties had been encountered in securing the most efficient organization of the stations because of their rapid expansion and the relative lack of thoroughly trained officers, on the whole they had been of much benefit to the agriculture of the country.

The general condition of the stations at that time is set forth in this report as follows:

> The principle of local control with a view to meeting the varied needs of different agricultural regions is in harmony with our governmental and educational system, and in the long run will undoubtedly produce the best results. The responsibility resting upon the State and Territorial authorities to maintain these stations will lead to their development in proportion to the interest taken in them by the people, and when once this interest is sufficiently awakened it will conduce to the building up of strong stations. This has already been the case in a number of States where the stations have been the longest established and most successful in their work. Already the aggregate funds annually received by the stations from other sources than the Hatch fund, largely from the State appropriations, constitute about one-fourth of their income.
>
> The connection of the stations with educational institutions has on the whole been of great advantage to the stations. The colleges have provided them with land, buildings, and other equipment. The college officers have supplied in large measure the expert services in administration and research which have enabled the stations to attain whatever substantial and permanent results they have gained. And most important of all, the colleges have afforded to the stations that scientific backing without which their work is more than likely to be crude in conception, imperfect in execution, and disappointing in results. On the other hand, the stations have aided the colleges by supplying peculiar incentives to a higher grade of work on the part of their students, with a view to preparing themselves to be original investigators, by enabling them to employ more thoroughly trained instructors, and by drawing public attention more strongly to them as sources of useful information to a large body of people outside the ranks of their students. It only remains to settle more definitely the exact relations of the stations to the other departments of the colleges and to give greater opportunity to the expert and scientific workers in these institutions to exercise their proper functions in administration, investigation, or instruction.
>
> The permanent success of scientific institutions in this country will depend upon the support of the people rather than upon the patronage of the few, and it is believed nothing can contribute more effectually to this than the union of establish-

ments in which science is applied to a great fundamental art like agriculture with institutions for higher education which are supported by public funds and open to youth from all ranks of life. * * *

The educational influence which they [the stations] have exerted has been of incalculable benefit. Compelled by the law to publish bulletins at least once a quarter, they have almost of necessity undertaken the instruction of our agricultural people on nearly every topic connected with their art. Making every allowance for crudeness and imperfection in their reports, it nevertheless remains true that the amount of reliable information thus disseminated has been very great. The agricultural press has been quick to appreciate the value of the information furnished by the stations, and has spread the results of their work far beyond the limits to which it would have been carried by the station publications. The mailing lists of the stations aggregate over 500,000 addresses. During the past fiscal year this office received from the stations 350 bulletins and 55 reports. An average of 10,000 copies of each of these publications was distributed in the several States and Territories, or over 4,000,000 copies in the aggregate. Added to this there are the vast correspondence with the individual farmers and hundreds of addresses annually delivered by station officers at farmers' meetings. Even the superficial observer of our agricultural affairs can see that the spirit of improvement is already active, and that there is more and more demand that theories of agricultural practice shall be subjected to the test of investigation by experts.

The stations have secured the confidence and respect of practical men to a remarkable extent. Where they have done their most thorough scientific work they have secured the greatest financial support. They have already produced important changes in agricultural practice. The fertilizer business has been largely revolutionized through their efforts. The dairy industry is rapidly shifting to the basis of quality of product established by the stations. The results of feeding experiments made at the stations are being largely taken as the basis on which changes in the methods of feeding different kinds of animals are made to conform to the conditions existing in different regions. Much has been done to aid the farmer in his contest with insect pests and diseases of plants and animals. Immigrants in many instances have been shown how to avoid costly mistakes. The causes of soil exhaustion and the means of reclaiming land hitherto deemed worthless for agriculture have been pointed out. Improved varieties of horticultural and agricultural plants have been introduced in many localities. Diversification of agriculture in many States is proceeding on lines laid down by the stations.

In conection with the examination of the expenditures of the stations it became necessary for the Department of Agriculture to define its views regarding the limitations of the Hatch Act, and this was accordingly done in a series of rulings issued March 10, 1896. The most important of these were to the effect: (1) That permanent substations were contrary to the spirit and intent of that act; (2) that land could not be purchased or rented with the Hatch fund; (3) that farm operations were permissible only so far as they definitely constituted a part of agricultural investigations or experiments; (4) that funds arising from the sale of farm products or other property in the possession of a station as the result of expenditures of the Hatch fund rightfully belonged to the station and therefore should be expended for station purposes.

During 1896 the separate station maintained for many years by the State of Massachusetts was combined with the Hatch Experiment

Station in that State. The number of stations thus again became 54. The total income of the stations during 1896 was $1,133,791.23, of which $720,000 was received from the National Government. In addition to this the Office of Experiment Stations received $30,000. The stations employed 584 persons in the work of administration and inquiry and issued 45 annual reports and 323 bulletins.

In 1897 the number of stations remained 54, but a preliminary investigation was made regarding the feasibility of conducting agricultural experiments in Alaska. The total income of the stations during 1897 was $1,129,832.99, of which $719,993.47 was received from the National Government. In addition to this the Office of Experiment Stations received $30,000. The stations employed 628 persons in the work of administration and inquiry, 283 of whom did more or less teaching in the colleges with which the stations are connected. Fifty-four annual reports and 324 bulletins were distributed to mailing lists aggregating 506,100 names.

In 1898 the number of stations remained 54. Agricultural investigations in Alaska were continued. The annexation of the Hawaiian Islands brought within the United States an experiment station at Honolulu, which has been in successful operation since 1895, under the direction of the Hawaiian Sugar Planters' Association, which supplies the funds for its maintenance.

The total income of the stations during 1898 was $1,210,921.17, of which $720,000 was received from the National Government. In addition to this the Office of Experiment Stations had an appropriation of $35,000, including $5,000 for the Alaska investigations. The stations employed 669 persons in the work of administration and inquiry, of whom 305 did more or less teaching in the colleges with which the stations are connected. Four hundred and six annual reports and bulletins were issued during the year.

In 1899 agricultural experiment stations were in operation in all the States and Territories and in Alaska and Hawaii. In each of the States of Alabama, Connecticut, New Jersey, and New York a separate station was maintained wholly or in part by State funds, and in Louisiana there were three stations receiving joint support from national and State funds.

Excluding the branch stations established in several States, the total number of stations in the United States in 1899 was 56. Of these, 52 received the appropriation provided for in the act of Congress above mentioned. The total income of the stations during 1899 was $1,143,334.93, of which $720,000 was received from the National Government, the remainder, $423,334.93, coming from the following sources: State governments, $240,300.20; individuals and communities, $12,100; fees for analyses of fertilizers, etc., $75,294.42; sales of farm products, $69,312.60; miscellaneous, $26,327.71. In addition to this, the Office of Experiment Stations had an appropriation of

$40,000, including $10,000 for the Alaska investigations. The value of additions to equipment of the stations in 1899, is estimated as follows: Buildings, $27,218.64; libraries, $10,796.15; apparatus, $16,917.07; farm implements, $10,784.88; live stock, $16,265.95; miscellaneous, $22,521.93; total, $104,504.62.

The stations employed 678 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work was as follows: Directors, 71; chemists, 148, agriculturists, 68; experts in animal husbandry, 9; horticulturists, 77; farm foremen, 21; dairymen, 23; botanists, 52; entomologists, 48; veterinarians, 26; meteorologists, 17; biologists, 7; physicists, 7; geologists, 5; mycologists and bacteriologists, 28; irrigation engineers, 5; in charge of substations, 16; secretaries and treasurers, 24; librarians, 9; and clerks, 43. There were also 48 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds, and buildings, apiarists, herdsmen, etc. Three hundred and eight station officers did more or less teaching in the colleges with which the stations are connected.

During 1899 the stations published 445 annual reports and bulletins. Besides regular reports and bulletins, a number of the stations issued press bulletins, which were widely reproduced in the agricultural and county papers. The mailing list of the stations now aggregates half a million names. Correspondence with farmers and calls upon station officers for public addresses at institutes and other meetings of farmers are more numerous than ever. The station officers continue to contribute many articles on special topics to agricultural and scientific journals.

The number of stations has increased from 46, in 1888, to 56, in 1899. The annual income of the stations, including the appropriation for the Office of Experiment Stations, has risen from about $720,000, in 1888, to $1,200,000, in 1899. Of this amount about $125,000 was derived from State appropriations, fees for fertilizer analyses, sales of farm products, etc., in 1888, and $423,000 in 1899. In 1889 393 officers were employed at the stations, while in 1899 their number had increased to 678. The stations published 282 annual reports and bulletins in 1889 and 445 annual reports and bulletins in 1899.

The stations are at present conducting a wide range of scientific research in the laboratory and plant house, and an equally large amount of practical experimenting in the field, the orchard, stable, and dairy. Practically all the stations are keeping a record of meteorological data, while 10 are making special studies of problems relating to meteorological phenomena and climatic conditions. Thirty-six stations are at work upon soil investigations, its geology, physics, and chemistry, or conducting soil tests with fertilizers or in other ways. Twenty-one stations are studying questions relating to drainage and seepage, or to irrigation in the field or greenhouse, and with orchard, garden, or farm crops. Thirty-three stations are making

analyses of commercial and homemade fertilizers, or are conducting field experiments with fertilizers. At least 15 stations either exercise a fertilizer control in their respective States or make analyses on which the control is based. All the stations are studying the more important crops, either with regard to their composition, nutritive value, methods of manuring and cultivation, and the best varieties adapted to individual localities, or with reference to systems of rotation. Forty-seven stations are investigating the composition of feeding stuffs, making digestion experiments, conducting feeding experiments for milk, beef, mutton, or pork, or are studying different methods of feeding. Twenty-nine stations are investigating subjects relating to dairying, including the chemistry and bacteriology of milk, creaming, butter making, or the construction and management of creameries. Studies on the food and nutrition of man, including the composition and digestibility of foods and metabolism, are being conducted at 14 stations. Fifty-two stations are doing chemical work, and many of them are studying methods of analysis. Botanical studies occupy more or less of the attention of 47 stations, including investigations in systematic and physiological botany, with special reference to the diseases of plants, testing of seeds with reference to their vitality and purity, classification of weeds, and methods for their eradication. Fifty-three stations work to a greater or less extent in horticulture, testing varieties of vegetables, and large and small fruits, and making studies in varietal improvement and synonymy. Several stations have undertaken operations in forestry. Thirty-six stations investigate injurious insects with reference to their restriction or destruction. Twenty-four stations study animal diseases and the methods for their prevention or cure. At least 5 stations are engaged in bee culture, and 8 in experiments with poultry. One or more stations have made investigations on miscellaneous subjects, such as the following: Technology of wine, olive oil, and vinegar, preservation of fruits and vegetables, the draft of farm implements, road making, the manufacture of beet, cane, sorghum, and maple sugar, oyster culture, etc.

At first there was a disposition, especially in the region west of the Mississippi River, where the area of the States and Territories is large and the population scattered, to divide the Hatch fund and maintain substations in different localities. This greatly weakened the effectiveness of the station work, and in some cases prevented the establishment of the stations on a firm basis. During the past few years, largely through the efforts of the Office of Experiment Stations, these substations have been generally abolished. In California, Minnesota, Texas, Michigan, Ohio, and New Mexico one or more substations are maintained with the aid of State funds, which are used to supplement the national fund, and thus make the extension of the station work feasible and successful.

RELATION OF THE FEDERAL GOVERNMENT TO THE STATIONS.

The agricultural experiment stations in the United States are State institutions supported in part by funds given by the National Government to the States to be used for their maintenance. They have also received the franking privilege under Federal authority. The direct management of the stations is wholly in the hands of State officers. The stations, however, sustain certain definite relations to different branches of the Federal Government. The appropriations called for by the Hatch Act are made by Congress from year to year. They come under the head of annual rather than permanent appropriations, Congress having the right to refuse to make them at any time. The Congressional appropriations for the stations have thus far been included in the appropriation acts for the Department of Agriculture. After a State or Territory has given its assent to the provisions of the Hatch Act and designated the college which is to receive its benefits, the money is paid directly from the United States Treasury to the treasurer or other officer of the institution with which the station is connected, who has been certified to the Treasury as the proper person to receive this fund. The payments are made quarterly in advance, as provided by law.

Regulations governing the use of the franking privilege by the stations are made by the Post-Office Department.

As departments of the colleges receiving the benefits of the land-grant act of 1862, reports of the stations are annually sent to the Secretary of the Interior, who is represented in his relations with these institutions by the Bureau of Education.

The stations have much more intimate relations with the Department of Agriculture than with any other branch of the Federal Government. The Hatch Act provides "that in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner (now Secretary) of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigations or experiments; to indicate from time to time such lines of inquiry as to him shall seem most important, and in general to furnish such advice and assistance as will best promote the purposes of this act." In accordance with this provision, the Office of Experiment Stations was established in 1888, to represent the Secretary of Agriculture in his relations with the stations. An account of the development and present status of this Office is given on page 89.

Beginning with the year 1894, Congress has each year inserted in the appropriation act for the maintenance of the stations a provision that "the Secretary of Agriculture shall prescribe the form of the annual financial statement [required by the Hatch Act], shall ascertain

whether the expenditures under the appropriation hereby made are in accordance with the provisions of said act, and shall report thereon to Congress." Thus, virtually, the Secretary of Agriculture now has general supervision of the expenditures of the stations under the Hatch Act. In this, as in other matters relating to the stations, he has been represented by the Office of Experiment Stations. From time to time Congress has given the Department of Agriculture funds for special investigations, with the provision that the Department shall, as far as practicable, cooperate with the experiment stations in carrying on these investigations. Notable instances of such appropriations are those for nutrition and irrigation investigations, which have been in charge of the Office of Experiment Stations, the inquiries conducted by the Office of Road Inquiry, and investigations with forage plants, in charge of the Division of Agrostology. There has been an increasing amount of cooperation between this Department and the stations in other ways, including all the general lines of work in which the scientific divisions of the Department are engaged. The Department has also afforded to station officers the privileges of its laboratories, collections, and library to an increasing extent from year to year.

RELATIONS OF THE STATIONS WITH ASSOCIATIONS.

The experiment stations, as well as the colleges with which they are connected, are brought together so as to form a national system of agricultural education and research through the Association of American Agricultural Colleges and Experiment Stations. The work of this association is carried on by means of conventions composed of one delegate appointed by each of the land-grant colleges and agricultural experiment stations in the United States, together with delegates representing the United States Department of Agriculture, the Office of Experiment Stations, and the Bureau of Education, of the Department of the Interior. Annual meetings are held in different parts of the country, at which questions relating to the management and work of the stations, as well as of the colleges, are discussed in the general assembly and in a number of sections. The proceedings of the association are edited by the chairman of its executive committee and the Director of the Office of Experiment Stations, and are published by the United States Department of Agriculture as bulletins of this Office. In the interval between meetings of the association much useful work for the promotion of the general interests of the agricultural colleges and experiment stations is performed by the executive committee and standing and special committees of the association. The association has done much to establish and strengthen the stations and to aid in their administration on a permanent and substantial basis.

The stations are also largely represented in the associations of

Official Agricultural Chemists, Economic Entomologists, and Experiment Station Veterinarians, through which the uniformity and efficiency of the station work in chemistry, entomology, and veterinary science, with special reference to the methods employed, are greatly promoted. A more detailed account of the above-mentioned associations may be found on page 79.

ORGANIZATION OF THE STATIONS.

The stations organized under the Hatch Act are by law departments of the colleges receiving the benefit of the land-grant act of July 2, 1862, and supplementary acts relating to similar colleges established in the States which have been admitted to the Union since the passage of that act, as well as to those in the Territories. The Hatch Act, however, made an exception in favor of State agricultural experiment stations which had been established separate from the land-grant colleges prior to the passage of this act. In this way State stations are maintained in Connecticut, New York, and Ohio which are not connected with colleges and yet receive, in whole or in part, the benefits of the Hatch Act. In New Jersey there is a station which is supported by State funds, as distinct from the station which receives the Hatch funds, but both stations are located at the land-grant college and have the same director.

As the station work in a considerable number of States grew out of attempts made by the professors in the agricultural colleges to add experimental inquiries to their duties as instructors before there were definite funds for research work in agriculture, the tendency was, after the funds were supplied for experiment-station purposes, to use these to supplement the work of various departments of the college rather than to conduct the experiment station actually as a distinct branch of the college. This arrangement was also quite generally favored in the States where the colleges were new institutions with limited funds which could be used for college purposes. Experience has, however, shown that to do its most efficient work the station must have a compact organization as a distinct branch of the college, and must have its operations clearly differentiated from those of the departments of instruction. In recent years, therefore, more attention has been given to separating the station business and securing a more perfect organization of the station as a research department of the college.

The stations which are departments of the colleges are, as a rule, under the general management of the governing boards of these institutions. The separate State stations have their own governing boards.

The governing boards of the stations are elected or appointed in a number of different ways. In some cases they are elected by the

people of the State. In other cases they are appointed by the governors, with or without the consent of the State senates. In a few instances the board is a self-perpetuating body, according to the charter of the college corporation, or it may consist of some members elected by the board and some appointed by the State. In a number of States the governor is an ex officio member of the board, and less frequently the State superintendent of education or the State commissioner of agriculture. In a few cases the State board of agriculture is the governing board of the college and station. The more immediate supervision of station affairs is often intrusted to a standing committee of the governing board.

As a rule the duties of the governing board are confined to determining in a general way the policy and lines of work, appointing the members of the staff and fixing their terms of office and compensation, deciding on the character and extent of expenditures, and approving and auditing the accounts. In some cases, however, the governing boards determine and supervise the work and expenditures of the stations in considerable detail. This was more generally true in former years than at present. As the stations have developed it has been found desirable to intrust the planning and execution of their work more fully to the director and other expert officers.

In many of the States the members of the governing board serve without compensation except their traveling expenses, but in some cases they are allowed a moderate per diem compensation while in the discharge of their duties. In a number of States the governing board has an officer, called a secretary, who resides at the college and represents the board during the intervals between its meetings, keeps a record of the transactions of the board and sometimes the accounts of the station, as well as of other departments of the college.

The president of the college with which the station is connected as a rule holds the same relation to the station that he does to other departments of the college; that is, he is the chief executive officer of the institution, including the experiment station, and represents the institution before the governing board, of which he is often an ex officio member. In a few instances the president has been relieved of all responsibility for the station, its director reporting directly to the governing board. In 14 States and Territories the president of the college is at present also director of the station.

Elsewhere the director is a separate officer, who, in addition to general executive duties connected with the station, carries on investigations in some special lines, or combines teaching in the college with his work for the station. Thus the station director may at the same time be the chemist or agriculturist of the station and the professor of chemistry or agriculture in the college. In some stations the director has large powers and responsibilities in the management of the station.

In other States the planning of the work and even details of administration are largely committed to a council composed of the heads of the different divisions of the station, or these officers and some members of the governing board.

Besides the president of the college and the director, the station staff usually comprises several scientific experts in charge of special lines of work, as dairying, horticulture, chemistry, entomology, or diseases of plants and animals, and scientific assistants. The members of the staff may be employed exclusively for experiment station work, but in a large number of instances they combine this with instruction in the college. At some stations the assistants are not considered members of the staff proper. There is very great variety in the amount and character of the services which members of the staff are expected to perform on behalf of the station, and no general statement can be made which will cover this matter It may, however, be said that as a rule the heads of the divisions take the initiative in planning the work of their divisions and superintend the operations of subordinates directly responsible to them. In addition to the scientific force there are usually persons of practical experience employed as foreman of farms, dairymen, feeders of cattle, etc., and clerical assistants, including accountants, stenographers, and typewriters. Women are often employed in these clerical positions. Laborers are employed regularly by the year or month, or work as occasion may demand by the day or hour. A considerable number of students of the colleges are employed as assistants and laborers at the stations. Special experts, scientific assistants, and other workers are from time to time employed by the stations for the conduct of particular investigations.

At many of the stations the staff constitute a station council. This council commonly meets once a month. Its duties may be confined to consultation or may extend to actual planning and supervision of the work and expenditures of the station, subject only to the approval of the governing board. In some cases one or more members of the governing board or outside persons representing State agricultural or horticultural societies are members of the council.

The tenure of office for members of the station staff is quite variable, ranging from a period of one year to an indeterminate tenure, practically depending on efficiency and good behavior. The salaries of station officers also have a wide range, depending upon the amount and character of service required as related to duties performed for the college or otherwise.

The substations are in immediate charge of a superintendent who is assisted by a small force of laborers. As the work of the substations is chiefly confined to field operations, all work requiring the use of laboratories and expert knowledge in various scientific lines is either done at the central station or under the immediate supervision of the sta-

tion officers in charge of such work. The superintendent of the substations is directly responsible, either to the director of the station or the governing board, and carries on operations planned by the director or the station staff or the governing board.

In cooperative experiments with farmers the station usually furnishes the plans of work and the seeds, fertilizers, fungicides, or other materials required by the experiment, and makes the chemical or other examinations of the soils, fertilizers, or crops necessary to determine the data or results sought in the experiment. The farmer on his part furnishes the land, orchards, labor, etc., most commonly without charge to the station.

EQUIPMENT OF THE STATIONS.

The colleges established under the land-grant act of 1862 generally had farms connected with their agricultural departments prior to the establishment of the experiment stations, and these farms had in many cases been used more or less for experiments with varieties of agricultural and horticultural plants, fertilizers, and feeding stuffs for different kinds of live stock. When the stations were established the colleges immediately provided them with land. In many cases the station was given a definite portion of the college farm for its exclusive use. In some cases it was permitted to use such portions of the farm as it needed for experiments from time to time, and in other cases the entire farm was turned over to the station. The stations established by the States independently of the colleges had farms connected with them, except the Connecticut State Station, which up to this time has not owned a farm. The station farms are generally divided into limited areas on which plat experiments are conducted; horticultural plantations, including vegetables and small, bush, and orchard fruits; fields devoted to experiments in growing crops on a relatively large scale; fields in which forage crops are grown for use in experiments with silos, the feeding of animals, dairying, etc.; and pastures or woodlands. These farms are often provided with more or less elaborate systems of drainage, and in many of the States west of the Mississippi River have irrigation ditches, with the accompanying water rights.

As the Hatch Act permits only very small expenditures for buildings and repairs, most of the buildings which the stations use have been supplied by the colleges or by the States through special appropriations for their construction. Many of these buildings are used jointly by the college and station. The buildings occupied by the stations are in many cases substantial structures of brick or stone and are provided with steam heating apparatus, gas, or electric lights, and often with steam or electric power for running light machinery.

There are usually at each station one or two main buildings which contain the executive and business offices, chemical, botanical, bacteriological and other laboratories, museums, and libraries. Vegetation houses, in a number of cases including arrangements for pot experiments, are quite common. Glass houses in which insects may be bred and their life history studied are a novel feature at a number of American stations, the first house of this description having been erected at the station connected with Cornell University in New York. In a similar way provision is now made at a number of stations for the culture and treatment of fungus and other diseases of plants. The stations generally have one or more barns which are used for the housing of live stock, grain and forage crops, or are fitted up with special arrangements for feeding experiments with different kinds of live stock. At a number of stations there are buildings set apart for experimental work in dairying. In some cases these are fitted up so as to be run as working creameries or cheese factories. Silos of different forms are quite generally a part of the equipment of our stations, being either separate structures or a part of other buildings. The round silos made on the general plan originating at the Wisconsin Station are now quite generally used. Piggeries and poultry houses, built with special reference to experiments with these animals, are found at a number of the stations. Special buildings for experiments in particular lines, such as sugar making, tobacco curing, animal diseases, etc., have been built at some of the stations.

The stations are, as a rule, well equipped with scientific apparatus suited to the lines of work in which they are engaged. This is especially true in the divisions of chemistry, botany, bacteriology, and entomology. In recent years the apparatus for studies in vegetable physiology and pathology and agricultural physics has been rapidly augmented. A considerable number of pieces of apparatus have been devised for special purposes by our station workers, reference to some of which will be found in the accounts of the individual stations. Besides the apparatus which is more directly the property of the stations, a large amount of apparatus belonging to different divisions of the colleges is available for the use of the stations.

The stations have made or purchased very considerable collections of specimens needed for use in their work, especially in the departments of entomology, botany, vegetable pathology, and horticulture. They also have at their command the general collections of the land-grant colleges, which in some cases are among the most extensive in this country. There is a steady growth in the extent of these collections, and better methods are constantly being devised for their preservation and utilization. Many of the stations maintain separate libraries, which usually consist of a limited working collection of

reference books, scientific manuals, files of American and foreign scientific and agricultural journals, the publications of American and foreign experiment stations and departments of agriculture, reports of scientific, agricultural, horticultural, live stock, and dairy associations, and miscellaneous Government and other documents on scientific and agricultural subjects. These are sometimes kept as one collection in an apartment specially provided for the purpose, and sometimes are distributed among the different divisions of the station. In a number of cases the books obtained especially for station workers are merged with the general college library, the privileges of which, however, the station officers fully enjoy. College and local libraries are quite generally at the disposal of the station workers. These range all the way from collections of a few thousand books to libraries with hundreds of thousands of volumes. To a limited extent station workers are also able to avail themselves of the large agricultural library at the Department of Agriculture at Washington through loan for special purposes under certain restrictions. The libraries are generally provided with card catalogues and with the Card Index of Experiment Station Literature issued by the Office of Experiment Stations.

The business offices of the stations are provided with typewriters, mimeographs or other duplicating machines, improved appliances for filing correspondence and records, machines for rapid mailing of publications, fireproof safes or vaults for the storage of records or other important papers, telephones, etc.

The number and kinds of live stock kept by the stations vary according to the lines of work in which they are engaged. At some of the stations a limited number of animals of different kinds are kept permanently. This is especially true of herds of dairy cattle. At other stations most of the animals are purchased from time to time for use in experiments and sold when the experiments are completed. In a number of cases the college furnishes the station with such animals as it needs for its general business and experimental purposes. The animals kept at the stations include different breeds of dairy and beef cattle, sheep, swine, horses, mules, chickens, ducks, geese, and other poultry. The stations are, as a rule, well provided with farm machinery and implements of improved patterns. In some cases these are obtained by the stations for practical tests regarding their utility for different purposes. In their experiments, especially in dairying and field operations, the American stations make much use of a large number of special forms of implements and machines, following in this respect the practice of our most progressive farmers, and believing that agriculture should, as far as practicable, take advantage of the results of the inventive ingenuity and skill shown by the makers of devices adapted to the requirements of agricultural practice in this country. The stations do not, however, attempt the testing of agri-

cultural machines in any wide way, nor do they as a rule use peculiar forms of machinery which it would not be practicable for the farmer or dairyman to utilize in general practice.

LINES OF WORK OF THE STATIONS.

Speaking broadly, the work of the stations in the United States corresponds in scope and extent with the complexity of their organization. It is difficult to make general statements regarding their work which will apply to the actual operations of any one of the stations. Perhaps the best introduction to the general consideration of their work will be a brief historical statement regarding its development. Experimental work in agriculture in this country began, as we have seen, with practical and scientific investigations in a few lines, carried on chiefly by college professors as supplementary to the work of instruction. When the first independent station was established, its early work related chiefly to studies of the chemical composition of fertilizers. This led to the establishment of a fertilizer control in a number of the States which founded such stations at a relatively early period. Thus the farmers and legislatures were led to look upon the stations as proper agencies for the performance of certain inspection duties on matters relating to agriculture. The stations soon began to issue reports and bulletins describing their operations. In order that the farmers might the better understand what the stations were doing, it was found necessary to describe to them the results of similar investigations elsewhere, and in general to make them acquainted with the progress of agricultural science and practice in various lines. In this way the stations came to be looked upon as bureaus of information and they were therefore more and more called upon to give advice to the farmers on all sorts of agricultural topics, either through correspondence or publications. Particularly as the stations were organized in our newer States and Territories, where there were no well organized boards of agriculture or commissioners of agriculture, they constituted the only State agency which the farmers had to give them information regarding their art.

After the passage of the Hatch Act there was a large and sudden expansion of the amount of scientific and practical investigation along agricultural lines, but it was soon found that the time was not ripe for the exclusive devotion of this fund to original research. It was necessary first to train a sufficient number of investigators, to collect information regarding the natural agricultural conditions and resources of many of the States and Territories, and to diffuse among the farmers a large amount of compiled information before they would be in a position to understand and utilize the more scientific work of the stations. As the work of the stations further developed,

their success in obtaining results which were useful to the farmers stirred up a very much greater demand for more information and for more inspection work on their behalf, and State legislatures have therefore from time to time increased the revenues of the stations with the distinct understanding that the funds thus given should be devoted to such work, together with practical tests and demonstration experiments, or diffusion of information. This has made it all the more difficult for the stations whose income was wholly or largely confined to the Hatch fund to keep their work strictly within the provisions of the act of Congress. The Federal authorities have exerted their influence steadily to limit the use of the Hatch fund to investigations and the publication of their results.

In studying the work of any one station it is necessary to ascertain how far and in what directions the funds granted by the National Government have been supplemented by State funds and for what purposes these different funds may be used. The general result of their historical development has been the broadening of the work of the stations to include a great variety of functions.

Along many of the lines in which the agricultural experiment stations have been working the different branches of the United States Department of Agriculture have also been pursuing investigations. Much of this work is of such a character that in general statements regarding the lines and the results of work of the stations it is impracticable wholly to segregate their operations from those of the Department.

In a general way the work of the stations in the United States may be grouped under the following heads: (1) Investigations involving original features; (2) verification and demonstration experiments; (3) studies of natural agricultural conditions and resources; (4) inspection and control work; (5) and dissemination of information.

It will, however, readily be understood that most of the enterprises of the stations are of a mixed character. Originality will, as a rule, be found only in some particular features of an investigation or in the adaptation of well-known facts or principles to special conditions. In the following outline the investigations of the stations which on the whole have most generally contained original features are grouped together, though in many cases they might with equal propriety be classed as demonstration experiments.

INVESTIGATIONS INVOLVING ORIGINAL FEATURES.

The investigations of the stations may be classified in a general way on the basis of the different divisions found in their organization. Thus it may be said that the investigations of our stations comprise studies in physics; chemistry; botany; zoology, and especially entomology; geology; meteorology; agronomy (plant production); horti-

culture; forestry; physiology (of man and domestic animals); zootechny (animal industry); veterinary science; agrotechny (agricultural technology), including especially dairying; and rural engineering.

In most of these lines the investigations have included studies with reference to the improvement of methods of research, devising of new apparatus and appliances, the relation of scientific principles to the science and practice of agriculture, the working out of new practical applications on the basis of well-known facts and principles, or the solution of special problems. The following statements may serve to indicate in what directions the investigations have chiefly been pursued.

Under the head of physics considerable attention has been given in recent years to studies on soils, especially as regards the methods for the physical examination of soils, the movement of soil water, and the apparatus required for such investigations.

In chemistry, studies with a view to the improvement of methods of analysis have occupied the attention of a considerable number of stations. This work has been done quite largely in connection with the Association of Official Agricultural Chemists. It has related chiefly to methods of analysis of soils, fertilizers, plants, foods, and feeding stuffs. They have also cooperated with this association in determining food standards as a basis for the determination of adulteration. A number of pieces of special chemical apparatus have been devised at our stations. These have included apparatus adapted to particular kinds of investigations, or intended to increase the speed, or multiply the operations of laboratory processes for scientific or practical purposes, and devices for making the chemical examinations required in agricultural industries. A very large number of analyses of economic plants, foods, and feeding stuffs, dairy products, fertilizers, and other agricultural materials, especially those distinctively American, have been made for the first time in the chemical laboratories of our stations. A considerable number of purely chemical investigations have been conducted, such as the isolation of the different proteids of seeds and cereals, and their examination as to properties and elementary composition; studies of the development of the constituents of wheat during growth of the plant; investigation of the constituents of the nitrogen-free extract of feeding stuffs; and systematic chemical studies of a considerable number of staple crops, as wheat, maize, cotton, tobacco, alfalfa. Chemistry has usually been an adjunct to the investigations on the fertilizer requirements of plants, human and animal nutrition, and dairying.

In botany considerable systematic work has been done, especially in the newer States. New species of useful and injurious plants have been discovered and described. Herbaria showing with more or less completeness the economic flora of individual States have been collected. New light has been thrown on the botanical relations of species

of economic plants. The botanical work of our stations has, however, been most largely along the lines of vegetable physiology and pathology and bacteriology. The studies in vegetable physiology have included investigations of special problems and the devising of methods and apparatus for such studies. In vegetable pathology much has been done in working out the life histories of fungi injurious to cultivated plants and in devising methods and apparatus for the repression of diseases of plants. The bacteriological work of the stations has included the isolation, culture, and description of many species of useful and pathogenic bacteria in air, soil, fertilizers, plants, food, feeding stuffs, and other agricultural products, and those affecting useful and injurious animals. Methods and apparatus for bacteriological investigations have been devised, and means for the repression of pathogenic bacteria have been worked out. Among the diseases of plants which have received most attention at our stations are those affecting potatoes (especially scab), cotton, cereals (especially smuts), sweet potatoes, beans, celery, grapes, and pears (especially blight).

Among investigations in vegetable physiology which have been undertaken by the stations, mention may be made of those conducted at several institutions regarding the cause and prevention of sun scald of fruit trees, the effect of arc and incandescent electric lights on plant growth and the influence of various forms of electricity on seed germination, and the influence of various enzyms upon the germination of old seeds of various kinds. Investigations have also been conducted upon the effect of alkali upon germination. Again, extensive series of investigations have been made on the flow of maple sap. The distribution of the roots of different plants in the soil has been studied at several stations. Weed distribution, propagation, seedlings, seeds, etc., have been studied by numerous station botanists.

In zoology by far the most important work of the stations has been along the lines of economic entomology. This has included the collection of large numbers of specimens of insects with a view to the determination of their economic importance in different regions; the description of many new species and the working out of their life histories in whole or in part; additions to our knowledge of many beneficial and injurious insects, including in many cases the completion of their life histories; studies in the breeding of insects, especially as a means for their investigation; the discovery or invention of methods and appliances for the repression of injurious insects; the devising of methods and appliances for the study of insects. Among the insects on which the station entomologists have made extensive studies resulting in the development of effective methods for their repression are the following: The codling moth, plum curculio, San José scale and other scale insects, chinch bug, Rocky Mountain locust, woolly aphis, cotton worm, boll weevil, forest insects, and insects affecting stored

grains. In other lines of zoological investigation systematic and other studies have been made of injurious mammals (especially gophers and rabbits) and useful and injurious birds. There have also been special investigations relating to the life history and culture of oysters and the life history of nematodes.

Under the head of agronomy (plant production) a large amount of work has been done in the introduction of new varieties of crops adapted to special regions or particular economic purposes. Investigations in the improvement of varieties by selection and by plant breeding have been undertaken. Fertilizer and tillage experiments have been conducted, drainage and irrigation problems investigated, and methods of harvesting and storage studied. Some work has also been done in studying methods of investigation.

The introduction of the Australian saltbush on the arid and semi-arid alkali lands of the West has extended our list of valuable forage plants and rendered available for grazing purposes thousands of acres of land hitherto practically worthless. Kafir corn has proved a most valuable drought-resistant forage and food plant in regions of the Southwest where maize is an uncertain crop. The introduction and increased culture of grasses and leguminous plants for forage and green manuring, especially in the Southern States, promises to become a factor of far-reaching importance in the agricultural development now taking place in those States. The adaptability of different parts of the United States to the culture of beets for sugar has been definitely established. The rape plant has been successfully introduced in a number of States as an adjunct to sheep husbandry. Alfalfa has been shown to be a useful and successful crop in many regions where it was not formerly grown. Improvement of wheat by selection and cross breeding has resulted in the establishment of varieties of wheat of better milling qualities and increased yield. Similar experiments with other cereals, flax, sugar cane, sorghum, cotton, and grasses are in progress. Experiments for the increase of the protein and oil content of maize are being conducted with promising results.

The experiments with fertilizers have included tests of a large number of different forms of commercial fertilizers and farm manures for different crops, the kind of plants best adapted to green manuring and the methods of their management, the forms of fertilizers (e. g., potash salts) best adapted to the production of high quality in the product; the fractional application of fertilizers to hasten growth and prolong ripening, the rendering of fertilizing material (e. g., leather refuse and fish) available to plants, and the economic utilization of refuse materials (e. g., seaweed) for fertilizers. The methods and times of application for fertilizers have also received considerable attention.

Tillage experiments with the farm crops grown in this country have been undertaken. Deep and shallow cultivation, frequent culti-

vation, subsoiling, fall and spring plowing, summer fallowing, planting winter catch crops, turning under green crops, etc., have been studied. In this connection thick and thin seeding, planting at different depths, use of light and heavy seeds and seeds from different parts of the fruit, distance experiments, and intercultural experiments have been tried.

Irrigation problems in arid and semiarid regions and in humid climates have been investigated with special reference to the number of irrigations, time and method of application, and amount of water required for various crops.

There have also been investigations in the harvesting of wheat, oats, and barley at different stages of growth and at different periods of ripening; curing of hay at different stages of development; the economy of different methods of harvesting maize; the shredding of maize stalks; and the storage of maize as silage. Much valuable work has been done on the curing, fermenting, and storing of tobacco, chemical and chemico-physiological studies being involved. Investigations of harvesting sugar cane at different times both before and after freezing have given valuable results.

In horticulture most attention has been given to testing the adaptability of varieties to different regions. In addition to this there have been studies of the selection and breeding of horticultural plants and the methods of culture, grafting, and pruning. Considerable attention has been given to questions relating to the growing of horticultural plants under glass, including the construction of houses, heating, irrigating, manuring, culture, etc. In accordance with American conditions a leading feature of the horticultural work of our stations has been in the line of experiments with orchard fruits grown on a relatively large scale. Valuable introductions of new and hardy fruits have been made. Native fruits have been studied and improved and wild species brought under cultivation. The Japanese plums have become widely distributed as far north as Michigan and are the most valuable fruit introduction of recent years. Native plums have been studied and nearly three-fourths of the present 200 named varieties brought into cultivation within the life of the experiment stations. Careful work has been done in the selection and cross breeding of native varieties of grapes. Superior varieties for certain localities have already been obtained. Dewberries, juneberries, and sand cherries are other native fruits which have been brought under cultivation and made permanent features of our fruit resources. Among the important fruit introductions may be noted the date palm. Some localities in the Southwest seem especially well adapted to the growth of this fruit. The introduction of the Japanese persimmon and the improvement of our native varieties by selection and grafting seem likely to result in placing this fruit among the permanent orchard crops of certain Southern localities. Extensive investigations of Russian fruits have been made.

The winter forcing of strawberries and certain vegetables has passed the experimental stage and is fast taking its place among the profitable commercial industries of the country. Combinations of forcing-house and field methods of culture of a number of American garden crops have been introduced. This has proven especially valuable in the case of onion culture. Irrigation as a feature of truck gardening and fruit growing in regions of considerable rainfall has formed a feature of horticultural work at several of the experiment stations, and the value of subirrigation in greenhouses with certain forcing crops thoroughly demonstrated. Fertilizer experiments with numerous horticultural crops have thrown much new light on the subject of intensive manuring. Methods of orchard cultivation have been greatly improved, especially by the increased application of valuable known principles to local conditions. The utilization of fruits, more especially the unmerchantable fruits, in the making of jelly, preserves, fruit sirups, and cider has been investigated and valuable suggestions given to this industry. Some of the stations have given considerable attention to the beautifying of home and school grounds by the introduction of ornamental trees, shrubs, flowers, etc., not previously used in their localities.

In forestry the work of our stations has been principally confined to the testing of different varieties of trees with reference to their adaptability to particular regions, and problems connected with the reforesting of our treeless regions.

In the physiology of man and the domestic animals the work of our stations has been largely along the line of nutrition. The most important piece of work in this line has been the devising of a special form of respiration calorimeter for experiments with men at the Storrs Experiment Station in Connecticut, as described elsewhere (p. 112). This is now being adapted to investigations with domestic animals at the Pennsylvania Experiment Station. The experiments with this respiration calorimeter already made with men have brought strong evidence that the law of the conservation of matter and energy holds good in the animal body, and have added important data to our knowledge of other laws of nutrition. Other studies have had to do with the substituting value of different nutrients and the proper combination of nutrients in the diet. Many dietary studies have been made with men and animals, under different conditions and performing different amounts of work, in various regions of the United States. A number of stations have made digestion experiments with men and animals, and the coefficients of digestibility for a considerable number of American foods and feeding stuffs have been worked out as the result of these experiments. Many metabolism experiments have been made with men and farm animals. In most of the experiments with men the balance of income and outgo of nitrogen has been determined. In a number of experiments the balance of carbon or carbon and energy

has also been made. In most of the experiments with animals the balance of income and outgo of nitrogen has been determined. In a few cases, however, the balance of ash or certain ash constituents has also been determined. Studies of the effect of different feeding stuffs on production of lean and fat meats have been made. In connection with nutrition investigations the composition of many American foods and feeding stuffs has been learned. Very extended studies have been made of the composition of beef, mutton, poultry, and pork fattened or fed under different conditions. The effect of cooking on different foods and the losses during cooking have also received attention. Physiological studies of digestibility and digestive ferments and of the milk glands have been undertaken. Much time has been devoted to the elaboration of experimental methods, the testing of methods already known, and the devising of new methods.

In zootechny (in the restricted sense of animal production) the work of the American stations has principally consisted of feeding experiments with different kinds of farm animals, in which various combinations of feeding stuffs have been tested with reference to maintenance, growth, or the production of meat or milk. In this way the nutritive value of a large number of different kinds of American feeding stuffs has been worked out, largely on a practical basis. Important studies have been made on the nutritive value of crops of recent introduction, or crops which have recently assumed importance. Thus, the food value of alfalfa at different stages of growth has been studied by a number of the stations. Important studies of rape and of Kafir corn have been made. Many feeding experiments have been made with silage made from a single crop cut at different stages of growth and from mixtures of two or more crops. Many studies have been made of the value of milling products and by-products as foods for animals. Some of these have an important commercial bearing; for instance, the studies which have shown the food value of dry distillery and brewery refuse. A number of studies have also been made with a view to learning the cause of the poisonous properties of cottonseed under certain conditions. In many cases the cost of the foods used and the value of the animals at the beginning and end of the tests have been taken into account with a view to determining the economic production of meat or milk or the proximate cost of rearing young animals. Many studies have been made with poultry; the effect of different rations on egg production has been investigated, and tests of incubators have been made. Some of the more important studies have had to do with the breeding, feeding, and marketing of geese.

Digestion experiments have been conducted with horses, cattle, sheep, goats, and pigs. Attempts have been made at several of the stations to formulate feeding standards more suitable for American

conditions than the German standards commonly in use. Tests of breeds of different kinds of animals have also been made, sometimes on a relatively large scale, and studies of types of animals best adapted to particular purposes have in some cases been made. The studies in zootechny have, to a considerable extent, been connected with the investigations in animal physiology.

In veterinary science, besides studies in bacteriology above referred to, investigations regarding the causes, nature, and treatment of various diseases of domestic animals have been made at the stations. The subjects to which most time and attention have been devoted include anthrax, Texas fever, hog cholera, swine plague, sheep scab, tetanus, milk fever, rabies, glanders, colic of horses, infectious abortion, actinomycosis, foot-and-mouth disease, and tuberculosis; dehorning; spaying; effects of poisonous plants, including the effects of smuts, ergot, and mildews on fodder; and the relation of water supply to diseases.

In agrotechny (agricultural technology) the most important work of the American stations has related to dairying. Besides the chemical and bacteriological studies of milk and dairy products, referred to under the head of chemistry and bacteriology, the stations have made many studies relating to the methods of manufacture of dairy products.

In dairy bacteriology, the extent and sources of infection of milk, means of avoiding infection by cleanly methods and by pasteurizing and sterilizing, the use of pure cultures for ripening cream in butter making, and the nature and cause of the changes in the ripening of cheese, have been some of the main lines covered.

The business relations between the milk producer and creameries or cheese factories have received attention. Various kinds of dairy and creamery apparatus have been tested to considerable extent, and in some cases demonstrations have been made of the method of conducting a hygienic dairy and milk route. Nearly every step in the handling of milk and in the manufacture of butter and different kinds of cheese has been investigated. In this connection considerable work has been done in studying methods of investigation and devising special apparatus and appliances for such work.

Other important investigations in agricultural technology have been those in sugar making by the Louisiana Stations, and in the manufacture of wine and olive oil by the California Station, and of vinegar and fruit sirups by the Virginia Station. In these investigations the devising of new methods of manufacture and special apparatus and appliances have received large attention.

The American stations have as yet given comparatively little attention to problems in rural engineering. Studies of the form and construction of barns, silos, and other farm buildings have been made, as well as of the construction and heating of greenhouses and the construction of cheese-curing rooms cooled by natural means. Questions

relating to methods of drainage and irrigation have been studied. The draft of farm vehicles, especially as related to the comparative merits of broad and narrow tires, has been tested. A considerable number of practical tests of implements and machinery used on farms or in dairying have been made.

VERIFICATION AND DEMONSTRATION EXPERIMENTS.

A considerable share of the work of the American stations has thus far consisted of the verification of the results obtained at our stations or elsewhere and the demonstration of the practical usefulness of these results. This work has been partly carried on at the stations, more especially on the farms under their control, and partly by experiments in different localities, largely with the cooperation of farmers. This demonstration work has included a wide range of subjects along most of the lines in which the stations have attempted more original investigations. Frequent references to work of this character will be found in the articles concerning the individual stations. Attention can be called in this introductory statement only to some of the larger enterprises of this kind in which the stations have engaged. Of this character have been very many of the experiments with fertilizers, thousands of which have been carried on in the States east of the Mississippi River. A very large number of practical tests of different field crops and horticultural plants have also been made by the stations in cooperation with the farmers, after the stations had determined on a small scale the adaptability of these varieties to the regions in which they are located. Many of the experiments in the feeding of animals and in dairying have been made by the stations for the purpose of confirming the results obtained through previous investigations in this country or abroad. Often the chief purpose of these investigations has been to convince the farmers that the results which have been obtained elsewhere were equally applicable to their local requirements. In a similar way many investigations along the lines of chemistry, botany, entomology, and veterinary science have been repeated at our stations either for the purpose of more firmly establishing the correctness of the results previously obtained or of showing the farmers that these results could be successfully applied in practice. Thus, many means for the repression of insect pests and the diseases of plants or animals have been tried over and over again at the stations and among the farmers until they have become a part of regular agricultural practice, at least among the more progressive portion of the agricultural community. For purposes of verification or demonstration thousands of cooperative experiments are now annually carried on in the United States, in which our farmers take part under the direction of the stations. While it is clearly recognized

that many of these experiments are very imperfectly carried out, yet it is believed that they have been an important element in the success of our stations. More attention is now being given to perfecting plans for such experiments and securing more thorough supervision of them.

Without doubt there has thus far been considerable duplication of work by the stations, but when we consider the wide agricultural areas for which many of our individual stations work, the varying natural conditions in the different States, and the comparative unfamiliarity of our farmers with the results of agricultural investigations, it will be realized that whatever incidental losses there have been through unnecessary duplication of work on the part of the stations have been more than overbalanced by the benefits which have accrued from a repetition of investigations until their results have become a part of the farm practice.

STUDIES OF NATURAL AGRICULTURAL CONDITIONS AND RESOURCES.

Closely united with the demonstration experiments of the stations have been those studies which have primarily had for their object the gaining of definite information regarding the natural agricultural conditions and resources of the different States. While our stations were not established for the making of agricultural surveys or the collection of agricultural statistics, yet in many cases, especially in the newer States and Territories, in the absence of accurate information acquired through other agencies, it has been necessary for the stations to do more or less work of this character as a preliminary to the scientific investigations and practical experiments which it is their real business to make. In this way the stations have in the past done considerable work in the collection of general meteorological data, sometimes in cooperation with State weather services and the United States Weather Bureau. This work has, however, now been given up for the most part, and the stations are confining their meteorological observations to those taken on their own grounds. In a number of States data regarding the geologic formations and soils in different localities have been obtained, and in a few States this has been done with sufficient thoroughness to enable the station to make a soil map of the whole State or of particular agricultural regions. Studies of the nature of the water supply available for household use, for live stock, or for irrigation have engaged the attention of a number of stations. There have been a considerable number of botanical surveys for the purpose of obtaining information regarding the native forage plants and fruits of different States, which might be utilized for economic purposes. Several stations have done some work on the

study of life zones of their States and the suitability of varieties of crops to these zones. The largest enterprise of our stations which may be said to have been essentially a study of the natural agricultural conditions has been the determination of the regions in which sugar beets may be grown with a sufficiently high percentage of sugar to make it probable that they might be utilized in sugar making, provided the economic conditions were favorable. This investigation was carried on by the stations very largely in cooperation with the United States Department of Agriculture and farmers. Thousands of experiments were made for several years, covering the entire country, and in this way the capabilities of the United States with reference to the growing of sugar beets were quite definitely established.

The marl and phosphate deposits have been investigated in a number of States, with reference to their use for fertilizers where conveniently located.

In several States legislatures have made special appropriations to the stations for studies of the agricultural resources of particular sections as yet undeveloped, or for overcoming natural obstacles to cultivation.

INSPECTION AND CONTROL WORK.

The experiment stations in 36 States and Territories are doing more or less work of inspection, either under special State laws or as a voluntary enterprise. The nature and amount of this service varies very greatly in different States. Sometimes the station conducts a complete inspection and control, sometimes it makes the chemical or other examinations for some other organization which exercises the control, or it may simply make the examinations and publish the results for the information of the public, no system of control being provided by law. The fertilizer inspection was the first line of station work established in this country, is most thoroughly organized, and is most intimately connected with the other work of our stations. More recently inspection of dairy products and other foods for man has been undertaken in a number of States and the stations have been called upon in various ways to promote this work. In some of the Eastern States, where concentrated feeding stuffs are largely used, laws for their inspection by the stations have been enacted within the past few years. Inspection for the prevention of diseases of animals and plants and the repression of injurious insects (especially the diseases and insect pests affecting nursery stock) and weeds has been begun in a number of States. Dairy apparatus and Paris green are required to be inspected in a few States, and there has been considerable voluntary inspection of seeds by the stations in different parts of the country.

The Hatch Act makes no provision for regular inspection work by

the stations. The stations supported exclusively by this fund have therefore undertaken such work only incidentally with a view to showing its usefulness. Wherever it has assumed importance and the necessity for its regular performance has been made apparent, the States have made provision for its maintenance. Naturally the laws and regulations regarding this kind of inspection have varied with local requirements and opinions. In recent years there has been an increasing tendency toward greater uniformity in the general features of inspection laws and regulations.

The variety and extent of the inspection service of the stations, as well as its economic importance, have seemed to make it desirable that a special chapter should be devoted to an account of this feature of their work, and the reader is therefore referred to this chapter for a more complete survey of this subject.

DISSEMINATION OF INFORMATION.

The Hatch Act requires that each station shall publish bulletins or reports of progress at least once in three months, and a full and detailed report of its operations, including a statement of receipts and expenditures, once a year. Most of the publications of the stations may therefore be divided into two general classes—annual reports and bulletins.

The annual reports of the stations vary very greatly as regards the character of their contents, their size, and the number of copies printed. In a number of States the annual report is a large document containing a detailed account of the investigations of the station, as well as statements regarding its administration and finances. In some States it is a brief document containing only short statements regarding administrative matters, finances, investigations and publications. In other cases the bulletins issued by the station during the year are put together with an administrative report in a single volume. In a number of States the annual report is printed at the expense of the State, sometimes by the State printer. The annual report may be sent out to the entire mailing list, thus requiring an edition of thousands of copies, or it may have a very restricted distribution to educational institutions, experiment stations, libraries, officials, and individuals known to be specially interested in the details of station administration. The Hatch Act provides that this report shall be made primarily to the governor of the State or Territory in which the station is located, and that a copy of the report shall be sent to each of the experiment stations, to the Secretary of Agriculture, and to the Secretary of the Treasury of the United States.

The bulletins of the stations are of different descriptions and can not be definitely separated into classes. All of the stations have, however,

a regular series of bulletins, usually numbered consecutively, which comprise the greatest part of their publications. These bulletins contain a great variety of information. Some of them consist wholly of compiled matter, some are popular accounts of station investigations, and others contain quite technical and elaborate descriptions of their investigations. Some stations have attempted to separate their technical and popular bulletins into different series, and in some cases new series have been begun after the station has been in operation a number of years. As a rule, however, the stations issue their regular bulletins in a single series. Illustrations are quite generally used in bulletins and more attention has been given from year to year to improving the general appearance of the bulletins. Many of the stations annually issue more than the four bulletins required by the Hatch Act. The bulletins are sent out to mailing lists containing from 2,000 to 32,000 addresses in different States, the aggregate number of addresses being about half a million. The stations endeavor to send their bulletins to all applicants within their own States and to satisfy outside demands for them as far as their means will allow. This outside demand has, however, grown to be so large as already to cause embarrassment. Each station has a considerable number of foreign correspondents to whom the bulletins are regularly sent.

In a number of the States the stations prepare press bulletins, which are either résumés regarding the station work, or contain information of more general character. In cases in which the station receives a large number of requests for information on any topic, it has been often found convenient to have answers distributed through the press rather than by correspondence.

At the New York State Station a special officer is employed to edit the publications of the station, and one of his duties is to prepare brief popular bulletins based on the longer and more technical publications of the station. These popular bulletins are sent to the mailing list generally which, in that State, numbers 32,000 addresses, while the larger publications are issued in more restricted editions.

Some of the stations have from time to time issued charts and posters illustrating special features of their work. Some of these have been made up in the same manner as advertising posters, with illustrations and display type. Such posters are placed in railroad depots, post-offices, and other public places, with a view to attracting the attention of farmers who are not already familiar with the work of the station, and thus leading them to apply for the station bulletins.

The station mailing lists are quite commonly kept on cards, each of which contains one address, and are catalogued by counties and post-offices. In some cases the mailing list is kept in type and copies are printed as required for use in a mailing machine. Such a list of the governing boards and officers of the stations is kept at the Office of

Experiment Stations and furnished to the stations on request whenever they desire to send out a publication.

The Hatch Act gave the experiment stations the right to send their publications through the United States mails free of charge. The postal regulations require that the envelopes containing such publications shall have a frank printed on them which bears the facsimile of the director's signature.

Meetings of farmers, known as "farmers' institutes," are now regularly held in 43 States and Territories, principally during the winter months. These meetings usually last from 1 to 3 days, and the exercises consist of addresses by experts in different lines of agricultural science and practice, successful farmers, and other persons who are able to give information which will interest and benefit farmers. Often there are music, popular readings or recitations, refreshments, and other social features. A question box, into which any person in the audience may drop a written question, to be answered by the leader of the meeting or some expert in attendance, is often a feature of these meetings. The institutes are commonly under the general management of the State boards or commissioners of agriculture, but in some States they are managed directly by the agricultural colleges and experiment stations. In Wisconsin and Minnesota there are special State officers known as "superintendents of institutes," who are connected with the agricultural colleges. Whatever may be the general management of the institutes, the station officers quite generally participate in them as speakers. There are now held annually in the United States some 2,000 institutes, which are attended by about half a million farmers. Through the institutes the stations are therefore able to reach a large number of farmers, many of whom do not read the station publications. These institutes also furnish the means for supplementing the station publications by oral explanations of the experiments recorded in them. Station officers also make a large number of addresses each year before State and local agricultural, horticultural, and dairy associations and miscellaneous meetings of farmers.

The correspondence carried on by station officers is very large, aggregating hundreds of thousands of letters annually. A large part of these are replies to inquiries by farmers, which cover almost every topic related to the theory and practice of agriculture.

A considerable number of stations make exhibits of their work at State and other agricultural fairs.

GENERAL RESULTS OF THE WORK OF THE STATIONS.

During the past ten years more than 10 million dollars have been expended for the maintenance of agricultural experiment stations in the United States. Of this sum about 7 million dollars came from the Fed-

eral Government and 3 million dollars from State sources. During that time the United States produced agricultural products valued at 30,000 million dollars. The maintenance of the stations, therefore, involved the expenditure of $1 for every $3,000 worth of agricultural products. Considered in this light, the funds used to improve the quality and increase the yield of our agricultural products do not seem disproportionately large. They are, however, sufficiently large to make it very important that the results shall clearly justify the continued expenditure of such great sums for the support of the stations. Many of the results obtained in experimental inquiries in agriculture are of course of such a character that it is difficult, if not impossible, to give any exact measure of their value, especially on a financial basis. A large share of the work must necessarily give negative results, the practical value of which consists in showing the farmer the things which he ought not to do. Obviously many of the results which have a limited or local value and which in the aggregate would go far toward justifying the maintenance of the stations can not even be referred to in a summary statement like this, or even in the accounts of the individual stations, to which the reader must go for a more complete view of the efficiency of our stations. We shall, however, attempt to call attention very briefly to some of the more prominent results which the stations have obtained and on which their claims of usefulness to our agriculture must depend. In doing this some references will necessarily be made to the work of individual stations, but it should be clearly understood that this is only a partial survey of the work of the stations and that those not mentioned in this brief résumé may have done things which, considering all the circumstances, are better evidence of their efficiency than the results which are cited here.

THE INTRODUCTION OF NEW AGRICULTURAL METHODS, CROPS, OR INDUSTRIES, AND THE DEVELOPMENT OF THOSE ALREADY EXISTING.

Beginning with the work of our stations in which the attempt has been made to introduce new methods, crops, or industries, we may with good reason assert that the most important general result of experiment-station work has been along the line of dairying. The working out of practical methods and apparatus for the rapid determination of the fat content of milk, most perfectly accomplished by the Wisconsin Station, the researches regarding the chemistry and bacteriology of milk and dairy products, the elaborate investigations on cheese making at the New York State Station and on the ripening of cheese at the Wisconsin Station, the more practical experiments in butter making at the Iowa Station—these and other investigations at our stations, combined with the dissemination of information regard-

ing the results of work in similar lines abroad, have brought about a widespread revolution in the business of dairying in this country.

Following the perfection of the Babcock test, a large amount of work was done which showed the weight or volume of milk to be an unfair and illogical basis for paying for milk at creameries, and the "relative-value plan" was developed by the Iowa Station in which the fat content of the milk is taken into account, payment being made on the basis of the pounds of milk fat delivered. Subsequent work has shown that this, with a slight correction, is the proper basis for buying milk at cheese factories. This has resulted in a culling of herds, improvement of the cows kept, and increased profit.

The work in bacteriology has dealt with the extent and character of infection with micro-organisms, means of gaining access to milk, prevention by cleanliness in the stable and in handling, pasteurization, the use of pure or of definite cultures in butter making and cheese making, the nature of the changes in the ripening of cheese and the kinds of organisms causing them, and the means of controlling ripening. This work has led to the discovery of a ferment in milk hitherto unknown, which is believed to play a very important part in cheese ripening. Furthermore, the artificial cooling of cheese-curing rooms has received attention, resulting in practical suggestions for this purpose.

Closely connected with the improvement of dairying have been the investigations on nutrition, many of which have been made with dairy cattle. These have had to do with the effects of feeding stuffs on the quality of milk and the character of butter, or have dealt with the economical production of dairy products. The highest point in the work on nutrition has been reached in the perfecting of methods and apparatus by the Connecticut Storrs Station in cooperation with this Department. The respiration calorimeter devised at that station having proved its usefulness in investigations on some of the fundamental problems of the nutrition of man, is now being adopted by the Pennsylvania Station and the Department to use in similar investigations with farm animals. Two European governments have made liberal appropriations for the construction of respiration calorimeters after the plan of the Connecticut apparatus. The Iowa, Maine, Massachusetts, Michigan, Minnesota, New York, Pennsylvania, Vermont, Wisconsin, and other stations have also made important investigations on the nutrition of dairy and other farm animals, which have widely changed the practice of feeding such animals. Among such investigations are those relating to the effect of the character of the food on the quality of the product and on the proportion of fat and lean meat in steers and pigs; the suitability of breeds of animals of different conformation to various purposes; effect of shelter and treatment on growth and gain, and the economy of a large number of different feeding

stuffs, representing those generally at the disposal of farmers; the effect of cooking and other methods of preparation. One very important result, on account of the enormous supply, has been the demonstration of the feeding value of maize stover when properly cared for, and the intrinsic feeding value of different by-products of wheat. A large number of these by-products, e. g., the gluten meals and feeds, cerealin feed, etc., have been widely tested.

Notable instances of the successful introduction of new crops are the Manshury barley by the Wisconsin Station, which has materially increased the yield of barley over a wide region, with results worth millions of dollars, and the Kafir corn brought in by this Department, but introduced to practical use on a large scale by the stations in California, Kansas, and Oklahoma, the crop being valued at over $5,000,000 in Kansas alone in 1899. The Minnesota and Wisconsin stations were instrumental in the introduction of rape as a forage plant for sheep, and it is now grown on thousands of farms in the Northwest, to the great advantage of the farmer. The hairy vetch introduced by the Mississippi Station has proved of great value to that State. Important studies on the nutritive value and practical usefulness of alfalfa (lucern) by the Colorado, Utah, and other western stations have done much to extend the area and enhance the value of that crop in the irrigated region, while recent experiments by the New York and New Jersey stations and a number of stations in the Gulf States seem to indicate that it has a wider usefulness in the East than has hitherto been supposed. The value of crimson clover as a crop for forage and green manuring over a considerable area has been shown by the Delaware and other stations. The investigations on sugar beets conducted throughout the country by the stations and this Department have already had a practical outcome in the successful establishment of sugar factories in several States, and have shown in a very definite way in what regions this industry has the best chance of success. The work of the Louisiana Stations on methods and apparatus for making cane sugar and on the culture of the sugar cane have been so far successful as to secure for the station the financial support of the State Sugar Planters' Association.

The staple crops of the country, as maize, wheat, cotton, tobacco, have been the subject of an immense amount of investigation, touching nearly every phase of their chemical composition, improvement by breeding and selection, culture, manuring, harvesting, and curing or storage. Many of the results have been of direct practical value, and have materially influenced the methods followed by farmers. These investigations have also led to a greater diversification of agriculture in many regions. The Nebraska Station was largely instrumental in convincing the farmers of that State that winter wheat should be grown instead of spring wheat, with the result that the wheat crop of the State

is now annually worth some $50,000,000. The investigations of the stations in Alabama, Tennessee, Mississippi, Louisiana, Florida, and other southern stations have shown that forage plants of different kinds may be successfully grown throughout the South, and thus have laid the foundation for a wide development of the live-stock industry of that region. The stations in the South and elsewhere have also done a great work in demonstrating the value of cotton seed and its products as feeding stuffs and fertilizers, and have thus added materially to the value of the cotton crop.

Experiments of large economic importance to this region have been those of the Arkansas Station on cheap methods of producing pork in connection with the raising of cotton and with a special view to the improvement of worn cotton soils, and a number of other stations in the South have experimented with the growing of crops to be harvested by hogs so as to form a rotation through the season.

The chemical studies and elaborate field experiments on tobacco by the Connecticut State Station in cooperation with tobacco growers have greatly improved the quality of wrapper leaf tobacco grown in that State, and thus materially increased its market value.

The South Carolina Station has shown the possibilities of the sweet potato as a starch-producing plant, and the Florida Station has demonstrated the value of cassava for this purpose and for feeding.

The investigations which a number of our stations have made regarding the storage of forage crops in silos and the use of silage for feeding purposes have been of great importance in connection with the development of dairying in this country. These have related to the methods of constructing and filling silos, the best time for cutting the crops to secure the maximum amount of nutrients, increasing the richness of the silage by adding leguminous crops, and the feeding of the product. The results of the investigations on silage have done much to promote economy of production in dairying. The investigations of the Illinois, Ohio, Indiana, and other stations, which demonstrated the superiority of shallow over deep cultivation of maize have produced widespread changes in the culture of that crop. Our stations have performed a very extensive and useful work relating to the use of commercial fertilizers. This is a subject of great economic importance in almost all the States east of the Mississippi River. The investigations of the stations have shown the fertilizer requirements of different soils and crops, and have led farmers quite generally to recognize the desirability of a discriminating use of fertilizers. More recently the stations have shown the feasibility and general advantages of the home mixing of fertilizers by the farmers themselves. In the investigations on fertilizers the stations in Connecticut, New Jersey, Massachusetts, New York, Kentucky, North Carolina, Rhode Island, and Ohio have taken a leading part. In New York the exten-

sive investigations of the station connected with Cornell University on the care and preservation of farm manures have given results of much practical value.

In the States west of the Mississippi River the conservation of moisture in the soil is an important factor in successful agriculture, and the stations in that region have done valuable work in showing the conditions under which the moisture is largely conserved and by introducing methods of tillage especially adapted to this purpose.

The investigations which the California Station has made regarding alkali lands have led to the reclamation of large tracts of land in that State which before were thought to contain alkali in such amounts as to make them useless for agricultural purposes. More recently the Wyoming Station has made important studies on alkali soils with special reference to the effects of different amounts of alkali on the germination of seeds. An interesting and important application of the theories regarding the need of certain soil micro-organisms for the successful growth of leguminous plants has been made by the Alabama College Station. Inoculations of the soil with pure cultures of these organisms or with soil containing them have greatly stimulated the growth of such plants. Clover, especially, has thus been successfully grown in regions in that State where it had hitherto been a failure.

Among the horticultural investigations of the stations which have given the most important practical results are those relating to the introduction of new kinds and varieties of fruits in different localities, the increase of hardiness and resistance to disease by grafting, the culture and management of orchards, the storage of fruits, and the heating and subirrigation of greenhouses. Those investigations which have related especially to the forcing of vegetables in the field and under glass, have been a considerable factor in the rapid development of the business of supplying markets in the United States with a large amount of green food at all seasons of the year, even in the States farthest north.

The work of the California Station with reference to the culture of grapes and olives and the manufacture of wine and olive oil have proved a great aid to the development of the wine and olive-oil industries in that State.

REMOVAL OF OBSTACLES TO AGRICULTURAL INDUSTRIES.

The American stations have done a great work in aiding the farmers in their contest with the natural enemies to successful agriculture, and in removing, in whole or in part, obstacles which hinder the progress of various agricultural industries. Under this head the most important investigations of the station have been those relating to insect pests and diseases of plants and animals.

Among the lines of work in entomology conducted at the stations which have been of greatest economic importance a few may be mentioned.

It has been shown that the injury caused by the codling moth may be almost entirely prevented by the use of bands upon the apple trees and arsenical sprays at the proper season. It has been demonstrated that plums may be protected against the attack of the plum curculio by the use of the jarring method and the curculio catcher, and also by spraying with arsenical poisons during the egg-laying season. Tobacco dust and bisulphid of carbon have proved to be effective remedies against the woolly aphis of the apple. Bisulphid of carbon has been used with good success against the various insects which affect stored grain. The hot-water method has also proved successful in this connection. In several States experiments have been conducted for the purpose of developing and perfecting practicable remedies against scale insects. Fumigation with hydrocyanic-acid gas has proved a very successful remedy both when applied to nursery stock in small quantities and in bulk, and also when applied to living trees. On the Pacific coast a lime, sulphur, and salt wash has given excellent results as an insecticide against scale insects. Experiments have also been conducted with whale-oil soap in various forms and quite recently with kerosene and crude oil. These last two substances have been applied both in diluted and undiluted forms, and in the experiments reported have proved effective remedies when applied properly and at the right season.

Numerous experiments have been made with the purpose of determining the relative value of various arsenical poisons as insecticides. The arsenicals in most common use are Paris green, London purple, and arsenate of lead. The experiments conducted with these substances have shown that Paris green and London purple vary in composition to a certain extent, and their differences in solubility and consequent liability to injure green foliage must be taken into account in spraying. It has been shown that arsenate of lead may be used in much larger proportion than Paris green or London purple without injuring the foliage. Experiments have been conducted to determine the value of pyrethrum and hellebore applied either in the dry form or as a spray. It has been shown by experiment that fungicides and insecticides in many cases may be combined in one treatment. The more common combination is that of Bordeaux mixture and some arsenical poison.

Numerous experiments have been carried out in spreading fungus diseases among insects, and practical results in this line have been obtained with work upon the chinch bug and locust.

Economic entomologists have devoted much attention to the study of the effectiveness of different spraying apparatus, and observations

made along this line in the field have suggested various improvements in spraying devices, which have been taken up by manufacturers, the result being much more effective spraying apparatus. Much useful work has been done in the improvement of nozzles for definite purposes, in the use of horse power, steam power, and gasoline engines for throwing the spray, in the development of apparatus for making a mechanical mixture of oil and water, and in the perfection of blowguns for the distribution of powdered insecticides upon plants.

The following are among the most successful investigations of the stations on plant diseases and their treatment. Potato scab was almost simultaneously investigated at the Connecticut State and Indiana stations, and the immediate cause of the disease was determined at the former station. Methods of treatment by means of soaking the seed tubers in corrosive sublimate solutions or in formalin were worked out at the Indiana and North Dakota stations. The use of sulphur as a means of preventing this disease is to be attributed to the New Jersey Stations. The influence of lime on the development of scab, especially on acid soils, has been extensively studied at the Rhode Island Station. Other potato diseases have been investigated at a number of stations, and especially at the Vermont Station, where it has been determined that instead of a single disease, or at most two, there are five or six distinct diseases to which the potato is subject. Their causes have for the most part been determined and remedies suggested based on the work of the Vermont Station.

The subject of cotton diseases has been investigated particularly at the Alabama and Texas stations, and most of the literature relating to the cause and means for the prevention of these diseases, so far as known, have emanated from these two stations. Cereal diseases and their treatment have been extensively investigated at quite a number of stations, especially those in Kansas, Indiana, Iowa, North Dakota, and Ohio. The credit for the extensive use in this country of the hot-water treatment for the prevention of smut diseases of small grain must be given to the stations, especially the Kansas Station. The value of formalin for the same purpose was determined by the botanist of the North Dakota Station. A very serious smut of rice has been recently described from the South Carolina Station, and, although its life history is not sufficiently known to suggest definite remedies, warnings and suggestions have been given to prevent its spread.

The asparagus rust, which at one time seemed to threaten this truck crop in the Eastern United States, was first noted in this part of the country by the stations. The New Jersey, Connecticut State, and Massachusetts stations gave timely warnings against it and valuable suggestions for keeping it in check.

Sweet potato diseases have been the subject of an extensive study by the mycologist of the New Jersey Stations. The causes of a num-

ber have been determined, and in several cases remedies have been discovered.

Bean and celery diseases have been especially investigated by the New Jersey, New York State, and Connecticut State stations and methods of prevention determined.

Pear blight, which is probably one of the most destructive of the diseases of apples, pears, and allied fruits, was first described and its bacterial nature demonstrated by the botanist of the Illinois Station, and extended and important investigations were later made on this disease at the New York State Station.

Grape diseases have been a subject of study at a number of stations, particularly the New York Cornell Station, where a number of the more obscure have been extensively studied. The causes of some of these have been determined and remedies suggested.

Among animal diseases, the work of numerous stations on tuberculosis has had widespread practical results. The methods of application and the limitations of the tuberculin test have been thoroughly and widely studied. Much attention has also been given to the prevention of hog cholera, using the serum made by the United States Department of Agriculture, and also a somewhat different one worked out at the Nebraska Station, which is believed to reduce the percentage of infection very materially.

Many experiments have been made in rendering animals immune to Texas fever when taken into the region where it prevails for breeding purposes or for grazing, and in preventing the spread of the disease to new regions through the movement of cattle. The source of infection of anthrax in Delaware has been traced to the pollution of streams with the wash water from morocco tanneries, and much effective work has been done in the repression of this disease in that State.

A number of stations in the West have investigated means of combating gophers. Carbon bisulphid has been shown to be quite an effective remedy in reducing their numbers.

DEFENSE OF THE FARMER AGAINST FRAUD.

As stated elsewhere, the stations east of the Mississippi River have been largely engaged in the control of commercial fertilizers. The fertilizer business in this country involves millions of dollars, and the stations have largely prevented the sale of fraudulent goods. The stations have also done much to expose extravagant claims made for commercial fertilizers as compared with farm manures. More recently the stations in a number of States have been engaged in the inspection of feeding stuffs, dairy products, and nursery stock for fungus diseases and insect pests, and have given a valuation to condimental feeding stuffs sold at high price. Besides the prevention of fraud by a

regular system of inspection, the stations have also done much useful work in this line in other directions. For example, their tests of varieties of grain, vegetables, fruits, etc., have often shown farmers how extravagant were the claims made for new varieties of plants. Their tests of the purity and vitality of seeds, while not systematically conducted, have yet done much toward making the farmer more careful in his purchases of seeds. From time to time the stations have exposed frauds relating to the sale of quack medicine for stock, especially hog-cholera remedies, creamery construction and equipment, dairy products, butter increasers and preservatives, adulterated foods and feeding stuffs, etc.

AID TO THE PASSAGE OR ADMINISTRATION OF LAWS FOR THE BENEFIT OF AGRICULTURE.

The experiment stations, as well as the agricultural colleges, have been largely instrumental in securing and administering State laws for the inspection of fertilizers, nursery stock, dairy products, foods and feeding stuffs, creamery glassware, Paris green, and for the suppression of plant diseases and injurious insects. They have also aided in the passage of laws establishing farmers' institutes, organizing associations for the promotion of agriculture, fixing a milk standard, quarantining animals for contagious diseases, regulating the sale of oleomargarine and kindred products, determining the apportionment and measurement of water for irrigation, securing the improvement of roads, etc.

EDUCATIONAL RESULTS OF STATION WORK.

Broadly speaking, the most important results of the work of the American stations during the past quarter of a century, and especially during the past decade, have been educational. As we have seen, they have distributed very widely in their own publications a vast amount of accurate and valuable information regarding the theory and practice of agriculture, and have thus directly contributed on a large scale to the technical education of our farmers. As the result of the investigations and publications of the stations, the agricultural books and the agricultural journals published in this country have been largely revolutionized. Instead of depending, as formerly, almost entirely on foreign agricultural literature as the standard for agricultural theory and practice, we have now a considerable body of distinctively American agricultural literature. If we contrast the meager amount of up-to-date information on matters connected with his art which was available to the American farmer ten years ago with what we now possess, we will without doubt be convinced that as educating agencies

our experiment stations have been a great success. No nation has ever attempted the free dissemination of agricultural information in so wide and thorough a way as has the United States, and it is believed that the results have justified the large expenditures which have been made for this purpose.

One large result of the educational work of the stations has been the general breaking down of the popular conception that agriculture is not capable of improvement through systematic and progressive researches in its behalf conducted on scientific principles. A widespread belief has been awakened that with the aid of science agriculture may be so lifted out of the ruts of a dead past that it will be able to hold its own amid the growing competitions and complexities of our modern civilization. Some of the consequences of this new belief are likely to be very important and far-reaching. Already the farmer in this country is much inclined to demand that theories and assertions regarding the practice of his art shall be brought to the test of rigid and accurate investigation. Those who have in recent years followed up the agricultural press or the farmers' institutes testify that articles or speeches which simply declare individual opinions or individual experience no longer satisfy the farmer. Whenever new ideas or theories are brought to his attention he is very apt to inquire if the experiment stations have looked into this matter, or he will at least demand that some sort of positive proof shall be presented that it is wise for him to accept the new proposition. While there has been at times widespread discontent among the farmers with regard to their economic condition, it may also be said that the experiment stations have done much toward inspiring a feeling of hopefulness. The stations are not only giving the farmer much information which will enable him to improve his practice of agriculture, but they are also leading him to a more intelligent conception of the problems with which he has to deal and of the methods he must pursue to successfully perform his share in the work of the community and hold his rightful place in the commonwealth.

As a result of the intimate association of the stations with institutions for higher education, the courses in agriculture have been improved and strengthened. The pedagogical possibilities of instruction in the science and practice of agriculture have thus been more clearly revealed, and the claims of agricultural science have increasingly gained the respect and attention of educators and scientists working in other lines.

There is now in this country a much keener appreciation than heretofore of the fact that the problems of agriculture furnish adequate opportunities for the exercise of the most thorough scientific attainments and the highest ability to penetrate the mysteries of nature. The general recognition of the high quality and successful outcome of

some of the best work of our stations has been a great encouragement to the continuance of faithful and thorough investigations in agricultural lines.

Considered merely as organizations for the advancement and diffusion of knowledge, the influence of the stations has by no means been inconsiderable. The establishment of so many institutions for original research as component parts of colleges and universities marked a decided advance in public sentiment regarding the desirability of such work as a part of the system of public education in the United States; and the success already attained by the stations has led to earnest efforts to secure public support of similar institutions for the promotion of other arts and industries.

As regards the stations themselves, we may confidently assert that their past history gives great assurance of increasing strength and efficiency in the future. While they have encountered many difficulties in their development and there has necessarily been much of crudity in their work thus far, they have every year secured a better equipment and more thoroughly trained officers. With increasing resources they have been able to specialize their work more thoroughly and to increase its scope. They have succeeded in securing, to a remarkable extent, the confidence of the people for whose benefit they were primarily established, and have thus had no difficulty in obtaining financial support from Congress and the State legislatures. The people generally have come to regard the stations as permanent institutions, and are convinced of the usefulness of their work. They will, therefore, enter upon the twentieth century with bright prospects for the development of their researches in scientific thoroughness and accuracy and for the securing of larger practical results.

ASSOCIATIONS AFFILIATED WITH THE STATIONS.

THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

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Vice-Presidents:

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WILLIAM M. LIGGETT of Minnesota.
JOHN H. WASHBURN of Rhode Island.
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F. P. ANDERSON of Kentucky.
A. W. HARRIS of Maine.
J. E. STUBBS of Nevada.

Collective Station Exhibit at Paris Exposition:

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W. H. JORDAN of New York.
A. W. HARRIS of Maine.
M. A. SCOVELL of Kentucky.
A. C. TRUE of Washington, D. C.

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A. C. TRUE of Washington, D. C.
ALEXIS COPE of Ohio.
J. H. WASHBURN of Rhode Island.

Cooperative Work between Stations and Department of Agriculture:

E. A. BRYAN of Washington, *Chairman.*
H. H. GOODELL of Massachusetts.
W. A. HENRY of Wisconsin.
H. J. WATERS of Missouri.
L. G. CARPENTER of Colorado.

Indexing Agricultural Literature:

A. C. TRUE of Washington, D. C., *Chairman.*
W. M. HAYS of Minnesota.
T. F. HUNT of Ohio.
E. DAVENPORT of Illinois.
W. P. CUTTER of Washington, D. C.

Military Instruction in Land-Grant Colleges:

G. W. ATHERTON of Pennsylvania, *Chairman.*
A. W. HARRIS of Maine.
C. W. DABNEY of Tennessee.
ALEXIS COPE of Ohio.
H. H. GOODELL of Massachusetts.
R. H. JESSE of Missouri.
H. C. WHITE of Georgia.

Revision of Constitution:

J. E. STUBBS of Nevada, *Chairman.*
J. K. PATTERSON of Kentucky.
M. H. BUCKHAM of Vermont.
W. A. HENRY of Wisconsin.
H. H. GOODELL of Massachusetts.

CONSTITUTION.

NAME.

This association shall be called the Association of American Agricultural Colleges and Experiment Stations.

OBJECT.

The object of this association shall be the consideration and discussion of all questions pertaining to the successful progress and administration of the colleges and stations included in the association, and to secure to that end mutual cooperation.

MEMBERSHIP.

(1) Every college established under the act of Congress approved July 2, 1862, or receiving the benefits of the act of Congress approved August 30, 1890, and every agricultural experiment station established under State or Congressional authority, the Bureau of Education of the Department of the Interior, the Department of Agriculture, and the Office of Experiment Stations of the last-named Department, shall be eligible to membership in this association.

(2) Any institution a member of the association in full standing may send any number of delegates to the meetings of the association, but one shall be designated to the association as the regular representative and voting delegate. The same delegate may represent both a college and a station, but shall cast only one vote in general sessions. Other delegates may be designated by any institution to represent it in specified sections of the association, but such delegates shall vote only in such sections, and no institution shall be allowed more than one vote in any sectional meeting.

(3) Delegates from other institutions engaged in educational or experimental work in the interest of agriculture or mechanic arts may, by a majority vote, be admitted to conventions of the association, with all privileges except the right to vote.

(4) In like manner, any person engaged or directly interested in agriculture or mechanic arts who shall attend any convention of this association may be admitted to similar privileges.

SECTIONS.

(1) The association shall be organized into sections upon (1) college work; (2) agriculture and chemistry; (3) horticulture and botany; (4) entomology; (5) mechanic arts. The executive committee shall, upon the request of any ten institutions represented in the association, provide for the organization of provisional sections at any convention.

(2) Each section shall conduct its own proceedings and shall keep record of the same, and present a synopsis thereof to the association at the close of every convention; and no action of a section, by resolution or otherwise, shall be valid until the same shall have been ratified by the association in general session.

MEETINGS.

(1) This association shall hold at least one meeting in every calendar year, to be designated as the annual convention of the association. Special meetings may be held at other times, upon the call of the executive committee, for purposes to be specified in the call.

(2) The annual convention of the association shall comprise general sessions and meetings of the sections, and provision shall be made therefor in the programme. The section meetings may be simultaneous or otherwise, at the discretion of the executive committee, but at least two sections of the association, to be designated each year by the executive committee, shall present in general session of each convention a portion of the subjects coming before them.

OFFICERS.

(1) The general officers of this association shall be a president, five vice-presidents, a bibliographer, and a secretary who shall also be treasurer. The president, junior ex-president, the secretary, and four persons to be chosen by the association, shall constitute an executive committee, which shall elect its own chairman.

(2) Each section shall, by ballot, nominate to the association in general session for its action, a chairman and a secretary for such section.

(3) Officers shall be chosen by ballot at the annual convention of the association, and shall hold office from the close of the convention at which they are elected until their successors shall be chosen.

(4) Any person being an accredited delegate to an annual meeting of the association, or an officer of an institution which is a member of the association in full standing at the time of election, shall be eligible to office.

DUTIES OF OFFICERS.

(1) The officers of the association shall perform the duties which usually devolve upon their respective offices.

(2) The president shall deliver an address at the annual convention before the association in general session.

(3) The chairman of each section shall make, at the annual convention, a report to the association in general session of the progress during the preceding year of the subject or subjects appertaining to his section, and such reports shall not occupy more than twenty minutes each.

(4) The executive committee shall determine the time and place of the annual conventions and other meetings of the association, and shall, between such conventions and meetings, act for the association in all matters of business. It shall issue its call for the annual conventions of the association not less than sixty days before the date on which they are to be held, and for special meetings not less than ten days before such date. It shall be charged with the general arrangements and conduct of all meetings called by it. It shall designate the two sections to present in general session a portion of the subjects coming before them, and shall give notice thereof to the chairmen of such sections at least ninety days prior to the annual convention. It shall provide a well-prepared order of business and a programme of exercises, and shall make a seasonable issue of said programme. Said committee may fill any vacancy in an office or committee of the association occurring after the adjournment of the annual convention, such appointee to serve until the next annual election.

FINANCES.

At every annual convention the association, in general session, shall provide for obtaining the funds necessary for its legitimate expenses, and may, by appropriate action, call for contributions upon the several institutions eligible to membership; and no institution shall be entitled to representation or participation in the benefits of the association unless such institution shall have made the designated contribution for the year previous to that in and for which such question of privilege shall arise, or shall have had said payment remitted by the unanimous vote of the executive committee.

AMENDMENTS.

This constitution may be amended at any regular convention of the association by a two-thirds vote of the delegates present, if the number constitute a quorum: *Provided*, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given in the call for the convention.

Every such proposition of amendment shall be subject to modification or amendment in the same manner as other propositions, and the final vote on the adoption or rejection shall be taken by yeas and nays of the institutions then and there represented.

RULES OF ORDER.

(1) The executive committee shall be charged with the order of business, subject to special action of the convention, and this committee may report at any time.

(2) All business or topics proposed for discussion and all resolutions submitted for consideration of the convention shall be read and then referred, without debate, to the executive committee, to be assigned positions on the programme.

(3) Speakers invited to open discussion shall be entitled to twenty minutes each.

(4) In general discussions the ten-minute rule shall be enforced.

(5) No speaker shall be recognized a second time on any one subject while any delegate who has not spoken thereon desires to do so.

(6) The hours of meeting and adjournment adopted with the general programme shall be closely observed, unless changed by a two-thirds vote of delegates present.

(7) The presiding officer shall enforce the parliamentary rules usual in such assemblies and not inconsistent with the foregoing.

HISTORY AND WORK.

As colleges having courses in agriculture were established in the different States under the act of Congress of July 2, 1862, their officers began to feel the need of meeting together for consultation regarding the management and work of these institutions. When experimental investigations in agriculture began to increase in number and variety at these institutions and a number of the States undertook the maintenance of agricultural experiment stations, the agricultural colleges became the natural leaders of a movement to secure national aid for the development of experiment stations through the action of Congress. With this object in view a convention of delegates from the agricultural colleges met at Washington, D. C., in 1883, to promote the establishment of experiment stations in connection with these colleges. On July 8, 1885, a convention of agricultural colleges and State experiment stations met at the Department of Agriculture in Washington in response to a call issued by the United States Commissioner of Agriculture, and on October 18, 1887, at a second convention in the same city, a permanent organization was effected under the name of "The Association of American Agricultural Colleges and Experiment Stations." As the institutions represented in this association had been largely instrumental in securing the passage of the act of Congress of March 2, 1887 (Hatch Act), for the aid of agricultural experiment stations by the National Government, it naturally devoted itself very largely during the first years of its existence to the discussion of questions regarding the organization, management, and work of the experiment stations, and to the promotion of the interests of the stations before Congress and throughout the country. In recent years the work of the association has become greatly broadened so as to include the promotion of the important and varied interests of the institutions comprising it, many of which are strong universities and colleges whose work

covers a wide range in education and research. The association has, however, devoted itself principally to matters relating to industrial and military education and research in agriculture. The meetings of the association and its committees, which are held in different parts of the country, afford many opportunities for the formation of personal acquaintances between officers of the widely separated institutions comprising its membership and in this way the solidarity of the movement for agricultural education and research is greatly strengthened and uniformity of plan and action on many important matters of general interest is greatly promoted. In many important ways it acts as a central agency for the experiment stations as well as for the colleges with which they are connected and serves to bind them together so as to form a national system of agricultural education and research. The association often represents the collective interests of the colleges and stations in transactions with different branches of the United States Government. It has been officially recognized by the Government as an essential part of the experiment station system and has joined with the United States Department of Agriculture in many enterprises in the interests of the stations. The association and the Department cooperated in the management of a collective exhibit of the experiment stations at the World's Columbian Exposition in 1893, and in a similar way have united in the preparation of an exhibit of the stations for the Paris Exposition of 1900.

In connection with the former Exposition, the association was the medium through which the stations received a very marked popular recognition of their services and an unusual expression of confidence in the ability of station workers to apply scientific methods to practical affairs. In preparing for the exhibit of dairy cattle and dairy products conferences were held by representative breeders and dairymen, and a supervising committee of fifty was appointed to prepare plans. This committee proposed a systematic comparative test of cows from the several dairy breeds upon a scale never before attempted, and the Association of American Agricultural Colleges and Experiment Stations was requested to take charge of the matter and name directors of stations to serve as the testing committee.

Four well-known investigators were selected to represent the stations, and these, together with one representative of each breed of cattle competing, constituted the committee in full charge of the test. There were included about 25 cows of each of the competing breeds, which formed the finest collection of dairy animals ever brought together. These were handled for six months on the Exposition grounds with the greatest skill and utmost attention to detail. Butter and cheese were made from the milk during fixed periods. The work was so well done that the results have never been challenged. It is estimated that the cost of this unique experiment exceeded $100,000.

The records of this famous dairy-cow test were wholly devised and controlled by the station officials, and were elaborate, complete, and so managed as to secure absolute accuracy. They comprise about 1,000 large sheets of tabulated matter, involving 400,000 separate entries of one to six numerals each, and over 20,000 computations. All the work was daily viséd and tested by members of the committee, and the final copy proof-read and compared with the original notes. These records have never been published entire, but a full copy has been made and placed on file at the United States Department of Agriculture, where it is held for reference and the use of students of dairying.

ORGANIZATION.

The annual convention of the association is a delegate body, consisting of one representative from each of the colleges and experiment stations in the United States, entitled to membership by its constitution. The Department of Agriculture, the Office of Experiment Stations, and the Bureau of Education of the Department of the Interior are also each represented in the association by one delegate. The delegates from the colleges and stations are appointed annually by the governing boards or executive officers of those institutions.

The officers of the association are elected annually by ballot, at its conventions, and include a president, five vice-presidents, secretary and treasurer, and bibliographer. There is also an executive committee, consisting of the president, junior vice-president, secretary, and four other persons chosen by the association. For a portion of its work, the association is divided into the following sections, each of which elects its own chairman and secretary, subject to the approval of the association: College work, agriculture and chemistry, botany and horticulture, entomology, mechanic arts. A number of standing and special committees are appointed. The executive committee determines the time and place of the meetings of the association, and in their interval acts for the association in all matters of business not specifically delegated to other committees.

The association holds annual conventions in different parts of the country. There is, however, a general understanding that it shall meet at Washington, D. C., at least once in every two or three years. Matters of general interest, especially those affecting the management of the institutions represented, are discussed in general sessions. Papers on special topics, including accounts of investigations in agricultural science, and discussions of methods of research, are read and discussed in the sections. The proceedings are edited by the chairman of the executive committee and the Director of the Office of Experiment Stations, and are published as bulletins of this Office.

THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

This association, organized in 1884, has been very intimately connected with one quite prominent feature of the experiment station work, namely, the control work intrusted to station chemists. It is composed of analytical chemists connected with the United States Department of Agriculture, the agricultural experiment stations, and other State or national institutions charged with official control of fertilizers, feeding stuffs, dairy products, and similar materials. Its meetings, held annually, are open to all analytical chemists interested in its deliberations, and are usually attended by the chemists of various fertilizer manufactories and other agricultural industries.

The object of the association is to secure uniformity and improvement in the methods of analysis employed by official agricultural chemists throughout the country. Its chief activity and most valuable work has been in the line of testing the common methods and new ones proposed from time to time, and in improving these methods so as to make them more accurate, more rapid, or more conveniently executed. At first the association confined its attention to fertilizer analysis, especially as related to fertilizer control, but as time has gone on its scope of operations has been broadened, until now it covers the whole range of agricultural and food analysis. The latest subject to be added was fungicides and insecticides, for which provisional methods of analysis were proposed and adopted at the last convention.

The method of work is to appoint referees and associate referees on the various subjects as follows: Phosphoric acid, nitrogen, potash, soils, ash, dairy products, foods and feeding stuffs, liquors and food adulteration, sugar, tannin, and fungicides and insecticides. These referees send out to the members of the association samples of various mixtures especially designed to test particular methods or modifications of methods. Suggestions are frequently made to the referees by the association as to points to be studied. The results of these investigations of methods are reported by the referees at the annual convention, together with notes by the analysts, and deductions by the referees as to the accuracy and reliability of the methods and suggestions as to any changes desirable. Methods which are found to be reliable after thorough trial are adopted by the association as official, alternate, or provisional.

This systematic study of methods has gone on year by year for the past fifteen years, the methods for agricultural analysis being gradually sifted, and those selected often improved in accuracy and rapidity of execution. A reliable system of official methods for nearly every kind of agricultural analysis has been elaborated and perfected, and the work of the association in this respect has been widely recognized as official, both by chemists generally and by the courts.

In addition to the reports of the referees on the various subjects, scientific papers relating to various phases of agricultural analysis, such as the sources of error involved in analysis, the necessity of determining additional constituents, description of new pieces of apparatus, and laboratory equipment in general, have frequently been presented before the association. From time to time the referees have given résumés of recent literature on their respective subjects, and for several years past the association has had a committee on abstracting, which has reviewed the current literature on agricultural analysis and published the abstracts in the Experiment Station Record. Lately the association has interested itself in securing more uniform fertilizer legislation in the various States, and a committee of the association, acting in cooperation with the Association of American Agricultural Colleges and Experiment Stations, has drawn up a form for a fertilizer law which, in the interest of simplicity, it is hoped will gradually be adopted by the various States. An important committee of the association is that on food standards, which is engaged in the formulation of standards for various foods, condiments, etc. For a number of years the association has also had an important committee on standards for volumetric apparatus, which, in cooperation with other scientific bodies, is endeavoring to bring about uniformity in the calibration and graduation of volumetric apparatus made by different manufacturers.

The annual convention of the association occupies at least two days, and has usually been held in Washington, D. C. The proceedings are published as a bulletin of the Division of Chemistry of this Department, and every few years the methods which have been adopted are, for convenience, brought together and published in a separate bulletin.

THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

This association was founded in the autumn of 1889 under the name of "The Association of Official Economic Entomologists." At a later meeting the word "official" was dropped from the title, so that the association became broader in its membership.

The objects of the association, as stated in the constitution, are: "(1) To discuss new discoveries, to exchange experiences, and to carefully consider the best methods of work; (2) to give opportunity to individual workers of announcing proposed investigations, so as to bring out suggestions and prevent unnecessary duplication of work; (3) to suggest, when possible, certain lines of investigation upon subjects of general interest; and (4) to promote the study and advance of the science of entomology."

The association has not officially undertaken any work in nursery inspection or in the enforcement of laws relating to this matter. The work of the association is and has been of a voluntary nature, and

involves an interchange of notes and experiences by the members, relating to injurious insects and remedies of economic importance.

The membership is confined to workers in economic entomology, and includes State entomologists, station entomologists, the entomologists of agricultural and horticultural associations, teachers of economic entomology, and other persons engaged in practical work in economic entomology. The active membership includes 104 persons interested in economic entomology, of whom 61 are official entomologists or assistants at experiment stations. There are 36 foreign members.

The association has held 11 annual meetings, the complete proceedings of which have been published by this Department. The proceedings of the first six meetings were published in Insect Life, and those of the other five in special bulletins of the Division of Entomology. The meetings of the association are held on the two days preceding the general sessions of the American Association for the Advancement of Science. At these meetings the members are at liberty to present papers upon any question relating to economic entomology, and a general discussion follows the presentation of the papers.

THE ASSOCIATION OF EXPERIMENT STATION VETERINARIANS.

A permanent organization under the name of "The Association of Experiment Station Veterinarians" was effected in 1897. The object of this association is to bring the several veterinarians of the different experiment stations into a closer communication, to advance their common interests by the establishment of fraternal relations, and to secure the benefits of cooperation and united action in bringing into prominence the merits of scientific veterinary investigation. The association was established for the mutual benefit of experiment-station veterinarians, and does not involve in an official way any action regarding quarantine of animal diseases or enforcement of laws relating to this matter.

The meetings of the association are held in connection with the United States Veterinary Medical Association, and at such meetings papers relating to veterinary science and practice are presented by members. The association participates in the discussion of the papers which have been presented.

The membership of the association is limited to veterinarians who are connected with experiment stations or colleges of agriculture and mechanic arts in the United States.

The proceedings of the annual meetings of the association are published by this Department and appear as bulletins of the Bureau of Animal Industry.

THE OFFICE OF EXPERIMENT STATIONS.

STAFF.

A. C. TRUE, Ph. D.—Director.
E. W. ALLEN, Ph. D.—Assistant Director and Editor of Experiment Station Record.

EDITORIAL DEPARTMENTS.

Assistant Director and H. W. Lawson, B. S.—Chemistry, dairy farming, and dairying.
W. H. Beal, B. A., M. E.—Meteorology, fertilizers, soils, and agricultural engineering; editor of Experiment Station Work.
W. H. Evans, Ph. D.—Botany and diseases of plants.
C. F. Langworthy, Ph. D.—Foods and animal production.
J. I. Schulte, B. S.—Field crops.
E. V. Wilcox, Ph. D.—Entomology and veterinary science.
C. B. Smith, M. S. and V. A. Clark, B. S.—Horticulture.
D. W. May, M. S.—Scientific aid.
Wm. Henry—Indexing and proof reading.
G. A. Harlow—Librarian.
Caroline E. Johnston—Correspondence clerk.
Sarah L. Sommers—Record clerk.

ALASKA EXPERIMENT STATIONS.

C. C. Georgeson, M. S.—Special agent in charge, Sitka.
C. H. Robison, B. S.—Assistant at Sitka.
H. P. Nielsen—Assistant at Kenai.

NUTRITION INVESTIGATIONS, MIDDLETOWN, CONN.

W. O. Atwater, Ph. D.—Special agent in charge.
C. D. Woods, B. S.—Special agent at Orono, Me.
F. G. Benedict, Ph. D.—Physiological chemist.
A. P. Bryant, M. S.—Editorial assistant.
R. D. Milner, Ph. B.—Assistant.
P. B. Hawk, B. S.—Assistant.

IRRIGATION INVESTIGATIONS, CHEYENNE, WYO.

Elwood Mead, M. S., C. E.—Irrigation expert in charge.
C. T. Johnston, M. S., C. E.—Assistant.
R. P. Teele, B. S.—Assistant.
E. S. Nettleton, C. E.—Agent and expert.
J. M. Wilson, C. E.—Agent and expert.

HISTORY.

The Office of Experiment Stations was established October 1, 1888, by the Commissioner of Agriculture, Hon. Norman J. Colman, as the agency for carrying out the provisions of the act of Congress of March 2, 1887 (Hatch Act), "That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purpose of this act."

Wilbur Olin Atwater, Ph. D., professor of chemistry in Wesleyan University and director of the Storrs Agricultural Experiment Station in Connecticut, was appointed the first Director of this Office. Professor Atwater had been the first director of the Connecticut Agricultural Experiment Station, established in 1875, and after his retirement from that position had devoted himself very largely to investigations in agricultural and physiological chemistry. While serving as Director of this Office he retained his professorship and the directorship of the Storrs Station. Abram W. Harris, M. A., of Pennsylvania, was made Assistant Director. The Office at once began the collection of information and statistics regarding the history and status of the experiment stations in the United States, as well as of the colleges of agriculture. The results of this inquiry were embodied in a report on "Agricultural Education and Research in the United States," prepared for the Paris Exposition of 1889 by A. C. True, Ph. D., who had become a member of the Office staff soon after its establishment. Arrangements were made for the systematic collection of the publications of the stations, on the basis of which it was planned to prepare publications of this Office to "meet the needs of the stations on the one hand, and, on the other, convey the fruits of their work to the public whom they are intended to serve." It was decided to divide these bulletins into two distinct classes, which were defined as follows in the report of the Director for 1888: "In those of the one class, which may, perhaps, be called 'Farmers' Bulletins,' it is the purpose to collate the results of station work bearing upon special topics and the teachings of other research, and put the whole into a form so plain that the intelligent farmer will understand it, so brief that he will read it through, and so practical that he will take it to heart. Thus, while each station is distributing its own results to the farmers of its own State, this instrumentality will help the several stations to be serviceable to the agriculture of the whole country. The bulletins

of the other class, which may, with like propriety, be called 'Experiment Station Bulletins,' will be intended more especially for station workers and others interested in the more abstract scientific matters." A series of monographs on special topics was also contemplated.

Bulletins of both classes have since been regularly published by the Office, and a number of monographs have been included among the bulletins of the second class. It was also found desirable to establish a series of circulars which should contain "matters of transient or restricted importance." The first document issued, February 1, 1889, was Circular No. 1, List of Agricultural Experiment Stations in the United States, with addresses. The first experiment station bulletin was issued the same month, and contained an organization list of the agricultural experiment stations in the United States. Farmers' Bulletin No. 1, issued in June, 1889, was entitled "The What and Why of Agricultural Experiment Stations," and comprised, in 16 pages, a brief statement of the history, work, and aims of the stations. The demand for this bulletin exceeded expectation, and an edition of 50,000 copies was soon exhausted. The second Farmers' Bulletin was issued in June, 1890, and contained brief accounts of the results of the work of the stations in several different lines. This series of bulletins proved so popular that it was thereafter adopted by the Department as one of its general series of publications, prepared in different divisions, and issued by the Division of Publications. During the past few years Congress has made a special appropriation for the publication of these bulletins, and has provided that each Congressman shall have several thousand copies each year for distribution to his constituents. Over one hundred Farmers' Bulletins have since been issued, the editions in a number of cases aggregating hundreds of thousands of copies. To this series the Office of Experiment Stations has contributed 43 numbers up to January 1, 1900.

The Association of American Agricultural Colleges and Experiment Stations held its second annual convention at Knoxville, Tenn., in January, 1889, at which meeting it was decided to ask the Department of Agriculture to publish the proceedings of the association. For this purpose a series of miscellaneous bulletins was established in this Office, the first of which contains the proceedings of the Knoxville convention. After three bulletins of this series had been published it was discontinued, and the proceedings of the association have since been issued in the regular series of bulletins of this Office. The Director or other representative of the Office was a delegate to the association, as a representative of the Department of Agriculture, previous to 1891, when, by an amendment to the constitution of the association, special provision was made for a delegate representing this Office. Other members of the Office force have from time to time participated in the meetings of the association. The Office has been represented on

important committees, and since 1895 the Director has been the bibliographer of the association.

In 1889 this Office began the preparation of abstracts of station publications, and in June of that year issued the first part of a Digest of Annual Reports of Stations in the United States as Experiment Station Bulletin No. 2. It also undertook the preparation of a periodical to contain such abstracts, and Experiment Station Record, Vol. 1, No. 1, was issued in September, 1889. An account of this journal is given on page 101. The visiting of stations was also begun in 1889 and continued thereafter in an irregular way until 1894, when it became a part of the regular business of this Office.

The promotion of cooperative investigations, in which the Department, the stations, and oftentimes farmers should share, was undertaken by this Office soon after its organization, the first definite enterprise of this character being the holding of a meeting of directors of experiment stations east of the Mississippi River, March 5 and 6, 1889. A plan for cooperative field experiments was formulated at this meeting and afterwards published as Circular No. 7 of this Office.

The intimate association of the colleges of agriculture with the experiment stations and the educational functions which the stations themselves performed, through their publications and otherwise, made it a natural thing for this Office to interest itself in the promotion of education, as well as research, in agriculture. This was first done in connection with the preparation of the report for the Paris Exposition of 1889, as already stated, and this work has since been developed as opportunity offered. In 1889 the collection and publication of information regarding farmers' institutes was begun. The act of Congress approved August 30, 1890, for the further endowment of the land-grant colleges (second Morrill Act) provided that a copy of the financial and statistical reports of these institutions should be annually sent to the Secretary of Agriculture. This Office was made the depository of those reports, and was thus furnished with considerable material on which to base publications regarding the development of education in agriculture in this country. This work has since been broadened to include a survey of the institutions for agricultural education in foreign countries. Considerable attention has been given in recent years to studies regarding the curricula and methods of teaching in institutions of different grades at home and abroad, especially in connection with the work of the committee of the Association of Agricultural Colleges and Experiment Stations on methods of teaching agriculture, of which the Director of this Office has been a member.

The desirability of a card index to the publications of the stations was urged by college and station officers almost from the establishment of this Office. In response to this demand, plans for such an index were formulated and presented to the Association of American

Agricultural Colleges and Experiment Stations, at its meeting at Champaign, Ill., in November, 1890, and with the aid of a committee of that association a classification of the subjects to be indexed was decided upon and the publication of the index begun in 1891. A further account of this index is given on page 103.

The business of the Office grew rapidly, and in 1891 it was found necessary that the Director should devote his entire time to its management. Professor Atwater preferred to continue his work as a professor and investigator in connection with Wesleyan University and Storrs Experiment Station, and therefore resigned the directorship of this Office. He has, however, since that time been continuously in the service of the Office as a special agent, and for the past six years has been in charge of nutrition investigations. (See p. 106.) The Assistant Director, Mr. A. W. Harris, was promoted to succeed him, and Dr. A. C. True was made Assistant Director. During 1890 a plan for a collective exhibit of the work of the experiment stations in this country at the World's Columbian Exposition in Chicago, Ill., was submitted by the Office to the Association of American Agricultural Colleges and Experiment Stations. It was proposed that this exhibit should be prepared and cared for by the Office in cooperation with a committee of station directors to be selected by the association. This plan was adopted and the committee called for was appointed, with Director H. P. Armsby, of the Pennsylvania Experiment Station, as its chairman. Space for the exhibit was obtained in the Agricultural Building. The methods and results of experiment station work were exhibited in the following sections: (1) Animal nutrition; (2) botany; (3) crops; (4) dairying; (5) entomology; (6) feeding stuffs; (7) fertilizers; (8) horticulture; and (9) soils. There were also small working laboratories in biology and chemistry in which apparatus was displayed and simple experimental operations were conducted. The publications of this Office and the experiment stations were also exhibited, and there was a large collection of photographs illustrating the station buildings, grounds, and equipment. Immediately adjoining the station exhibit was a collective exhibit of the agricultural colleges, prepared by a committee appointed by the association of colleges and stations, of which Maj. H. E. Alvord, formerly president of the Maryland Agricultural College, was chairman. Both of these exhibits were for the most part of a popular character, being intended to show the general public something of the nature and scope of the work of the stations and colleges. As a special feature of the exhibit prepared by the Office, a popular résumé of the publications of the stations from the time of their establishment in this country was prepared, entitled "The Handbook of Experiment Station Work" (Bulletin No. 15). It consists of several hundred short articles arranged in an alphabetical series with numerous cross references. The Handbook has proved to be a very useful reference book and has been widely

used in the agricultural colleges. The general demand for the Handbook has also been very great and several editions have been issued. A revision which will bring the contents quite closely up to date is now in progress.

Mr. Harris resigned the directorship of this Office in 1893, to assume the presidency of the Maine State College (now the University of Maine), and Dr. True was promoted to succeed him. Dr. E. W. Allen, who had been a member of the staff of the Office for several years, was promoted to the position of Assistant Director.

In 1894 Congress, on the recommendation of the Secretary of Agriculture, made an appropriation for investigations on the nutrition of man, which were to be carried on by the Department in cooperation with colleges, experiment stations, and other institutions having facilities for such work. The general supervision of these investigations was assigned to this Office and Professor Atwater was appointed special agent in charge. An account of these investigations is given on page 106. During this year the Office was also charged with the supervision of the expenditures of the experiment stations, in accordance with the provisions of appropriation acts for this Department beginning with 1894, which contained a clause requiring the Secretary of Agriculture to prescribe the form of the annual financial statement required by the Hatch Act and to ascertain whether the expenditures of the stations have been in accordance with the law. This supervision has brought the Office into much more intimate relations with the stations, representatives of the Office visiting all the stations in the country about once a year. A special report on the work and expenditures of each station is annually prepared in this Office and submitted to the Secretary of Agriculture for transmission to Congress.

In 1895 the Director of this Office having been appointed bibliographer of the Association of American Agricultural Colleges and Experiment Stations, a systematic effort was begun to follow up the publication of books on agriculture and agricultural science. This was in addition to the review of the periodical literature of agricultural science made in the Experiment Station Record. Lists of books have been prepared from time to time in cooperation with the library of the Department and have been published as circulars of this Office.

The discovery of relatively large amounts of gold in Alaska and the consequent increase in the population of that region made it seem desirable that the Department should undertake investigations of the agricultural resources and capabilities of Alaska, with a view to the establishment of agricultural experiment stations there. The Director of this Office, in his report for 1896, suggested that Congress be asked to make an appropriation to enable the Secretary of Agriculture to undertake this work. The Secretary adopted this recommendation in his report to the President for that year, and Congress, at its ensuing

FIG. 1.—UNITED STATES DEPARTMENT OF AGRICULTURE—MAIN BUILDING.

FIG. 2.—UNITED STATES DEPARTMENT OF AGRICULTURE—LIBRARY.

FIG. 1.—OFFICE OF EXPERIMENT STATIONS—DIRECTOR'S OFFICE.

FIG. 2.—OFFICE OF EXPERIMENT STATIONS—CORNER IN MAIN EDITORIAL ROOM.

session, made an appropriation of $5,000, with which the enterprise was begun. An account of the Alaska work is given on page 131.

In 1898 Congress made an appropriation for irrigation investigations by this Department, which were to be conducted as far as practicable in cooperation with the experiment stations. The supervision of this work was assigned to this Office by the Secretary of Agriculture. An account of these investigations is given on page 116.

ORGANIZATION.

The Office of Experiment Stations as a branch of the United States Department of Agriculture is under the immediate control of the Secretary of Agriculture and transacts all its business as his representative. The Secretary appoints all its officers and they are subject to the regulations governing the civil service of the United States. The Director and almost all the subordinate officers except the special agents and experts employed for temporary service are included in the classified civil service, having entered the service through competitive examinations, or having been included therein by general orders of the President relating to that service. All officers assigned by the Secretary to duty in this Office are subject to the orders of the Director in accordance with the terms of their commissions. The growth of the business of the Office has recently made it necessary to divide its work more definitely into separate branches, for the direct management of which some one member of the staff is made responsible. The work of the Office is now divided and assigned as follows: (1) Relations with American and foreign institutions for agricultural education and research, including the supervision of the expenditures of agricultural experiment stations in the United States, under the immediate charge of the Director; (2) the Experiment Station Record, in charge of the Assistant Director, Dr. E. W. Allen; (3) Experiment Station Work and miscellaneous publications of the Office, in charge of Mr. W. H. Beal; (4) experiment stations in Alaska, in charge of Prof. C. C. Georgeson, with headquarters at Sitka; (5) nutrition investigations, in charge of Prof. W. O. Atwater, with headquarters at Middletown, Conn., and (6) irrigation investigations, in charge of Prof. Elwood Mead, with headquarters at Cheyenne, Wyo.

EQUIPMENT.

This Office occupies five rooms in the main building of the Department of Agriculture (Pl. I, fig. 1) at Washington. With one exception these rooms are in immediate connection with the library (Pl. I, fig. 2) of the Department, which is constantly used in the work of the Office. (The Director's office is shown in Pl. II, fig. 1, and the

main editorial room in Pl. II, fig. 2). The library contains 67,000 volumes, mainly works on agriculture and agricultural science; 2,500 American and foreign journals are regularly taken by the library. There are also quite complete collections of the experiment-station publications and the reports of kindred institutions abroad. The libraries of Congress, the Surgeon-General's Office, and Smithsonian Institution, and others in the city of Washington, and the scientific collections of this Department and the Smithsonian Institution, are available for the use of the Office. The publications of the Office are printed at the Government Printing Office. Those which are for gratuitous distribution are sent out from the folding room of the Department and those on which a price is fixed are sold by the Superintendent of Documents, whose office is in the Union Building, Washington, District of Columbia. Matters relating to the printing, illustration, and distribution of the Office publications are in charge of the Division of Publications of this Department. The publications of the Department are sent through the mails free of charge under the Department frank, in accordance with the regulations of the Post-Office Department.

A building which is to serve as the headquarters of the Alaska Stations has recently been constructed at Sitka. This is a wooden structure and when completed will contain 10 rooms, which will be used for offices, laboratories, and quarters for the special agent in charge.

The headquarters of the nutrition investigations at Middletown, Conn., occupy three rooms in Orange Judd Hall of Wesleyan University, the use for this purpose being freely granted by the university. The apparatus for these investigations include the Atwater-Rosa respiration calorimeter, Rosenthal respiration calorimeter, bomb calorimeters, and other chemical apparatus, much of which belongs to the Connecticut Storrs Experiment Station and Wesleyan University. The private library of Professor Atwater, which is an unusually complete collection of works on the food and nutrition of man, and the university library are freely used for the purposes of these investigations. Wherever investigations are carried on outside of Middletown, the cooperating institutions furnish the laboratory facilities as far as may be required.

The headquarters of the irrigation investigations at Cheyenne, Wyo., occupy three rooms, which are provided with facilities for drafting, photography, and other things required for the preparation and illustration of reports of the investigations. The apparatus thus far used in the investigations has consisted mainly of water registers of a special form devised by the special agent in charge, which are distributed to observers throughout the arid regions. The experiment stations which cooperate in these investigations furnish facilities for this work as far as practicable.

FINANCIAL SUPPORT.

The work of this Office is maintained by appropriations made annually by Congress and included in the appropriation act for the Department of Agriculture. To the appropriation specifically made for the work in charge of the Office should be added the funds derived from the printing funds of the Department, which are used for the illustration, printing, and distribution of the Office publications. For the fiscal year ended June 30, 1899, these amounted to nearly $35,000.

The income of the Office for the fiscal year ending June 30, 1900, is as follows:

Office of Experiment Stations proper	$33,000
Alaska Stations	12,000
Nutrition investigations	15,000
Irrigation investigations	35,000
Total	95,000

LINES OF WORK.

The work of the Office of Experiment Stations at present includes: (1) Its relations with American and foreign institutions for agricultural education and research, together with the supervision of the expenditures of agricultural experiment stations in the United States; (2) the preparation of publications, mainly based on those of the experiment stations; (3) the management of experiment stations in Alaska, and (4) the supervision of special investigations ordered by Congress and assigned to the Office by the Secretary of Agriculture, which involve cooperation with the agricultural colleges and experiment stations.

RELATIONS WITH INSTITUTIONS FOR AGRICULTURAL EDUCATION AND RESEARCH.

The work of the Office involved in its general relations with institutions for agricultural education and research may be conveniently described under the following heads: (1) Agricultural experiment stations in the United States; (2) American institutions for agricultural education; (3) Association of American Agricultural Colleges and Experiment Stations and Association of Official Agricultural Chemists; (4) other branches of the United States Department of Agriculture, and (5) foreign institutions for agricultural education and research.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Advisory Relations.

With each succeeding year this Office comes into more intimate relations with the experiment stations in the different States and Terri-

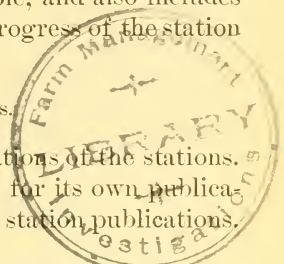
tories. This has led to a steady increase in the amount of general advice and assistance which it has been called upon to render to the stations. This work is performed partly by personal conferences with station officers and partly by correspondence. It includes such things as advice regarding the organization and management of the stations; the choice of officers; the lines of work to be undertaken; the planning, recording, and execution of special lines of work; the nature and form of publications; the plans for station buildings; the materials, apparatus, and literature required for use in connection with different kinds of agricultural investigation. By its work in this direction the Office has been enabled to offset, to a certain extent, the difficulties in station management and work, especially those arising from frequent changes in the governing boards and staffs of the stations, and has secured an increasing amount of uniformity in the general policy of station management throughout the country. It has, at the same time, been clearly recognized that each station is an independent State institution, for the conduct of which the United States does not assume responsibility further than is involved in the requirements of the national law under which the stations are organized and the terms on which appropriations toward their maintenance are made year by year by Congress.

The Office has endeavored to maintain a broad and consistent policy regarding the general principles on which experiment station management and work should be based and to aid the individual stations in their attempts to adjust these principles to the varying needs and conditions of the different States and Territories. It has also sought to promote their cooperation with each other, with the different branches of the Department of Agriculture, and with the farmers; and as a central agency established for their benefit, it has helped to bring them into relations with similar institutions abroad and to promote their interests in matters involving transactions with different branches of the United States Government.

Supervision of Expenditures.

The Office prepares and distributes to the stations annually the financial schedules prescribed by the Secretary of Agriculture in accordance with the act of Congress, and examines and passes upon the financial statements rendered on these schedules. Representatives of the Office visit the stations in all the States and Territories annually to examine the accounts kept by the station officers and to inquire into the work of the stations as related to their expenditures. The printed reports and bulletins of the stations are also examined with reference to the nature and extent of the work which they report. On the basis of the annual financial statements, the publications and the reports of personal examinations of the work and expenditures of the stations, a report is made to the Secretary of Agriculture for transmission to Congress. This report briefly describes the work, income, and expenditures of each

station, with such criticisms as are deemed desirable, and also includes a general statement regarding the condition and progress of the station enterprise as a whole during the year.



COLLECTION OF STATION PUBLICATIONS.

The Office collects and catalogues all the publications of the stations. This is done partly that it may have the material for its own publications and partly to make a permanent library of the station publications.

RELATIONS WITH AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

The Office is the official depository in the Department of Agriculture for the annual reports of the expenditures and operations of the colleges receiving the benefits of the acts of Congress of July 2, 1862, and August 30, 1890, as well as for the catalogues and other publications of these institutions. From these documents and through special letters of inquiry, the Office collates and publishes statistical and other information relating to courses of instruction in agriculture given throughout the country. Information regarding farmers' institutes, home reading courses, and other methods of university extension in agriculture is also published. The Office has endeavored to promote the recent effort for the improvement of courses of instruction and methods of teaching in agriculture, as well as the movement to establish agricultural courses of secondary grade in special schools and otherwise, and the introduction of nature study, involving lessons on agricultural subjects, in the elementary schools. It has also aided in the movement of the agricultural colleges which has for its object the securing of opportunities for the graduates of these colleges to continue their studies in connection with those branches of the National Government which possess facilities for scientific study and research.

RELATIONS WITH THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS AND THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

As a central governmental agency for promoting the interests of the agricultural colleges and experiment stations this Office has been naturally brought into close relations with the association voluntarily formed to promote these same interests. By taking part in the conventions of this association, preparing and assisting in editing a stenographic report of its proceedings, and by acting on its committees, representatives of the Office have endeavored to aid the association in carrying out the purposes for which it was formed.

The Association of Official Agricultural Chemists, which includes in its membership the chemists of the United States Department of Agriculture and of many of the experiment stations, appoints a committee whose duty it is to prepare abstracts of publications relating

especially to methods of analysis. This Office is represented on this committee, and the abstracts furnished by the committee are published in the Experiment Station Record, as well as a condensed report of the proceedings of the association.

RELATIONS WITH OTHER BRANCHES OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

As a branch of the United States Department of Agriculture the Office of Experiment Stations joins in the general business of the Department by carrying on a large amount of correspondence and performing other duties assigned to it from time to time by the Secretary. It conducts negotiations between the different branches of the Department and the experiment stations with reference to the formulation of plans for cooperative work and keeps a record of the plans agreed upon after they have been approved.

By agreement between the Secretary of Agriculture and the United States Civil Service Commission, the Director of this Office acts as a special officer of the commission, charged with the general supervision of the examinations for positions in the Department of Agriculture which require technical or scientific knowledge. This involves the settlement of the terms of such examinations, and arrangements for the preparation of examination questions and tests, and the rating of the papers submitted by candidates.

RELATIONS WITH FOREIGN INSTITUTIONS FOR AGRICULTURAL EDUCATION AND RESEARCH.

By correspondence, exchange of publications, and personal visits of its representatives, the Office seeks to secure and maintain definite relations with institutions for agricultural education and research throughout the world. It publishes abstracts of the reports of investigations made by these institutions and general information regarding their organization, resources, and work. It aids the officers of agricultural colleges and experiment stations in this country in securing special information about foreign institutions and in becoming personally acquainted with their officers and work. It receives visits from many officers of foreign institutions and introduces them to the officers of our institutions, and, through correspondence, it aids foreign institutions in obtaining special information or publications from our agricultural colleges and experiment stations.

PUBLICATIONS.

The publications of the Office may be conveniently described under two heads: (1) The Experiment Station Record, and (2) bulletins and miscellaneous publications. A list of the publications of the Office will be found in the Appendix.

EXPERIMENT STATION RECORD.

The Experiment Station Record, begun in 1889, at first included only abstracts of the bulletins of the experiment stations in the United States. Its scope has been from time to time enlarged, so that at present it comprises abstracts of the bulletins and annual reports of our stations, the publications of the United States Department of Agriculture, books, journals, and miscellaneous publications containing reports of investigations in agricultural science in different countries of the world; special articles by American and foreign experts in agricultural science; editorials on important matters regarding the progress of agricultural education and science, with suggestions of lines of inquiry for our stations, and notes on the organization, equipment, and development of institutions for agricultural education and research at home and abroad. Each volume of the Record, as at present made up, consists of twelve numbers, the last of which contains detailed author and subject indexes. The editorial supervision of the first ten volumes of the Record was performed by the Director of this Office. For several years the Assistant Director, Dr. E. W. Allen, had a large share of the active editorial management of this journal, and beginning with the eleventh volume was made the editor. The Record is divided into a number of departments, each of which is put in charge of one or more special editors. These departments and the editorial staff are shown on page 89.

The preparation of abstracts in special lines is from time to time intrusted to persons employed for that purpose and, as already stated, abstracts are also prepared by a committee of the Association of Official Agricultural Chemists. The special abstracts thus prepared are signed in each case when published. A limited number of illustrations are used.

The general scope and extent of the ground covered by the Record is indicated by the following statistical tables:

Summary showing scope and extent of Experiment Station Record, Volumes I–X.

Record volumes.	Station reports.	Station bulletins	U. S. D. A. publications.	Foreign articles.	Pages of abstracts.	Pages of original matter.	Editorials.		Special articles.		Notes.		Titles.
							Number.	Pages.	Number.	Pages.	Number.	Pages.	
1	.....	243	23	.....	275	6,942	15	20	.....	.....	.....	.....	.....
2	39	333	39	42	653	15,467	22	54	2	17	142	22	.....
3	46	305	72	128	783	19,779	21	51	6	59	159	36	299
4	25	298	73	189	752	18,646	21	30	11	103	125	28	875
5	43	267	67	227	683	18,894	25	32	11	207	204	50	1,514
6	42	295	78	526	773	28,263	20	29	11	138	79	12	2,104
7	46	304	83	443	646	25,281	15	27	11	120	88	14	3,256
8	62	340	92	702	778	38,552	15	26	9	118	75	13	2,200
9	56	317	201	842	770	56,569	14	30	8	136	93	11	2,471
10	35	361	172	1,224	881	57,230	14	24	9	94	104	17	1,820
Total	394	3,063	900	4,323	6,994	285,623	182	323	78	992	1,069	203	14,539

Classification of articles abstracted in Experiment Station Record Vols. V–X.

Chemistry	715
Botany	420
Fermentation and bacteriology	80
Zoology	74
Meteorology	333
Air, water, and soils	390
Fertilizers	564
Field crops	1,376
Horticulture	815
Forestry	104
Seeds and weeds	209
Diseases of plants	606
Entomology	840
Foods and animal production	1,043
Dairy farming and dairying	735
Veterinary science	387
Technology	38
Agricultural engineering	156
Statistics	487
Miscellaneous	2

An edition of 5,000 copies of the Record is regularly printed. This journal is sent without charge to institutions for agricultural education and research in this country and the officers of such institutions, to similar institutions in foreign countries, important libraries, and to a select list of scientists and specialists who cooperate with the Department by furnishing information, exchanging publications or otherwise. It is also sold by the Superintendent of Documents at 10 cents a number, or $1 per volume.

BULLETINS AND MISCELLANEOUS PUBLICATIONS.

The bulletins and miscellaneous publications of this Office may be classified as follows: (1) Technical bulletins; (2) Farmers' Bulletins, including the subseries entitled Experiment Station Work; (3) The Card Index of Experiment Station Literature; (4) circulars; (5) miscellaneous publications, comprising schedules, articles published as separates from the Yearbook of the Department and Experiment Station Record, and charts.

Beginning with 1899 general editorial supervision of the bulletins and miscellaneous publications of this Office was assigned to Mr. W. H. Beal. He is assisted in editorial work by the staff of the Experiment Station Record.

Technical Bulletins.

The technical bulletins of the Office include special reports to Congress as required by law, reports of the investigations on the nutrition of man and on irrigation in charge of this Office, monographs on special

subjects based on the work of the experiment stations, bulletins containing statistics and general information regarding institutions for agricultural education and research, and the proceedings of the Association of American Agricultural Colleges and Experiment Stations.

Farmers' Bulletins.

As already stated, the series of Farmers' Bulletins was begun in this Office with a view to making a popular record of the results of work at the experiment stations for general distribution among the farmers of the country. After the scope of this series was enlarged and it was made a general series for the Department, the Office continued to prepare, or to obtain from officers of the experiment stations, articles of a popular character on different subjects which might properly be included in this series. Latterly the Office has restricted these articles to subjects connected with the special investigations in its charge and résumés of the publications of the experiment stations. The latter are grouped together in a subseries entitled Experiment Station Work.

Experiment station work.

This title has been given to Farmers' Bulletins prepared in this Office, in which a number of short articles on different subjects, based on the publications of the experiment stations, are grouped together to form single bulletins. As stated in a note inserted in each number of this series, "The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side."

Each article included in the Experiment Station Work is signed by the person who prepares it. The meaning of technical terms necessarily used in these articles is explained in an appendix. Illustrations are used as far as seems desirable. Whenever the number of these bulletins is sufficiently large to make a volume of convenient size, an index will be prepared covering the numbers to be included in the volume. In this way, as time goes on, it is expected that there will be in libraries and in the homes of many farmers a series of volumes containing a popular record of the practical results of the work of our stations. Through this series the farmer in any part of the country is enabled to ascertain the most important practical things our stations are accomplishing wherever they may be located.

The Card Index of Experiment Station Literature.

The Card Index of Experiment Station Literature prepared in this Office is a subject index printed on cards. Each card contains the title

of the article, the name of the author, a bibliographical reference to the experiment station publication containing the article, and also to the Experiment Station Record, and a brief abstract showing the nature and scope of the article. A classification number is printed at the right hand upper corner of the card and a serial number at the left hand lower corner. The subjects treated in experiment station literature are divided into thirteen general topics, and these are subdivided on a decimal system as far as may be found necessary without making too minute a subdivision for practical purposes. The titles of the general divisions and the subdivisions are printed on division cards of different colors. A set of these division cards is furnished with each set of the index cards, and in this way provision is made for the orderly arrangement of the index in a cabinet. A key showing the system of classification is also furnished. A copy of this key and of sample cards is given in the Appendix. The number of cards thus far prepared is 19,000, covering the publications of the stations from 1888 to 1897. A set of the index is furnished to each agricultural college and experiment station in this country, and to the boards or commissioners of agriculture in the several States. The index is also sold to subscribers at the rate of $2 per thousand cards, and $1.25 for a set of division cards. Three hundred sets are printed.

Circulars.

The circulars prepared in this Office are, as a rule, brief documents containing information on special topics connected with the work of the colleges and stations, reports of committees of the Association of American Agricultural Colleges and Experiment Stations, lists of books on agricultural subjects, and miscellaneous information of limited importance or transient character. They are used to a considerable extent in lieu of letters in answer to inquiries.

Miscellaneous Publications.

The schedules prepared in this Office are forms required in recording work connected with the investigations in charge of the Office.

The Office prepares several articles each year for the Yearbook of the Department. These and special articles from the Experiment Station Record are published in limited editions as separates.

A set of four colored charts, based on tables and diagrams in publications of the Office, and describing some of the results of investigations on the food and nutrition of man has been distributed to some 2,000 educational institutions in this country.

DISTRIBUTION OF PUBLICATIONS.

All matters relating to the printing, illustration, and distribution of the Department publications are in charge of the Division of Publi-

cations. Whenever the manuscript of a publication is transmitted from the Office of Experiment Stations to the Division of Publications it is accompanied by a statement of the edition required and the proposed plan of distribution.

Lists of the governing boards, staffs, and libraries of the experiment stations are kept in this Office. These are printed for use in a mailing machine and are furnished to the Divison of Publications and to the experiment stations in different parts of the country as occasion requires. Select classified lists of colleges and other educational and scientific institutions, professors, teachers, and scientists in the United States and other countries are kept on cards. Written copies of such addresses are furnished the Division of Publications as the plan for the distribution of each publication may require. A select printed list of libraries is kept by the librarian of the Department, who furnishes them copies in a similar way. Lists of newspapers and journals are kept by the Division of Publications, to which the publications of this Office and press notices of the same are distributed.

The Experiment Station Record is sent to regular lists, as stated on page 102. The technical bulletins are printed in editions of a few thousand copies and distributed to the lists mentioned above, according to the subject-matter of each bulletin. The Farmers' Bulletins, including Experiment Station Work, are also distributed to these lists and to farmers' organizations. Each member of Congress is entitled to several thousand copies of Farmers' Bulletins annually. They are also freely sent from the Department to all applicants. The circulars, schedules, and separates are issued in limited editions, and are not, as a rule, distributed in any regular way, but are used for special purposes or in connection with correspondence. Under existing laws, copies of the Experiment Station Record and technical bulletins are furnished to a general officer of the Government called the Superintendent of Documents (Union Building, Washington, District of Columbia), who is authorized to sell them at a fixed price.

From its organization in 1888 to January 1, 1900, this Office issued 344 documents, which may be classified as follows: Experiment Station Record, 10½ volumes, 119 numbers; technical bulletins, 73; Farmers' Bulletins, 43; circulars, 43; schedules, separates, etc., 66. The number of copies printed in 1897, 1898, and 1899 was as follows:

Number of copies of publications of the Office of Experiment Stations issued in 1897, 1898, and 1899.

Publication.	1897.	1898.	1899.
Experiment Station Record	59,000	61,000	54,000
Technical bulletins	44,500	33,500	49,500
Farmers' Bulletins	1,052,000	710,000	1,082,000
Circulars	9,000	14,500	8,100
Miscellaneous	5,900	15,200	6,800
Total	1,170,400	834,200	1,200,400

The Yearbook of the Department, to which this Office annually furnishes several articles, is largely distributed by Congress. The edition of the Yearbook is 500,000 copies.

ALASKA EXPERIMENT STATIONS.

Beginning with 1897, agricultural investigations have been carried on in Alaska under the direction of this Office. The work is now established on a permanent basis and is in many respects comparable with that done by the agricultural experiment stations in other parts of the United States. An account of the Alaska Stations has therefore been included with those of the other stations and may be found on page 131.

NUTRITION INVESTIGATIONS.

The subject of food economy in all its details, always of vital interest, has acquired increased importance in this country in recent years from the extensive investigations on the subject that have been and are being prosecuted in connection with and as a part of the work of the Department of Agriculture and the agricultural experiment stations. There had been a large number of investigations on the food of man, as well as some work with domestic animals, before the experiment stations were established in the United States. Much of the early work was carried on in connection with physiological investigations or some other work connected with the study of medicine. Some of the investigations, however, were directly comparable with more recent work. With the rise of the experiment stations more systematic inquiries into the composition of feeding stuffs and their appropriate use in the nutrition of domestic animals were undertaken and have ever since been carried on quite actively. Later some of the stations undertook similar investigations on the food and nutrition of man. The science of the nutrition of man has so much in common with that of nutrition of animals that a distinction between the two is not easily made, and naturally they have often been studied together. These researches have been carried on mainly in the physiological and chemical laboratories of universities as well as of experiment stations. On the whole, for the study of foods and the laws of nutrition much more experimental inquiry has been made with animals than with men, partly because of the greater ease and convenience of experimenting with animals and partly because of the especial activity of the experiment stations in this direction.

The first American investigation on the subject of human nutrition which has been found by the authors was carried on by J. R. Young, in Philadelphia in 1803. It was entitled "Experimental Inquiry into

the Principles of Nutrition and the Digestive Process." The author studied the nutritive value and digestibility of such materials as sugar, gum, beans, and wheat, making experiments with frogs and other small animals. The article summarizes the ideas of human nutrition held at that time.

Some mention should be made of the very extended investigations of Dr. William Beaumont. Commencing in 1822, he carried on a series of observations extending over many years on the digestibility of foods. His experiments were made with a man who had received a wound in the stomach, which healed but did not entirely close. It was possible to remove the stomach contents readily through this opening or to examine the food while in the stomach. Many experiments were also made in *vitrio*. Dr. Beaumont studied especially the length of time required for foods to be converted into chyme, or, as he is ordinarily quoted, the length of time required for digestion of different foods. Very many of the statements made to-day as to the time required to digest certain foods can undoubtedly be traced to these experiments.

Much of the early work in the study of foods in this country was analytical, along the line of the chemical composition of different food materials. The first work of this kind of which we have found record was the ash analysis of rice, rice flour, husk, etc., reported in 1844 by C. U. Shepard. Mention should also be made of the extended investigation of Salisbury upon the composition of maize and a number of vegetables, and the similar work of Emmons and of Jackson. A not inconsiderable amount of such work was carried on between the years 1844 and 1860, most of which, however, is of interest to-day chiefly from a historical standpoint. The greatest accuracy of the work done at that time was in the determination of the elementary composition and the inorganic compounds of the food products. A considerable number of analyses were carefully made in an attempt to learn the proximate composition also; but accurate and reliable methods of organic and analytical chemistry had not yet been fully developed, so the results are comparable only in a general way with those of analyses which have been made according to the so-called "Weende" methods, which were devised and came into general use about 1864. Since that time it has been possible to carry on systematic investigation of food materials from the standpoint of their nutritive values as determined by their chemical composition. The first analyses made by the Weende method in this country of which record has been found were a series of analyses of maize by Prof. W. O. Atwater in 1869.

A considerable amount of investigation of materials used as food by man has been for many years and is still being carried on by the Division of Chemistry of the United States Department of Agriculture. Mr. Clifford Richardson made a large number of analyses of specimens

of American flour and the bread made from them, and of fresh vegetables and other materials. Prof. H. W. Wiley, the present chief of the division, and his associates have also made a great many analyses of cereal grains and their products, canned foods, meats, and other materials. A great deal of study of the composition of food materials has been made by Professor Wiley in the prosecution of his investigations of adulteration of foods. A large number of analyses of foods, especially dairy products, sugars, fruits, and vegetables, were made elsewhere in this country prior to the establishment of the experiment stations. This work has been continued and materially extended by the stations.

Some very interesting experiments were made by earlier American investigators on the effect of muscular exertion on the production of urea. One of the most noteworthy investigations of this nature was made by Dr. Austin Flint in 1871 with the professional pedestrian Weston. The earliest study of dietaries which we have found was made by J. S. Gould, published in 1852, entitled "Report on the food and diet suited for almshouses, prisons, and hospitals." These are only a few of the investigations which might be cited.

From the first, many investigations have been made in which food was studied incidentally in connection with some special problem; for instance, the effect of some drug. Mention should be made in this connection of the experiments of Professor Chittenden, of Yale University, on this and similar lines. This work is still carried on. The earliest results were published, however, some 20 years ago.

The particular inquiry on the nutrition of man, which has developed into the cooperative inquiries now being prosecuted in different parts of the country under the auspices of the United States Department of Agriculture, had its inception in the study of the chemical composition and nutritive economy of food fishes and invertebrates, which was undertaken by Prof. W. O. Atwater, in 1877, in the laboratory of Wesleyan University, at the instance of Prof. S. T. Baird, secretary of the Smithsonian Institution and United States Commissioner of Fish and Fisheries.

The investigation begun then, and continued until 1882, included (1) chemical analyses of fishes and invertebrates, (2) experiments upon the digestibility of fish, and (3) studies of the chemical composition of the albumin of the flesh of fish. In the course of these investigations, there were studied some 200 specimens of marine and fresh-water fishes and invertebrates commonly used for food in America. For the prosecution of this inquiry small sums were appropriated from time to time, through the agency of Professor Baird, to defray the expense for apparatus and labor of assistants. Several citizens of Middletown, Conn., New York City, and other places, feeling personally

interested in just such work and recognizing its need, contributed generously toward carrying out investigations much more elaborate and extensive than would have been possible without such material assistance. Doubtless from the interest of those individuals, manifested in such a manner, the work was given at once an importance which otherwise it might have been long in acquiring. The information regarding the food value of fish that was obtained through these studies emphasized the need of similar study of other food materials.

In 1884 Professor Atwater was asked to prepare plans for specimens, labels, and other illustrative materials for the food collection of the United States National Museum. In the development of these plans it appeared very desirable to illustrate the fundamental principles of food economy, for which purpose there was need of considerable information concerning the chemical composition of some of the more common food materials in use in this country. This information was not then available, because no extensive investigations of American food products had ever been made. To make such investigations was a large undertaking, and the necessity for doing so was not popularly understood. A beginning was made, however, with the hope that as the results of the work should appear, and their value should be realized, the means for continuing the inquiry would be found. By 1888 nearly 100 specimens of food products, mostly animal, but including some vegetable, had been analyzed in the laboratory of Wesleyan University, the expense of the work being met in part by the National Museum and in part by contributions from private sources. In 1888 the Connecticut Storrs Station was established, and the analysis of animal and vegetable food products was continued as part of its work, both as independent investigations and in connection with dietary studies and other investigations which will be mentioned later.

The World's Columbian Exposition in 1893 afforded a most favorable opportunity for collecting specimens of food materials of particular interest in the United States. On behalf of the executive committee on awards for that exposition, Prof. H. W. Wiley, of the United States Department of Agriculture, undertook the investigation and analysis of a large number of specimens of cereal grains and milling products from them, sugars, and other products. These investigations were carried on at the Exposition, and were completed later in the laboratory of the Division of Chemistry of this Department at Washington. On behalf of the same committee, Professor Atwater undertook similar investigations of prepared foods, and especially of animal foods. Over 600 specimens of such foods were collected for this investigation. The work was carried on so far as possible at Chicago during the Exposition. Afterwards it was transferred to Middletown, Conn., and was continued in the laboratory of the Storrs

Station. Analyses of over 500 specimens were completed by 1894. This was the most extensive investigation of this character undertaken up to that time in this country.

Meanwhile the investigations in nutrition had been begun along another line, namely the study of dietaries, in an attempt to learn something concerning the character and quantity of food actually consumed by people in different circumstances of life in different localities. The first extensive work of this kind carried on in this country by the methods at present followed was undertaken by Hon. Carroll D. Wright, in 1886, while chief of the Massachusetts Bureau of Statistics of Labor. For the purpose of supplying, in some measure, information necessary to enable the working man to regulate more intelligently his expenditures for food and to secure with a given expenditure the maximum amount of nutritive ingredients, the Bureau collected a number of schedules of dietaries giving quantities and costs of food used by working people in different cities in Massachusetts, and also in several localities in Canada, from which some of the working people had come. The data thus collected were submitted to Professor Atwater, under whose supervision the quantities of nutritive ingredients in the food purchased were estimated. The statistics of quantities of food purchased were compiled from original accounts with tradesmen. No analyses of foods were made in these studies. The amounts of ingredients contained in the food were estimated upon the basis of the results of analyses of similar foods already made. So far as possible American analyses were used; for the materials of which no analyses had been made in this country, however, the results of European analyses were employed.

The results of these studies were only approximately correct. In order to secure more reliable data, which might be useful in estimating dietary standards and in more accurate inquiry in food economy, similar studies were carried on in Middletown, Conn., under the direction of Professor Atwater. In these studies the errors in collecting data observed in the preceding studies were eliminated so far as possible, and analyses of many of the foods used were made. The persons studied included not only laborers' families, but also students' boarding clubs and well-to-do families. The results of these studies, together with those of the former studies, seemed to warrant generalizations of considerable interest, and particularly to indicate the directions in which further inquiry was needed. The work thus done represented the beginning of an investigation of an important subject. In 1890 the Connecticut Storrs Station, in cooperation with Hon. Carroll D. Wright as United States Commissioner of Labor, began a series of accurate dietary studies which was continued for several years. By January, 1895, twenty-one such studies of the actual food

consumption of families of mechanics and professional men had been made and reported by the station. Similar investigations have since been carried on elsewhere, especially under the auspices of the United States Department of Agriculture, as explained in a later paragraph; so that at the present time the results of about 300 such studies are recorded, while the work is still going on.

The nutritive value of foods is determined by several factors. It is well known that it depends upon the kinds and amounts of nutritive ingredients which they contain, as shown by chemical analysis, and upon the quantities in which they are used in the dietaries of different individuals; but their value further depends upon the proportions of the different nutrients which can be digested from them by persons under normal physiological conditions. For this reason one very important part of the investigations on the food and nutrition of man has been the study of the digestibility of different food materials, with particular reference to the proportions of nutrients that may be digested from them. This study has been made by actual experiments with men in which the coefficients of digestibility of food materials were determined from the amounts of nutrients in the food eaten and in the feces excreted.

Previous to the spread of investigations in nutrition in this country very little research had been made along this line. Even in Europe, where the study of nutrition had been carried on for many years, the number of digestion experiments with men was not large. In connection with the nutrition investigations which are being carried out by the Department of Agriculture in cooperation with experiment stations and other institutions, a considerable number of digestion experiments have already been made, and at the present time some elaborate experiments are in progress.

One important function of food is to furnish energy to the body. For a thorough study of the laws of nutrition, therefore, and of the uses and nutritive values of food, there must be a means of determining the amounts of potential energy in the food consumed and in the products formed from the food by the body. Since different forms of energy may be transformed into heat, the energy of a substance may be expressed in terms of heat, and therefore the potential energy of a substance may be measured by the heat developed when the substance is burned in oxygen. In the investigations conducted under the auspices of the United States Department of Agriculture a very satisfactory method is employed whereby the amount of heat thus developed by food materials is determined. The result obtained in this way is called the "heat of combustion" of the material burned. The apparatus used for this purpose is called a calorimeter. Various forms of calorimeter have been devised. That form now in use in

connection with the nutrition investigations of this Office is called a bomb calorimeter. The early work done by the Connecticut Storrs Station along this line was with a Stohmann calorimeter, a modification of an earlier form devised by Thompson. This apparatus proved unsatisfactory, and the attempt was made to secure a better one. The bomb calorimeter devised by Berthelot was superior, but was very costly because of the large amount of platinum used in its construction. With the aid of Professor Hempel, of Dresden, Professor Atwater and his associates succeeded in modifying the Berthelot apparatus, especially with regard to the amount of platinum used, so that a very accurate and satisfactory calorimeter has been obtained at a much lower cost. By the use of this apparatus the heats of combustion of a large number of different food materials have been determined.

In the study of nutrition of both man and domestic animals at the present time, considerable attention is paid to the fuel value of foods—that is, to their actual value to the body as a source of energy. This net value is taken as the heat of combustion of the total food consumed, minus the sum of the heats of combustion of the unoxidized material in the feces and in the urine. The values thus determined are used in the calculation of dietary standards, which serve to indicate in a general way the proportions of the nutritive ingredients of food that are approximate for persons in different conditions.

Studies of some of the more fundamental laws of animal nutrition have been carried on for the purpose of determining what uses the body makes of its food under different conditions. Special inquiries of this nature were begun by Professor Atwater in 1892, by means of an apparatus known as a respiration calorimeter, so arranged that a man may spend a number of days in comparative comfort within it, and so manipulated that the metabolism of both matter and energy in his body may be determined. In devising and perfecting the apparatus and in carrying out the investigations with relation to the measurements of heat and mechanical work, Professor Atwater was assisted by Dr. E. B. Rosa, professor of physics in Wesleyan University. Several years were spent in the development of this apparatus and the elaboration of methods of experimenting with it. By the winter of 1895–96 the apparatus was considered accurate enough to justify its use in experiments with men, and several experiments were made in which determinations of the metabolism of matter were made with considerable accuracy. The determinations of the metabolism of energy, however, were not considered sufficiently accurate. As experience in the use of the calorimeter was gained, several improvements in the apparatus and in methods of manipulation were made, until the results finally obtained were as accurate as those secured in investigations on a much smaller scale, in which ordinary laboratory methods were followed.

Later experiments are furnishing definite, accurate information concerning the action of the fundamental laws of the conservation of matter and of energy in the living organism. The results already attained show remarkable agreement in income and outgo of both matter and energy in the bodies of men at work and at rest, with different kinds and amounts of food, thus giving very exact indication of the ways in which food performs its functions in the body. These results are exceedingly valuable from the standpoint of both pure science and practical utility.

The larger part of the investigations on the food and nutrition of man that was carried on previous to 1894 were made with the aid of contributions from private individuals,[1] though funds were supplied by the Connecticut Storrs Station and more especially by the Smithsonian Institution and the United States Fish Commission through Prof. S. F. Baird, and by the United States Department of Labor, through Commissioner Carroll D. Wright.

As early as 1890 the results of the nutrition investigations already made had aroused so much public interest that steps were taken to induce Congress to appropriate funds for carrying on the work. Nothing definite was accomplished there, however, until 1894. In that year the act of Congress providing appropriations for the experiment stations, and authorizing the inquiries which they were to conduct, was changed so as to include the study of the food of man. The stations were called upon to report progress in the work to the Secretary of Agriculture. At the same time Congress provided a special appropriation of $10,000 "to enable the Secretary of Agriculture to investigate and report upon the nutritive value of the various articles and commodities used for human food." The prosecution of this inquiry was assigned to the Office of Experiment Stations, and Professor Atwater was appointed special agent in charge of nutrition investigations. In the following year the appropriation was increased to $15,000, which amount has been provided annually since then. The State of Connecticut, by act of legislature of 1895, also makes an annual appropriation of $1,800 to Connecticut Storrs Station, part of which is to be expended in the study of nutrition in the State.

The administrative and editorial work connected with the nutrition investigations is conducted at Washington and Middletown. The investigations themselves are conducted at different places, the general policy being to make particular institutions centers of inves-

[1]Among these may be mentioned Hon. J. W. Alsop, M. D.; I. E. Palmer and A. R. Crittenden, of Middletown, Conn., and Messrs. F. B. Thurber and E. G. Blackford, of New York.

tigation in special lines. The following summarized statement shows the present distribution of these investigations:

Present distribution of nutrition investigations.

Cooperating institution.	Officer in immediate charge.	General nature of the investigation.
Wesleyan University and Storrs Experiment Station, Middletown, Conn.	Prof. W. O. Atwater	Metabolism experiments and laws of nutrition, with respiration and bomb calorimeters.
Maine University and Experiment Station, Orono, Me.	Prof. C. D. Woods	Nutritive value of bread and cereals, with digestion experiments.
Minnesota University and Experiment Station, Minneapolis, Minn.	Prof. Harry Snyder	Nutritive value of bread and cereals.
New Jersey Experiment Stations, New Brunswick, N. J.	Prof. E. B. Voorhees	Nutritive value of bread and cereals, cost and composition of milk, and dietary studies.
Illinois University, Urbana, Ill.	Prof. S. Grindley	Nutritive value of meats.
California University and Experiment Station, Berkeley, Cal.	Prof. M. E. Jaffa	Nutritive value of fruits.
Tennessee University, Knoxville, Tenn.	Prof. C. E. Wait	Digestion experiments.
Lake Erie College, Painesville, Ohio.	Prof. Isabel Bevier	Dietary studies with college students.

The work in charge of this Office is carried out largely in cooperation with scientific and educational institutions and philanthropic organizations in different parts of the country. Extended series of investigations have been prosecuted in Maine, Connecticut, Massachusetts, New York, New Jersey, Pennsylvania, Virginia, Tennessee, Alabama, Missouri, Indiana, Illinois, Minnesota, North Dakota, California, and New Mexico. In New York City this Office has cooperated with the Association for the Improvement of the Condition of the Poor and the Industrial Christian Alliance, in studying the food and nutrition of the people of the congested districts. A similar work has been done with Hull House in Chicago. The Polytechnic Institute and the Tuskegee Institute in Alabama and the Hampton Institute in Virginia have made investigations in their regions, particularly among the negroes in the Black Belt of the South. In other localities experiment stations, colleges, and universities make investigations among people of various classes and conditions of life, including not only dietary studies, but also other phases of the subject of the nutrition of man.

The method of cooperation adopted in the prosecution of these studies has some very decided advantages, particularly in the fact that so many different institutions, representing the varied interests of people in widely separate regions, unite in a study of prevalent conditions and an effort for improvement. Besides this, the funds provided from the Department are used economically and are often supplemented by means from other sources. By this extensive cooperation of individuals and institutions with the Department, under very favorable conditions, a large amount of valuable work is being done systematically, the results of which are made available to the public. The particular topics that have thus far received special attention are the composition of food materials; the kinds and amounts of food consumed by individ

uals, families, boarding houses, and institutions; the digestibility of food materials, and the fundamental laws of nutrition. The results of these investigations are given in bulletins of a popular or technical character, which are issued through the Office of Experiment Stations. The results of analyses of food materials made in America have been compiled and printed in a bulletin for popular use. In a revision of this bulletin, issued during the past year, the compilation was based upon over 4,000 analyses, the larger portion of which were made in connection with the nutrition investigations. The results and discussion of dietary studies appear in bulletins prepared for popular use. The results of digestion experiments and metabolism investigations with the calorimeter are given in bulletins which are more or less technical in character, intended rather for the scientific student of the subject. A list of these publications may be found in the Appendix.

From the scientific standpoint the most noteworthy feature of these inquiries is found in the researches with the Atwater-Rosa respiration calorimeter, by means of which the study of the application of the laws of conservation of matter and of energy in the human body are being carried out with a completeness not previously attained. Indications of the value of this apparatus and method of inquiry are already apparent in the fact that an apparatus on the same general plan, but large enough for experiments with domestic animals, is already in process of construction at the experiment station of the State College of Pennsylvania, under the direction of Prof. H. P. Armsby, and in cooperation with the Bureau of Animal Industry of this Department. The Prussian Government has provided means for the construction of a similar apparatus for the Institute of Animal Physiology at Bonn, under Professor Hagemann. An appropriation, under government authorization, has also been made for the construction of a like apparatus in connection with the Institute of Animal Physiology at Budapest, under Professor Tangl.

From the practical standpoint the information gathered is already being utilized, and the interest of economists, educators, and housekeepers in the results is constantly increasing. The usefulness of this work is by no means confined to the United States, but is extending to other countries as well.

One especially encouraging feature is found in the interest in the subject that is being continually manifested by progressive educators. There is much reason to hope that gradually the results of these inquiries will find place in regular public-school instruction, and thus become a part of the common knowledge of the community. The results of these investigations are being utilized in the determination of rations for the Army and Navy of the United States. Public institutions, in which dietaries are made up for a considerable number of persons, are likewise taking advantage of these results. The Commission of Lunacy of New York, which has charge of all the public

insane hospitals of that State, has employed Professor Atwater as a consulting expert on nutrition, and special studies of dietaries for these institutions are being conducted under his direction, with a view to the improvement of the dietaries for the insane patients as regards both quality and economy.

The reaction of this inquiry upon scientific research and the scientific spirit in institutions where investigations are being carried on deserves special mention. It has been the policy of this Department to encourage inquiry by investigators and organizations, and in institutions whose own resources in the form of money and of labor can be devoted to the purpose, the funds supplied by the Department being regarded as supplementary. In this way the appropriation by Congress becomes, to a considerable extent, a fund for aid of scientific research. Two important advantages are evident in such a policy. On the one hand, the amount and value of the product, and consequently the direct benefit to the community, are very much larger than could otherwise be obtained from a like expenditure of public funds. On the other hand, the aid thus given by the Government to research in different parts of the country is a very important stimulus, encouraging professors and trustees of institutions to undertake inquiries which, without such aid, they would not undertake, and enabling gifted and aspiring students to enter fields of original inquiry, such as will be useful to both themselves and the public, as well as to the cause of science in general.

IRRIGATION INVESTIGATIONS.

In the appropriation act for this Department for the fiscal year ended June 30, 1899, $10,000 was appropriated by Congress "for the purpose of collecting from agricultural colleges, agricultural experiment stations, and other sources, including the employment of practical agents, valuable information and data on the subject of irrigation, and publishing the same in bulletin form."

By order of the Secretary of Agriculture, supervision of the work on irrigation was assigned to the Director of this Office. After careful consideration it was determined to undertake the work in two general lines: (1) The collation and publication of information regarding the laws and institutions of the irrigated region in their relation to agriculture, and (2) the publication of available information regarding the use of irrigation waters in agriculture as determined by actual experience of farmers and experimental investigations, and the encouragement of further investigations in this line by the experiment stations.

Agriculture is very largely dependent on irrigation in 17 States and Territories west of the Mississippi River. The extensive development of irrigation in the United States has largely taken place during the past quarter of a century. As settlers came into the new States

and Territories of the arid region they appropriated water from different streams in the simplest and easiest manner. Comparatively cheap canals and ditches were constructed. Each locality enacted such laws and adopted such administrative regulations as seemed suited to their immediate requirements. As long as the population was small and the water abundant, little difficulty was experienced in matters relating to its distribution and use in agriculture. As population increased and water became relatively more difficult to obtain, an increasing number of disputes regarding its ownership arose. These questions were brought before the legislatures and courts. The lawyers who were largely instrumental in framing and interpreting the irrigation laws had received their legal training in humid regions, and were guided by legal principles and statutes based upon the common law of England, hence they made laws and rendered decisions frequently at variance with the best interests of the arid regions. The fact that each State and Territory made its own laws and regulations, for the most part without regard to what had been done elsewhere, added greatly to the confusion. Very many of the streams from which water is taken for irrigation in the United States cross State lines in their courses, but this fact was almost entirely ignored in the irrigation legislation of the different States. The attitude of the Federal Government to questions relating to irrigation has never been clearly defined. Recently the people of the irrigated region have become awakened to the importance of the legal and administrative problems involved in the appropriation and use of water, have discovered the existing confusion in their laws and regulations, and have become alarmed at the rapidly increasing volume of litigation and the varying and often contradictory decisions of the courts on these matters. They are therefore demanding that facts regarding the existing system of irrigation laws and regulations and their results shall be collated and published and have appealed to the United States Government to do this work. The objects of the work which this Office has undertaken regarding the laws and institutions of the irrigated region are (1) to furnish impartial and adequate information on which wiser and more equitable legislation and court decisions may be based, and (2) to assist farmers in the acquirement of water rights and to protect their interests in the appropriation and use of water for irrigation.

It will readily be seen that it is no small task to make a clear presentation of the facts and principles involved in the legal and institutional aspects of the irrigation problems of the Great West, stripped of unnecessary technicalities and put in such shape as to form a correct and intelligible guide which may be relied upon as an authoritative summary of the data on which the development of the irrigation system should be founded. A promising beginning of this work has, however, been made, and it is hoped that within a reasonable time a

complete survey of the legal problems relating to irrigation will be completed for the entire irrigated region of the United States.

The other general line of irrigation investigation which this Office has undertaken relates to the determination of the amount of water actually used or required for the growth of different crops on different soils. This involves, first, the accurate determination of the amounts of water actually applied by farmers under different conditions, and secondly, experimental investigations with reference to the minimum amounts of water required and the best methods for the utilization of the available water supply. These investigations are needed for the information and guidance not only of the farmers in the irrigated regions, but also of the legislatures, courts, and administrative officers. Hitherto one great difficulty in securing the passage of satisfactory irrigation laws and their just interpretation by the courts has been the lack of definite and thorough information regarding the actual requirements of agriculture under irrigation. In the absence of any standard authority regarding the amounts of water required and the proper regulation of the distribution of water during different seasons of the year, each legislature or court has followed its own imperfect view of the case, often with most disastrous results as regards the best interests of the farmers.

It is obvious that the experimental investigations in this direction can best be carried on in cooperation with the agricultural experiment stations in the irrigated region, and this plan has therefore been followed by this Office as far as practicable in accordance with the provisions of the act of Congress.

A considerable portion of the first year was occupied in a preliminary study of the conditions existing in the different States and Territories, with a view to determining the best plan of operations and the organization of a force to do the work. It soon became apparent that more funds would be required to carry on these investigations in a satisfactory way, and Congress was therefore asked to increase the appropriation, with a view to putting the work on a more permanent basis. Congress responded to this appeal by increasing the appropriation to $35,000 for the fiscal year ending June 30, 1900. The terms of the appropriation act were also changed so as to indicate that the decision had been reached to put these investigations upon a basis which promised their continuance as long as they proved successful. Under this act the money is appropriated "to enable the Secretary of Agriculture to investigate and report upon the laws and institutions relating to irrigation and upon the use of irrigation waters, with special suggestions of better methods for the utilization of irrigation waters in agriculture than those in common use, and for the preparation, printing, and illustration of reports and bulletins on irrigation; and the agricultural experiment stations are hereby authorized and directed

to cooperate with the Secretary of Agriculture in carrying out said investigations in such manner and to such extent as may be warranted by a due regard to the varying conditions and needs of the respective States and Territories, and as may be mutually agreed upon."

The investigations having thus been more satisfactorily provided for, measures were at once taken to organize the work more systematically and on a more permanent basis. As it seemed clear that the work would be most efficiently prosecuted by having its headquarters in the irrigated region, an office was established at Cheyenne, Wyo. Prof. Elwood Mead, for many years State engineer of Wyoming, who had previously been aiding this Office very materially in the organization of these investigations, was appointed irrigation expert in charge and undertook the active management of the enterprise, which, however, remained subject to the general supervision of the Director of the Office of Experiment Stations. The organization of an expert and clerical force was undertaken under the general regulations of the service, and arrangements were made for the cooperation of the agricultural experiment stations and the employment of experts in the different States and Territories to aid in carrying on special investigations. The study of the irrigation laws and institutions was greatly broadened and a large amount of data in this line is now being collated. Arrangements were made for the measurement of the actual volume of water used in irrigation and the time of such use. During the past season these investigations on the duty of water have been carried on in 15 States and Territories. A special form of register for recording the amount of water used was designed for this work by the expert in charge. The measurements themselves are to determine (1) the general duty of water, or (2) the difference in the time of use, and the relative volumes required by different crops.

The first class of measurements embraces determinations of the water used in the irrigation of large areas devoted to different crops. Record is kept of the volume flowing through the main canal, and a measurement of the acres cultivated gives the duty it has performed, including loss in transportation through the main canal and in distribution through the lateral. No distinction is made in these measurements of the requirements of different crops, although the final record will probably show their influence.

Under the second class of measurements losses in distribution are eliminated. Measurements are made at the borders of the field where the water is used, the object being to determine the crops which require large amounts of water and those which do not; also to determine those crops which require to be irrigated during the season when streams are low, and those which can be brought to maturity by irrigation during the flood period. The latter measurements have a special reference to the usefulness and value of storage reservoirs.

The location of the official stations and the names of the observers are as follows:

Official stations and names of observers.

State.	Location.	Observer.
New Jersey	New Brunswick	Prof. E. B. Voorhees, of the New Jersey Experiment Stations.
Nebraska	Gothenburg	A. M. Allen.
	Lincoln	Prof. O. V. P. Stout, of the Nebraska Experiment Station.
Montana	Bozeman	Prof. S. Fortier, of the Montana Experiment Station.
Wyoming	Wheatland	M. R. Johnston.
	Laramie	Prof. B. C. Buffum, of the Wyoming Experiment Station.
Colorado	Holly	Thomas Berry.
Texas	Beeville	Prof. S. A. McHenry, of the Texas Experiment Station.
New Mexico	Carlsbad	W. M. Reed.
	Mesilla Park	Prof. J. D. Tinsley, of the New Mexico Experiment Station.
Arizona	Phenix	W. H. Code.
California	Riverside	W. Irving.
Utah	Logan	Prof. Geo. L. Swendsen, of the Utah Experiment Station.
	Salt Lake City	R. C. Gemmel, State engineer.
Idaho	Boise	D. W. Ross, State engineer.

The establishment of additional stations was prevented by delay in securing apparatus for measuring the variations in discharge, but records are being kept by volunteer observers in cooperation with this investigation in Montana, Washington, and Kansas.

The usefulness of this investigation is not limited to the arid region. On the contrary, there is no question that irrigation can be profitably employed in the cultivation of large areas in both the eastern and southern States. There are now over 100,000 acres of sugar land being irrigated in Louisiana alone, and the area is being constantly extended. The irrigated rice fields of the Carolinas produce a product unequaled elsewhere in quality, and wherever natural conditions will permit of its aid there is no agency which will do more to increase the yield or insure the quality of crops than the application of moisture when needed. There is a wide field for the employment of irrigation in the East and South in market gardening, in the irrigation of alfalfa and of pastures, in the cultivation of high-priced products, and in the utilization of the sewage of cities and towns.

A beginning of irrigation investigations in the humid region has already been made. Prof. E. B. Voorhees, of the New Jersey Experiment Stations, is now collecting data showing the area of land irrigated in that State, the methods employed, the duty of water obtained, and the benefits received. Arrangements have also been made for experiments in irrigating tea plants, in connection with investigations on tea culture, made by this Department under direction of Dr. C. U. Shepard on his tea plantations at Summerville, S. C.

Several bulletins containing information collated in these investigations have already been published and a number of others are in course of preparation. These are being widely distributed, chiefly in the irrigated region. A list of the irrigation publications of this Office may be found in the Appendix.

THE AGRICULTURAL EXPERIMENT STATIONS IN THE SEVERAL STATES AND TERRITORIES.

ALABAMA.

Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama, *Auburn.*

Department of the Agricultural and Mechanical College of Alabama.

GOVERNING BOARD.

Board of Trustees—Committee on Experiment Stations: F. M. Moseley (*President*), *Union Springs;* J. G. Gilchrist, *Hope Hull;* Jon. Haralson, *Montgomery.*

STATION STAFF.

W. L. Broun, M. A., LL. D., *President of the College and of the Station Council.*
P. H. Mell, M. E., PH. D., *Director; Botanist.*
B. B. Ross, M. S., *Chemist.*
C. A. Cary, D. V. M., *Veterinarian.*
J. F. Duggar, M. S., *Agriculturist.*
F. S. Earle, *Horticulturist and Biologist.*
J. T. Anderson, PH. D., *Associate Chemist.*
C. L. Hare, M. S., *1st Assistant Chemist.*
J. Q. Burton, *2d Assistant Chemist.*
A. McB. Ransom, B. S., *3d Assistant Chemist.*
T. U. Culver, *Superintendent of Farm.*
R. W. Clark, *Assistant in Agriculture.*
Moses Craig, M. S., *Assistant Horticulturist.*

HISTORY.

The Alabama College Station is located on the southern edge of the middle agricultural section of the State, a region several hundred feet above sea level, where good maize and cotton are produced. The temperature is high at times in the summer and there are occasional frosts in winter. The annual rainfall averages about 50 inches. South of this is a lowland region of light but productive alluvial soil with a warmer climate and larger rainfall. The northern section is a mineral region containing much poor and hilly land, but embracing the fertile valley of the Tennessee River. This section has a more moderate climate and is naturally adapted to a more diversified agriculture. The settlement of the State began with the eighteenth century, and agriculture developed rapidly when cotton growing with slave labor was enormously expanded in the United States from 1820 to 1860. This system led to the rapid depletion of the soil and the use of large amounts of commercial fertilizers. Cotton has since remained the principal crop, and

the station has therefore given much attention to investigations relating to it. The inspection of fertilizers undertaken by the State has also been a large matter. In general the improvement of the soil and the diversification of agriculture have been the main objects of the station's work. The college with which the station is connected was established in 1872, and has been developed largely along technical and scientific lines. It is a well-equipped institution with about 350 students.

The history of experimental work in Alabama is comprised within three well-defined periods. The first period is that of work by the agricultural and mechanical college, and extends from the inauguration of experimental research in agriculture in the State in 1875 to the establishment of a State experiment station in 1883. Experiments were carried on both at Auburn and at a station in North Alabama called the branch station of the college. The latter occupied 10 acres of land, and its first bulletin was on the subject of fertilizers in the cultivation of cotton. This bulletin was published in the annual report of the president of the college to the State legislature for the year 1875. At the college the farm was conducted mostly as a model farm for students and farmers of the vicinity, although a few experiments were carried on, the results of which are also to be found in the president's report.

The first separate and systematic report of the results of experiments made at the college farm was printed in March, 1882, and consisted of a bulletin of 89 pages treating of the following subjects: The vineyard and analyses of grapes suited for making wine; brief notes on strawberry culture and the orchard; experiments on field peas, grass, *Desmodium molle*, *Symphytum asperrimum*, maize, and cotton; nitrogenous experiments; agricultural museum; chemical work of the station; bones and how to use them; feeding stuffs; cotton seed; analyses of chicken corn; and an appendix devoted to meteorological data.

The second period is that of the State experiment station and extends from its establishment in connection with the agricultural college by the State legislature in 1883 to its reorganization under the act of Congress in 1888. The officers appointed were Prof. J. S. Newman, director, and Dr. W. C. Stubbs, now director of the Louisiana Stations, chemist. A farm was purchased near the college and equipped with live stock and the necessary appliances for experimental work. By enactment of the legislature, the State department of agriculture, just then established, was also located at the college and the commissioner was required to publish the bulletins of the station.

The third period is that in which the station has been a department of the agricultural college and extends from the reorganization of the State station under the provisions of the act of Congress, April 1, 1888, to the present time. The lines of work were much extended, but not

interrupted. A board of direction was created, consisting of the president of the college and the heads of divisions in the experiment station. Professor Newman continued to serve as director until 1891, when the office was abolished and its duties were performed by the president of the college. In 1898 the directorship was reestablished and Prof. P. H. Mell, the botanist, appointed to it. At the same time the name of the board of direction was changed to that of station council.

In 1891 a strong effort was made to give three branch stations $2,000 each from the Federal appropriation, thus reducing the annual income of the Auburn station from this source to $9,000, and a bill passed the State legislature to that effect, but was vetoed by the governor in a message presenting in a plain and powerful manner the facts and the law bearing on the case. This message is regarded as a paper of great value to the experiment stations.

ORGANIZATION.

The station, as a department of the Agricultural and Mechanical College of Alabama, is governed by its board of trustees. There are twelve members in the board, two of whom, the governor and the State superintendent of education, are ex officio. The other members are appointed by the governor for six years, one from each Congressional district, except the district in which the college is located, which is entitled to two members. This board has full control and supervision of all matters pertaining to the election of officers of the station, the appropriation of its funds, and the final decision of all questions relating to its management. There is a standing committee of the board consisting of three members, designated the committee of trustees on the experiment station. This committee is required to visit the station each year and inspect each division and make a special report at the annual meeting of the board. No permanent improvement may be made without its approval. Members of the board are reimbursed for expenses incurred in the discharge of the duties of their office. The full board meets only once each year, in June.

The staff is composed of the president of the college, director (who is also botanist), chemist, veterinarian, agriculturist, horticulturist and biologist, associate chemist, three assistant chemists, farm superintendent, assistant in agriculture, and assistant in horticulture. The general control of all the affairs of the station not exercised by the governing board is intrusted to a station council appointed or elected by that board and consisting at present of the president, director, heads of divisions, and associate chemist. The term of office of the members of the staff is not fixed, and is terminated only by action of the board of trustees. The president presides at all meetings of the station council, and station officers are directly responsible to him.

The duties of the director are the supervision of all correspondence and publications of the station and the recommendation to the president of new lines of work or changes in existing lines. The director must make his report to the president, and only through that officer is access had to the board. Each head of division is in full charge of his work, and is expected to make recommendations to the station council of changes desired in his experiments, and has a vote in all matters coming before the council relating to the general welfare of the station.

EQUIPMENT.

The buildings occupied by the station are the main college building; chemical laboratory; electrical and veterinary building; horticulturist's, agriculturist's, and assistant's residences; office of the agriculturist; two large barns; dairy building; greenhouses; veterinary hospital, and several small buildings devoted to the cotton gin and press, silos, etc. The total value of the buildings used by the station amounts to about $170,000. In the main building (Pl. III, fig. 1), which is a pressed-brick structure with stone trimmings, 160 by 71 feet and four stories high, are located the divisions of botany, biology, (Pl. III, fig. 2), entomology, and horticulture; the station library, and the museums. The chemical laboratory (Pl. IV, fig. 1) is a two-story brick and stone structure with a one-story addition. There is at present in process of construction a new chemical laboratory of stone and pressed brick, 26 by 60 feet, which is to be devoted exclusively to station and State inspection work. This building will be equipped with appliances and apparatus especially suited to agricultural analysis. After the completion of this building the present laboratory will be used chiefly for college work. The electrical building and power house supply power to the farm for all purposes where a steam engine would otherwise be required. The veterinary building (Pl. IV, fig. 2) consists of a two-story part, containing four laboratories on the second floor and a lecture room, museum, and office on the first floor, and a one-story part which contains an operating room. (The greenhouse is shown in Pl. V, fig. 1).

The station farm, the title to which lies with the State, consists of about 100 acres of woodland, 56 acres of pasture, and 70 acres of arable land. Twenty-five acres are laid out in plats of one-twelfth, one-sixteenth, or one-twentieth acre each, included in which is a grass garden (Pl. V, fig. 2). The experimental areas are arranged somewhat irregularly on account of the broken and unfavorable character of the land. The most uniform portions of each field, especially flat hill tops and gentle hillsides, are used for the purpose. The entire farm is managed by the station, and has no connection directly with college work. A recent purchase increases the amount of pasture land by 78 acres. The station live stock consists of 15 head of dairy cattle; 10 head of beef cattle, representing three breeds, and 30 hogs.

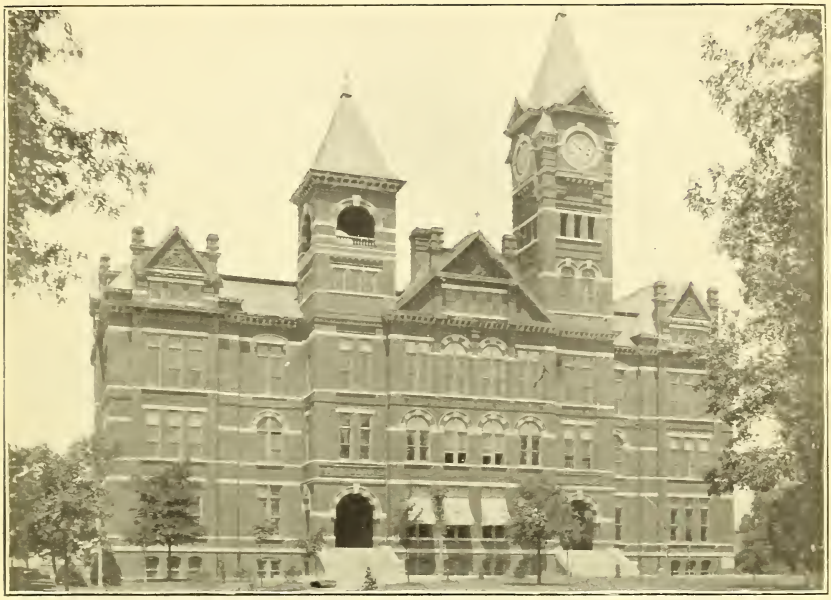


FIG. 1.—ALABAMA COLLEGE STATION—MAIN BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—ALABAMA COLLEGE STATION—BIOLOGICAL LABORATORY.

FIG. 1.—ALABAMA COLLEGE STATION—CHEMICAL LABORATORY.

FIG. 2.—ALABAMA COLLEGE STATION—VETERINARY BUILDING.

FIG. 1.—ALABAMA COLLEGE STATION—GREENHOUSE.

FIG. 2.—ALABAMA COLLEGE STATION—GRASS GARDEN.

The collections of specimens in the cabinet, museum, botanic garden, etc., are not as numerous and extensive as they were in 1887, when the main building of the college containing the museum was destroyed by fire. However, the collection of flowering plants, pressed and classified, will amount to 16,000 specimens, and the collection of fungi and lower cryptogams ready for study and examination amounts to 15,000 specimens. In the division of veterinary science there are skeletons of all domestic animals, numerous models of the anatomical structure, and many pathological specimens. In the division of botany there is a collection of lantern slides, illustrating various stages of plant development, and others illustrating geology in its relation to agriculture.

Until recently the station library was kept separate from the college library, but both are now under one management and comprise more than 12,000 volumes.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund, State fertilizer tax, and sales of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
State fertilizer tax	6,432.60
Farm products	720.65
Balance on hand July 1, 1898	3,240.55
Total	25,393.80

LINES OF WORK.

A prominent line of work at this station has from its organization been the analysis of fertilizers. The division of chemistry cooperates with the State department of agriculture and makes all analyses for the State. In return the college and station receive one-sixth of the net receipts from the fertilizer tax collected. The station is doing much to point out other directions in which inspection is needed for the protection of the agricultural interests of the State and the health of the people. Under the former head may be mentioned analytical studies of insecticides by the chemist, and under the latter efforts by the veterinarian to establish a system of meat and milk inspection in the cities of the State.

Another important line of work in which the station is interested is the "Alabama biological survey," organized by the members of the college faculty who are engaged in natural history studies. The officers of the station council are members of this survey. This work has been vigorously prosecuted, and a large collection of plants and of some of the lower animals has been made. The part of this work already completed includes a preliminary list of the known species of

Alabama fungi, the first part of a phænogamous flora of Alabama, a catalogue of the principal weeds of the State, and a collection of animal parasites, especially those of the domestic animals. In connection with a series of cooperative fertilizer tests, the soils of the State are being carefully studied, especially with reference to the reclamation of many acres of worn-out soils and soil improvement in general. When sufficient data have been collected it is proposed to prepare a map showing the character of the fertilizers chiefly needed on the most extensive soil areas of the State.

The scientific investigations are concentrated on the important problems of Alabama agriculture, central among which is that of the culture of cotton, the staple crop of the State. With this the other problems are closely related. Years of continuous cotton production have impoverished the soil, investigations in the renovation of which have involved an extended study of the most promising leguminous plants and their use in green manuring. The failure of leguminous plants on certain soils of the State has led to important experiments in soil inoculation. As a remedy for the evils of the one-crop system of planting in the cotton-growing industry, the station is encouraging the development of diversified agriculture, especially along lines of animal husbandry. Work in this line involves the question of forage production. This has led to a study of native and introduced forage plants, especially grasses and legumes. Not merely adaptation to soil and climate must be investigated, but also nutritive value as determined by feeding experiments. These look both to the cost and nutritive value of the rations themselves and to their effect on the relative amounts of fat and lean meat in the carcass.

The work with cotton has included experiments to determine water and fertilizer requirements, culture experiments, breeding, acclimatization of foreign varieties, and studies of diseases. The station has made numerous hybrids between foreign and American varieties. This work has now been carried on for a number of years, and the results indicate that cotton can be bred to produce long staple when grown on upland, and by proper treatment can be made to mature the fiber more surely when the bolls are opened, at the same time increasing the yield. A general study has been made of the diseases of the cotton plant, the cause of the cotton-boll rot disease has been worked out, and a bacterium associated with it has been described. It has been ascertained that the so-called "rust" of cotton is primarily a physiological disease which may usually be prevented by proper culture, drainage, and choice of suitable soils and fertilizers. It was found that on some soils potash salts act as an almost complete preventive. The agricultural division is now carrying on further experiments on this point. Analyses are being made in the chemical division to determine the composition of the cotton plant at different stages of

growth, its water and fertilizer requirements, and its ability to utilize the phosphoric acid in the several phosphatic materials used in the South for the manufacture of fertilizers.

Studies in soil renovation involve first a determination of the soil requirements and second the problem of supplying these requirements most economically. Soil tests have been carried on in 20 to 40 localities in the State for about a decade, a test in one locality, however, seldom being continued for more than four years and often less. The fertilizer needs of the most important soil belts in the State have been determined, and considerable areas of acid soils in uplands in widely different parts of the State have been located. Various fertilizer materials have been tested, but especial attention has been paid to green manuring. The work with legumes has demonstrated the practicability of improving worn-out soils by their use and, at the same time, has determined the kinds best adapted to Alabama soils and climate. In connection with the work on legumes the agricultural division has made inoculation experiments with a number of kinds, the result of which has been to demonstrate that by the aid of artificial cultures crimson clover, vetch, and alfalfa may be grown on soil where they would not otherwise thrive. Closely related with this work are investigations of a more general nature on the availability of the different fertilizer constituents of the soil. These are carried on by means of pot experiments in the vegetation house or open field.

The work in live-stock feeding has been principally along lines of determining the nutritive and economic value of various native and introduced forage plants, cowpeas, peanuts, chufas, and artichokes for hogs. The station has been very successful in demonstrating to the farmers of the State that poor soils may profitably be used for growing certain crops for feeding to hogs. The chemical division has made a study of the effect of foods upon the character and quality of butter produced. The veterinary division is studying the toxic effects of cotton seed on hogs. It has also manufactured and distributed large quantities of tuberculin to the veterinarians of the State. The work of the division of horticulture has been along lines of determining the varieties of fruits and vegetables best adapted to the State and studies of the local diseases of the plum, peach, and grape.

DISSEMINATION OF INFORMATION.

Previous to its reorganization in 1887 the station had issued 32 bulletins through the State commissioner of agriculture. From the reorganization of the station to January 1, 1900, there had been issued in a new series 106 bulletins and 11 annual reports. The latter are now merely administrative documents. A few press bulletins have also been issued. Prof. G. F. Atkinson, formerly biologist of the station, is the author of "Biology of Ferns," "Elementary Botany,"

and the article on the diseases of cotton in Bulletin 33 of the Office of Experiment Stations on "The Cotton Plant." Prof. L. M. Underwood, also formerly biologist, is the author of "Our Native Ferns and How to Study Them," "Our Native Ferns and their Allies," and "North American Hepaticæ." Prof. P. H. Mell, director and botanist, is the author of "Wild Grasses of Alabama," 1886; "Report on the Climatology of the Cotton Plant," prepared for the United States Weather Bureau and published in 1893; three volumes on "The Climate of Alabama," published by the Alabama weather service; "Botanical Laboratory Guide," and a revision of "White's Gardening for the South." The station correspondence amounts to about 3,500 letters a year, exclusive of circular letters. Farmers' institute work is in charge of Dr. C. A. Cary, the veterinarian, but all members of the station council are called upon to assist. During 1898, 21 institutes were held by the station, and some members of the staff assisted in six others held under the authority of the State department of agriculture. The mailing list contains 7,910 names.

GENERAL RESULTS OF WORK.

The Alabama College Station has most largely affected the agriculture of the State through its inspection of fertilizers, its investigations regarding the improvement of soils and the prevention of washing by the growing of leguminous crops such as crimson clover, cowpeas, and hairy vetch, and by better methods of culture and terracing. Much useful work has also been done for the promotion of stock raising and dairying and the repression of diseases of plants and animals.

Canebrake Agricultural Experiment Station, *Uniontown.*

GOVERNING BOARD.

Board of Control: I. F. Culver, *Montgomery;* P. H. Mell (*Director ex officio*), *Auburn;* J. Huggins, *Newbern;* A. Sledge, *Whitsett;* G. D. Stollenwerck, *Uniontown;* M. Walker, *Faunsdale;* S. H. Knight, *Uniontown.*

STATION STAFF.

P. H. Mell, Ph. D., *Director ex officio.*
H. Benton, M. S., *Assistant Director in Charge.*
J. F. Connor, D. V. M., *Veterinarian.*
M. Walker, *Treasurer.*

HISTORY.

The Canebrake Branch Experiment Station was organized in accordance with an act of the State legislature as a branch of the State Experiment Station at Auburn in 1885. It had its origin in a demand for the investigation of the needs of the peculiar calcareous soils known as the prairie region and especially that part of the prairie known as the Canebrake, which was once a very fertile region but has by injudicious cultivation been seriously impoverished. The State

Experiment Station at Auburn had been established in 1883, but it was found that the results of field experiments at that place were of little value for cultivators of the widely different canebrake soils. In 1887 the State legislature amended the act establishing the station and changed its name to The Canebrake Agricultural Experiment Station and increased the appropriation for it for the purpose of supplying needed buildings and securing the services of an assistant director. This act took effect April 1, 1888. At about the same time the board of trustees of the Agricultural and Mechanical College of Auburn supplemented the State appropriation for this station by $2,000 drawn from the $15,000 received for the station at Auburn from the National Government. The appropriation of $2,000 from the national fund was discontinued in 1890.

ORGANIZATION.

The station is now maintained exclusively by the State. The board of control consists by law of the commissioner of agriculture of the State, the director of the station, "and five cultivators of canebrake land." The director of the station at Auburn is by law director ex officio of the Canebrake Station. The resident members of the staff are an assistant director in charge, veterinarian, and treasurer.

EQUIPMENT.

The station owns 40 acres of typical canebrake land. Twelve acres are laid off in experimental plats of one-fourth acre each, 20 acres are devoted to general field crops, and 8 acres to orchards, vegetable, garden, and ornamental plants.

The main building is an eight-room cottage containing office and library, small rooms for meteorological instruments and photographic work, and living rooms for the officer in charge and the superintendent of the farm. Attached is a small greenhouse. Other buildings are a two-story ginhouse, silo, two barns, and piggery. The live stock consists of 2 mules and 9 registered hogs. The station has small collections of fungi and other cryptogams. The library contains 1,000 volumes.

FINANCIAL SUPPORT.

The financial support of the station is derived from a State appropriation of $2,500 a year, and the sale of farm products. During the last fiscal year it was as follows:

State appropriation	$2,500.00
Farm products	350.00
Total	2,850.00

LINES OF WORK.

The station has no inspection duties. Its work has been directed mainly to practical questions of immediate importance in the region in which the station was established. These have been especially inquiries relating to the chemical and physical needs of the black prairie land, together with tests of crops and methods of culture best adapted to local conditions. It has been shown that the infertility of the canebrake lands is due not to lack of mineral elements, but rather to imperfect drainage. Observations have been made on the influence of drainage upon soils at depths varying from 1 to 30 inches. Observations have also been made on the relations between rainfall and outflow from tile and the effects of rainfall upon soil temperature. Maize, cotton, and small grains have been the subjects of numerous experiments bearing on methods of preparation of the soil, planting, cultivation, and harvesting, and comparative merits of varieties. The forage crops adapted to local soils and climate have received attention with special reference to seasons and manner of planting, fertilizers and the best methods of utilizing them, and the effects upon the productiveness of the soil. Experiments have been made with various leguminous plants as renovators on soils too poor for profitable cultivation. These experiments have shown that cowpeas and melilotus supply at once the two greatest needs of the black prairie soil, drainage, and vegetable matter, and, through the latter, nitrogen. Studies have also been made of the diseases affecting animals in the region of the station, and modern methods of treatment have been introduced. In the interest of horticulture and pomology considerable time has been given to experiments with varieties of vegetables, melons, small fruits, apples, pears, peaches, and grapes.

DISSEMINATION OF INFORMATION.

Prior to the reorganization of the station in 1888 its reports were published by the State station at Auburn. At that time the station began issuing its own publications, of which there have appeared to the present time 18 bulletins and 12 annual reports. The annual report contains a general survey of the work of the year with accounts of experiments. The mailing list contains 2,100 names.

GENERAL RESULTS OF WORK.

The Canebrake Station has promoted the interests of the region in which it is located by demonstrating the usefulness of drainage, green manuring, and the more careful culture of crops in the management of the peculiar canebrake soils. It has also aided in the local diversification of agriculture and the development of animal husbandry.

ALASKA.

Agricultural Experiment Stations in Alaska, *Sitka and Kenai.*

Under the supervision of A. C. True, Director of the Office of Experiment Stations, United States Department of Agriculture.

STATION STAFF.

C. C. Georgeson, M. S., *Special Agent in Charge, Sitka.*

Chas. H. Robison, B. S., *Assistant at Sitka.*

Hans P. Nielsen, *Assistant at Kenai.*

HISTORY.

It is only recently that Alaska has been regarded as possessing agricultural possibilities. While under Russian control some attempts were made to introduce various crops and different kinds of live stock, with a view to encouraging the regular practice of agriculture by the natives and settlers, but this was not systematically carried on and met with but little success.

For more than a quarter of a century after Alaska became a part of the United States no effort was made to encourage agriculture there. Vegetables, however, were grown in a small way by some of the settlers and at a few mission stations. The native population, which does not exceed 30,000 souls, maintained itself through hunting, fishing, and the trade in furs. A small number of white immigrants became permanent settlers. These men were chiefly engaged in salmon fishing and in trading with the natives. The opening up of the gold mines in southern Alaska gave employment to a limited number of persons. It was not, however, until relatively large amounts of gold were found in the Yukon Valley in 1896 that public attention was strongly turned to Alaska. Since that time there has been an increasing realization that the vast region of Alaska contains large natural resources in its minerals, forests, and fisheries. There has also been a gradual awakening to the fact that it would be difficult to maintain in Alaska a sufficient permanent population to develop these resources unless a considerable portion of the food supply could be obtained from the Territory itself. This has led to a desire on the part of both the residents and outsiders who are interested in the development of the Territory that the Government should undertake a study of the agricultural capabilities of Alaska, and by experimental inquiries help to establish there at least sufficient agriculture to meet a considerable portion of the needs of the population of the Territory.

The conditions under which agricultural investigations must be pursued in Alaska can best be understood by considering the general topographical and climatic features of this vast region. In a general way, Alaska may be divided into four distinct regions: (1) the south-

eastern coast region; (2) the middle coast region; (3) the southwestern coast region; and (4) the interior. The southeastern coast region, extending from the southern boundary to Cross Sound, a distance of about 4° of latitude, embraces the great Alexandrian Archipelago, which consists of more than one thousand islands, and the adjacent mainland as far north as Juneau. This region is heavily timbered with spruce, hemlock, and cedar; but, wherever afforded a chance, grasses, representing several species, grow luxuriantly. Mosses of many kinds abound, often forming layers, and their decay has resulted in the formation of peat, which is sometimes 4 to 5 feet in depth. There are frequent rains, producing a total annual precipitation of about 100 inches. Cloudy and foggy weather is frequent. The temperature is moderate, ranging at Sitka from 87° to −4° F. There are some natural meadows in this region, but for the most part the land must be cleared of timber and stumps, at considerable expense, before it can be used for agricultural purposes.

The middle coast region, which extends westward from Cross Sound to the southwestern point of the Kenai Peninsula, having a coast line of more than 600 miles, consists to a large extent of high mountains, which in many places reach down to the water's edge, and which are usually more or less timbered at the base. In some parts of this region are found considerable stretches of level land, but, on the whole, it offers opportunities for the practice of agriculture only to a limited extent.

The southwestern coast region embraces all of the Alaska Peninsula, with adjoining islands, and the Aleutian Islands. In the northeastern portion of this region, and in the north end of Kadiak Island, some timber exists, but west of this the region is practically barren of trees. The characteristic vegetation is a wealth of grasses which not only cover the lower levels, but extend far up the mountain sides. The climate is similar to that of southeastern Alaska, but there is somewhat less rain and more sunshine. The region is well adapted to grazing and stock raising.

The vast interior of Alaska is mountainous, but some elevated plains and more or less extensive bottom lands along the streams, of which the Yukon River is the chief, are to be found. The climate is more rigorous than along the coast. In summer the temperature frequently reaches 100°, and in winter, on the other hand, it often sinks below −50° F. There is less precipitation than on the coast, and more sunshine. Grasses abound in many parts of this region, and vegetables have been grown on a small scale by careful methods in many localities.

The report of the Director of the Office of Experiment Stations for 1896 contained this suggestion: "That Congress be asked to make a moderate appropriation to enable the Secretary of Agriculture to investigate and report to Congress upon the agricultural resources and

capabilities of Alaska with special reference to the desirability and feasibility of the establishment of agricultural experiment stations in said Territory and the selection of suitable locations for such stations." This recommendation was indorsed by the Secretary of Agriculture, and, in accordance with his estimates, an appropriation of $5,000 was made by Congress for this purpose for the fiscal year ended June 30, 1898.

To carry out the provisions of this act of Congress a commission, consisting of Mr. Benton Killin, a member of the board of regents of the Oregon Agricultural College, and Dr. W. H. Evans, botanist of the Office of Experiment Stations, were sent to visit the coast region of Alaska from its southern boundary as far west as Unalaska. Through the courtesy of the Secretary of the Interior and the Commissioner of Education, the services of Dr. Sheldon Jackson, superintendent of Government schools and reindeer experiments in Alaska, were secured to investigate the agricultural possibilities of the Yukon Valley. It was shown by these investigations that while there was very little agriculture practiced in Alaska in a regular way, various crops, especially vegetables and berries, have been successfully grown in different localities, and that live stock was kept to a limited extent.

As a result of the report made to Congress on this preliminary survey, an appropriation of $10,000 was made for the fiscal year ended June 30, 1899, under the same terms as for the preceding year. As this indicated the purpose of Congress to put this work on a more permanent basis, Prof. C. C. Georgeson, who had had a long experience as professor of agriculture and experiment station worker in Japan and Kansas, was made special agent in charge of Alaska investigations, and headquarters were established at Sitka in May, 1898. At the same time the Weather Bureau of the United States Department of Agriculture undertook the establishment of a special meteorological service for Alaska. Dr. Evans was again sent to Alaska to continue the botanical survey of the coast region during the summer. Under the direction of Professor Georgeson, experiments were made in growing cereals of different kinds, forage plants, flax, and vegetables at Sitka and Skagway.

A second report on the agricultural investigations in Alaska was made to Congress in January, 1899. As a result, $12,000 was appropriated for the continued investigation during the fiscal year ending June 30, 1900. The terms of the appropriation act were so changed as to enable the Secretary of Agriculture "to investigate and report to Congress upon the agricultural resources and capabilities of Alaska and to establish and maintain agricultural experiment stations in said Territory, including the erection of buildings and all other expenses essential to the maintenance of such stations."

This may be regarded as the fundamental act for the establishment

of experiment stations in Alaska. Hitherto the investigations have been made with a view to ascertain if agriculture was feasible in that Territory. Now the establishment of experiment stations is authorized. In accordance with this act a two-story frame building, containing offices, laboratories, and quarters for the special agent in charge has been partly completed at Sitka, on the lot reserved for that purpose. Several acres of the tract which was reserved for experimental purposes near Sitka have been cleared. Similar work has been done on the reservation at Kenai and a small log barn and a silo have been erected there.

ORGANIZATION.

The Alaska Experiment Stations, instituted under the above-mentioned clause in the appropriation bill for the United States Department of Agriculture, approved March 1, 1899, are under the direct control of the Secretary of Agriculture. The Secretary manages them through the Office of Experiment Stations, the Director of which exercises general supervision of this enterprise. The immediate management of these stations is committed to a special agent in charge who has two assistants, one of them located at Sitka, and the other at Kenai, in Cook Inlet. The work is still in the formative stages. One or more stations in the vast interior will, presumably, be added in the near future and, as more stations are created, the force of workers must necessarily increase. Headquarters have been established at Sitka, and the work of the outlying stations will be confined to those questions which are of interest to the regions in which they are located.

EQUIPMENT.

An office and laboratory (Pl. VI, fig. 1) 30 by 43 feet, and two stories high, was erected at Sitka in 1899, but only partly completed. It will have ten rooms, and is designed to contain the offices, laboratories, library, and quarters for the official in charge. There is a log barn at Kenai (Pl. VI, fig. 2).

Aside from this the equipment is at present limited to the implements necessary to clear, break, and otherwise prepare land for culture. There is a yoke of work oxen at Sitka, and another at Kenai. No equipment for the laboratories has as yet been provided. The land so far reserved for experimental purposes, by order of the President, comprises 110 acres at Sitka (Pl. VII, fig. 1), 166 acres at Kadiak, and 320 acres at Kenai. At Sitka this land is for the most part an old forest from which the timber has been removed, but the stumps still remain. As has already been said, the ground is deeply covered with moss, the method of removing which is shown in Pl. VII, fig. 2. At Kadiak the reservation is partly timbered, and at Kenai nearly the whole tract is covered with small timber.

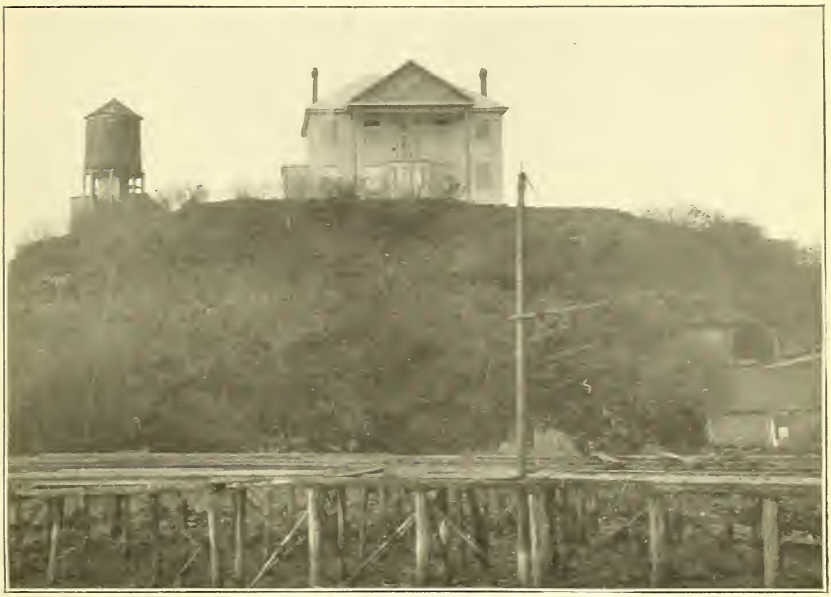


FIG. 1.—ALASKA STATIONS—OFFICE AND LABORATORY, SITKA.

FIG. 2.—ALASKA STATIONS—LOG BARN AT KENAI STATION.

FIG. 1.—ALASKA STATIONS—RESERVATION FOR EXPERIMENTAL FIELD, SITKA.

FIG. 2.—ALASKA STATIONS—REMOVING MOSS FROM EXPERIMENTAL FIELD, SITKA.

FIG. 1.—ALASKA STATIONS—GRAIN PLATS AT SITKA.

FIG. 2.—ALASKA STATIONS—VARIETIES OF OATS GROWN AT SITKA.

FIG. 1.—ALASKA STATIONS—EXPERIMENTAL PLATS AT KENAI STATION.

FIG. 2.—ALASKA STATIONS—VILLAGE OF KADIAK AND VICINITY.

LINES OF WORK.

The experimental work in Alaska has so far been confined to the coast region. It has consisted chiefly in testing vegetables and cereals with a view to ascertaining how far these crops are suited to Alaska conditions. In the summer of 1898, barley, oats, and flax were matured at Sitka and at Skagway, and a long list of vegetables, including all the hardier kinds in common use, were successfully grown also at these points. The past summer this work was continued and extended with marked success. At Sitka several varieties each of spring wheat, barley, and oats matured perfectly, as did also flax and buckwheat. (The plats are shown in Pl. VIII, fig. 1, and the results of some of the experiments with oats in Pl. VIII, fig. 2.) The same varieties were also successfully grown at Kenai, and attempts on a small scale at Kadiak were also partially successful. (The experimental plats at Kenai are shown in Pl. IX, fig. 1, and a view of Kadiak, where the last-mentioned experiments were made, is given in Pl. IX, fig. 2.) As in the preceding year, the hardier sorts of vegetables grew well at the three places named. Aside from this, some data have been secured with regard to soil temperatures and soil characteristics which are of importance in practical agriculture. The work has of necessity been chiefly of a pioneer nature, as it had to begin with the clearing and draining of the land.

The lines which will hereafter engage the attention of the stations may be classed under the following heads: (1) Soil investigations, (2) the development of varieties of small grain adapted to Alaskan conditions, (3) cultural experiments with vegetables, (4) the introduction of hardy fruits, (5) animal production, and (6) dairying.

In a general way the work differs from that of the stations elsewhere in the United States, in that it is essentially an attempt to develop agriculture in a region where it has no existence.

GENERAL RESULTS OF WORK.

As the investigations have covered a period of only two years, great results could not be expected, but the evidence already obtained regarding the agricultural possibilities of Alaska is in itself of much importance. Previous to 1898 but few would admit that agricultural operations were possible there. It was popularly believed that the fisheries, the fur trade, and mining were the only industries which could be carried on in the Territory. The demonstration that small grain and flax can be successfully grown there, together with most of the vegetables which are in common cultivation in the Northern States and Canada, will have an important bearing on the development of the Territory, and especially its mining interests. Alaska will probably never become an exporter of agricultural products, but it is believed that the people

whose interests demand that they shall live there can largely produce the food stuffs they require, and this is in itself of sufficient importance to justify the maintenance of agricultural experiment stations in that region.

ARIZONA.

Agricultural Experiment Station of the University of Arizona, *Tucson.*

Department of the University of Arizona.

GOVERNING BOARD.

Board of Regents: William Herring (*Chancellor*), *Tucson;* H. W. Fenner (*Secretary*) *Tucson;* H. B. Tenney (*Treasurer*), *Tucson;* Charles R. Drake, *Tucson;* Governor N. O. Murphy (*ex officio*), *Phenix;* R. L. Long (*Territorial Superintendent of Public Instruction*), *Phenix.*

STATION STAFF.

M. M. Parker, M. A., *President of the University.*

R. H. Forbes, M. S., *Director; Chemist.*

J. W. Toumey, M. S., *Botanist.*

A. J. McClatchie, M. A. (*Phenix*), *Agriculturist and Horticulturist.*

G. H. True, B. S., *Expert in Animal Husbandry.*

A. A. Tyler, Ph. D., *Associate Botanist.*

Wm. W. Skinner, M. S., *Assistant Chemist.*

Angus McBride, *Stenographer and Bookkeeper.*

S. P. Greenleaf, *Foreman.*

HISTORY.

The Arizona Station is located in the valley of the Santa Cruz River, at the foot of the lofty Santa Catalina Mountains, on a plateau about 2,500 feet above sea level. The town of Tucson is one of the oldest in the United States, having been founded by the Spaniards in the first half of the sixteenth century. There are evidences that prior to the advent of Europeans the Aztecs occupied this valley and irrigated a much larger area than is now used for agricultural purposes. The Territory is composed of plateaus ranging from 7,500 feet in the north to a few feet above sea level in the south. These plateaus are crossed by mountain ranges whose peaks often attain a height exceeding 10,000 feet. The rainfall is very scanty and the summer temperature of the valleys is high. The soil, largely of volcanic origin, is arid but very fertile when water is applied in sufficient quantities. Irrigation alone makes agriculture possible, except in a few localities. The largest irrigated region is in the valleys of the Gila and Salt rivers. The Territory has a considerable Indian and Mexican population. Mining is the principal industry. Considerable numbers of cattle, sheep, and other live stock are raised on the ranges. Wheat, barley, and alfalfa are the principal field crops in the irrigated regions. Oranges and other citrus fruits are successfully grown, and many other kinds of semi-tropical fruits, including olives, pomegranates, and date palms are being introduced. Arizona belonged to Mexico until 1848, and did not

become a separate Territory until 1863. The University of Arizona was opened to students in 1891, and the station began work about the same time. Its task is to aid in the development of agriculture in an arid region, where modern methods of agriculture are of very recent introduction.

The Agricultural Experiment Station of the University of Arizona was organized as a department of the university October 9, 1890, with Prof. F. A. Gulley as director. Upon his resignation in 1894, Prof. T. B. Comstock, the president of the university, performed the duties of the office until the appointment of Prof. William Stowe Devol in June, 1895. Upon the resignation of that officer in November, 1897, the botanist, Prof. J. W. Toumey, became acting director and served until July 1, 1898. At that time Prof. C. S. Parsons was appointed director and irrigation engineer, and served until May, 1899, when he was succeeded by the present incumbent.

At the organization of the station in 1890 three substations were also established, one at Phenix and one at Tempe, in the Salt River Valley, and the third at Mesa, in the lower Gila Valley. The stations at Tempe and Mesa were discontinued in 1895. In 1892 the station undertook experiments at Willcox, in the Sulphur Spring Valley, in cooperation with citizens of that place. This work was continued, however, but two years. On account of the unfavorable conditions for field work in agriculture and horticulture at the university this part of the station's work has been gradually transferred to Phenix, where most of it is now carried on.

ORGANIZATION.

The governing board of the station consists of the governor of the Territory and the superintendent of public instruction ex officio, and four members appointed by the governor for an indefinite term. The governor also has the power of removal of members. Board meetings are held twice a month, and the traveling expenses of members are paid. The staff consists of the president of the university, director (who is also chemist), botanist, agriculturist and horticulturist, expert in animal husbandry, associate botanist, assistant chemist, stenographer and bookkeeper, and foreman. Members of the staff are generally appointed on the recommendation of the director by the board of regents for a term of office which may be terminated by either party on one month's notice.

EQUIPMENT.

The office and chemical and botanical laboratories are in the main university building (Pl. X, fig. 1) at Tucson, where the station also owns two greenhouses (Pl. X, fig. 2). On the farm at Phenix are an

office and farmhouse (Pl. XI, fig. 1), barn, implement shed, and laborer's dwelling. The farm at Phenix has an area of 25 acres, devoted in about equal amounts to orchards and to miscellaneous field experiments with grain, vegetables, and forage crops. The station has also secured a tract of land near Phenix, where experiments in growing date palms will be carried on in cooperation with the United States Department of Agriculture. The station has collections of seed and agricultural products which serve to illustrate in some measure the agricultural resources of the Territory. The station library contains about 200 volumes, exclusive of files of experiment station publications. Station officers also have access to the university library.

FINANCIAL SUPPORT.

The main source of revenue is the national fund, supplemented by small amounts received for farm products and laboratory fees for chemical work. The income of the station during the last fiscal year was as follows:

United States appropriation	$15,000.00
Fees for analyses	71.67
Farm products	121.10
Balance on hand July 1, 1898	311.93
Total	15,504.70

LINES OF WORK.

No inspection work is undertaken by the station officially, but numerous samples of water and fertilizers and other substances which are of interest to the general public are examined from time to time.

Agriculture being of very recent introduction in Arizona, the problem set before this station is to assist in determining the natural resources and conditions of the Territory, the adaptation of different kinds of plants to soil and climate, and the methods of cultivation best suited to local conditions. As Arizona is located in the great arid region, irrigation is a problem of first and fundamental importance. Thus far a general survey has been made of the conditions in several important valleys of the Territory with reference to the economic development of irrigation. The chemist has made analyses of numerous samples of water, and for several years a soil survey of the Territory has been in progress.

The special crops which are receiving most attention are alfalfa, wheat (Pl. XI, fig. 2), barley, and the subtropical fruits which thrive in the southern part of the Territory. It has been found that the date palm (Pl. XII, fig. 1) succeeds in southwestern Arizona, and to the culture of this tree the station is paying much attention. A considerable amount of historical data bearing on the history of the plant in

FIG. 1.—ARIZONA STATION—MAIN BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—ARIZONA STATION—GREENHOUSES.

FIG. 1.—ARIZONA STATION—OFFICE AND FARMHOUSE, PHENIX.

FIG. 2.—ARIZONA STATION—IRRIGATION OF WHEAT.

FIG. 1.—ARIZONA STATION—DATE PALMS, PHENIX.

FIG. 2.—ARIZONA STATION—CANAIGRE FIELD.

America has been collected, notes have been made on the seedlings of local origin, and experiments carried on in growing imported palms. Recently the United States Department of Agriculture has cooperated with the station in the introduction and culture of improved varieties. For several years investigations were made on canaigre (Pl. XII, fig. 2). Studies were made on the formation and distribution of tannin in the plant, and these investigations brought to light several interesting and important points in its development. The investigations were extended to include the value of canaigre bagasse as food, fuel, and fertilizer, and the relation of canaigre to the soil. Cooperative experiments with the sugar beet have been carried on throughout the Territory, and have resulted in demonstrating that, contrary to the popular opinion, beets of high sugar content can be grown in that arid climate. Some field experiments have been carried on with the Canada field pea. An economic study has been made of the mesquite, a native leguminous tree. The botanist has also made a study of the native opuntias, to determine the economic value of their fruits. The same officer has made a preliminary study of the root rot of alfalfa and sunburn of fruit trees, and more extended investigations on the crown gall of fruit trees, and a general survey has been made of the weeds and scale insects found in Arizona. Meteorological observations are in progress.

DISSEMINATION OF INFORMATION.

The station has issued 30 bulletins and 10 annual reports, two of which have, however, been included in the series of bulletins. The annual reports have been for the most part merely administrative documents, though recently notes on minor investigations have been added. But few press bulletins have as yet been issued, but numerous press notices have been sent out which have aided in keeping the station and its work before the public. Recently a series of popular publications called "Timely hints for farmers" has been begun. They are mailed biweekly to the farmers of the Territory, whose names are on the mailing list. The mailing list contains 3,250 names.

The station correspondence amounts to about 5,000 letters a year. Recently a beginning has been made in farmers' institute work, especially in the Salt River Valley, and it is the intention that this department of the station's activities shall be much developed in the near future.

GENERAL RESULTS OF WORK.

The Arizona Station has thus far been largely engaged in aiding in the determination of the adaptability of different kinds of fruits, especially olives and date palms, and sugar beets, to the climate and soil of the Territory. Its investigations on the composition and culture of canaigre and on the nature of the soils in different parts of the Territory have also been important.

ARKANSAS.

Arkansas Agricultural Experiment Station, *Fayetteville.*

Department of Arkansas Industrial University.

GOVERNING BOARD.

Board of Trustees—Agricultural Committee: T. A. Futrall (*President*), *Marianna;* T. M. Seawel, *Little Rock;* V. Y. Cook, *Elmo.*

STATION STAFF.

J. L. Buchanan, LL. D., *President of the University.*
R. L. Bennett, M. S., *Director.*
———— ————, M. S., *Chemist.*
R. R. Dinwiddie, M. D., *Pathologist and Bacteriologist.*
W. G. Vincenheller, *Pomologist and Institute Worker.*
Ernest Walker, B. S. Agr., *Horticulturist and Entomologist.*
J. F. Moore, B. S., *Assistant Chemist.*
G. B. Irby, B. A., *Assistant in Feeding Experiments.*
C. L. Newman, B. S., *Agriculturist.*

HISTORY.

The Arkansas Station is located in the hill region which occupies the northwestern portion of the State. From this the land slopes down to the Mississippi River, along which there are large areas of level and highly fertile lowlands. The average annual rainfall for the State is nearly 60 inches and the temperature ranges from 98° F. to about zero. Cotton and maize are the principal crops in the State. Fruit growing is becoming a large industry in the hill region. The population of the State remained small until 1850. During the next ten years immigration from the Southern States brought in a large number of white and black people and made cotton growing with slave labor the leading industry. Since 1870 the population has increased nearly threefold and there has been considerable diversification of agriculture. The work of the station has in recent years been an important factor in producing this change. The Industrial University with which the station is connected is a well-equipped institution, with over 600 students.

The Arkansas Agricultural Experiment Station was established April 2, 1888, as a department of the Arkansas Industrial University, although the bill of the State legislature accepting the provisions of the act of Congress was not approved by the governor until March 7, 1889. Prof. A. E. Menke was the first director and served until 1891. He was succeeded by the present incumbent.

In 1889 a law was passed requiring the station to analyze fertilizers, but it was repealed in 1895. In 1899 the scope of the station's work was extended by the addition to the staff of a pomologist and institute worker, one of whose duties is to assist in farmers' institute work throughout the State.

In 1888 a substation was established at Newport in the northeastern part of the State, and in 1892 another at Camden in the southern part. The work at the substations consisted principally of variety and culture tests of field crops so conducted as to encourage diversification of crops by cotton farmers, the ascertainment of the best means for improving worn cotton soils and for maintaining them, and the improvement of existing methods and the introduction of new ones. At the Camden substation experimental work in truck gardening for northern markets received much attention. In 1897 the Camden substation was discontinued. At the present time there is in progress at the Newport substation an experiment to test the comparative value of cotton-seed meal and cotton seed as feeding stuffs for steers, and another experiment in which pigs have been pastured on chufas, Spanish peanuts, and soy beans to determine the effect of these foods on pork and lard, and their value in supplying a succession of food for hogs and in improving worn cotton soils. As soon as these experiments can be brought to a satisfactory conclusion this substation will also be discontinued.

ORGANIZATION.

The governing board is the board of trustees of the university, which is composed of the governor of the State, chairman ex officio, and six members, one from each Congressional district, appointed by the governor, with the consent of the senate, for a term of six years, the appointments being so arranged by law that the term of office of two members expires every two years. The board has entire management of the station in matters of salaries, appointment of officers, and important expenditures. Immediate oversight of the station is intrusted to a committee of the board, consisting of three members, known as the agricultural committee. The trustees are required by law to hold one annual meeting at the university and as many special meetings as may be necessary. Their compensation and expenses are provided for by State appropriations.

The staff is composed of the president of the university, the director (who is also expert in animal husbandry), pathologist and bacteriologist, pomologist and institute worker, horticulturist and entomologist, agriculturist, assistant in feeding experiments, and assistant chemist. The secretary and the treasurer of the college also act in these capacities for the station. Appointments are made by the trustees for a term of one year. The director has general supervision of station affairs. He is required to report annually through the president to the trustees on the condition of the station, experiments in progress and completed during the year, and proposed new work. Each head of division selects his own line of work, subject to the approval of the director and board of control.

EQUIPMENT.

The station occupies a main building, in which the laboratories are located, director's office, greenhouse, barn, implement house, and storage house. The main station building is a one-story brick structure, 40 by 80 feet, with towers at the four corners, and contains 10 rooms arranged on either side of an 8-foot hall. Attached to one corner of this building is a one-room brick structure, 18 by 20 feet. (The buildings and grounds are shown in Pl. XIII, fig. 1.)

The station makes use of 20 acres of the college farm for field experiments. The land is rolling and has a gravelly soil, which is terraced to prevent washing. A tract of about 14 acres is divided into plats of various sizes and used for field experiments. The rest of the land is occupied by nursery stock and seedling apples. An orchard belonging to the college is available for experimental purposes.

With the exception of 4 work horses the station has no permanent equipment of live stock. For experimental purposes animals are bought only as needed and disposed of at the close of the experiment. In all experiments, where practicable, specimens, photographs, and slides showing results of work are preserved for reference and illustration. Specimens of the important hay and pasture grasses of the State have been mounted and are on exhibition. All specimens collected from experiments are intended to show visitors the nature and results of experiments and are used for reference in station work. The station maintains a separate library of about 750 volumes. The university library is also available to station workers.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund. For the last fiscal year it was as follows:

United States appropriation	$15,000.00

LINES OF WORK.

The station has no inspection duties. In laying out lines of work it has always been the purpose of the station to select those of immediate practical importance. Eighty per cent of the farmers of Arkansas are engaged in cotton growing, but the low price of cotton makes the reduction of acreage and the growing of some other money crop a necessity. For many reasons pork and beef furnish the most available substitutes. Accordingly, experiments have been in progress for some years to determine the cheapest and best methods of pork and beef production and at the same time to ascertain how best to improve soils exhausted by cotton growing. This statement is the key to the largest part of the station's work.

With forage plants tests have been made of varieties of grasses and cultivated and wild legumes for hay and for pasturing, and fertilizer

FIG. 1.—ARKANSAS STATION—BUILDINGS AND GROUNDS.

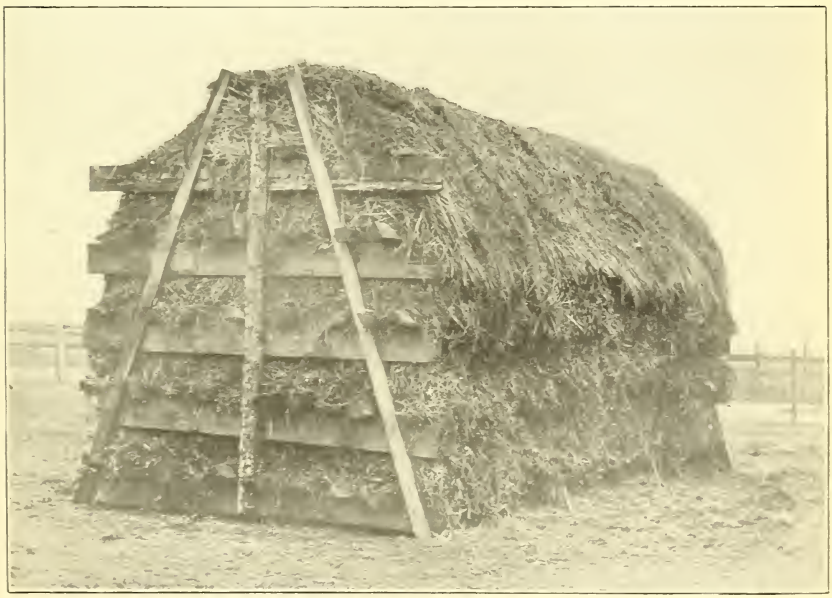


FIG. 2.—ARKANSAS STATION—STACK FRAME FOR CURING HAY.

FIG. 1.—ARKANSAS STATION—FERTILIZER EXPERIMENTS WITH WHEAT.

FIG. 2.—ARKANSAS STATION—SPRAYED APPLES.

experiments have been carried on with these crops. (Pl. XIII, fig. 2, shows a peculiar method of curing hay that is used locally.) The cowpea has received especial attention. It has been studied with reference to its value for green manuring and for hay, and tests have been made of the value of the hay for fattening different kinds of live stock. Studies have been made of the adaptability to the State of different crops which will enable farmers to grow more live stock. A study has been made of the profit of raising beef on cotton seed and cotton-seed products, and of the cheapest and best methods of producing pork. A study has also been made of the effect of the various forage crops experimented with on worn cotton soils. Tests have been made of various rotations of crops to determine those best suited for improving such soils without the use of commercial fertilizers. Comparative tests have been made of the productiveness of maize from different latitudes in the United States. Observations have also been made on the effect of variations in soil and climate on different varieties of maize. Experiments have been carried on in the manuring of wheat on worn cotton soils and on sandy soils. (Pl. XIV, fig. 1.)

Experiments in stock feeding and crop production have resulted in the determination of methods which enable the farmer in the cotton-growing region of the State to produce pork for market in competition with the farmer of the maize-growing sections of the Western and Northern States. They have thrown light on the relative feeding value of cotton seed and cotton hulls in fattening steers, and the value of cowpeas and other legumes for feeding and for increasing the yield of cotton and maize on worn cotton soils. They have indicated an increased yield and profit from manuring cotton with legumes over manuring with commercial fertilizers; they have illustrated the advantages of careful selection of varieties and seed of cotton and maize; they have demonstrated the superiority of Southern-grown maize over the Northern product for seed, and of Northern-grown potatoes over second-crop Southern-grown potatoes for planting in Arkansas; and they have shown the adaptability to local conditions of various crops, such as orchard grass, cowpeas, soy beans, and velvet beans, not previously grown in the State.

Arkansas is well adapted for fruit growing, and this industry the station is endeavoring to develop, especially along lines of apple and strawberry culture. The State has produced many fine seedling apples, and new ones are being brought into notice each year. The horticulturist has made a study of these seedlings with a view to establishing their nomenclature and bringing their merits before the public. The common questions of culture, varieties, and diseases have also received attention. (Some of the results obtained in spraying apples are shown in Pl. XIV, fig. 2.)

The pathologist and bacteriologist has for some time been engaged in the study of bovine tuberculosis and its relation to the same disease in man. Several of the more prevalent parasitic and contagious diseases of animals of the State have been identified, and researches made on the causation of "liver rot" and Texas fever of cattle.

For several years the chemist has been carrying on important investigations on the proteids and carbohydrates of the wheat grain and on the milling qualities of wheat.

DISSEMINATION OF INFORMATION.

Up to January 1, 1900, the station had issued 59 bulletins and 11 annual reports. The latter are now administrative documents, to which are appended reprints of the bulletins issued during the year. Only 250 copies of this report are issued.

The mailing list contains 7,000 names. Addresses are written on cards and classified alphabetically by counties and post-offices in each county. All names on the mailing list are there by personal or written request of persons who are to receive the station publications. No name is entered at the request of others until a blank card is filled out and returned to the station after the person has received a bulletin as a specimen copy. The list is revised at intervals of about four years.

The station sends out 1,500 letters a year in reply to inquiries for information. Until very recently the station has not been engaged in any farmers' institute work, but since the appointment of a pomologist and institute worker this line of work has been rapidly developed and in the future will be made quite prominent. Arrangements have recently been made for holding institutes throughout the State under the auspices of the station, the purposes of which are to arouse greater interest in scientific agriculture, and to induce more farmers to make use of the results of the station's work.

GENERAL RESULTS OF WORK.

The experiments which the Arkansas Station has conducted with reference to the economical production of pork and beef in connection with the growing of cotton, and as an aid to the improvement of worn soils, have already done much to help the farmers of the State. Closely connected with these experiments has been the work in determining the best varieties of grasses and forage plants for hay and pasture at different seasons of the year and on different soils. The station has also aided materially in the development of the growing of vegetables and small fruits which can be matured earlier in Arkansas than in the States farther north. This trucking industry has rapidly increased in importance in recent years.

CALIFORNIA.

Agricultural Experiment Station of the University of California, *Berkeley.*

Department of the University of California.

GOVERNING BOARD.

The Regents of the University: Gov. H. T. Gage (*President*), *Sacramento;* Louis Sloss (*Treasurer*), *310 Sansome street, San Francisco;* Jacob H. Neff, *Auburn;* Alden Anderson, *Suisun;* T. J. Kirk, *Sacramento;* Adolph Spreckels, *327 Market street, San Francisco;* Andrew S. Hallidie, *330 Market street, San Francisco;* Jas. A. Waymire, *Alameda;* Charles W. Slack, *309 Montgomery street, San Francisco;* Chester Rowell, *Fresno;* W. H. L. Barnes, *San Francisco;* John E. Budd, *Stockton;* Stephen M. White, *Los Angeles;* J. B. Reinstein, *217 Sansome street, San Francisco;* H. S. Foote, *San Francisco;* I. W. Hellman, *Nevada Bank, San Francisco;* W. T. Wallace, *799 Van Ness avenue, San Francisco;* Mrs. Phœbe Hearst, *San Francisco;* J. F. Houghton, *Safe Deposit Building, San Francisco;* Arthur Rodgers, *309 Montgomery street, San Francisco;* Albert Miller, *corner Annie and Stevenson streets, San Francisco;* Geo. C. Pardee, *Oakland;* E. A. Denicke, *San Francisco.*

STATION STAFF.

Benjamin Ide Wheeler, PH. D., LL. D., *President of the University.*

E. W. Hilgard, PH. D., LL. D., *Director; Geologist and Chemist.*

E. J. Wickson, M. A., *Horticulturist.*

R. H. Loughridge, PH. D., *Agricultural Geologist and Agricultural Chemist.*

M. E. Jaffa, PH. B., M. S., *1st Assistant Chemist in Agricultural Laboratory.*

C. W. Woodworth, M. S., *Entomologist.*

W. A. Setchell, PH. D., *Botanist.*

J. Burtt Davy, *Assistant Botanist.*

A. P. Hayne, PH. B., *Assistant in Charge of Viticulture and Olive Culture.*

Geo. E. Colby, PH. B., M. S., *Assistant Chemist, Viticultural Laboratory.*

F. T. Bioletti, B. S., M. S., *Instructor in Wine Making and Bacteriology.*

A. M. dal Piaz, *Assistant in Viticulture.*

C. H. Shinn, B. A., *Inspector of Stations.*

Emil Kellner, *Foreman of Grounds.*

A. V. Stubenrauch, B. S., *Clerk to Director.*

F. J. Snow, *Student Assistant.*

OUTLYING STATIONS.

Southern Coast Range Station, F. D. Frost, *Patron, Paso Robles;* J. H. Barber, *Foreman, Paso Robles.*

San Joaquin Valley Station, John Tuohy, *Patron, Tulare;* Julius Forrer, *Foreman, Tulare.*

Sierra Foothill Station, R. C. Rust, *Patron, Jackson;* J. W. Neal, *Acting Foreman, Jackson.*

Southern California Station, Rev. C. F. Loop, *Patron, Chino;* James W. Mills, *Foreman, Pomona.*

East Side Santa Clara Valley Viticultural Station, John Gallegos, *Patron, Mission San José.*

Station for Resistant Vine Tests, St. Helena, J. K. Moffett, *Patron, San Francisco.*

Chico Forestry Station, V. C. Richards, *Patron, Chico;* H. B. Allen, *in Charge.*

Santa Monica Forestry Station, Roy Jones, *Patron, Box 4, Los Angeles;* Charles A. Colmore, B. S., *Foreman, Santa Monica.*

HISTORY.

The headquarters of the California Station are located at Berkeley, a suburb of San Francisco, on the grounds of the University of California.

The State is traversed from north to south by the Sierra Nevada and the Coast ranges, between which is a valley about 400 miles long and from 40 to 100 miles in width. There are also other large valleys among the mountains. The soils are for the most part very fertile. The climate varies with the elevation and proximity to the Pacific Ocean. The annual rainfall ranges from nearly 60 inches on the slope of the Sierra Nevada Mountains to less than 5 inches in some of the southeastern valleys. The forests are very extensive and include over 100 species of trees. The principal crops are wheat, barley, maize, and oats. Large numbers of sheep, cattle, milch cows, and horses are produced. Gold mining has been and is a very large industry. Manufactures have been greatly developed in recent years. Agriculture has been practiced in the State by white men for over one hundred years, but has been vastly extended since the discovery of gold in 1848. The State was admitted to the Union in 1850. The university, of which the station is a department, is the leading institution for higher education on the Pacific Coast and has well equipped laboratories in many departments of science. Its faculty numbers 296 professors and instructors and the number of students is 2,547.

In considering the work of this station it is important to remember the great area of California, the wide diversity of soils, climates, and products found within its borders, and the fact that its agriculture and horticulture have been very greatly expanded for the most part on virgin soils and very largely with the aid of irrigation during the past forty years. The reclamation of great tracts of arid land, the development of horticulture on a large scale and with many different kinds of fruits, such as are grown in temperate and semitropical climates, and the successful establishment of the manufacture of wine, olive oil, and beet sugar are among the notable achievements of this period, and in these the experiment station has had an important part.

The experiment station of the University of California was established by action of the board of regents in 1873. In 1874 Prof. E. W. Hilgard was appointed director and work was begun at once by planting an experiment orchard, vineyard, and a large collection of exotic trees and shrubs and by erecting propagating houses and stables. In 1875 the first plat experiments were made to determine the effects of deep culture and of different fertilizers on various plants, and a laboratory for station work was equipped by the regents from the funds of the university. In 1877 the first legislative appropriation was made specifically for experiment station work, and was subsequently followed year after year by liberal appropriations for experiments in agriculture, viticulture, and wine making. Frequent additions were made to the facilities for investigation in laboratory, library, field, and garden. Soil analyses were made and soil collections arranged as component parts of an agricultural survey of the State, which has been

held steadily in view from the beginning of the station's work. An experimental wine cellar was constructed, and experiments in the management of different kinds of grapes in wine making was accompanied by must analyses and fermentation experiments in large numbers. The introduction and acclimatization of plants was undertaken on an extensive scale. To this end large numbers of cuttings, seeds, and plants were distributed to volunteer cooperators for trial in different parts of the State. The staff of station workers was increased and reports and bulletins were published at frequent intervals.

The work of the station, already proceeding actively, was simply extended and reenforced by the reorganization in 1888 under the act of Congress of March 2, 1887. Owing to the great diversity of soils and climates in California and the unfamiliar conditions in arid regions generally, outlying stations were established, where culture experiments with numerous kinds of plants could be carried on simultaneously. The land and buildings for these substations were donated. The addition of the national fund to the station income rendered possible improved laboratory and field facilities, additions to the station staff, and a widening of the field of investigation. A new station building was erected in 1889, and upon its destruction by fire in 1897 it was replaced by a much larger one. A range of iron and glass greenhouses was built in 1895.

ORGANIZATION.

The governing board is the board of trustees of the university which consists of the governor of the State (who is president of the board), the lieutenant-governor, the speaker of the assembly, and the State superintendent of public instruction, as ex officio members, and 16 members appointed by the governor, with the approval of the senate, for terms of sixteen years. Meetings are usually held monthly or more frequently. Members of the board receive no compensation.

The staff consists of the president of the university, the director (who is also geologist and chemist), horticulturist, agricultural geologist and agricultural chemist, first assistant chemist in the agricultural laboratory, entomologist, botanist, assistant botanist, assistant in charge of viticulture and olive culture, assistant chemist in the viticultural laboratory, instructor in wine making and bacteriology, assistant in viticulture, inspector of stations, foreman of grounds, clerk to director, student assistant, and six foremen of substations. Members of the station staff are appointed by the board of regents upon the nomination of the director of the station. Tenure of office has no stated limitations, except in those cases in which specialists are appointed for definite periods. The director has the general management and initiative in all lines of work, policy, and expenditure.

Three substations were established during the fiscal year 1888–89. They were the Sierra Foothill substation, near Jackson, Amador

County, elevation 1,975 feet, area of experimental tract 35 acres; the Southern Coast Range substation, near Paso Robles, San Luis Obispo County, in the Upper Salinas Valley, area of tract 20 acres, and the San Joaquin Valley substation, near Tulare City, Tulare County, area of tract 20 acres. A fourth outlying station was established during the fiscal year 1890–91, under the title of the Southern California substation, near Pomona, Los Angeles County, occupying two tracts of land, one of 30 acres, where the buildings were located, and the other of 10 acres of moist land 2 miles distant. In 1893 the State legislature transferred two forestry stations, which were previously under the control of a State board of forestry, one near Chico, Butte County, the other near Santa Monica, Los Angeles County, to the university and they became forestry substations. As early as 1886 three viticultural test stations were established under private auspices. These were the West Side Santa Clara Valley station, the East Side Santa Clara Valley station, and the Fresno Valley station. In 1897 a viticultural test station was established, also under private auspices, near St. Helena. Work at the first three of these viticultural test stations has now been practically concluded.

The local salaried officer of each substation is a foreman. There is a local unsalaried trustee called a patron. Connection with the central station is maintained by a traveling inspector. All appointments are made by the board of regents on recommendation of the director.

Lines of work at the substations have varied according to local needs. Orchards, vineyards, and collections of grasses, clovers, cereals, and other economic plants have been planted at each. Practically all the land is now in use. Soils, climate, and local conditions have been studied over large contiguous districts. The San Joaquin Valley substation has devoted itself chiefly to the alkali problem. Both there and at the Southern Coast Range substation the Australian saltbush has been cultivated on an extensive scale. The Sierra Foothill and the Southern California substations especially have large collections of varieties of fruits. Persian sheep are being bred at all of these substations. Large collections of valuable trees and shrubs have been made, especially at the forestry substations. (Pl. XV, fig. 1, shows the experimental fields of the Foothill substation, and fig. 2 of the same plate shows the buildings of the Southern Coast Range substation. Date palms grown at the San Joaquin substation are shown in Pl. XVI, fig. 1, and an almond orchard at the Southern California substation in fig. 2. A view of the sequoia grove at the Forestry substation is presented in Pl. XVII, fig. 1).

The four larger substations are maintained at a total expense of about $8,000 per annum. The forestry substations cost at present $1,230 per annum, derived from the general university fund. The most of the laboratory work for the substations and the compiling of results is done at the central station.

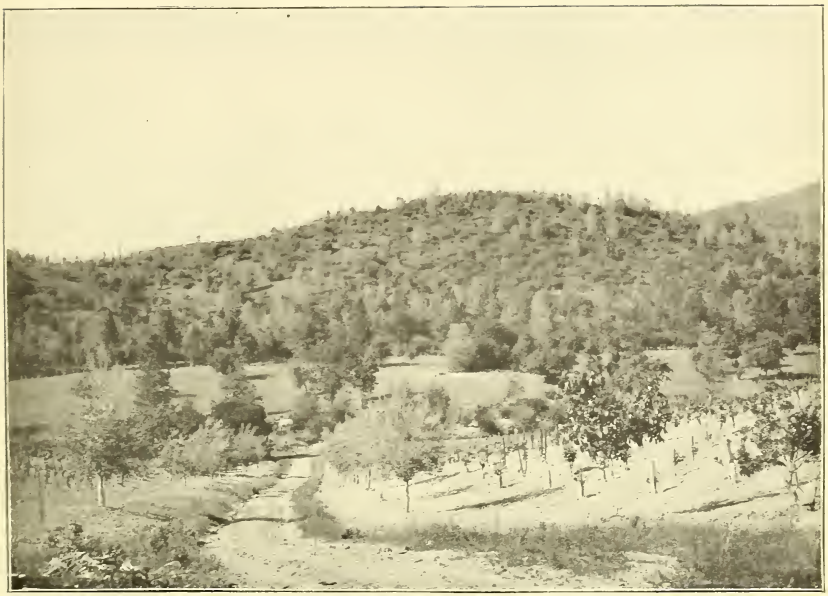


FIG. 1.—CALIFORNIA STATION—EXPERIMENTAL FIELDS. FOOTHILL SUBSTATION, JACKSON.

FIG. 2.—CALIFORNIA STATION—BUILDINGS, SOUTHERN COAST RANGE SUBSTATION, PASO ROBLES.

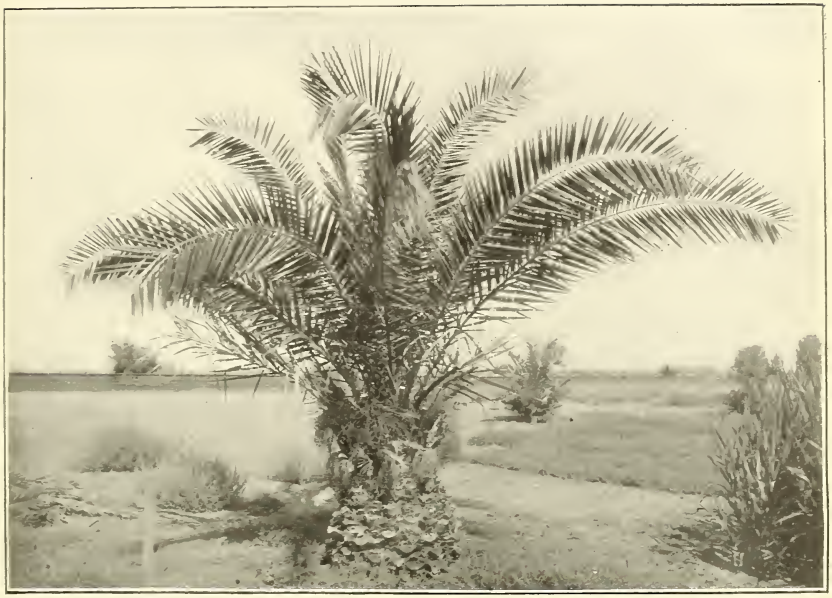


FIG. 1.—CALIFORNIA STATION—DATE PALMS AT SAN JOAQUIN SUBSTATION, TULARE.

FIG. 2.—CALIFORNIA STATION—ALMOND ORCHARD, SOUTHERN CALIFORNIA SUBSTATION, POMONA.

FIG. 1.—CALIFORNIA STATION—SEQUOIA GROVE, FORESTRY SUBSTATION, CHICO.

FIG. 2.—CALIFORNIA STATION—MAIN BUILDING, USED BY COLLEGE AND STATION.

FIG. 1.—CALIFORNIA STATION—SOIL LABORATORY, BERKELEY.

FIG. 2.—CALIFORNIA STATION—BOTANIC GARDENS, BERKELEY.

EQUIPMENT.

The buildings occupied by the central station at Berkeley are a main station building, a range of plant houses, an olive laboratory, a set of propagating and tool houses, a seed house, and a stable for work animals. The main building (Pl. XVII, fig. 2) is a frame structure of three stories, resting upon a brick structure of two stories, the size of the building being about 50 by 150 feet. In it are the offices and laboratories of the station. (The soil laboratory is shown in Pl. XVIII, fig. 1.) Its cost was about $20,000. The plant houses consist of a range of five iron and glass houses with a total length of 170 feet, and greatest width of 87 feet, costing, with heating apparatus, equipment, and necessary improvement of surroundings, $18,000. The other buildings are of frame construction. The total cost of all buildings was about $45,000.

The buildings of the outlying stations are as follows: At the Sierra Foothill substation, foreman's cottage, stable, workshops, etc., costing in all about $5,000; at the Southern Coast Range substation similar buildings, with windmill, tank, and tank house, all costing about $6,000; at the Southern California substation, buildings costing nearly $8,000; at the Santa Monica Forestry substation, buildings worth about $3,000, and at the Chico Forestry substation, buildings costing less than $600. In most of these cases the cost of the main buildings was defrayed by the communities in which the substations are located. If the water systems, pumps, etc., be included, the permanent improvements at the six substations represent a total investment of about $40,000.

At the central station at Berkeley there are about 25 acres—10 acres of field plats, 5 acres of orchards, 5 acres of gardens and propagating grounds, and 5 acres of arboretum—aside from the general university park and forest plantings. The station land is the college farm. At the six outlying stations the lands owned by the university amount in all to 180 acres, besides which it has the use of certain wood and pasture lands. The tracts at the substations range in area from 20 to 40 acres.

At the central station there are no animals except for work. At the outlying stations, besides the work animals, there are four small flocks of Persian sheep of the Bayazit breed, raised from stock imported by the United States Department of Agriculture. There is also some thoroughbred poultry.

The collections of the college of agriculture and the experiment station are almost inseparable, both being under the control of the agricultural department of the University of California. Those contained within the college and station building comprise chiefly the following: 2,000 samples of soils and subsoils, representing the typical agricultural lands of the State; many specimens of minerals directly concerned in agriculture; 400 boxes, containing 10,000 entomological

specimens representing mostly California insects; 800 specimens of economic fungi; about 1,000 samples of wines made at the station from California-grown grapes; 300 specimens of grape seeds, representing the different varieties of grapes grown in the State; 225 pressed specimens of vine branches; 200 specimens of vine leaves; 180 samples of preserved olives grown in California; 800 specimens of olive pits, and 112 samples of olive oil made at the station from California-grown olives. There is a collection of about 500 photographs, charts, diagrams, and lantern slides illustrative of California agricultural practices, as well as typical botanical and entomological subjects. There is also maintained on the station grounds a garden of economic plants, in which are represented most of the plants of importance to California, as well as those that give promise of future value. The station workers have at their command the large and valuable collections of the various scientific departments of the university, which cover all branches of natural science. The division of botany maintains a botanical garden (Pl. XVIII, fig. 2) of about 5 acres on the university grounds, to which the station staff has free access. The city of San Francisco being within easy reach, the collections of its many private and public institutions are available, the most important of which is that of the California Academy of Sciences.

As in the case of the collections of specimens, the connection with the State university places at the command of the station workers the excellent general library of the university, consisting of nearly 80,000 volumes. For this reason the books actually owned by the station are limited mostly to the current publications of the experiment stations of the world obtained by exchange. Only those especially needed in the work of the station are purchased with its funds. The bound volumes obtained by exchange and purchase number about 800. There are also about 8,000 unbound station bulletins and pamphlets. These are kept in the station building separate from the main university library, but are regarded as "The agricultural library of the University of California." In addition, the libraries in the cities of Oakland and San Francisco are easily accessible. These contain, in the aggregate, 180,000 volumes. Many of the private libraries of the members of the station staff and the university faculties are extensive and are available for special needs, as is also the State library at Sacramento, of 160,000 volumes, with which institution the university library maintains a system of exchange loans.

All the divisions of the station are well equipped with apparatus, the cost of which was about $9,600. Special mention should be made of an elutriator for the chemical analysis of soils, designed by the director, Professor Hilgard, the main feature of which is a churn arrangement for breaking up any flocculation of fine particles. The advantages of the instrument, aside from the churn arrangement, are

a saving of time and labor, as the operator can carry on other work in the laboratory while watching the movements in the automatic instrument. An orienting microscope for the superficial study of minute anatomy was designed by Professor Woodworth, entomologist of the station. This permits the examination of an object from all directions without change of focus. There has been devised by the viticultural staff of the station an apparatus for the cooling of fermenting wine, which takes the place of ice or large quantities of cold water, chemicals, etc. The apparatus consists of a double row of thin, well-tinned, flattened copper tubes, through which the wine is pumped. Over these tubes, filled with hot fermenting wine, a small exhaust fan or "blower" carries about 200 gallons of water per hour in a very fine spray. The current of air so cools the fine spray that the temperature of the fermenting mass may be controlled. The apparatus may be made of any capacity.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, from the general funds of the university, and from the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
University fund	14,114.00
Farm products	137.43
Total	29,251.43

LINES OF WORK.

The station has no inspection duties. The most extended investigations made at the station have been in connection with the subject of alkali soils, their origin, nature, and methods of reclamation. This work has been carried on for twenty years, and has included field explorations with borings, followed by chemical analyses, to determine the nature, distribution, and movements of the salts; culture experiments in connection with such analyses to ascertain the tolerance of native and cultivated plants for different salts and saline mixtures; observations on the native flora to determine to what extent it may serve as an indicator of the kind and quantity of alkali in soils, and verification of conclusions reached by actual reclamation of barren alkali lands.

It has been shown that alkali salts in injurious amounts are restricted to the upper 4 or 5 feet of the soil mass, except in the case of the axes of valleys. This explains the relative freedom of ground water from alkali. It also permits of a quantitative estimate of the amount of salts per acre, and therefore of a determination of the limits of plant tolerance for alkali, and of the possibilities of reclaiming alkali

land. The limit of tolerance of a number of important native and cultivated plants for alkali salts has been determined.

The station has demonstrated that carbonate of soda is formed from other sodium salts by the action of free carbon dioxid on earth carbonates. This discovery suggested that lands "swamped" by overirrigation may be reclaimed by the reversal of that process. This suggestion led to the demonstration of the fact that it is practicable to neutralize carbonate of soda (black alkali) with ground gypsum. This demonstration was followed by the discovery and development of mines of that mineral within the State adjacent to the principal alkali regions. An investigation of the agency of carbonate of soda in forming hardpan resulted in demonstrating that the depressions known as "alkali spots" are caused by the collapse of tilth and puddling of the soil mass. This investigation also explained how the "rise of the alkali" resulting from irrigation causes the death of fruit trees and grape vines.

Extended observations have been made on the moisture content of soils supporting vegetation under extreme arid conditions. Determinations were made of the rate and height of ascent of water by capillarity in numerous soils and in the several parts of each as separated by mechanical analysis. Thus the effect of each of these parts on the capillarity of the whole mass was demonstrated and mechanical analysis of soils was shown to be of practical value.

The systematic investigation of soils in general, both chemical and mechanical, has been steadily pursued, resulting in the demonstration of the peculiarities of arid soils as compared with those in humid regions, especially of the United States. It has been shown that arid soils contain relatively small amounts of clay. Hence they are readily penetrable by air, moisture, and the roots of plants to great depths. This explains the observed fact that cultivated as well as native plants on such soils have very deep-growing root systems, and this in turn explains their remarkable endurance of prolonged drought. It follows that in arid climates the condition of the subsoil is of relatively more importance than that of the surface soil and that the practice of subsoiling is unnecessary.

Another important result of this work has been the demonstration of the fact that arid soils have almost universally a high content of the elements of fertility, notably lime, potash, and nitrates. It has also been demonstrated that almost all of them are calcareous as a result of aridity, and thus possess advantages elsewhere realized only on areas underlaid by calcareous rock or artificially limed or marled. Hence followed a recognition of one reason for the preference shown for arid countries by the ancient civilizations in both hemispheres.

It has been proven that the humus in arid soils, while usually small in amount, is from three to six times richer in nitrogen than is that in

the soils of humid regions; also that such nitrogen content rapidly decreases under exhaustive culture.

The soil survey of the State, which has been in progress since the organization of the station, has been extended to include other materials of interest to agriculture or industries intimately connected with it, such as clays, marls, limestones, gypsum, and other fertilizer deposits, and the waters of the State.

Investigations of the proximate and ash composition of fruits grown in the State, and of their products, have been very extensive and are still in progress. Among the most extended series of such analyses are those of oranges, apricots, prunes, nuts, olives, and of the musts and wines from a very large number of varieties of grapes. This work resulted in a demonstration of the exceptionally high sugar content of California orchard fruits, especially prunes and apricots. The influence of climate upon the different varieties of grapes grown in California was determined, showing increase of sugars and tannin and decrease of acid and color with rise of summer temperature. Extended determinations have been made of the nitrogen content of musts and wines, showing that, contrary to former suppositions, there is no relation between it and quality. It has also been shown that the keeping quality of wine is not dependent upon the quantity of nitrogenous compounds present, but upon their nature. Extended investigations on the composition of olives have shown that the oil content of one and the same variety may vary to the extent of nearly 100 per cent in different localities, while in other cases the variation is but slight, indicating the wide range of adaptation of some varieties and limited range of others.

This station first pointed out the fact that the sugar beet maintains in California a relatively high sugar percentage and purity coefficient, and that, contrary to European teachings, it can be successfully grown on land containing considerable alkali. The analyses made at the station seem also to establish the fact that the canaigre root produces a higher percentage of tannin in California than farther southeast.

The most notably successful of introduced plants has been the Australian saltbush (*Atriplex semibaccata*), which is now extensively grown throughout the State, not only on alkali lands, but also on light, arid uplands. Its success in the latter case led to the discovery of the fact that all upland soils in arid climates contain from 2,000 to 4,000 pounds of alkali per acre, without giving any visible indication of it. Other successful introductions are a number of dry-land grasses, such as *Bromus inermis*, *Agropyron japonicum*, *Bromus unioloides*, *Poa arachnifera*, etc. The station has also introduced and is testing in various parts of the State all obtainable varieties of fruits cultivated in other countries having a similar climate. These collections comprise at the present time about 1,000 varieties of pome fruits, 600

varieties of stone fruits, 100 varieties of nuts, and 150 varieties of semi-tropical fruits. The vineyards contain about 250 varieties of grapes, European and American.

The introduction and testing of useful trees have been carried on since the university was established. Distribution of cork oaks, English oaks, acacias, camphor trees, and other valuable trees have been made from time to time, and reports published. A system of seed exchange has been maintained with countries of similar climates. Many useful species of trees have been introduced into California from Chile, South Africa, Australia, Algeria, and other countries, noteworthy among which is the English oak.

Investigations of the composition and nutritive value of cattle foods have shown among other things that California soils produce alfalfa relatively rich in protein. Foods have been examined and rations compounded for the purpose of increasing the quantity and quality of milk. Similar examinations have included the compounding of rations for horses, poultry, swine, etc. Investigations on the nutrition of man have been carried on and a large number of human foods have been analyzed. The station cooperates quite extensively with farmers in special investigations made on the occurrence of injurious insects and plant diseases, and in trials of newly introduced plants. A large percentage of those cooperating report results and thus enable the station to determine the adaptation of any plant to the widely different local conditions in California soils and climate in a very short time. In cases of severe outbreaks of injurious insects or diseases members of the staff are detailed for personal investigation.

DISSEMINATION OF INFORMATION.

The station has issued 125 regular bulletins, a few special bulletins, and 14 annual or biennial reports. The reports contain a full account of all the work of the station during the period covered by each volume, and include reprints of the more important bulletins issued. The mailing list, which contains about 6,000 names, is kept as a card catalogue, from which printed slips are made and the envelopes addressed with a mailing machine.

In addition to numerous contributions to magazines and scientific journals, the following are the more important publications by station officers: By Prof. E. W. Hilgard: "Report of a Geological Reconnoissance of Louisiana," 1869; "Geology of Louisiana and Rock Salt Deposit of Petite Anse," 1870; "Report on the Geology and Agriculture of Mississippi," 1880; "Report on the Climatic and Agricultural Features of the Pacific Slope" (with R. C. Furnas and T. C. Jones); edited Volumes V and VI of United States Census Report for 1880 (Cotton Production, containing as personal work the reports on the States of Mississippi, Louisiana, California, and general discussion); "Soil Maps

of Portions of Washington" (folio), 1883; "Ueber den Einfluss des Klimas auf die Bildung und Zusammensetzung des Bodens" (republished in French), 1893. By E. J. Wickson, M. A., horticulturist: "California Fruits and How to Grow Them," third edition, 1899; "California Vegetables in Field and Garden," 1897. By R. H. Loughridge, Ph. D., agricultural geologist and agricultural chemist: "Report on the Geology of the Purchase Region of Kentucky," 1888; "Report on the Geology of Clinton County, Kentucky," 1889. By C. W. Woodworth, M. S., entomologist: "Laboratory Manual for the Course in Elementary and Economic Entomology at the University of California," 1893. By W. A. Setchell, Ph. D., botanist: "Phycotheca Boreali-Americana;" Fascicles I–XII and Fascicles A, 1895–1899 (with Frank S. Collins and Isaac Holden): "Laboratory Practice for Beginners in Botany," 1897. By F. T. Bioletti, M. S., instructor in wine making and bacteriologist: "Wines, Classification and Tasting" (translation from the Italian of G. Grazzi-Soncini), 1892. By A. M. dal Piaz, assistant in viticulture: "Untersuchung von Most und Wein," 1897; "Handbuch des praktischen Weinbaues," 1898; "Rebencultur im Hausgarten," 1899. By Charles H. Shinn, B. A., inspector of stations: "Pacific Rural Handbook," 1879; "California Mining Camps," 1884; "History of Cooperation on the Pacific Coast," 1888; "The Story of a Mine," 1897.

The station correspondence amounts to about 5,000 letters per year. Exhibits of station work in plant introduction and acclimatization are frequently made at leading fairs, and experts are furnished for milk testing in connection with the award of dairy premiums. Demonstrators and lecturers on improved practice and new methods, as well as speakers on general agricultural subjects, are usually present at State fairs, and the managers of these fairs cordially cooperate with the station in these matters. Members of the station staff attend agricultural meetings of all kinds, the number thus attended during 1898 being about one hundred.

GENERAL RESULTS OF WORK.

Some of the most important ways in which the California Station has benefited the agriculture and horticulture of the State have already been indicated in the foregoing account. The fact that it has been managed with a consistent and continuous policy during the entire period of its existence has enabled it to carry out certain lines of work with unusual thoroughness and success. Its studies of soils, particularly those containing alkali, have given results of very great practical value, not only in California, but also in many regions where similar conditions exist. The information published as the result of its researches in this direction has led to the reclamation of great tracts of land formerly considered worthless, has shown how the ruination of

land by improper irrigation may be prevented, and has given timely warning to many immigrants to avoid settling on lands until they had determined their actual availability for agricultural purposes. The tests of a great variety of plants made by this station, and the subsequent systematic and carefully conducted distribution of the varieties giving promise of successful introduction, has been of very great benefit, not only in effecting the profitable culture of varieties new to the State, but also in preventing much loss of time and money which would have been caused by the unsystematic trial of numerous varieties by farmers and horticulturists. The value of the station's investigations on the manufacture of wine and olive oil is also generally recognized as being very considerable.

COLORADO.

Agricultural Experiment Station, *Fort Collins.*

Department of the State Agricultural College of Colorado.

GOVERNING BOARD.

P. F. Sharp, (*President*), *Pueblo;* A. Lindsley Kellogg, *Rockyford;* P. A. Amiss, *Pruden;* Harlan Thomas, *Denver;* James L. Chatfield, *Gypsum;* B. F. Rockafellow, *Canon City;* Mrs. Eliza F. Routt, *Denver;* Jesse Harris, *Fort Collins;* Governor Charles S. Thomas, *Denver;* President B. O. Aylesworth, *Fort Collins.*

STATION STAFF.

B. O. Aylesworth, M. A., LL.D., *President of the College.*

L. G. Carpenter, M. S., *Director; Meteorologist and Irrigation Engineer.*
W. W. Cooke, B. S., M. A., *Agriculturist.*
C. S. Crandall, M. S., *Botanist and Horticulturist.*
W. P. Headden, M. A., Ph. D., *Chemist.*
C. P. Gillette, M. S., *Entomologist.*
A. M. Hawley, *Secretary.*
L. M. Taylor, *Stenographer.*
F. L. Watrous, *Assistant Agriculturist.*
Carl H. Potter, B. S., *Assistant Horticulturist.*
Louis A. Test, B. M. E., A. C., *Assistant Chemist.*
Fred Alford, B. S., *Assistant Chemist.*
Joseph Lownes, B. S., *Assistant Chemist.*
R. E. Trimble, B. S., *Assistant Meteorologist and Irrigation Engineer.*
E. D. Ball, B. S., *Assistant Entomologist.*

Harvey H. Griffin, B. S., *Superintendent Arkansas Valley Substation, Rockyford.*
J. E. Payne, M. S., *Superintendent Plains Substation, Cheyenne Wells.*

HISTORY.

The Colorado Station is located near the base of the Rocky Mountains at an elevation of about 5,000 feet, in a region in which irrigation has been successfully and extensively used as a necessary basis for agriculture. The eastern third of Colorado is a part of the Great Plains which rise gradually from the Missouri River to the Rocky Mountains, and are in a natural state a vast treeless and arid region with a fertile soil covered very largely with nutritious grasses. The rainfall varies with different seasons, but is always scanty. At Fort

Collins it averages 13.7 inches. The remainder of the State is covered with mountains, hundreds of whose peaks attain a height of over 10,000 feet. Among these are numerous streams and fertile valleys which are more and more utilized for agricultural and horticultural purposes. The development of irrigation and agriculture on anything like a large scale has taken place mainly during the past quarter of a century. At the present time agriculture is a very important industry in the State. The principal crops are wheat, oats, maize, barley, alfalfa, and potatoes. The growing of fruits and vegetables is becoming an important industry. Large numbers of sheep and cattle are produced. There are extensive forests on the mountain slopes. The college with which the station is connected has been developed mainly along technical and scientific lines.

Previous to the establishment of the Colorado Agricultural Experiment Station, the State Agricultural College had been opened in 1879, and had certain experimental duties laid upon it by the State law. The legislature had provided that all agricultural operations on the farm should be carried on experimentally with a view to the improvement of scientific agriculture in Colorado. While the intent of this provision was carried out as far as possible, and in fact considerable work was done, especially by the professors of agriculture and horticulture, nevertheless the limited revenue of the college did not admit of great development along experimental lines. As Colorado was then a new State, and the people were unaware of the possibilities of its agriculture, experimental work consisted very largely in ascertaining field, garden, and orchard varieties which would be hardy under local conditions. The results of these experiments were published in the annual reports of the State board of agriculture prior to 1888 and in two special pamphlets issued in 1884 and 1886, respectively.

When the national fund became available, in 1888, the Colorado Agricultural Experiment Station was organized as a department of the college, with divisions of agriculture, horticulture, veterinary science, chemistry, and irrigation engineering, and the president of the college, Prof. C. L. Ingersoll, became director. Subsequently the division of veterinary science was discontinued, and one in entomology was formed. A State law provided that substations should be organized in different parts of the State, one in the Arkansas Valley, one on the divide between the Arkansas and Platte rivers, one in the fruit districts in western Colorado, and one in the high mountain park known as the San Luis Valley. A later act of the legislature required that one should also be established on the Plains, at Cheyenne Wells. The substation in western Colorado was never organized. Those in the San Luis Valley and on the divide were in operation only a few years. The two still in existence are at Rockyford, in the Arkansas Valley, and Cheyenne Wells, on the Great Plains in eastern Colorado.

ORGANIZATION.

The governing board of the station is the State board of agriculture, which consists of eight members appointed by the governor and confirmed by the State senate, with the governor of the State and the president of the college ex officio. The term of office is eight years. Two members are appointed biennially. If vacancies occur before the term of office expires they are filled by the remaining members. There are a number of standing committees, but these committees do not have the authority of the board except by special authorization. The most important committee is the executive committee, consisting of five members elected by ballot for two years, which was formed especially to supervise the affairs of the experiment station. This committee meets monthly and audits the expenditures of both experiment station and college. The board holds two meetings annually, one in December and one in June. Other meetings may be called by the president of the board at the request of three members. Members are allowed $4 per diem and expenses.

The staff is composed of the president of the college, director (who is also meteorologist and irrigation engineer), agriculturist, botanist and horticulturist, chemist, entomologist, secretary, stenographer, assistant agriculturist, assistant horticulturist, three assistant chemists, assistant meteorologist and irrigation engineer, assistant entomologist, superintendent of the Arkansas Valley substation, and superintendent of the Plains substation. These officers are appointed by the State board of agriculture and, in general, hold office during good behavior and efficiency. During the most of the station's existence the president of the college has also served as director of the station, acting as chairman of the council and representing the station as its executive officer. Under the present organization the director is a working member of the staff. The heads of divisions are professors in the college and give only a part of their time to station work. The station council, consisting of the heads of divisions, has had heretofore the general supervision of station matters under the executive committee, such as deciding upon lines of work and preparation of bulletins. Hereafter greater responsibility will rest upon the director, and the council will act as an advisory body. Particular lines of investigation are usually selected by each member of the staff, after conference with the members of the council, and adopted by the executive committee.

The substations have heretofore been field stations, with a superintendent as the permanent officer in charge. Their principal line of work has been the testing of varieties to determine those adapted to their localities. In future the amount of field work at the stations will be reduced, and the superintendents will devote more time to investigations of questions not confined to the station grounds.

FIG. 1.—COLORADO STATION—AGRICULTURAL HALL, USED BY COLLEGE AND STATION.

FIG. 2.—COLORADO STATION—HORTICULTURAL AND BOTANICAL LABORATORY, USED BY COLLEGE AND STATION.

FIG. 1.—COLORADO STATION—CHEMICAL BUILDING, USED BY COLLEGE AND STATION.

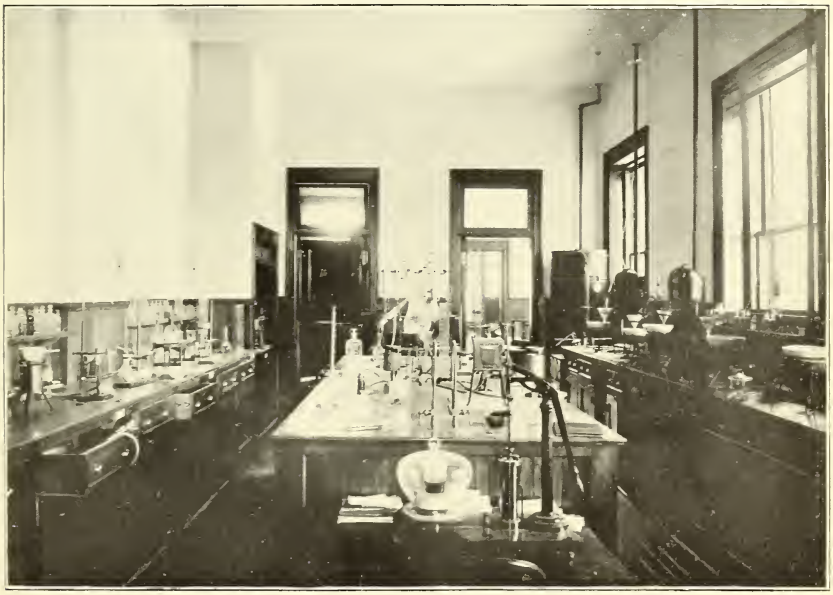


FIG. 2.—COLORADO STATION—CHEMICAL LABORATORY.

FIG. 1.—COLORADO STATION—IRRIGATION BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—COLORADO STATION—ENTOMOLOGICAL LABORATORY.

EQUIPMENT.

At the station at Fort Collins the college buildings which are used to a greater or less extent for the work of the station, comprise Agricultural Hall, the horticultural and botanical laboratory, chemical laboratory, irrigation building, a general storage barn, and a sheep barn.

Agricultural Hall (Pl. XIX, fig. 1), of red sandstone, has an office and agricultural museum on the upper floor, with seed room, dairy room, and laboratory on the first floor. A basement gives ample room for many other purposes.

The horticultural and botanical laboratory (Pl. XIX, fig. 2) was erected in 1894, at a cost of $15,000. It is built of red sandstone, 52 by 64 feet, two stories with attic. The offices of the professor and his assistant, class room, laboratory, and workrooms with greenhouses attached, are on the first floor. On the second floor are the horticultural and botanical museum, laboratory for physiological botany, apparatus room, and seed rooms.

The chemical building (Pl. XX, fig. 1) was built in 1897, at a cost of $27,000, and was first occupied in 1898. The second floor is devoted to class rooms and museums. On the first floor, besides the quantitative and qualitative laboratories for class use, are a private laboratory for the chemist, a laboratory (Pl. XX, fig. 2) for the assistants in the experiment station, with balance room and hoods, and offices for the assistants. The drying and the coarser preparation of samples are done in the basement. The irrigation building (Pl. XXI, fig. 1) contains the offices of the director, irrigation engineer, and meteorologist. The entomological laboratory (Pl. XXI, fig. 2) is located in the main building of the college. The college also furnishes the station heat, light, water, furniture, and, for the most part, scientific apparatus.

At each of the substations there is a house and office for the superintendent, and barns and other buildings for the housing of crops, stock, and implements.

The station makes use of the college farm of 240 acres, of which, however, from 80 to 100 acres are in pasture, campus, and waste land. Of the 140 acres available for cultivation, a part is used for horticultural experiments, and the remainder, under the charge of the farm division, is divided between experimental work and farm crops, the amount devoted to each varying from year to year.

The Arkansas Valley substation at Rockyford has an area of 200 acres, of which about 40 acres are devoted to variety tests of fruits and vegetables and the remainder to farm crops, or is leased. The Plains substation at Cheyenne Wells has an area of 160 acres, about 40 of which have been devoted to tests of crops and methods of culture best adapted to farming without irrigation.

The live stock used by the central station, consisting of 10 horses, 21 head of cattle, and 40 sheep used in feeding tests, are provided by the college. In general, museums and other collections of specimens are owned and used in common by the college and station. These consist of collections of agricultural and horticultural products, models and photographs, and a herbarium of 12,000 sheets, which is especially rich in the Rocky Mountain flora and contains about 1,300 Colorado species. The entomological division has a collection of 20,000 specimens of insects, nearly all of which are from Colorado. The irrigation division has a collection of photographs illustrative of its work.

A separate station library is not maintained. Books purchased with station funds are marked and numbered separately, but are otherwise treated as books purchased with college funds. The number of books thus purchased is less than 600. Each worker of the station staff has in his office a series of works bearing upon his specialty, which have been purchased mostly with college funds or by the workers themselves.

FINANCIAL SUPPORT.

The financial support of the station is derived in large part from the national fund and the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	1,212.01
Miscellaneous	837.76
Balance on hand July 1, 1898	763.66
Total	17,813.43

LINES OF WORK.

The station has no inspection duties. Colorado is located in the arid belt, and hence irrigation is a prime prerequisite for agricultural operations. The irrigation engineer has carried on extensive investigations relative to the water supply of the State and the better use of water. He has made measurements for a series of years to determine the amount of water which is used, and a series of determinations bearing upon the sources of loss in order to determine the ultimate duty of water. The artesian basins of the State have been located and the extent to which they may be utilized in irrigation investigated. The chemist has made soil analyses to determine the amount of alkali present in different soils of the State and in the waters used in irrigation.

Forage plants that will thrive under the peculiar soil and climatic conditions of the State have naturally received much attention. The horticulturist and botanist has made an extensive study of the native

grasses with a view to finding species that are adapted to local conditions, and numerous fodder analyses of the different species have been made by the chemist. Various cultural, feeding, and digestion experiments have been made with alfalfa, and the plant has been analyzed at different stages of growth. A chemical examination has been made of the changes produced in the soil by continued cropping with it, and alfalfa hay has been compared with other kinds of hay The horticulturist and botanist has studied the weeds of the State, especially the Russian thistle. In the chemical division the loco plant has been the subject of much study.

The agricultural division has carried on investigations with sugar beets as a commercial crop in Colorado. Similar work has been done with potatoes and tobacco. The same division is studying the effect of altitude and latitude upon the characteristics of grain, especially wheat, oats, and maize. Barley has been made a subject of especial experiment, the work including studies of varieties, uses, methods of culture, and feeding experiments with steers, sheep, and pigs. Various other feeding tests have also been made.

The entomologist has made an economic study of various injurious insects, including the codling moth, grapevine leaf hopper, and cutworms. The life history of the mite causing sheep scab has been studied. Experiments in bee keeping have been in progress since the establishment of the station, and have had to do mainly with methods of feeding and tests of different appliances. Much of the work of the entomologist has been in the nature of systematic studies of families of insects. He has prepared a preliminary list of the Hemiptera and Lepidoptera of Colorado, and has described a large number of new species. In a similar way the agriculturist has prepared a preliminary list of the birds of the State. The horticulturist and botanist has made a survey of the fruit-growing industry of the State, and in its interest has undertaken a study of cross pollination of fruits, especially plums.

DISSEMINATION OF INFORMATION.

Up to January 1, 1900, the station had issued 52 bulletins and 11 annual reports. Previous to the establishment of the station, a number of bulletins had also been issued by the agricultural college. Different members of the staff have been frequent contributors to the newspapers of the State, and these articles have served all the purposes of newspaper bulletins, although they have not been officially recognized as such. It is expected that hereafter regular press bulletins will be issued frequently. Some of the annual reports have contained detailed accounts of experimental work, while others have been merely administrative documents. It is expected that hereafter they

will contain considerable scientific matter. The mailing list contains about 5,200 names, 3,300 of which are from Colorado. All bulletins are sent to each address, with the exception of technical bulletins and annual reports which are issued only in small editions. The station correspondence amounts to about 2,000 letters a year. The station workers cooperate freely in farmers' institute work, and the station makes frequent exhibits at different fairs.

GENERAL RESULTS OF WORK.

The investigations of the Colorado Station relating to the duty of water and other irrigation problems have already been of great practical value to this and other States in the arid region. The development of the reservoir system as an aid to irrigation has been greatly helped by the facts in regard to water supply obtained by the college, and extensions of it that are now being made are based almost entirely on the facts concerning the return of seepage water that have been ascertained by the station. The station estimates that either of these items has been worth more to the State than the total cost of the experiment station since its organization. The growing of crops in the mountains has been largely increased by the planting of the hardy varieties of barley and maize distributed by the college and station. One of the varieties of barley sent out has practically superseded all others in Colorado. A beet-sugar factory has recently been erected, largely as a result of the preliminary work of the station in studying the possibilities of sugar-beet culture in the State.

CONNECTICUT.

The Connecticut Agricultural Experiment Station, *New Haven.*

GOVERNING BOARD.

State Board of Control: Governor George E. Lounsbury (*President*), *Hartford;* W. H. Brewer (*Secretary and Treasurer*), *New Haven;* E. H. Jenkins, *New Haven;* W. O. Atwater, *Middletown;* Edwin Hoyt, *New Canaan;* J. H. Webb, *Box 1644, New Haven;* T. S. Gold, *West Cornwall;* S. M. Wells, *Wethersfield.*

STATION STAFF.

E. H. Jenkins, Ph. D., *Director.*
Samuel W. Johnson, M. A., *Advising Chemist.*
A. L. Winton, Ph. B., *Chemist.*
T. B. Osborne, Ph. D., *Chemist.*
A. W. Ogden, Ph. B., *Chemist.*
George F. Campbell, Ph. B., *Chemist.*
Clifford Langley, *Assistant Chemist.*
Wm. C. Sturgis, M. A., Ph. D., *Mycologist.*
W. E. Britton, B. S., *Horticulturist.*
Miss V. E. Cole, *Librarian and Clerk.*
Charles J. Rice, *in Charge of Buildings and Grounds.*
Hugo Lange, *Laboratory Assistant.*
William Pokrob, *Laboratory Assistant.*
J. B. Olcott, *Grass Gardener* (*South Manchester*).
V. L. Churchill, *Sampling Agent.*

FIG. 1.—CONNECTICUT STATE STATION—HALF-GROWN TOBACCO.

FIG. 2.—CONNECTICUT STATE STATION—TOBACCO SEED BEDS.

FIG. 1.—CONNECTICUT STATE STATION—BUILDINGS.

FIG. 2.—CONNECTICUT STATE STATION—VEGETATION HOUSE.

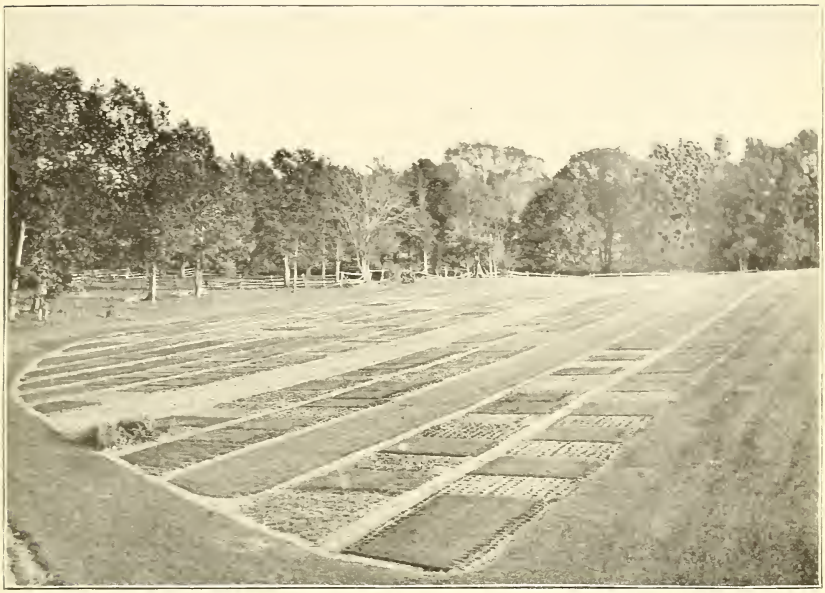


FIG. 1.—CONNECTICUT STATE STATION—GRASS GARDEN, SOUTH MANCHESTER.

FIG. 2.—CONNECTICUT STATE STATION—EXPERIMENTS WITH CARNATIONS.

HISTORY.

In considering the work of the Connecticut State Station it is important to remember that the State in which it is located is chiefly distinguished for its highly diversified manufactures. The areas devoted to agriculture are relatively limited, and with the growth of a population principally residing in towns and cities agricultural industries requiring intensive culture of crops or expert management of dairy and other live stock have been increasingly developed. The use of commercial fertilizers is very extensive. The settlement of the State began in 1633 and much of the land has been under cultivation for over two hundred years. The mean summer temperature is about 68° F., and the annual rainfall about 50 inches. The principal crops are hay, maize, potatoes, and tobacco. (Pl. XXII, fig. 1, shows a field of half-grown tobacco. Pl. XXII, fig. 2, shows the seed beds in which the young plants are raised.) Fruit growing, truck farming, seed growing, and dairying are important industries. Considerable areas are covered with forest trees. While the station has been an independent institution, it has been located during most of its existence in the immediate vicinity of Yale University, its director being at the same time professor of agricultural chemistry in that institution. The station has thus enjoyed many benefits through its association with the scientific work of the university and the utilization of its libraries, collections, and other facilities.

Connecticut was the first State in America to establish an agricultural experiment station as a separate institution. July 20, 1875, a law was enacted appropriating $2,800 to Wesleyan University at Middletown, "$700 per quarter for two years," beginning October 1, 1875, "to be used in employing competent scientific men to carry on the appropriate work of such a station." The university tendered free use of its laboratories and other facilities, and Mr. Orange Judd, a graduate and patron of the university, who was the founder and for many years editor of the American Agriculturist, contributed $1,000 toward the payment of expenses. Prof. W. O. Atwater was made director.

Before the expiration of the two years fixed for the duration of this station, the legislature established its successor as an independent and permanent institution of the State by an act which became a law March 21, 1877, and appropriated $5,000 annually for its support.

The station at Middletown had been appropriately designated by its officials "The Connecticut Agricultural Experiment Station." That became the legal title of the new station, which by vote of its board of control was opened July 1, 1877, at New Haven, with Prof. S. W. Johnson as director, in rooms placed at its disposal and fitted up for its use by the authorities of the Sheffield Scientific School of Yale College. The station occupied these quarters, rent free, for six years. In 1882 the annual appropriation was raised to $7,000, and a special

appropriation of $25,000 was granted "for the purpose of buying a suitable lot and erecting thereon buildings and equipping the same for the permanent use of the station." The station then bought a piece of land of about 5 acres, which had on it a commodious house and a barn, and added a chemical laboratory. This place is still occupied by the station.

In May, 1887, the Connecticut legislature accepted the provisions of the act of Congress, appropriating to each State annually the sum of $15,000 for experimental work, and designated the board of control of this station to receive and expend one-half of this appropriation. In the same year a biological laboratory was built and equipped. In 1884 the annual State appropriation was made $8,000 and so continued until 1895, when it was raised to $12,500. In the latter year a special appropriation of $2,500 was given for better equipping the laboratories and for other specified purposes.

In 1877 the staff consisted of the director and two chemists. The vice-director was appointed in 1883. In 1888 a botanist was added to the staff and a stenographer-clerk was employed. In 1894 a horticulturist was engaged, and from time to time laboratory helpers, sampling agents, and a night watchman have been added to the working force. After twenty-three years of continuous service Professor Johnson retired from the directorship January 1, 1900, but retained his connection with the station as advising chemist. The vice-director, Dr. E. H. Jenkins, was appointed his successor.

ORGANIZATION.

The board of control consists of eight members, one appointed by the State agricultural society, one by the State board of agriculture, one by the board of trustees of the Wesleyan University, one by the governing board of the Sheffield Scientific School of Yale University, and two by the governor of Connecticut, with the advice and consent of the senate. These members serve for a term of three years. The governor of the State and the director of the station are also ex officio members of the board of control. The board has general management of the institution and holds at least three meetings annually. The executive committee, consisting of three members of the board, meets more frequently. The station has no official connection with any college or school. The director has the management and oversight of the experiments, investigations, and publications of the station. The station's accounts are audited annually by officers of the State. The treasurer receives a small salary.

The staff consists of a director, advising chemist, four chemists, assistant chemist, mycologist, horticulturist, two laboratory assistants, sampling agent, superintendent of buildings and grounds, grass gardener at South Manchester, and clerk, who is stenographer and libra-

rian. The members of the staff hold office as long as they and the station authorities are mutually satisfied.

No substations have ever been operated by the Connecticut State Station on land belonging to it, but various investigations have been undertaken on the property of landowners in different parts of the State. Under the auspices of the station, Mr. James B. Olcott has carried on for ten years, upon his farm at South Manchester, systematic observations on the cultural value of a large number of varieties of meadow, pasture, and lawn grasses, both native and foreign. The Connecticut Tobacco Experiment Company, which owns a tobacco barn and two acres of land suitable for tobacco culture at Poquonock, has placed both at the disposal of the station, and the station has yearly, since 1891, carried out experiments on the manuring, curing, and fermentation of Connecticut wrapper-leaf tobacco. For several years cooperative experiments in the manuring of peach and apple orchards have been carried on in large orchards at Branford, New Haven, and Cromwell. The botanist of the station experiments during each summer season on the prevention or remedial treatment of fungus diseases in various parts of the State, on land and crops which are very willingly set aside for his use by their owners. The late Mr. J. J. Webb, of Hamden, and his son, Mr. J. H. Webb, have placed the resources of a well-equipped farm at the disposal of the station for field and feeding trials. The station is at present cultivating various legumes on a plat of barren land near New Haven, in the valley of the Quinnipiac River, at Montowese, to determine what plants will best serve to bring the sandy wastes of the State under cultivation.

EQUIPMENT.

The station buildings (Pl. XXIII, fig. 1) comprise an office building, chemical laboratory, biological laboratory with three greenhouses attached, glass vegetation house (Pl. XXIII, fig. 1) for pot cultures in the warmer seasons, barn, and ice house. The office building is a three-story, brick-filled frame house, containing the station offices and library and the dwelling of the director. It has two additions, each two stories high, which are the quarters of the superintendent of buildings and grounds. In the basement of the main building are the coal bunkers and a tubular boiler, from which the house, laboratories, and greenhouses are heated. The chemical laboratory is a two-story brick structure. On the first floor is the main laboratory, a sampling room fitted with mills for grinding samples, and storage rooms adjoining. On the second floor are two laboratories and two small storage rooms. In the basement are two storerooms and various pieces of apparatus. The biological laboratory is a two-story frame house, in which the botanical, horticultural, and entomological divisions are accommodated. The basement contains a dark room for photography

and a storage room. On the main floor are two workrooms, and on the second floor a museum. Connected with this building are a small plant-house for the use of the mycologist, a wooden frame greenhouse, and an iron frame greenhouse with a potting house and workroom attached, all heated by steam. These are devoted wholly to experimental work.

The station owns about 5 acres of land, on which the station buildings are situated. It keeps no live stock for experimental purposes.

In the botanical division is an herbarium containing over 5,000 specimens of phænogams and vascular cryptogams, and a number of mycological exsiccati. There are two collections of seeds of economic importance. The cabinet of insects contains over 3,000 specimens. There are also collections of minerals, rocks, and soils, fertilizers and fertilizer chemicals, native phosphates and potassic minerals, pure and adulterated food products, and charts, diagrams, tables, and lantern slides for illustrating addresses on agricultural subjects.

The station has sets of the more important agricultural, horticultural, chemical, physiological, and botanical journals and the essential books of reference on these subjects, numbering over 2,000 bound volumes, exclusive of pamphlets and station publications. Some of the books are quite rare and costly. The private libraries of the director, advising chemist, and botanist contain sets of other journals and many older works of reference, which, taken with the station library, very fully represent the useful literature of agriculture and the related natural sciences. While the station has no official or business connection with Yale University, the university library, numbering 266,000 volumes and 100,000 pamphlets; the special technical library of the Sheffield Scientific School, of about 5,000 volumes, and the special chemical libraries of the same school and of the other university laboratories are readily accessible to members of the station staff. The private libraries of many specialists connected with Yale University can also be consulted.

FINANCIAL SUPPORT.

The station now receives each year from the State treasury $10,000 for general purposes, and $2,500 for the investigation of food products. From the United States Treasury the station annually receives $7,500. Under the provisions of the Connecticut fertilizer law the station receives analysis fees amounting in recent years to about $6,000 per annum. The annual income from the sale of forcing-house crops raised in the course of experiments is about $100. The income of the station during the last fiscal year was as follows:

United States appropriation	$7,500.00
State appropriations	12,500.00
Fees	6,721.00
Farm products and miscellaneous	168.95
Total	26,889.95

LINES OF WORK.

The station has, strictly speaking, no control duties. It is required to examine and report upon the composition of foods and fertilizers, but no prosecutions for violations of the laws are made by the station or its officers. The station is authorized to take samples of any lot or package of commercial fertilizer which may be in the possession of any dealer, and is required by statute to analyze annually at least one sample of every brand of commercial fertilizers sold in the State, as well as to publish in its reports the results of such analyses, and to send at least two copies of its bulletins to every post-office in the State.

The station is required by statute "at such times and places and to such extent as it may determine" to examine food products, which are defined by the statute as "anything used as food or drink by men, horses, or cattle." Any cases of adulteration must be reported to the dairy commissioner, who is charged with bringing prosecutions. The station must make an annual report of this work to the governor, not to exceed 150 pages.

The station is also authorized by statute to collect samples of concentrated feeding stuffs, and is required to cause at least one sample of each brand of feeding stuff collected to be analyzed, so far as to determine crude protein and fat, and annually to publish these analyses with such additional information in relation to their composition, character, and use as may seem important. Though not required by law, the station does all the chemical work requested by the State dairy commissioner, consisting chiefly of the analysis of molasses, butter, and vinegar, and furnishes expert evidence in court when needed by the commissioner.

The total number of samples of materials that have been examined in the chemical laboratory amounts to 24,630.

Connecticut includes within its boundaries 22,264 acres of salt marsh and about 1,000 acres of brackish marsh, of which nearly one-fourth lie in the neighborhood of New Haven. In 1889 the station made an extended study of the botanical and chemical composition of the forage that grows on these marsh lands. Chemical analyses have also been made for the purpose of learning something of the agricultural value of swamp muck or peat, soils, marine mud, seaweeds, limestones, maize raised in Connecticut, hay, and a few other substances.

The station began the cultivation of grasses in 1886. Mr. J. B. Olcott was employed to collect roots of any species or variety of grass that appeared useful or promising. From these and from seeds procured from various sources the station garden had, in 1887, 650 sods and 219 drills or plats raised from seed, all distinct in immediate origin and mostly distinct in appearance. With the idea that grasses, like

fruit trees, have developed into many different varieties, Mr. Olcott has made six journeys of exploration with the sole purpose of collecting cultivated grass plants and seeds whose repute or appearance would indicate special value for use in pastures, meadows, or lawns. He thus visited some of the best grazing districts of Connecticut and Rhode Island, Pennsylvania, various Southern, Central, and Pacific States, Great Britain, Denmark, Austria, Switzerland, France, Hawaii, and Australia, and through correspondents received sods from other States and countries. It being impossible to care for these collections at the station, where the soil is not adapted to grass, Mr. Olcott undertook to transplant the most promising grasses to favorable ground on his farm near South Manchester (Pl. XXIV, fig. 1). Since 1890 Mr. Olcott has devoted himself untiringly to the care of the South Manchester grass garden of about 2 acres area, where he has had growing in pure cultures 3,022 distinct grass plats, comprising 600 sods from station grounds at New Haven, 793 sods collected in the United States, 1,005 from Europe, 125 from Australia and the Hawaiian Islands, 250 miscellaneous, and 250 plats from trade seeds. Of these 1,500 are now under observation and about the same number have been destroyed as inferior or unfit for culture. Of the 144 genera in Vasey's Descriptive Catalogue of the Grasses of the United States, 54 are represented in these collections.

The station is cooperating with the Division of Forestry of the United States Department of Agriculture in testing and comparing the growth of forest trees raised from seed obtained from different sections of the United States.

An important investigation has been the study of the vegetable proteids, on which Dr. Osborne, with an assistant, has been continuously engaged for eight years. Subjects of this investigation have been mostly seeds. The distinct proteids that have been identified, described, and analyzed are the following: (1) Globulins insoluble in water, soluble in salt solutions: *Avenalin* and *Oat myosin* in oats; *Maysin* and *Maize globulin* in maize; *Edestin* in flax, squash, hemp, wheat, rye, barley, sunflower, and cotton seed; *Excelsin* in Brazil nut; *Phaseolin* in kidney bean and adzuki bean; *Phaselin* in kidney bean; *Glycinin* in soy bean; *Vignin* in cowpea; *Conglutin* in lupine; *Vicilin* in pea, horse bean, and lentil; *Legumin* in pea, horse bean, lentil, and vetch; *Tuberin* in potato tuber; *Bynedestin* in barley malt; *Legumelin* in vetch, pea, horse bean, lentil, cowpea, soy bean, and adzuki bean; *Amandin* in almond and peach; *Corylin* in filbert and walnut. (2) Glutinoids soluble in alcohol of 75–95 per cent: *Gliadin* in wheat and rye; *Oat-gliadin* in oats; *Zein* in maize; *Hordein* in barley; *Bynin* in malted barley. (3) Glutinoid insoluble in neutral solvents: *Glutenin* in wheat. (4) Albumin: *Leucosin* in wheat, rye, barley, and barley malt. (5) Proteose-like bodies have been found in nearly all seeds examined,

of which many have been described and analyzed, but none specifically named.

The organism causing the scab of potatoes (*Oospora scabies*) was isolated and described at this station by Dr. Roland Thaxter. A new species of Phytophthora has been described, which has caused extensive damage to Lima beans; the methods of infection have been studied and preventive measures suggested. A considerable number of new species of fungi of less economic importance have also been described.

The nature and cause of "pole burn," a very destructive disease to which leaf tobacco is liable while curing, and its prevention by the use of suitable devices for ventilating by means of artificial heat, have been studied. Studies on the curing and fermentation of wrapper-leaf tobacco are now in progress.

Investigations are in progress with the object of determining the cause of "calico," a destructive disease of growing tobacco. It has been ascertained that the disease is purely physiological, and experiments indicate that the use of lime upon soils where "calico" is liable to occur is attended with good results.

The effect of shading growing tobacco plants has also been under trial, and some interesting and possibly important results with respect to the texture of the leaf have been obtained.

Experiments with fertilizers in the culture of carnations (Pl. XXIV, fig. 2) have been a prominent line of work in the horticultural division.

For several years the disease known as onion smut, due to the fungus *Urocystis cepulæ*, which seriously threatens onion growing in Connecticut, has been a subject of study. In 1889 Dr. Thaxter found that when onion seed was sown in soil that has been impregnated with *Urocystis cepulæ*, the young plants were infected under ground, and if the fungus did not become manifest in them shortly after they appeared above the soil they were not subsequently affected by it. Dr. Thaxter noted that "the fact of subterranean infection is further confirmed by the absence of smut on sets and seed onions, as well as on transplanted seedlings." Dr. Sturgis has more recently shown that when onion seed is sprouted in clean soil in hotbeds, and the seedlings are transplanted into smutty land the onions entirely escape infection.

Extensive studies have been made on the chemical composition of maize as affected by fertilizers and by open and close planting. For six years the availability of various forms of nitrogen has been studied in a large number of pot cultures, with various soils, fertilizers, and conditions.

This station has from the first done much work in improving laboratory methods, operations, and apparatus. Among the pieces of apparatus devised by the station workers which have proved satisfactory are a fat extractor, a hydrogen generator, gas desiccator, appa-

ratus for drying in hydrogen, aliquotimeter, apparatus for determining nitrogen by the absolute and by the Kjeldahl methods, an oven for drying large samples (e. g., maize stalks, coarse grasses, or other forage plants), and apparatus for determining nitric acid (modification of Schulze-Tiemann apparatus).

DISSEMINATION OF INFORMATION.

The station has issued 129 bulletins and 23 annual reports. The publication of the annual report, not to exceed 550 pages, is done at State expense. It contains a full account of all the work done by the station during the year and includes the matter published in bulletins. The edition published at public expense is now limited by law to 7,000 copies. The station has frequently printed large numbers of additional copies to meet the demand.

Prof. S. W. Johnson is the author of "Essays on Peat, Muck, and Commercial Manures," "Peat and Its Uses as Fertilizer and Fuel," "How Crops Grow," and "How Crops Feed," which were written previous to the establishment of the station. The two books last named have been translated into French, German, Swedish, Russian, and Japanese, and have been used as text-books. "How Crops Grow" was reprinted in England and translated into Italian, and a revised edition was issued in New York in 1891. Dr. H. P. Armsby, while on the staff of this station, wrote his "Manual of Cattle Feeding." Numerous papers have from time to time been published in scientific journals by members of the station staff. Messrs. Jenkins and Winton made a "Compilation of Analyses of American Feeding Stuffs" that was published as a bulletin of the Office of Experiment Stations.

The mailing lists are constantly under revision. They contain the addresses of more than 9,500 Connecticut farmers, but the actual lists correspond to the number of available copies of publications, which for 1898 were of bulletins 5,000 and of annual reports 6,750, except the part on food products, of which 16,750 copies were distributed.

The station correspondence is over 3,500 letters a year. The members of the station staff are frequently called upon for papers or addresses before the annual meeting of the State board of agriculture, the Pomological Society, and the Dairymen's Association, and at farmers' institutes, as well as meetings of the county and subordinate granges.

GENERAL RESULTS OF WORK.

The Connecticut State Station has been a leader in the establishment of fertilizer inspection in this country and in investigations regarding the use of fertilizers and their effect on the composition of the crop. The benefits of this work have been very great and their influence has been widely extended. As a result of the constant supervision of the

fertilizer market, fraudulent fertilizers have long been practically excluded from the State. Although food inspection has been in operation for only four years, a decided decrease in the extent of adulterations is already noticed.

Many of the cooperative experiments undertaken by this station have been highly successful, and in this as well as in other ways, much has been done to educate practical cultivators of the soil in matters pertaining to the application of chemistry and other sciences to agriculture.

In recent years the investigations on tobacco have helped to enable Connecticut growers to improve the quality and hence maintain a relatively high price for their wrapper-leaf tobacco.

Through information and instruction given in its publications, and more particularly by the personal supervision of the station staff and practical demonstrations made in various parts of the State, the use of insecticides and fungicides, and spraying with improved machinery, were first introduced into Connecticut, to the very great benefit of the fruit and vegetable industries.

The larger nurseries of the State are annually inspected by station officials for injurious insects or fungus pests. On being notified of the appearance of any such pest in any part of the State, a member of the staff at once visits the place to give what help is possible.

Largely through this station, the very crude and unfair methods of payment for milk and cream delivered by farmers to creameries in the State have been replaced by a rational system based on the Babcock test.

Storrs Agricultural Experiment Station, *Storrs.*[1]

Department of the Connecticut Agricultural College.

GOVERNING BOARD.

Board of Trustees: Governor George E. Lounsbury (*President*), *Hartford;* T. S. Gold (*Secretary*), *West Cornwall;* Wm. D. Holman (*Treasurer*), *Tolland;* W. E. Simonds (*Vice-President*), *Hartford;* E. H. Jenkins, *New Haven;* E. S. Henry, *Rockville;* S. O. Bowen, *Eastford;* Edmund Halladay, *Suffield;* Martin M. Frisbie, *Southington;* George A. Hopson, *Wallingford.*

Executive Committee: T. S. Gold, S. O. Bowen, G. W. Flint.

STATION STAFF.

G. W. Flint, *President of the College.*

W. O. Atwater, Ph. D., *Director* (*Middletown*).

C. S. Phelps, B. S., *Vice-Director; Agriculturist.*

Francis G. Benedict, Ph. D., *Chemist* (*Middletown*).

P. B. Hawk, B. S., *Assistant Chemist* (*Middletown.*)

F. E. Singleton, *Secretary* (*Middletown*).

Herbert Kirkpatrick, *Assistant Agriculturist.*

[1] Telegraphic address, *Storrs via Willimantic;* railroad station, express, and freight address, *Eagleville.*

HISTORY.

At the time the act of Congress of March 2, 1887, was passed there was in Connecticut the Connecticut Agricultural Experiment Station, which had begun its work in Middletown, but had been transferred to New Haven. By act of the State legislature in May, 1887, the annual appropriation of $15,000 made by Congress for Connecticut was divided. One-half was placed in charge of the board of control of the station at New Haven, and the other half was placed in charge of the board of trustees of the Storrs Agricultural School (now the Connecticut Agricultural College), in the town of Mansfield, for the purpose of establishing and maintaining an experiment station in connection with the school. Accordingly the Storrs Agricultural Experiment Station was established in March, 1888, when the appropriation was first available for the Storrs School.

The board of trustees invited Dr. W. O. Atwater, professor of chemistry in Wesleyan University, one of the pioneers of the experiment station movement in this country, to become director of the station; and as the Storrs School had not such laboratories, libraries, and other facilities for research as were necessary, they asked Professor Atwater to conduct the chemical and other scientific investigations in the chemical laboratory at Wesleyan. To such an arrangement the trustees of the latter institution gave their cordial assent.

The farm and farm appliances of the Storrs School were placed at the disposal of the station for experimental purposes. Provision was made for carrying out field, garden, greenhouse, and stable experiments on the grounds and in the buildings of the school, and in cooperation with farmers and dairymen on their farms and in their dairies in different parts of the State. The supervision of this work was given to Mr. C. S. Phelps of the Storrs School, who was appointed agriculturist and vice-director of the station. Dr. H. W. Conn, professor of biology in Wesleyan University, was soon invited to undertake, on behalf of the station, biological investigations in his laboratory at Wesleyan University. Mr. C. D. Woods, who had previously been associated with Professor Atwater at Wesleyan University, was made chemist of the station, carrying on the work at Middletown. During the years 1888–1891 Professor Atwater was Director of the Office of Experiment Stations, and hence was necessarily absent from Middletown most of the time. At this time Mr. Woods was made vice-director and so continued until 1896, when he was called to the professorship of agriculture and the directorship of the station of the Maine State College, now the University of Maine, at Orono. Since that time, Dr. F. G. Benedict has been chemist of the station, and Prof. C. S. Phelps again vice-director.

FIG. 1.—CONNECTICUT STORRS STATION—OFFICE AND LIBRARY.

FIG. 2.—CONNECTICUT STORRS STATION—POT EXPERIMENTS.

FIG. 1.—CONNECTICUT STORRS STATION—ORANGE JUDD HALL, WESLEYAN UNIVERSITY, MIDDLETOWN.

FIG. 2.—CONNECTICUT STORRS STATION—CHEMICAL LABORATORY IN ORANGE JUDD HALL, WESLEYAN UNIVERSITY, USED BY STATION.

FIG. 1.—CONNECTICUT STORRS STATION—EXPERIMENTAL FIELDS.

FIG. 2.—CONNECTICUT STORRS STATION—GRASS GARDEN.

FIG. 1.—CONNECTICUT STORRS STATION—ATWATER-ROSA RESPIRATION CALORIMETER.

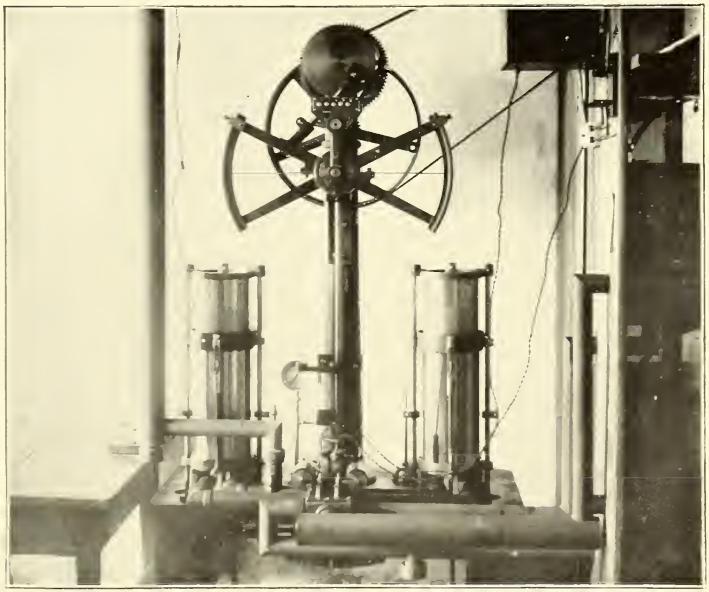


FIG. 2.—CONNECTICUT STORRS STATION—BLAKESLEE METER PUMP.

ORGANIZATION.

The governing board of the station is the board of trustees of the college, which consists of six members elected by the State senate for terms of four years, one member elected annually by the State board of agriculture, one member, a graduate of the college, elected by the alumni, and the director of the State Station at New Haven ex officio. The governor of the State is ex officio president of the board. This board meets annually. Its members, with the exception of the secretary and the treasurer, receive no compensation. The duties of the board are those of general supervision and control of finances. The more direct management of station affairs is delegated by the board to an executive committee consisting of two of its members and the president of the Connecticut Agricultural College. This committee places the work of the station in charge of the director, upon whom rests, in fact, the entire responsibility for the management in detail.

The staff consists of a director, vice-director (who is also agriculturist), chemist, assistant chemist, assistant agriculturist, and secretary. The director and vice-director are appointed by the board of trustees. Formerly the tenure of office was for one year, but is now without limitation. The other members of the staff are appointed by the executive committee on nomination of the director.

EQUIPMENT.

The only buildings owned by the station are a few small frame buildings at Storrs, one general office and library building (Pl. XXV, fig. 1), one barn, and one shelter for pot experiments with plants (Pl. XXV, fig. 2). Chemical and biological investigations are carried on in the laboratories in Orange Judd Hall of Science (Pl. XXVI, fig. 1) of Wesleyan University. In a room of this building (Pl. XXVI, fig. 2) some of the early experiment station work in the United States, and for two years after its establishment, the work of the first regularly organized State experiment station was carried on. In the basement of this building is now located the respiration calorimeter used in certain nutrition investigations carried on by the station in cooperation with the United States Department of Agriculture.

The Storrs Agricultural School, now designated by act of the State legislature as the Connecticut Agricultural College, gives to the station free use of stables, herds, farm appliances, and farm land for experimental purposes. About twelve acres are set apart for the use of the station in general field and plat experiments (Pl. XXVII, fig. 1.) (One of the plats is shown in Pl. XXVII, fig. 2). Of the twelve

acres, about half an acre is occupied by a small pear orchard; the rest is used for experiments with forage crops and fertilizers.

The station live stock consists of a few cows and sheep kept for feeding and digestion experiments. The college herd, consisting of 25 head of dairy cows, is available for the use of the station; but animals are bought as they are needed from time to time for particular experiments. Four condemned cows and their offspring are used by the station at present in investigations on tuberculosis of cattle.

The combined libraries of the station at Storrs and the Connecticut Agricultural College contain about 7,100 volumes, mostly scientific. The chemical and biological libraries at Wesleyan University, containing about 2,500 volumes, are available to the station workers.

The facilities placed at the disposal of the station by Wesleyan University made it unnecessary to build chemical and biological laboratories, or to purchase much apparatus. For use in a certain kind of nutrition investigations, namely, the study of metabolism of matter and energy, a respiration calorimeter (Pl. XXVIII, fig. 1) has been devised and is now regularly employed. Many of the mechanical devices which contribute materially to the success of the apparatus are due to the ingenuity of the mechanician, Mr. O. S. Blakeslee. This is true of the meter pump (Pl. XXVIII, fig. 2), a marked improvement over the aspirators formerly used, which performs the threefold office of drawing the air current through the respiration chamber, measuring and recording its amount automatically, and delivering an aliquot portion for analysis. For the determination of heats of combustion, a bomb calorimeter has been improved, which costs very much less than similar instruments employed in European laboratories.

FINANCIAL SUPPORT.

Since its establishment the station has received annually $7,500, one-half of the amount appropriated to the State from the national fund. Previous to 1894 the station cooperated with the United States Department of Labor for several years in the study of dietaries, a large part of the expense of the work being met by that department. In 1894 the United States Department of Agriculture began investigations on the food and nutrition of the people of the United States. Since that year the station has cooperated with this Department in the prosecution of these investigations. In the same year the State legislature provided for an annual appropriation of $1,800 to the station, to be expended in nutrition and bacteriological investigations. From time to time, also, private individuals have contributed toward the expense of carrying on special investigations. The late Dr. J. W. Alsop, of Middletown, Conn., was a generous contributor at times when funds for special

investigations were greatly needed. The regular income of the station during the last fiscal year was as follows:

United States appropriation	$7,500.00
State appropriation	1,800.00
Farm products	43.17
Miscellaneous	1,131.15
Total	10,474.32

LINES OF WORK.

The station has no inspection duties. A considerable part of its work has been in continuation and development of inquiries begun by Professor Atwater in the chemical laboratory of Wesleyan University and elsewhere before the establishment of the station. Some of the more important investigations finished or still in progress are studies of the acquisition of atmospheric nitrogen by leguminous plants; analyses of foods and feeding stuffs; cooperative field and feeding experiments; studies on the effects of nitrogenous fertilizers upon yield and composition of plants; bacteriological investigations, and researches on the food and nutrition of man.

Previous to the organization of the station Professor Atwater had made some experiments, the results of which, published in 1883–1885, showed that peas were capable of utilizing the free nitrogen of the air. This fixation of free nitrogen was shortly afterwards shown by Hellriegel and Wilfarth to be due to the action of bacteria and to be characteristic of the legumes. In the years 1889–1892 the station made several hundred experiments with peas, beans, cowpeas, alfalfa, crimson clover, maize, oats, millet, and other crops, continuing the study of the acquisition of nitrogen. All of the legumes, including cowpeas, alfalfa, and crimson clover, which had not been experimented upon previously, were found to fix free nitrogen of the air when the proper bacteria were present. But there was no fixation of free nitrogen without bacteria, nor was any such fixation detected with plants other than legumes in the presence of bacteria.

A study of the composition of American food fishes and invertebrates, from the standpoint of their nutritive value, was undertaken for the Smithsonian Institution and for the United States Fish Commission by Professor Atwater in the chemical laboratory of Wesleyan University. In connection with this study a series of analyses of meats was also undertaken for the United States National Museum. These investigations were carried out during the years 1878–1888, and included the analyses of about 200 samples of sea and fresh-water fishes, oysters, clams, etc., and nearly 100 samples of meats, besides a few analyses of milk, butter, cheese, flour, bread, etc. The studies thus begun were continued by the station as food investigations in

cooperation with the Massachusetts Bureau of Labor and the United States Departments of Labor and Agriculture. Thus far analyses of over 1,600 samples, comprising a great variety of materials used as food by man in the United States, have been made by Professor Atwater and associates in his laboratory. About as many samples of different kinds of feeding stuffs for animals have also been analyzed in connection with the field and stable experiments made at the station. The data thus collected supply much of the information concerning the composition of foods and feeding stuffs that is needed in the study of the nutrition of both man and animals.

For several years before the Connecticut Storrs Station was established a large number of farmers and several colleges and experiment stations in Connecticut and other States had carried on field experiments according to plans proposed by Professor Atwater, and had reported the results to him for publication. The station continued the experiments both at Storrs and in cooperation with farmers on their farms in different parts of the State. A large part of the experiments thus carried out were soil tests.

These experiments emphasized the differences between species and families of plants in respect to their feeding capacities, that is, their power to gather nitrogen, phosphoric acid, and potash from natural sources, and the effects of these different materials upon the growth of the plants when applied in fertilizers.

For a number of years the station has carried on a series of experiments which were planned to show the effects of nitrogen in different amounts and combinations, alone, and more especially with other fertilizing materials, upon both the yield and the composition of different crops. The results of a large number of these experiments indicate that the yield of the cereals, maize, wheat, and oats, and of the grasses is considerably increased by the proper use of nitrogenous fertilizers, but that the legumes, clover, peas, soy beans, and cowpeas, respond only slightly to them. The yield is, however, materially increased by phosphates and potash salts.

In experiments with mixed grasses the total yield of the hay was considerably increased by the use of nitrogenous fertilizers, while the nitrogen of the fertilizers increased also to a marked degree the proportion of protein in the crop.

In experiments with maize the total yield of the crop was not very largely increased by the nitrogen of the fertilizers, but there was considerable increase in the proportion of protein in both grain and stover. The experiments with oats were fewer than with the other crops, but the results were similar to those with mixed grasses, an increase of both the total yield of crop and the proportion of protein in the crop following the use of nitrogen. In the experiments with different species of grasses the effect of nitrogen upon the proportion

of protein in the crop was more marked than in any of the experiments with other crops. In all these experiments the results show what improvement can be made in the ordinary crop by the proper use of nitrogenous fertilizers, not only in increasing the total yield and hence the market value, but also in increasing the protein content and hence the feeding value of the crop independently of the effect upon the yield.

Feeding experiments of different kinds have been carried on at the station and in cooperation with farmers and dairymen in different parts of the State. The experiments at the station have been chiefly upon the digestibility of different feeding stuffs. Besides this there has been considerable study of the effect of nitrogenous rations on the production and quality of milk. In cooperation with farmers and dairymen the station has made a study of the actual rations fed to milch cows in Connecticut, and has suggested a change in rations where such changes seemed advisable.

For several years Prof. H. W. Conn, of Wesleyan University, has carried on, in behalf of the station, investigations in dairy bacteriology. This work has been along two parallel lines. One has been a study of the species of bacteria commonly occurring in dairies in the State; the other, which is more important, has been a study of the effects of bacteria upon milk, cream, and butter. The organisms that are connected with the souring of milk and with the ripening of cream have been most studied. For the past few years the station has made investigations with four condemned tuberculous cows and their offspring. The most important specific result of this work so far is the indication that when milk from such cows is fed to calves the danger of spreading the disease is less than has been supposed.

One of the chief lines of work followed by the station since its establishment has been the study of the nutrition of man. Much of this work has been carried on in cooperation with Wesleyan University and the United States Department of Agriculture. (See p. 106). This has been done by dietary studies and by digestion and metabolism experiments. As a result of this work a knowledge of the fundamental laws of nutrition is being acquired. The digestion experiments furnish data concerning the digestibility of different classes of food materials. The metabolism experiments furnish data concerning the conservation of matter and energy in the human body, and concerning the physiological requirements of the body.

In connection with some of the lines of work already mentioned, as the field experiments, feeding experiments with cattle, and the nutrition investigations, there has been a considerable amount of analytical work. Considerable attention has been given to the improvement of methods of manipulation and analysis. The analytical details connected with experiments with the respiration calorimeter have had to

be worked out. Among the more important methods which have been studied are the determinations of water and fats in foods and feeding stuffs; of nitrogen by the Kjeldahl process; of carbon dioxid and water in large currents of air, and of carbon and hydrogen in organic substances.

The determination of heats of combustion of organic compounds has been an essential part of the work of the station. The different forms of apparatus which had been devised and were in use for this purpose were either very expensive or in some way unsatisfactory. To meet the need of an accurate, durable, and comparatively inexpensive apparatus, modifications have been made in the ordinary Berthelot bomb and accessories. An instrument has been devised which the experience of several years has shown to be very satisfactory, and the cost of which is only a fraction of that of the apparatus of Berthelot. By means of this the heats of combustion of several hundred specimens of foods and feeding stuffs have been determined.

For use in the metabolism experiments a respiration calorimeter (designated the Atwater-Rosa calorimeter) has been devised, which is so constructed and manipulated as to measure with a high degree of accuracy the income and outgo of both matter and energy of the body of a man within the chamber of the apparatus. Numerous experiments in which a man has remained in the chamber of this calorimeter for periods varying from three to twelve days have afforded very exact quantitative proof that, under the circumstances of the experiments, the law of the conservation of energy holds in the human body. These experiments also afford exact information as to the demands of the body for nutriment and the nutritive values of different food materials. A more detailed account of this apparatus is given on page 112.

DISSEMINATION OF INFORMATION.

The station has issued 11 annual reports and 19 bulletins. The annual reports give the details of investigations, with discussions of the results and applications, especially to conditions in Connecticut. Brief and popular discussions of the work are given in bulletins. The reports of the station are published at the expense of the State. The limited resources of the station have hitherto prevented a larger publication of bulletins, but a recent act of the State legislature provides for the expense of bulletins as well as reports, so that more frequent bulletins may be expected in the future.

The director and other station officers have published a large number of articles in Government bulletins, scientific journals, and popular magazines. The number of addresses on the mailing list is about 7,000. The lists are kept on files, the Connecticut list alphabetically by towns, the miscellaneous United States list by names, and the for-

eign list by countries. There are separate files also for the different classes of station officers, libraries, and newspapers. So far as possible the station answers calls for assistance in farmers' institute work made by such organizations as the State board of agriculture, the State Dairymen's Association, and the granges. The college and station make combined exhibits of products and educational facilities at State and county fairs.

Since its organization the station has cooperated with farmers in carrying on field experiments on about twenty-five different farms in the State. Within the past five years, some thirty studies of rations fed dairy herds have been made, and in not far from half of these cases new rations have been proposed and put into use, and the results from the use of the two rations have been compared. All cooperative experiments are made under the immediate supervision of an officer of the station, who visits the farm or dairy, and directs the more important parts of the work. One assistant remains in charge of the dairy tests throughout the entire period of study.

GENERAL RESULTS OF WORK.

The work of the Connecticut Storrs Station has been very largely of a directly scientific character, but the outcome of much of this work has been of great practical importance. The studies on the nutrition of man, inaugurated by the director of the station, have resulted in giving great aid to what is now a widespread movement in the United States for the betterment of public and private instruction regarding human physiology and hygiene, and for the application of the results of scientific research in the improvement of the dietaries of different classes of our people. For example, the results of this work are being applied in the feeding of our Army and Navy, and in making up dietaries for schools, hospitals, and other public institutions.

The investigations of this station on dairy bacteriology have been an important factor in bringing about changes in the manufacture of dairy products, which have resulted in raising the general grade of these products, and giving them a great uniformity of quality and flavor.

This station has also been fortunate in the conduct of cooperative experiments with farmers, relating especially to the feeding of farm animals, particularly dairy cattle, and to the use of commercial fertilizers and of leguminous plants for green manuring. These experiments, supplementing the investigations of the station in similar directions, have done much to improve the practice of farmers in the State along the lines in which they have been conducted.

DELAWARE.

The Delaware College Agricultural Experiment Station, *Newark.*

Department of Delaware College.

GOVERNING BOARD.

Board of Trustees—Committee on Agriculture: James Hossinger, *Newark;* Manlove Hayes, *Dover;* W. F. Causey, *Milford;* W. H. Stevens, *Seaford;* Lewis C. Vandegrift, *Wilmington.*

STATION STAFF.

Geo. A. Harter, M. A., Ph. D., *President of the College.*
Arthur T. Neale, M. A., Ph. D., *Director and Agriculturist.*
C. L. Penny, M. A., *Chemist.*
W. H. Bishop, B. S., *Meteorologist.*
F. D. Chester, M. S., *Mycologist.*
H. P. Eves, D. V. M., *Veterinarian.*
G. H. Powell, M. S., *Horticulturist.*
E. D. Sanderson, B. S. A., *Entomologist.*

HISTORY.

The Delaware Station is located in the northeastern part of the State. The surface of the State consists for the most part of lowlands rising gradually from the Delaware River and Bay and the Atlantic Ocean toward the west and north. Numerous small rivers traverse the State, flowing in an easterly direction, and the necks or peninsulas thereby formed are frequently typical wheat lands. Inland the country immediately adjacent to the northern banks of these streams is a rich clayey loam, while that adjacent to the southern banks is oftentimes a decidedly sandy loam. The northern third of the State is especially adapted to grain, grass, and potatoes, and dairying is one of the most profitable agricultural industries. About five-sixths of the area of the State is arable land. The climate is mild, the mean annual temperature being 54° F., and the annual rainfall 45 inches. The principal crops are hay, maize, wheat, and potatoes. The horticultural interests are large, especially the growing of peaches, apples, pears, small fruits, and vegetables. A considerable number of sheep, swine, milch cows, cattle, and horses are maintained. Agriculture has been practiced in the State for over 200 years. The growth of manufacturing in the State and the development of great cities and large towns not far from its borders have led to the development of agricultural industries requiring more intensive culture.

The college with which the station is connected was established in 1833, and has in recent years been developed along scientific lines.

The Delaware College Agricultural Experiment Station was organized as a department of Delaware College in May, 1888, and soon after, Dr. Arthur T. Neale, chemist of the New Jersey State Station, was appointed director. During the first eleven years of the station's

FIG. 1.—DELAWARE STATION—COLLEGE AND STATION BUILDINGS.

FIG. 2.—DELAWARE STATION—MAIN BUILDING.

FIG. 1.—DELAWARE STATION—MYCOLOGICAL LABORATORY.

FIG. 2.—DELAWARE STATION—HORTICULTURAL AND ENTOMOLOGICAL LABORATORY.

FIG. 1.—DELAWARE STATION—CHESTNUT GROVE.

FIG. 2.—DELAWARE STATION—TOMATOES UNDER GLASS.

existence its officers had no teaching duties in the college. In July, 1899, a reorganization was made by the college trustees, under which station officers are named as lecturers on agricultural topics in the college.

ORGANIZATION.

The governing board of the station is the board of trustees of the college, which consists of 32 members, 15 of whom represent an original body which managed Delaware College prior to the passage of the first act of Congress establishing land-grant colleges. Upon the acceptance of that grant by the State, a second board of 15 members was created, which was appointed by the governor of the State. To these 30 members are to be added the governor of Delaware and the president of the college, ex officio. The original board has power to fill vacancies in its membership. The governor fills vacancies in the State board by appointment. Immediate oversight of the station is delegated to a committee on agriculture, consisting of 5 members. Two stated board meetings are held annually. No compensation is paid to members for services, and in very few instances are even traveling expenses charged against the institution.

The staff consists of the president of the college, director (who is also agriculturist), mycologist, horticulturist, chemist, meteorologist, veterinarian, and entomologist, appointed by the board. The tenure of office under the recent reorganization is one year. Under the same reorganization a council was created which consists of the agricultural committee of the board of trustees and the members of the station staff.

EQUIPMENT.

The station buildings (Pl. XXIX, fig. 1) consist of a main building, a greenhouse, and two storehouses containing rooms equipped for rough mechanical work preparatory to more exact studies in the laboratory. In the main building (Pl. XXIX, fig. 2), a brick structure, 43 by 27 feet, two stories, are located the station offices and laboratories. (Pl. XXX, figs. 1 and 2, show the mycological and the horticultural and entomological laboratories respectively). The greenhouse, which is in an isolated location, is used partly as an insectary, partly for photographic purposes, and partly as a bacteriological laboratory, in which contagious diseases of animals, as anthrax, rabies, and tuberculosis, are studied.

The college owns about 4 acres of land in Newark, of which the station makes use for field experiments in horticulture, tests of forage plants, and studies in crop rotations. The station also makes use of land placed at its disposal, without rental charges, by fruit growers and farmers in various sections of the State. Such lands are used for

horticultural tests, mycological or entomological investigations, and for work in plant breeding.

The station maintains no live stock permanently. Cows, horses, and sheep are purchased as needed for experimental work in protective inoculation and in serum therapy. The station also makes use of herds of milch cows, both thoroughbred and grades, owned and maintained by private individuals, but placed at the limited disposal of the station officers. Such stock is used during chemical studies on methods of milk analysis, on milk sampling, and on milk standards underlying herd improvement by breeding and selection. In a similar way dairy stock, both young and mature, owned by private parties, is used by the station in determining relative feeding values of leguminous forage crops as pasture and as silage.

The station makes use of the college museums. It owns a collection of lantern slides and negatives. It also owns approximately 4,000 volumes which are kept separate from the college collection. Libraries in Wilmington, Philadelphia, and Baltimore may be consulted when desirable. Current periodicals in the departments of chemistry, horticulture, mycology, bacteriology, entomology, general agriculture, veterinary science, and live-stock industry are purchased regularly. They represent activities in these sciences in Germany, France, England, and the United States. This library represents an investment approximating $7,000, to which from $500 to $700 is added annually.

The chemical and bacteriological laboratories are well equipped with all appliances necessary for carrying out work along the station's special lines of investigation. A method for the composite sampling of milk has been devised by the chemist of this station.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Miscellaneous	20.02
Total	15,020.02

LINES OF WORK.

The station has no inspection duties. The underlying thought in its management is soil enrichment by the use of leguminous plants and the utilization of this increased fertility in general agriculture, horticulture, and animal industry. The work in agriculture has in recent years been concentrated upon the crimson clover for winter and the cowpea for summer culture. The former is now thoroughly introduced. The latter is a crop of promise for Delaware, and a study

of varieties and ways in which the plant may be utilized will be a leading line of work in the immediate future.

In dairy management considerable attention has been given to tracing out errors which might unjustly afford a basis for charges of fraudulent practices against dairymen supplying milk to city markets.

The strict city censorship of the milk trade makes the improvement of herds by breeding and selection a work of primary importance, and to this the station has paid attention. Some of the problems involved are studies on variations in composition of milk under different conditions.

The chemical division has assisted in promoting the interests of the dairy industry by introducing the system of purchasing milk by tests, by comparing the efficiency of different hand separators, and by locating and describing unavoidable losses of butter. A method of preserving milk samples for analysis known as the method of submergence has been devised, which depends on the fact that a fat solvent not entirely miscible with water will, if it is heavier than milk, and if it is present in sufficient quantities, carry all of the fat to the bottom. In samples kept according to this method the ring of cream that always adheres to the glass at the surface in samples kept in the ordinary way is wholly wanting.

The chemical division has also made studies with a view to harmonizing chemical analyses of soils and field experiments with fertilizers, and an apparatus for determining the potash in soils has been devised, the essential feature of which is the digestion of the substance in hydrochloric acid at a temperature of 100° C., maintained by surrounding the containing flasks with an atmosphere of steam. In the course of the work on introduction and utilization of leguminous plants the division has been called on to make numerous analyses. Analyses have also been made of various fungicides.

On account of the very small returns derived from the maize crop locally, the station is endeavoring to find a substitute for it which shall involve no other change in present crop rotations and no special outlay to the farmer for machinery. Sorghum, used as a source of seed and of sugar, is the proposed substitute. It is commonly believed that the climatic conditions on the Delaware peninsula are unfavorable to the culture of the sugar beet, but the station believes that it has demonstrated that these very conditions are extremely favorable to the production of sorghum. Besides this general demonstration, the chemist has tested nearly 3,000 stalks singly in order to select for propagation those which are most suitable in sugar content, in size, and in weight.

For a number of years the station has given much attention to the study of anthrax, with the result that the diagnosis has been placed above all question. It has been demonstrated that the original source of the trouble is imported in goatskins used in the morocco factories

along the Delaware River, whence the germs are distributed over adjoining areas of land. The limits of the area subject to infection have been defined. The possible channels by which the disease may be spread have been ascertained, and a treatment of live stock which will give them immunity to this disease for one year at least has been repeatedly verified. The station has taken the initiative in securing State legislation looking to a control of the disease.

Various other bacteriological studies have been carried on, among which may be mentioned studies on a new ferment useful in butter making and on cerebro-spinal meningitis.

Along lines of mycology experiments have been made in the treatment of plant diseases, notably those of the grape, the peach, and the apple, and investigations have been made on some, especially peach rot and diseases of the tomato and potato. These studies have included experiments with sulphur as a preventive of scab of the Irish potato and black rot of the sweet potato.

Since 1896 the leading line of study in bacteriology has been bacteriology of the soil. In the course of this work various species of bacteria were isolated and studied, but much difficulty was experienced in ascertaining whether a species under observation was new or had already been described. This necessitated much preliminary work in systematic bacteriology. As a result, there has already appeared from this station preliminary arrangements of the species of the genera Bacterium and Bacillus, which are to be followed by other similar studies until the entire group of Schizomycetes has been thus treated.

As a preliminary to reorganizing the work of the horticultural division on the appointment of the present horticulturist in 1896, a statistical study was made of the principal horticultural industries of the State, in order to determine wherein the station could be of assistance to them. The subjects included the Kieffer pear, Japanese plum, and the pea-canning industries. Studies have been made of the adaptability of certain new horticultural industries to the State and the possibility of extending those but slightly developed. In this category are comprised studies of the sour cherry, the apple, and the cultivated European and Japanese chestnuts. (Pl. XXXI, fig. 1, shows a chestnut grove.) Experiments have been made in the root pruning of young fruit trees and investigations have been made on a yellows-like appearance on peach trees in the nursery. Some experimental work has been done in top-working apple trees. Along lines of plant breeding a study is being made of the relation of bud variation to variety improvement. The forcing of vegetables has received some attention. (Tomatoes grown under glass are shown in Pl. XXXI, fig. 2.)

During the first seven years of the station's existence the leading lines of work in entomology were the collection and arrangement of specimens of the injurious and beneficial insects for reference and

study, and the improvement of insecticides and the study of their effects upon fruits and vines. During the past three years the work has been limited to investigations on the use of insecticides and on the life history of the strawberry-root aphis. Numerous experiments have been made with various insecticides for the destruction of the San José scale, kerosene receiving the most attention.

As the station has control of very little land, much of its field work is carried on in the form of cooperative experiments. A number of interested land owners donate the use of land and carry out the work according to prescribed lines. Such work is always under the immediate personal supervision of one of the chiefs of divisions. That officer inspects the work, receives and records the reports, and prepares the material for publication.

During a considerable part of the station's history it has followed the practice of cooperating with veterinarians throughout the State instead of employing a veterinarian as a member of the station staff. This was done to avoid undesirable results of any possible misunderstanding by citizens of the State engaged in agricultural pursuits as to the proper function of such an official. This policy was adopted in 1890 and followed until 1899. Facilities were offered to the veterinarians cooperating in the way of libraries, laboratories, and the services of station officers. In return the veterinarian furnished reliable information concerning prevalent diseases, and oftentimes gave timely warning of outbreaks of contagion among farm animals.

DISSEMINATION OF INFORMATION.

The station has issued 45 regular bulletins, 2 special bulletins, and 11 annual reports. The annual reports contain a full and detailed account of the work of the station for the year. They are not printed in editions in excess of 1,000 copies. The station has recently begun issuing regular newspaper bulletins. The mailing list contains 6,700 names, and the correspondence amounts to about 2,700 letters a year. Nearly all of the members of the staff are identified with the Grange, or Patrons of Husbandry, and all of them are called upon frequently for addresses before such meetings or at farmers' institutes.

GENERAL RESULTS OF WORK.

The Delaware Station has done much to benefit the agriculture of the State by assisting in the introduction of crimson clover for forage and green manuring. The work of the station on this plant has also been an important factor in determining the range of its usefulness in other parts of the country. Its studies of anthrax and the means for its repression have been of general importance as well as of direct practical benefit to Delaware farmers. Much useful work has also been done for the promotion of the dairying and horticultural interests of the State.

FLORIDA.

Agricultural Experiment Station of Florida, *Lake City.*

Department of Florida State Agricultural College.

GOVERNING BOARD.

J. R. Parrott (*President*), *St. Augustine;* J. D. Callaway, *Lake City;* L. Harrison, *Lake City;* F. E. Harris (*Secretary*), *Ocala;* Geo. W. Wilson (*Vice-President*), *Jacksonville;* E. D. Biggs, *Pensacola;* C. A. Carson, *Kissimmee.*

STATION STAFF.

W. F. Yocum, M. A., *President of the College and Director.*

Horace E. Stockbridge, Ph. D., *Agriculturist.*
H. K. Miller, M. S., *Chemist.*
H. A. Gossard, M. S., *Entomologist.*
Howard H. Hume, M. S., *Horticulturist and Biologist.*
A. W. Blair, M. A., *Assistant Chemist.*
John F. Mitchell, *Foreman of Farm.*
W. P. Jernigan, *Auditor and Bookkeeper.*
J. H. Jefferies, *Foreman of Garden and Orchards.*

HISTORY.

The Florida Station is located in the northeastern part of the State. The land of the State in general rises gradually from the Atlantic Ocean and the Gulf of Mexico to a central ridge, which attains an elevation of about 300 feet. There are numerous inlets of the sea, small lakes, and swamps. Forests, especially of pines, are extensive. The soils are sandy and generally underlaid with limestone, and are as a rule productive. "Though Florida extends over 6 degrees of latitude, its climate is very uniform." The mean annual temperature is about 70° F. The annual rainfall ranges between 40 and 75 inches in different localities. Truck farming and orange growing have in recent years been the principal agricultural industries. Cotton, tobacco, and sugar cane are grown in considerable amounts. Pineapples are successfully grown in the southern part of the State. Agriculture has been practiced in the State by white men to some extent for more than two hundred years, but its chief development has taken place within the past quarter of a century.

The college with which the station is connected was established in 1884, and is being developed along industrial and scientific lines.

The Agricultural Experiment Station of Florida was organized in March, 1888, in accordance with the act of Congress, as a department of the Florida State Agricultural College, with Prof. J. Kost, LL. D., as director. At the organization of the station substations were organized at Defuniak Springs, Fort Myers, and Ocala. These substations were discontinued in 1897. In January, 1889, Rev. James P. De Pass became director of the station, serving until June, 1893, when he was

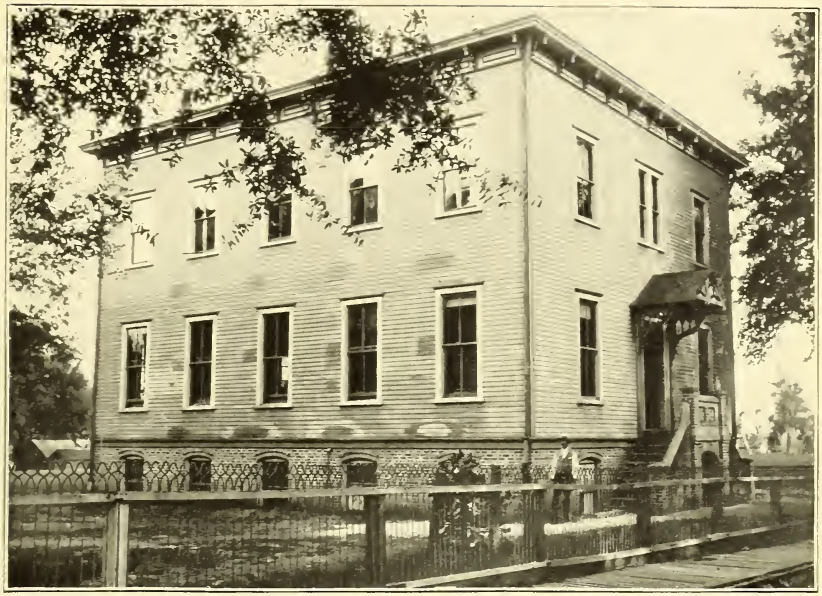


FIG. 1.—FLORIDA STATION—CHEMICAL LABORATORY.

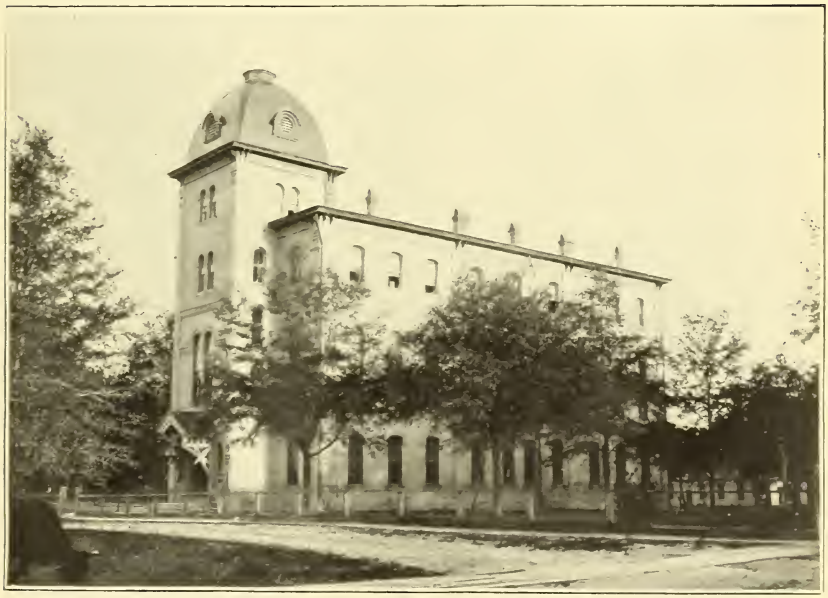


FIG. 2.—FLORIDA STATION—MAIN BUILDING, USED BY COLLEGE AND STATION.

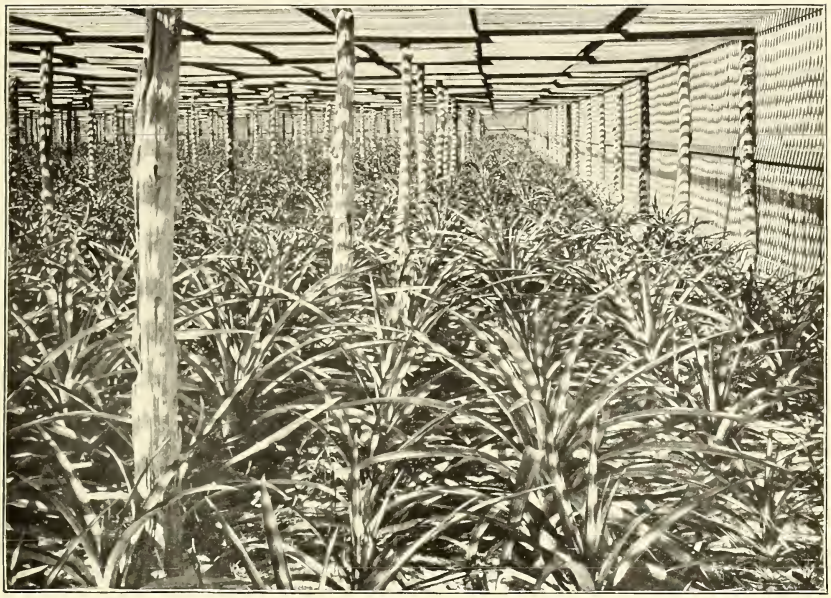


FIG. 1.—FLORIDA STATION—PINEAPPLE SHELTER.

FIG. 2.—FLORIDA STATION—FERTILIZER EXPERIMENTS WITH PINEAPPLES, JENSEN.

FIG. 1.—FLORIDA STATION—GROWING CELERY IN WINTER.

FIG. 2.—FLORIDA STATION—CASSAVA FIELD.

succeeded by Prof. Oscar Clute, who was also president of the college. The present incumbent has served in both capacities since October, 1897.

ORGANIZATION.

The board of control of the station is the board of trustees of the college, which consists of seven members appointed by the governor for terms of four years, and confirmed by the State senate. Not more than two members may belong to the county in which the college and station are located. Meetings of the board are held at the call of the president of the board. No compensation is allowed for services. The State treasurer is ex officio treasurer of the station.

The staff consists of the president of the college (who is also director), a biologist and horticulturist, chemist, agriculturist, entomologist, farm foreman, auditor and bookkeeper, and foreman of garden and orchards, appointed by the board of control for a term of one year. The duties of the director are chiefly administrative. His approval is required prior to all expenditures of funds. He edits and publishes the bulletins and reports and has general supervision of all the work of the station.

EQUIPMENT.

The station buildings comprise a chemical laboratory, residences for the farm foreman and gardener, fertilizer and tool house, two barns, tobacco house, forcing house and conservatory, building containing a stable, tool house, and office of the farm foreman, and several other small buildings. The chemical laboratory (Pl. XXXII, fig. 1) is a frame building, 50 by 60 feet, two stories and basement. It is used partly for college and partly for station purposes. At present the offices of the director, agriculturist, and auditor are in this building. The botanical and entomological laboratories are on the third floor of the main college building (Pl. XXXII, fig. 2), which is a three-story brick structure, 105 by 43 feet.

The station makes use of a part of the college farm. Forty-five acres are devoted to field experiments and 8 acres to plat experiments. All experimental plats contain one-tenth acre each. The station owns a few horses, 12 head of dairy stock, 70 swine, about 30 ducks, and a small flock of geese. The dairy animals are used in feeding experiments and in demonstrating the practicability of breeding up a dairy herd from native stock. Individual animals are purchased from time to time for the purposes of special experiments. The station makes use of the college museums, which contain about 5,000 specimens of insects and 6,000 specimens of plants, as well as specimens in various other branches of natural history. The station library contains about 2,000 volumes, and the college library about 3,000 volumes. The two libraries are kept together.

In the agricultural division several pieces of apparatus have been devised for use in handling sugar cane or in the manufacture of cane sugar. These are a sirup tester for determining the relative density of sirup, which is designed to assist the manufacturer in producing a uniform grade of product; a set of steam evaporating pans for use in making sirup without the direct application of heat; a filter for straining or clarifying cane juice; a modification of the upright cane mill, adapted for use with steam power; and a new centrifugal machine for the separation of sugar from molasses.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	155.90
Total	15,155.90

LINES OF WORK.

The station has no regular inspection duties. The entomologist occasionally inspects nursery stock and issues certificates of apparent freedom from scale and other injurious insects. No revenue is derived from this work.

The investigations of the station have been, in general, restricted to such as would be of immediate practical benefit to the agricultural industries of the State and have been along lines of horticulture, with its important branches of plant diseases and economic entomology, and agriculture, emphasizing especially fertilizer and cultural tests with the staple field crops of the State. Considerable attention has been given to the culture of the pineapple (Pl. XXXIII, fig. 1), and numerous fertilizer tests have been made with it (Pl. XXXIII, fig. 2). General studies have been made of methods of cultivation of many of the garden vegetables grown for home consumption or the Northern market, with a view to their improvement (Pl. XXXIV, fig. 1). In 1895 a general survey was made of the condition and culture of the orange groves of the State. The strawberry has been similarly studied.

Along lines of entomology studies have been made on the life history and habits of a number of the more injurious insects of the State, together with experimental work in methods of treatment. The species studied have included the bean-leaf roller, corn delphax, sweet-potato prodenia, snowy chionaspis, fig scale, cassava scale, rust-red flour beetle, chinch bug, rubus white fly, ramie-leaf roller, *Pyrameis cardui*, fall army worm, southern grassworm, strawberry thrips, and

onion thrips. Studies were made on the canna-leaf roller, which proved to be a hitherto undescribed species. General studies have been made of the insects attacking a number of the principal crops of the State, among them tobacco, strawberries, and truck and garden crops; also insects injurious to stored grain and cereal crops. A feature of the work in entomology has been the preparation of technical descriptions of many of the species studied from specimens collected in the State.

Studies have been made in field and laboratory of several fungus and bacterial diseases of garden plants, among them the fungus and bacterial blight of tomato, tomato rust, celery blight, and pear blight. In the course of field studies of the San José scale in 1895 it was discovered that certain orchards which were known to have been previously infested with the pest were rapidly becoming free from it. Investigations on the cause of this disappearance resulted in the discovery that it was due to a fungus parasite of the scale. This led to experiments in growing the fungus in artificial cultures, which was successfully done. Experiments with this fungus in combating the scale have been carried on in different parts of Florida and in several other States.

The agricultural division has but recently been separated from the chemical division. It is devoting itself to improving methods of producing and utilizing the standard crops of the State rather than to introducing new crops. Cultural, fertilizer, and rotation experiments are in progress with a considerable number of crops, among them tobacco, cotton, Irish potatoes, sweet potatoes, hemp, tomatoes, cassava (Pl. XXXIV, fig. 2), maize, sugar cane, peanuts, velvet beans, and cowpeas. The fertilizer experiments comprise investigations on the quantity of plant food, proportions of ingredients, and sources, methods, and time of application. Experiments with legumes are in progress to study the relative merits of the different leguminous plants thriving in Florida as nitrogen gatherers and soil renovators.

Some attention is being given to the introduction of the dairy industry and the development of dairy methods suited to local conditions. Feeding experiments have been carried on with cassava, demonstrating its high value as a cattle food. Investigations have been made on big head, leeches (bursatte), liver fluke, and Southern cattle fever, and the distribution of these diseases in Florida has been determined.

The chemical division has been occupied principally in making miscellaneous analyses. A soil survey of the State has been in progress for several years. Ash analyses have been made of a number of economic plants, among them the orange, and food analyses of certain grasses and feeding stuffs. A number of samples of local phosphates have also been examined.

DISSEMINATION OF INFORMATION.

The station has issued 50 bulletins and 6 annual reports. The latter publication has generally been merely an administrative document, though occasionally it has contained reports of minor experiments. The mailing list contains about 4,000 names, and the correspondence amounts to about 2,500 letters a year. By resolution of the board of trustees the superintendence of farmers' institutes is made one of the duties of the agriculturist. Other members of the staff cooperate with him.

GENERAL RESULTS OF WORK.

The Florida Station has materially aided in the development of truck farming and fruit growing in the State. Its investigations of injurious insects and plant diseases have been important, and it has greatly promoted the practice of spraying for the repression of these pests. The introduction of the velvet bean for forage and green manuring and of cassava as a root crop for animals and for starch making has already been of practical benefit to the agriculture of the State. The station has also materially increased the value of the sugar-cane crop by introducing improved methods for its utilization for the making of sirup.

GEORGIA.

Georgia Experiment Station, *Experiment.*[1]

Department of Georgia State College of Agriculture and Mechanic Arts.

GOVERNING BOARD.

Board of Directors: O. B. Stevens (*President*), *Atlanta;* J. B. Park, jr. (*Secretary and Treasurer*), *Greensboro;* Walter B. Hill, *Athens;* H. C. White, *Athens;* James H. Evans, *Hideyondale;* P. E. Boyd, *Leary;* J. T. Ferguson, *Leesburg;* J. H. Mobley, *Hamilton;* A. J. Smith, *Conyers;* Eden Taylor, *Popes Ferry;* Felix Corput, *Cavespring;* A. V. Deadwyler, *Maysville;* W. H. Warren, *Augusta;* William Henderson, *Ocilla.*

STATION STAFF.

H. C. White, C. E., Ph. D., *President of the College.*

R. J. Redding, *Director.*

H. C. White, C. E., Ph. D., *Vice-Director; Chemist.*

A. L. Quaintance, M. S., *Biologist and Horticulturist.*

J. M. Kimbrough, *Agriculturist.*

Mark Riegel, *Superintendent Horticultural Grounds.*

H. J. Wing, *Dairyman.*

Miss Pearl Bush, *Stenographer and Typewriter.*

HISTORY.

The State of Georgia has a considerable diversity of elevation, soils, and climate, ranging from the fertile alluvial lands of the coast, where the

[1] Telegraph, express, and freight address, *Griffin.*

temperature is semitropical, to the hill regions of the northern part of the State, where the winters are comparatively cold. The annual rainfall averages about 48 inches, well distributed through the year. The first settlement was in 1733. The great profit accruing from the growing of cotton with slave labor in the middle of the nineteenth century caused a great expansion of the area devoted to this crop, especially in the uplands where short staple cotton alone could be produced. The continuous growing of cotton and the washing of the land, due to careless methods of tillage, led to a widespread impoverishment of the soil and necessitated the extensive use of commercial fertilizers. In recent years the desirability of improvement of agricultural methods and diversification of agricultural industries has been clearly seen by the more intelligent farmers, and very naturally the station has bent its energies chiefly in that direction. The development of manufacturing in Georgia during the past quarter of a century has been quite remarkable and is having very important results in stimulating the betterment of agriculture. The manufacture of cotton goods in particular has reached large proportions.

The Georgia Agricultural Experiment Station was organized in accordance with the act of Congress, February 18, 1888, by the board of trustees of the University of Georgia as a department of the Georgia State College of Agriculture and Mechanic Arts and located at Athens. Prof. W. L. Jones was appointed director. In 1889, however, the State legislature passed an act reorganizing the station and creating a board of directors for its management. The reorganized station was named the Georgia Experiment Station and was located at Griffin. Prof. R. J. Redding has served as director since the reorganization.

ORGANIZATION.

The governing authority of the station is vested in a board of directors, which is composed of the commissioner of agriculture of Georgia (who is ex officio president of the board), the chancellor of the State University, ex officio, one member of the faculty of the State College appointed by the governor each year, and one "practical and successful" farmer from each Congressional district in the State, of which there are at present 11, appointed by the governor for a term of five years. The board holds regular quarterly meetings at the station. The members receive no compensation, but traveling expenses are paid from a fund provided by the State. A standing executive committee of three members is charged with the duty of auditing and approving requisitions of the director for funds for ordinary expenses, and, in general, exercises the authority of the board when that body is not in session. Temporary and special committees are appointed as occasion may demand.

The staff is composed of the president of the college (who is also vice-director and chemist), a director, biologist and horticulturist, superintendent of horticultural grounds, agriculturist, dairyman, and stenographer and typewriter. The biologist and horticulturist also performs the duties of accountant. The staff officers are elected at the October quarterly meeting of the board of directors, the tenure of office being one year. The director is ultimately responsible to the board of directors for the character and condition of the station's work in every particular. He plans or passes on all projected lines of investigation and has control of the publication of results. No expenditures for the ordinary work of the farm may be made without his approval.

EQUIPMENT.

The station buildings comprise residences for the director (Pl. XXXV, fig. 1), horticulturist, agriculturist, dairyman, and six small cottages for the use of farm employees and laborers; frame horse and cattle barn with annexes for carriage house, silo, calf barn, and manure shed; dairy building with cemented basement; chemical and biological laboratory with cellars and an annex; propagating house; tobacco barn; ginnery and tool house, with machinery for ginning and baling cotton; carpenter and blacksmith shop; engine house with stationary engine; complete system of waterworks, hydrants, house service, etc.

The farm (Pl. XXXV, fig. 2) covers 130 acres, 80 of which are under cultivation, 35 in pasture, and 15 in parks and lawns (Pl. XXXVI, fig. 1). The cultivated land, including orchards and vineyards, is mostly divided into square sections of 1 acre, each being bordered by roads 12 feet wide. About 15 acres are planted to orchards (Pl. XXXVI, fig. 2) and vineyards (Pl. XXXVII, fig. 1).

The station owns 4 mules, 18 head of cattle, including 12 registered Jerseys (Pl. XXXVII, fig. 2), and a few hogs. Special animals are bought for beef-feeding experiments as needed, and are disposed of at the close of the experiment. The relation of Texas fever to cattle ticks was investigated with 6 head of cattle supplied by the United States Department of Agriculture.

The station has a collection of about 2,500 named species of insects, besides many not yet determined. In the herbarium there are about 2,000 named specimens, including economic fungi. A collection of fruits preserved in fluid now includes about 300 different varieties, principally grapes. Photographs have been made of many economic insects and fungi and of the more valuable varieties of fruits tested at the station. Lantern slides are made as needed. The library contains about 800 volumes of reference books.

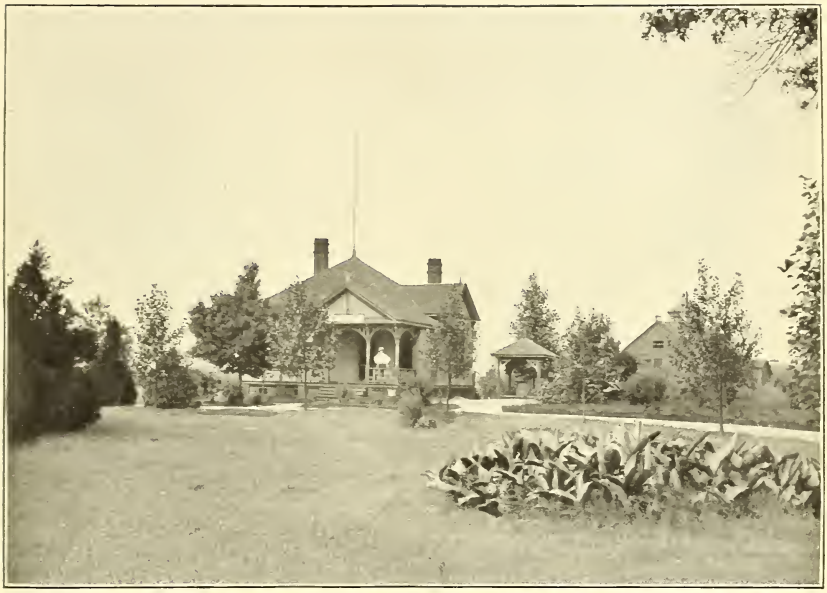


FIG. 1.—GEORGIA STATION—DIRECTOR'S OFFICE.

FIG. 2.—GEORGIA STATION—EXPERIMENTAL FARM.

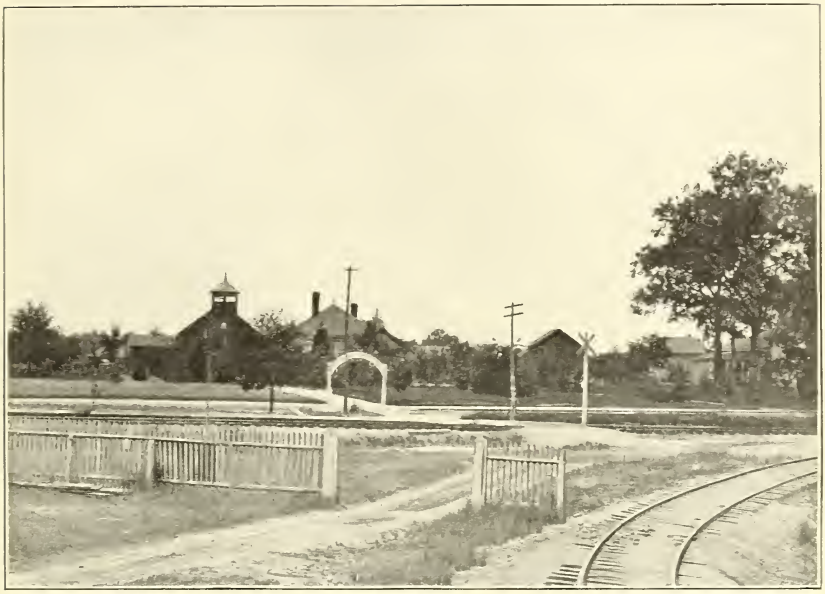


FIG. 1.—GEORGIA STATION—GROUNDS.

FIG. 2.—GEORGIA STATION—EXPERIMENTAL ORCHARDS.

FIG. 1.—GEORGIA STATION—EXPERIMENTAL VINEYARDS.

FIG. 2.—GEORGIA STATION—THOROUGHBRED JERSEYS IN STATION HERD.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund, a small appropriation from the State to cover the traveling expenses of the board of directors, and the sale of farm products. The income of the station during the last fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	650.00
Farm products	1,763.32
Miscellaneous	248.06
Balance on hand July 1, 1898	2,755.28
Total	20,416.66

LINES OF WORK.

The station has no inspection duties. It has been the policy of the station to consult the immediate needs of the farmers of the State. These are, primarily, instruction in soil renovation, improved methods of culture of the staple crops, and diversified farming as a remedy for overproduction of cotton. The work of the station has been mainly along the lines of fertilizer, cultural, and variety tests with maize and cotton; cultural tests and analyses of forage plants for Georgia; and horticultural investigations, especially with grapes, peaches, small fruits, garden vegetables, and sweet and Irish potatoes.

Fertilizer experiments with cotton have comprised tests of the comparative value of kainit and different forms of phosphates, and of muriate and sulphate of potash, the relative importance of nitrogen as a fertilizer for this crop, and its cheapest forms, the effect of different proportions of the fertilizing elements, the merits of successive applications of fertilizers, and the effects of increasing amounts of fertilizers on cotton production. The cultural experiments have had to do with depth of culture, hill as compared with drill culture, and distance of planting. Some work has been done in hybridization.

Fertilizer experiments with maize have included tests of the relative importance of nitrogen in the fertilizer formula, and its cheapest forms; tests of successive applications of fertilizers as compared with a single application, the relative effect of different quantities of fertilizers, comparisons of crushed cotton seed and cotton-seed meal as fertilizers, tests of muriate of potash as a fertilizer for maize, and the residual effects of a number of fertilizer substances. The cultural experiments with maize have included depth of culture, distance of planting, subsoiling, and methods of harvesting and curing. The chemist has made analyses of the different parts of the plant. Fertilizer and cultural experiments have been carried on with sweet and Irish potatoes, and tests made of methods of preserving sweet potatoes in winter.

It has been the policy of the station to encourage the development of the dairy interests of the State, with the object of diversifying its agricultural interests and increasing the fertility of the poor soils. This has involved field experiments with a variety of forage crops, including maize, Kafir corn, sorghum, millet, teosinte, field pea, peanut, cowpea, and soy bean, and chemical analyses of the products. Cowpeas have received special attention on account of their great importance in southern agriculture. Fertilizer and variety tests have been made and investigations carried on to determine the best methods of using them in green manuring. Analyses have also been made of a number of local fodders and feeding stuffs. Feeding experiments have recently been carried on.

Investigation of the relation of cattle ticks to Texas fever, including breeding of ticks of different strains, and microscopic examination of the blood and internal organs of infected animals, has been undertaken.

The problems occupying the horticultural division have included tests to determine the relative resistance of a considerable number of varieties of peaches to standard fungicides and insecticides, especially to Bordeaux mixture of varying strengths. Investigations have been made on the root pruning of the peach, apple, and cherry. Tests of the different races of peaches are being conducted in cooperation with the Division of Pomology of the United States Department of Agriculture. Studies have been made with strawberries, blackberries, and some other small fruits, with a view to extending their culture in the State. Observations have been made upon the habits of the imported cabbage butterfly and the occurrence of the San José scale in the State.

DISSEMINATION OF INFORMATION.

The station has published 47 bulletins and 11 annual reports. The annual report is an administrative document, of which but 1,200 copies are issued at the present time. Thirty-seven press bulletins have been issued, usually in the form of stereotyped plates ready for use, each containing three columns 2½ inches wide and 20 inches long, a set of which is sent to each of 50 newspapers in the State for use in their regular editions. The mailing list contains 14,170 names, classified and kept separately as Georgia farmers, farmers in other States, newspapers in the State, newspapers without the State, libraries and public institutions, scientists and students, experiment stations, public officials, Washington, D. C., and foreign countries. The correspondence amounts to about 3,500 letters a year. The station is in active cooperation with all agricultural and horticultural associations in the State, and aids in farmers' clubs, State fairs, etc.

GENERAL RESULTS OF WORK.

The Georgia Station has been effectively aiding the movement for the diversification of agriculture, which is increasing in strength from year to year in Georgia as well as in the other Southern States. The station has systematically advocated and illustrated the advantages of a proper system of rotation of crops suited to Southern conditions, and has done much to introduce improved methods of culture and fertilizing. It has also shown that the climate and other natural conditions in Georgia are well suited to the dairy industry and that high-grade dairy products can be made in the State. Much interest has been aroused in this subject and some successful creameries and cheese factories are the direct result of the station's demonstration.

HAWAIIAN ISLANDS.

Experiment Station of the Hawaiian Islands, *Honolulu.*

Maintained by the Hawaiian Sugar Planters' Association.

STATION STAFF.

Walter Maxwell, PH. D., *Director and Chemist.*
F. Thompson, B. S., *Assistant Chemist.* E. G. Clarke, *Field Assistant.*
C. F. Eckart, *Assistant Chemist.*

HISTORY.

The Experiment Station of the Hawaiian Islands is located at the capital, on the island of Oahu. The islands are of volcanic origin and their surface is generally mountainous, some peaks rising to a height of over 13,000 feet. There are two active volcanoes. The climate of the lowlands is warm and equable. The annual rainfall ranges from about 12 inches to 19 feet in different localities. The soils are generally fertile. There are considerable forests on the mountains. The principal crops are sugar cane, rice, kalo, maize, and wheat. Bananas, pineapples, oranges, and other fruits are successfully grown. Numerous sheep are produced. Sugar making has in recent years become a very important industry. The Hawaiian Islands were annexed to the United States in 1898.

The Hawaiian Experiment Station was organized in 1895 as a private institution by the Hawaiian Sugar Planters' Association, with Dr. Walter Maxwell, formerly of the Division of Chemistry of the United States Department of Agriculture and later of the Louisiana Experiment Stations, as director. The station is under the auspices of the government of Hawaii, but does not receive any support from it. The staff comprises the director (who is also chemist), two assistant chemists, and a field assistant. The station occupies laboratories and an experimental field of 5 acres within the limits of the town of Honolulu.

LINES OF WORK.

The investigations of the station have been mainly in the interests of the sugar industry of the islands. They have comprised investigations on soils, fertilizer, culture, and variety experiments with sugar cane, and studies on the technology of sugar-making. The soils of the Hawaiian Islands have been formed exclusively from lavas, on which studies have been made. Differences in soil are due to the widely varying climatic conditions existing in the islands and the different modes in which the lavas were dissolved. The different soils have been studied and classified according to the physical and chemical agencies that controlled their formation. They have also been studied in their relation to the widely varying climatic conditions. Analyses have been made of the different types of soils, and the specific fertilizer requirements of each have been studied. On the basis of the information thus acquired the station advises planters in regard to the use of commercial fertilizers. Incidentally, it also analyzes samples of commercial fertilizers and fertilizing materials sent in for the purpose. Considerable work has been done in irrigation, in connection with which observations have been made on the amount of evaporation from soils and plants.

Extended studies have been made of varieties of sugar cane and the peculiar soil and climatic adaptations of each, and varieties have been classified according to physical, chemical, botanical, and economic characteristics. Comparisons have been made of different methods of cultivating the cane. Methods of manufacturing sugar have been studied, and this work has been accompanied by examinations of the methods and practices obtaining in the sugar mills of the islands. Some attention has been given to testing other plants of possible value in the islands.

The results of the station's work have been published in three annual reports and a volume by the director and chemist, Walter Maxwell, Ph. D., on the "Lavas and Soils of the Hawaiian Islands." Frequent contributions have been made to the local press.

IDAHO.

Agricultural Experiment Station of the University of Idaho, *Moscow.*

Department of the University of Idaho.

GOVERNING BOARD.

Board of Regents: G. A. Robethan (*President*), *Pocatello;* F. N. Gilbert (*Vice-President*), *Moscow;* F. E. Cornwall (*Secretary*), *Moscow;* A. H. Alford, *Lewiston;* J. B. Goode, *Coeur d'Alene;* C. E. Harris, *Montpelier;* J. E. Hickman, *Preston;* Mrs. George Williams, *Hailey.*

STATION STAFF.

Joseph P. Blanton, M. A., LL. D., *President of the University and Director.*
Samuel Avery, PH. D., *Chemist.*
Louis F. Henderson, PH. B., *Botanist.*
John M. Aldrich, M. S., *Entomologist.*
John E. Bonebright, M. A., *Meteorologist.*
Fred G. Frink, B. S., *Irrigation Engineer.*
Fred A. Huntley, B. S. A., *Horticulturist.*
Hiram T. French, M. S., *Agriculturist.*
Thorn Smith, B. S., *1st Assistant Chemist.*
Herbert T. Condon, *Clerk.*
William L. Payne, *Treasurer.*

HISTORY.

The Idaho Station is located in the narrow northern part of the State, on the eastern side of the Palouse Valley. This region consists in large part of low, rounded, treeless hills which can be cultivated to their summits. The fertile soil is usually retentive of moisture, and though the rainfall is comparatively scanty agriculture is carried on without irrigation. The great length of the State from north to south gives a wide range of climate and other agricultural conditions. There are large tracts of arid land, much of which has an elevation of several thousand feet, and many fertile valleys. Until within a comparatively short time mining and grazing were the almost exclusive occupations of the scattered and small population. Wheat growing has since attained much importance, and fruits of fine quality, especially apples and peaches, are now being produced in considerable amounts in different localities. The sparse population, the great area of the State, and the lack of adequate railroad facilities have greatly increased the difficulties attending the development of experiment station work in a region where agriculture has not been practiced in any regular way for a longer period than twenty-five years. The State was admitted to the Union in 1890, and the university with which the station is connected was opened for students in 1892.

The agricultural experiment station of the University of Idaho was organized in accordance with the act of Congress of February 26, 1892, with Prof. Franklin B. Gault, president of the university, as chairman of the station council, and Robert Milliken as director. The station was reorganized August 31, 1893, with Prof. Charles P. Fox as director. At the same time three substations were established in different parts of the State, one at Grangeville, in the pluvial region of north Idaho; one at Nampa, in south Idaho, in the low arid section, and the third at Idaho Falls, in eastern Idaho, in the high arid section. These substations were established for the purpose of ascertaining the agricultural conditions of these respective sections and to determine varieties and cultural methods suitable to each. In each case the land was donated to the university regents for station purposes by the several communities. The deeds of conveyance contained the provision that when the University of Idaho ceased to operate the farms as agricultural experiment stations the same should

revert to the grantors. These substations were operated until 1896, when they were discontinued on account of lack of funds, and the land reverted to the original donors as provided in the deed of conveyance. The loss of the substations left the station without a farm. The needs of the university were laid before the citizens of Moscow, as a result of which a committee was appointed and subscriptions secured with which a tract of 83 acres, located one-half mile from the university buildings, was procured for the use of the station. In order to comply with the law of the State relating to the university, as well as to systematize the business of the institution, the board of regents decided in 1897 that thereafter the president of the university should serve also as director of the experiment station. Accordingly, President Franklin B. Gault assumed the office. He was succeeded July 1, 1899, by Prof. Joseph P. Blanton, as president of the university and director of the station.

ORGANIZATION.

The governing board of the station is the board of regents of the university, which consists of nine members appointed by the governor of the State, and confirmed by the senate, for terms of six years. The duties of the board of regents are to appoint the director and other members of the station staff and to supervise the operations of the station in a general way. The board of regents meets once a year. In the intervals between board meetings matters of minor importance are considered and passed upon by a resident executive committee consisting of three members of the board, which holds monthly meetings. All members of the governing board serve without compensation.

The staff consists of the president of the university (who is also director), chemist, botanist, entomologist, meteorologist, irrigation engineer, horticulturist, agriculturist, first assistant chemist, treasurer, and clerk. Members of the station staff are appointed by the board of regents and hold office at the will of the board. The director is the executive officer of the staff. All plans of work must receive his approval before being carried into execution. There is a station council, consisting of the director and heads of divisions, which meets monthly to discuss and pass upon lines of work proposed or under way.

EQUIPMENT.

The buildings occupied in whole or in part by the station comprise the administration building of the university, Horticultural Hall (Pl. XXXVIII, fig. 1), "The Annex," a farmhouse, and two barns, with a silo of 75 tons capacity. The administration building is a three-story structure of stone and pressed brick, with basement.

The horticultural building is a one-story wooden structure, 24 by 34 feet, with mansard roof, to which is attached a greenhouse, 50 by 18

FIG. 1.—IDAHO STATION—MAIN AND HORTICULTURAL BUILDINGS, USED BY UNIVERSITY AND STATION.

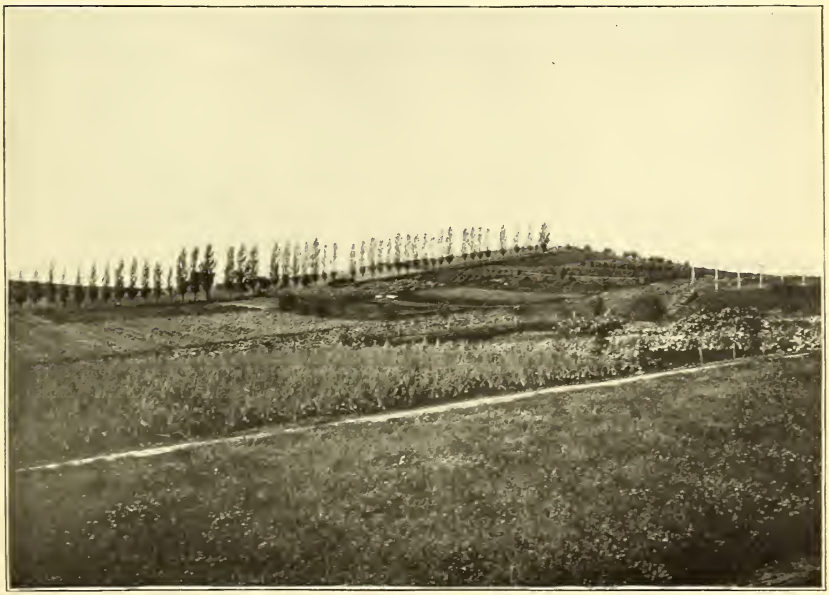


FIG. 2.—IDAHO STATION—HORTICULTURAL PLANTATION.

FIG. 1.—IDAHO STATION—VARIETY TESTS WITH GRAIN.

FIG. 2.—IDAHO STATION—FIELD EXPERIMENT WITH RAPE.

feet. The main part contains the horticulturist's office, a class room, a boiler room, and a potting room. The building is heated throughout by hot water. The framework of the greenhouse is of iron, resting upon a masonry foundation. "The Annex" is a one-story structure, with basement, 50 by 125 feet.

The station farm at present contains 104 acres, of which 94 are devoted to field experiments with forage plants and cereals, and 10 acres to field experiments in horticulture (Pl. XXXVIII, fig. 2).

The station live stock consists of 25 steers and a few sheep. In the agricultural division is a collection of about 500 specimens of grains, illustrating the different varieties grown on the station farm. In the entomological division are about 14,000 mounted specimens of insects, representing about 4,500 species. In the herbarium are about 500 sheets, mostly sedges and economic fungi. All divisions are well equipped with lantern slides, photographs, and microphotographs. The station library contains about 300 volumes. Station workers also have access to the university library.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund and the sale of farm products. The income of the station during the last fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	390.40
Farm products	115.26
Total	15,505.75

LINES OF WORK.

The station has no inspection duties. The work of the Idaho Station has been of a pioneer nature, such as making observations on the natural and agricultural conditions in the State and testing and introducing varieties of plants. The botanist, accompanied by the horticulturist, has made tours of inspection of orchards, fields, and gardens in all parts of the State, in order to learn the conditions ordinarily obtaining, and to ascertain, in a general way, the prevalence of fungus and insect pests. A considerable time has been spent upon the study of weeds, the wild oat receiving especial attention. Reports have been made upon the smuts and rusts occurring most commonly on the cultivated plants of the State. Considerable experimental work has been done in spraying.

The chemical division has been occupied mainly in making analyses of soils, waters, fruits, vegetables, sugar beets, and numerous other substances. A soil survey of the State is in progress, the mechanical analyses for which are made in the division of physics. Analyses have

been made of different varieties of strawberries and local orchard fruits to determine sugar content. Similar analyses were made of a large number of garden peas which had been grown in a comparative test of varieties. Analyses have been made of beets grown on the station farm and at other points in the State, and tests have been made of different methods of cultivation. The chemist is now engaged in making an examination of cattle foods and analyses of numerous varieties of native and cultivated grasses.

In the entomological division an outbreak of grasshoppers has been investigated and experiments made in combating them. Observations have been made on the habits and life history of the box-elder bug and the Putnam scale. Tests have been made of different methods of using kerosene in combating scale insects. The extent of the occurrence of the San José scale in the State has been mapped.

In the divisions of agriculture and horticulture numerous variety tests of forage crops and cereals (Pl. XXXIX, fig. 1) have been made to determine adaptability to different parts of the State and comparative merits of varieties. About 30 varieties of grasses have been under observation and those best adapted to local conditions determined. Similarly, observations have been made on various leguminous forage plants, such as the clovers, hairy vetch, sanfoin, rape (Pl. XXXIX, fig. 2), and field pea. A test is being made of silver-hull buckwheat as an exterminator of wild oats. Studies have been made on sugar beets to determine their value for sugar and for feeding farm animals. Meteorological observations have been made since the establishment of the station. The irrigation engineer has carried on experiments in irrigation in cooperation with the State engineer.

DISSEMINATION OF INFORMATION.

The station has published 19 bulletins and a few press bulletins. The annual report is merely an administrative document, and is numbered serially with the bulletins. The mailing list, which contains about 2,200 names, is kept on cards arranged alphabetically by States, counties, and towns. The chemist, Dr. B. Avery, is the author of a book entitled "Laboratory Exercises." Members of the station attend farmers' institutes in different parts of the State.

GENERAL RESULTS OF WORK.

The work of the Idaho Station has thus far been largely of a preliminary character with a view to ascertaining the agricultural capabilities of different parts of the State and determining the lines of work most necessary and feasible. Thus far its tests of different plants with reference to their adaptability to the State have been of the most practical value. A notable example of this is the work accomplished with sugar beets.

ILLINOIS.

Agricultural Experiment Station of the University of Illinois, *Urbana.*

Department of the University of Illinois.

GOVERNING BOARD.

Board of Trustees of the University: Governor John R. Tanner, *Springfield;* William H. Fulkerson, *Jerseyville;* Alfred Bayliss, *Springfield;* Alexander McLean, *Macomb;* Samuel A. Bullard, *Springfield;* Mrs. Lucy L. Flower, *The Virginia, Chicago;* Mrs. Mary Turner Carriel, *Jacksonville;* Francis M. McKay, *61 Alice Court, Chicago;* Thomas J. Smith, *Champaign;* Mrs. Alice Asbury Abbott, *467 Bowen avenue, Chicago;* Frederic L. Hatch, *Spring Grove;* A. F. Nightingale, *Schiller Building, Chicago.*

ADVISORY BOARD.

T. J. Burrill, PH. D. (*President*), *Urbana;* J. F. Prather (*of State Board of Agriculture*), *Williamsville;* H. Augustine, *Normal;* H. B. Gurler (*of State Dairymen's Association*), *Dekalb;* Frederic L. Hatch, *Spring Grove;* William H. Fulkerson, *Jerseyville;* Stephen A. Forbes, PH. D., *Urbana;* Eugene Davenport, M. AGR., *Urbana.*

STATION STAFF.

Andrew S. Draper, LL. D., *President of the University.*

Eugene Davenport, M. AGR., *Director; Expert in Animal Husbandry.*
T. J. Burrill, PH. D., *Botanist and Horticulturist.*
S. A. Forbes, PH. D., *Entomologist.*
D. McIntosh, V. S., *Veterinarian.*
[1] C. G. Hopkins, PH. D., *Chemist.*
P. G. Holden, *Agronomist.*
J. C. Blair, *Horticulturist.*
W. J. Fraser, *Expert in Dairying.*
G. P. Clinton, M. S., *Botanist.*
L. H. Smith, B. S., *Assistant Chemist.*
A. D. Shamel, B. S., *Assistant in Farm Crops.*

HISTORY.

The Illinois Station is located in the eastern part of the State, nearly midway between its northern and southern boundary, on the rich black loam which characterizes most of the agricultural land of the State. As Illinois covers about five and one-half degrees of latitude the range of climate within its borders is considerable. In general the variation of temperature during the year is over 100° F. The land originally was for the most part a vast gently rolling prairie covered with luxuriant grasses, with trees along the river courses. Agriculture in a regular way may be said to have begun about the time (1818) Illinois was admitted to the Union, when the population was less than 40,000. The raising of maize, oats, wheat, and live stock have been the principal agricultural industries and these have attained very large proportions. More than half of the broom-corn of the world is grown in this State. In more recent years dairying has been of very great importance. With the development of great manufacturing and commercial interests and the growth of numerous cities and towns the diversification of agriculture has proceeded with increasing rapidity and the planting of

[1] On leave.

shade trees and orchards has radically changed the general aspect of the region. The university with which the station is connected has developed very largely along technical and scientific lines and is a strong and well-equipped institution with over 2,200 students.

The work of the Illinois Station was preceded by very important investigations at the college of agriculture. September 13, 1876, Prof. T. J. Burrill announced, in a report to the trustees of the University of Illinois, the discovery of bacteria in great numbers in the blighting bark of pear and apple trees. In 1878, in a discussion before the Illinois State Horticultural Society, he further stated that bacteria caused the disease and that proof of this had been obtained by inoculations. But it was not until 1880 that he undertook a thorough investigation of the subject. By a large number of inoculations the causal relation of the bacteria to the disease was substantiated. A report of these researches was read by him before the American Association for the Advancement of Science, at Cambridge, Mass., that year. This report was subsequently published in the Transactions of the Board of Trustees of the University of Illinois for 1880, and in the Transactions of the Illinois State Horticultural Society for the same year. This was the first disease of plants that was demonstrated to be caused by bacteria.

The Agricultural Experiment Station of the University of Illinois was organized under the act of Congress as a department of the university, March 21, 1888, and the affairs of the station were placed under the immediate control of a board of direction consisting of nine persons appointed by the trustees of the university. Persons eligible for appointment were the president of the university, one member each from the State board of agriculture, the State Horticultural Society, State Dairyman's Association, and five other persons, two of whom must be members of the board of trustees. The president of this board of direction was appointed by the trustees. The first to serve in this capacity was S. H. Peabody, LL. D. He was succeeded in 1892 by Prof. G. E. Morrow, the agriculturist of the station. Upon the resignation of Professor Morrow in 1894 to become president of the Oklahoma Agricultural College and director of the Oklahoma station, Prof. T. J. Burrill assumed the duties of the office. June 9, 1896, the station was reorganized and the dean of the college of agriculture, Prof. E. Davenport, was made ex officio director of the experiment station, and the name of the board of direction was changed to that of advisory board. The director was charged with the responsibilities formerly laid upon the board of direction and now reports directly to the president of the university.

ORGANIZATION.

The experiment station is regarded as coordinate in rank with the agricultural college rather than a department of it, that is, the experi-

ment station is regarded as a department of the university rather than of the college. The relations of the college to the station are very intimate, however, and either is allowed free use of the other's property provided that in so doing it is not injured or destroyed, but each department bears the entire expense of its own enterprises. The governing board of the station is the board of trustees of the university, which consists of the governor of the State, the president of the State board of agriculture, and the superintendent of public instruction, ex officio, and 9 members elected by the people, 3 at each biennial election, for a period of six years. The duties of this board are those of trustees, to administer funds as appropriated and directed by Congress and the State legislature. Immediate supervision of station affairs is delegated to a committee of 4 of the board of trustees, known as the committee on agriculture. The functions of the advisory board are advisory only. Action is ordinarily taken upon recommendation of the director indorsed by the president, although a matter might arise in the committee on agriculture, or upon the recommendation of the advisory board or of the president of the university.

In all cases the work of committees is preliminary; the board alone can take final action. Regular meetings of the board are held quarterly, and members serve without compensation. The general policy as regards work and officers is to hold each officer absolutely responsible for the work and money intrusted to him. But little restraint is placed on his freedom of action or the nature of his expenditures, but he is held strictly accountable for results. He is charged with the duty of reporting regularly to his superior officer, and may be called upon at any time for report upon any feature of the work assigned to him. The secretary and the treasurer of the university serve the station in the same capacity.

The staff consists of the president of the university, director (who is also expert in animal husbandry), botanist and horticulturist, entomologist, veterinarian, chemist, agronomist, expert in dairying, botanist, horticulturist, assistant chemist, and assistant in farm crops. These appointments are made without definite time limit. The director is the executive officer of the station and has immediate charge of all of its property. There is an unofficial organization known as the station staff, which holds regular meetings for discussion of work and methods, but it has no executive or administrative function.

EQUIPMENT.

At present the different divisions are located in the college buildings. (For illustrations of the natural history building, building occupied by the horticulturist, soil laboratory, and dairy bacteriological laboratory, see Pl. XL, figs. 1 and 2, and Pl. XLI, figs. 1 and 2.) No special building has thus far been erected for the use of the experiment

station, except a small wooden structure used as a seed house. The last State legislature, however, appropriated $150,000 for an agricultural building to accommodate the work of both college and station. This will be the largest building devoted to agriculture on the continent, and will be ready for occupancy September 1, 1900.

It consists of four separate structures built around an open court and connected by corridors. The main building is 248 feet long, from 50 to 100 feet in depth, and three stories high, and contains offices, classrooms, and laboratories for the divisions of agronomy, animal husbandry, dairy husbandry, horticulture, and veterinary science; offices of the State entomologist, the chemical laboratory of the experiment station, commodious administration rooms, an assembly room with a seating capacity of 500, and on each floor a fireproof vault for records. The three wings are each 45 by 116 feet and two stories high. One is for dairy manufactures, one for farm machinery, and one for veterinary science and stock judging. A glass structure on the west serves the divisions of agronomy and horticulture. It is a little over one-fourth mile around the building, which is of stone and brick covered with slate, and contains in all 113 rooms and a total floor space of nearly 2 acres.

The college farm contains 160 acres, about 100 of which are available to the station for the purposes of field and orchard experiments. This is all surveyed, and about 20 acres are divided into plats of one-tenth acre each (Pl. XLII, fig. 1). There is an experimental forest plantation of which the station has charge. A view of the area planted to white pine is given in Pl. XLII, fig. 2. Farming operations are reduced to a minimum. The station maintains no permanent herd, but animals are purchased from time to time for special experiments. For experimental purposes the station also makes use of the live stock on the college farm (Pl. XLIII, fig. 1), consisting of Shorthorn, Holstein-Friesian, and Jersey cattle, Morgan and work horses, and Shropshire, Merino, and Dorset sheep, providing such use is in no way detrimental to the animals.

The station owns a collection of about 1,000 photographs and lantern slides illustrating horticultural and field experiments, about 500 samples of seeds, and 100 specimens of plants illustrating the results of experimental work, besides an herbarium of 4,699 specimens. The extensive museums of the university are open to station workers. There are also important collections belonging to the State laboratory of natural history.

The station owns a library of 4,559 bound volumes, mostly botanical or chemical works, but no additions are being made at present, except by donations. The library is housed with the general university library, which contains about 45,000 volumes.

The station is well equipped with apparatus for its special lines of

FIG. 1.—ILLINOIS STATION—NATURAL HISTORY BUILDING, USED BY UNIVERSITY AND STATION.

FIG. 2.—ILLINOIS STATION—HORTICULTURAL BUILDING.

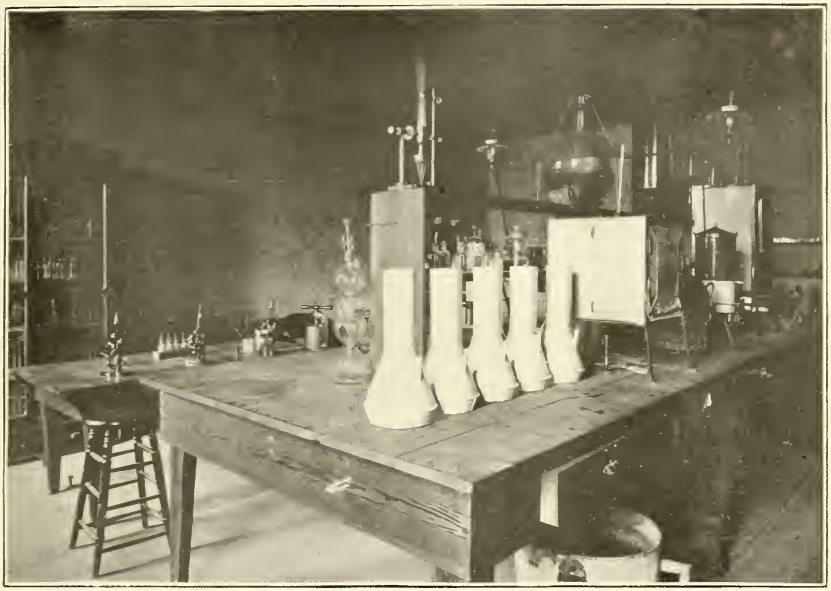


FIG. 1.—ILLINOIS STATION—SOIL LABORATORY.

FIG. 2.—ILLINOIS STATION—DAIRY BACTERIOLOGICAL LABORATORY.

FIG. 1.—ILLINOIS STATION—EXPERIMENTAL PLATS.

FIG. 2.—ILLINOIS STATION—WHITE PINE PLANTATION.

FIG. 1.—ILLINOIS STATION—DAIRY HERD AND BARN.

FIG. 2.—ILLINOIS STATION—ORCHARD CULTIVATION.

work. Special mention may be made of a pair of scales devised at the station. These scales have a beam 16 feet long, to one end of which is attached a pair of arms capable of picking up an entire shock of maize or other grain, lifting it free from the ground, and setting it down again undisturbed. The weighing is done with a pair of steelyards at the opposite end of the beam. The whole is mounted on a wagon. With these scales 10 acres of grain or maize may be weighed in a single day. By so doing all weighings are made under uniform conditions of weather.

FINANCIAL SUPPORT.

The financial support of the station is derived principally from the national fund, fees for fertilizer analyses, and sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Individuals	356.53
Fees for fertilizer analyses	195.00
Farm products	3,148.95
Miscellaneous	40.00
Total	18,740.48

LINES OF WORK.

The station analyzes all brands of fertilizers licensed by the State board of agriculture to be sold in the State. The analyses are made at the uniform rate of $10 each. Less than 20 samples are analyzed yearly.

The work of the Illinois Station has been principally along lines of dairying and fruit growing, and field experiments with maize, oats, and wheat, together with a comprehensive study of maize. The experiments in the interests of dairying were made chiefly for the purpose of determining the kinds and extent of variation to which animals and milk are subject, and the cost of producing milk. The object of the work on variations of milk was to get an exact record of the performance of different cows, with a view to determining the influence of changes in weather, season, and feed; the extent of variation in live weight and quantity of milk; and the chemical composition of milk at different stages of the period of lactation. Tests were made to determine to what extent the composition of milk may be affected by different kinds of concentrated feeding stuffs, and by the accidental and normal changes of environment to which the cow is subject. Experiments are now in progress to ascertain how a grain ration affects the milk production of cows fed on grass. The digestibility of various cattle foods has been tested. A few experiments have been made in pig feeding. In forage production, tests have been carried on with varieties of grasses and clovers since the organization

of the station, together with various cultural experiments, such as field tests of mixtures and methods of sewing, and studies have been made on the effect of ripeness on yield and composition. Some attention has been given to experiments with other forage plants.

Maize is the most important agricultural product of the State, of which it produces more than any other State, with one exception. From the organization of the station, this crop has received much attention, and in recent years investigations on it have been made the leading line of work at the station. Plans are now laid according to which this feature of the work will be even more emphasized than formerly. It is proposed to study the maize plant from every point of view that concerns agriculture, among which will be investigations on its botanical, chemical, and physiological characters, fertilizer requirements, culture, and cross fertilization, together with tests of rotations or systems of cropping. Tests of varieties have been in progress since the organization of the station. The permanence of varieties is being studied, especially in its application in plant breeding. Numerous culture experiments have been made, relating especially to time, depth, thickness of planting, planting in hills or drills, effect of depth and time of planting, frequency and depth of cultivation, and the effects of root-pruning, different fertilizers, and removing tassels. Experiments are now in progress with companion and catch crops for maize. Observations have been made on the habits of growth of the roots and on the rate of growth of the plant. Experiments are in progress to determine the effects of sowing rye in the maize field at the last plowing, and other experiments to determine the yield of maize planted with and without pumpkins, and of pumpkins planted with and without maize. For some time the botanist carried on experiments, the purpose of which was to inoculate the root of the maize with the bacteria of the root tubercles of legumes. Observations have been made on the amount of water required to produce one pound of dry matter in the plant. An extensive study of the history of maize is in progress. The botanist, Professor Burrill, has discovered and described a bacterial disease of the plant. The same officer has also made important investigations on the biology of silage, which have resulted in distinguishing the different fermentations that occur in the silo and the conditions under which each takes place.

The cereals next in importance in the agriculture of the State are oats and wheat. The experiments with oats have been principally cultural in nature and have comprised experiments made to determine the quantity of seed to be used per acre, the relative merits of compact and loose seed beds, and the time and depth of sowing, together with tests of varieties. The experiments with wheat are similar in nature; they have included tests of fertilizers, of methods of soil preparation, of quantity of seed to be used per acre, and of time and depth

of sowing, comparisons of yields from large and small seed, and tests of varieties. Experimental work looking to the improvement of cereals by the production of new varieties by selection and breeding has been in progress for several years. Extensive studies have been made and are still in progress to determine the adaptability of the soil and climate of Illinois to the culture of the sugar beet.

Some attention has been paid to soil studies. A record has been kept of soil temperatures at the college since the organization of the station. Observations have been made on the rapidity of evaporation from the surface of water, from uncultivated soil, from maize, and from grass. Considerable attention has been paid to the improvement of unproductive white clay soils in the southern part of the State. Experiments are in progress in subsoiling and to determine the influence of nitrogen on the growth of leguminous plants. In horticulture considerable attention has been paid to testing new varieties of orchard and small fruits and vegetables, and to originating new varieties. Experiments in the cultivation (Pl. XLIII, fig. 2), management, and fertilization of orchards have been carried on since the organization of the station. Tests are being made of different methods of transplanting trees. Investigations are being made on the deterioration of fruits and vegetables. Tests have been made of new varieties of apples, both by planting and by top grafting, and comparisons have been made of the hardiness of root-grafted and double-worked trees, as also of methods of propagation by whole and by piece roots. The reciprocal effect of stock and scion is being studied.

Investigations have been made on pear blight, the rot of the potato and tomato, and the life history and method of treatment of smut of broom corn. Studies have been made of the economic parasitic fungi of the State and of the smuts of cereals and methods of prevention. Some attention has been paid to the weeds of the State.

DISSEMINATION OF INFORMATION.

The station has issued 11 annual reports, 56 regular bulletins, 17 circulars, and a few press bulletins. The annual report contains in general only a list of experiments in progress and an itemized statement of the station's accounts. The circulars are in the nature of information bulletins, or are issued to collect facts or to report upon work not sufficiently advanced to be put in bulletin form.

The mailing list contains about 17,000 addresses. New names are kept on cards, but from time to time they are added to a printed list which is kept set up in galley proof. The correspondence amounts to about 5,000 letters a year. The call for the assistance of the station in farmers' institutes and at fairs is greater than can be met. During the past year members of the staff attended 75 institutes and other farmers' gatherings. The station regularly makes an exhibit at the State fair and some other fairs.

GENERAL RESULTS OF WORK.

The Illinois Station has done much toward the establishment of better methods of culture of maize, oats, and wheat, noteworthy among which was the introduction of the method of shallow cultivation of corn, which has now been quite generally adopted throughout the State. The introduction of rape into the State was due almost entirely to station effort. In recent years the relative adaptability of different parts of the State to the successful culture of beets for sugar has been ascertained. The station has also accomplished considerable useful work in informing farmers regarding modern methods of dairying, in the promotion of horticulture, and in the repression of plant diseases.

INDIANA.

Agricultural Experiment Station of Indiana, *Lafayette.*

Department of Purdue University.

GOVERNING BOARD.

Board of Trustees: William V. Stuart (*President*), *Lock Box 37, Lafayette;* E. A. Ellsworth (*Secretary*), *Lafayette;* J. M. Fowler (*Treasurer*), *Lafayette;* William A. Banks, *Laporte;* Sylvester Johnson, *Irvington;* D. E. Beem, *Spencer;* Job H. Van Natta, *Lafayette;* Benjamin Harrison, *Indianapolis;* William H. O'Brien, *Lawrenceburg;* James M. Barrett, *Fort Wayne;* Charles Downing, *Greenfield.*

STATION STAFF.

James H. Smart,[1] M. A., LL. D., *President of the University.*
Charles S. Plumb, B. S., *Director.*
William C. Latta, M. S., *Agriculturist.*
James Troop, M. S., *Horticulturist.*
Henry A. Huston, M. A., A. C., *Chemist.*
Joseph C. Arthur, D. Sc., *Botanist.*
A. W. Bitting, D. V. M., *Veterinarian.*
William Stuart, M. S., *Assistant Botanist.*
A. H. Bryan, B. S., *Assistant Chemist.*
J. H. Skinner, B. S., *Assistant Agriculturist.*
H. E. Van Norman, B. S., *Assistant to Director and Superintendent of Farm.*

HISTORY.

The Indiana Station is located in the western part of the State, toward the north. The surface of the State is in general an undulating plain with an elevation ranging between 1,200 and 500 feet. The land was originally covered with a variety of forest trees which had to be removed before agriculture could be pursued. There are a number of different kinds of soil and large areas of fertile land. The average annual rainfall is about 42 inches and the temperature 52° F. Maize, wheat, oats, hay, and potatoes have been the principal crops, and large numbers of cattle, sheep, swine, and horses are produced. The practice of agriculture on an extensive scale may be said to have

[1] Deceased February 21, 1900.

begun with the admission of the State into the Union in 1816. Great commercial and manufacturing interests have been developed, and numerous cities and towns have grown up. This has led to much diversification of agriculture. The university with which the station is connected has developed very largely along technical and scientific lines, and is a well-equipped institution, with 850 students.

The organization of the Agricultural Experiment Station of Indiana was preceded by a limited amount of laboratory and field work at the College of Agriculture of Purdue University. The second annual report of the university for 1876 contains an account of farm operations for 1875 and 1876, which included tests of varieties of cereals and other field crops. Laboratory analyses of soils and milk from the farm are also given by Dr. H. W. Wiley, now chief of the Division of Chemistry of the United States Department of Agriculture, but at that time professor of chemistry in the university. The report for 1879 refers to experiments begun the fall of the previous year on the quantity of seed wheat needed per acre and a comparison of maize planted in hills and drills.

In the autumn of 1879 a series of plat experiments was instituted, some of which have been continued to the present time. The next year field experiments with fertilizers, wheat, and maize were begun, and a large number of varieties of grapes, small fruits, potatoes, grasses, and clovers were planted. A series of experiments in rotation of crops was also begun the same year. All of these lines of work were continued for several seasons. The first bulletins from Purdue University were issued by the School of Agriculture and were twelve in number. Bulletin No. 1 was issued in December, 1884.

The Indiana Station was organized July 1, 1887, as a department of Purdue University, in accordance with the act of Congress. Prof. J. W. Sanborn was appointed director, but never entered upon the duties of the office. He was succeeded by the president of the university, Dr. J. H. Smart, who served as director pro tempore until the appointment of Prof. H. E. Stockbridge in 1889. Upon the resignation of Dr. Stockbridge in June, 1890, the president of the university again served temporarily as director, with Prof. C. S. Plumb as vice-director, until June, 1891, when Professor Plumb was made director.

ORGANIZATION.

The board of control of the station is the board of regents of the university, which consists of 9 members appointed by the governor for a term of four years each. The board is nonpartisan. The State board of agriculture has the privilege of nominating 2 members and the State Horticultural Society 1 member. The board meets four or five times a year and the affairs of the station are considered at these meetings. Three of the trustees constitute a farm committee, which

meets with the director or president, as circumstances require. The secretary of the university trustees is also secretary of the board of control. All of these officers, as well as the treasurer, are paid by the university. The State legislature appoints a committee at each session to visit the station and inspect its work and report on its needs.

The staff consists of the president of the university, director, agriculturist, horticulturist, chemist, botanist, veterinarian, assistant botanist, assistant chemist, assistant agriculturist, and farm superintendent, who is also assistant to the director. The director has general supervision of the work of the station. The staff meets at irregular intervals, subject to the call of that officer or the president, to consult upon important matters. All considerable expenditures of money must be made through the president on orders signed by him and issued on the recommendation of the director of the station.

EQUIPMENT.

The station buildings comprise an agricultural building (Pl. XLIV, fig. 1), cattle barn, horse and hay barn (Pl. XLIV, fig. 2), pig house, sheep house, tool house, dairy building, veterinary hospital, vegetation house, mushroom pit (Pl. XLV, fig. 1), botanical greenhouse, horticultural greenhouse, and director's house. The agricultural building is of brick, 48 by 135 feet, two stories with basement and attic, and contains about 20 rooms. It is used jointly by the station and college of agriculture. In it are the offices of the director and other members of the staff, and the chemical (Pl. XLV, fig. 2), botanical, and veterinary laboratories. The botanical laboratory comprises a general workroom, a bacteriological room, an office for library, and an herbarium with a greenhouse attached. The rooms used by the chemical division comprise an office and library, laboratory for special work, weighing and sampling room, general laboratory, two fire-proof rooms for combustion work, two store and sample rooms, and dark room for polariscope. The rooms occupied by the veterinary division comprise an office, general laboratory, room for microscope, transfer room, dark room, and specimen room.

The university farm of 150 acres is under the control of the station. About 18 acres are used in systematic crop rotations, 13 acres are devoted to experiments with forage and soiling crops, 10 acres to horticultural work, 18 acres are in permanent blue-grass pasture, and about 30 acres are laid out in 122 field plats (Pl. XLVI, fig. 1), which are under the charge of the agriculturist.

The plats are usually one-tenth or one-twentieth acre in size, and are used for experiments in crop rotation, tillage, constant cropping with and without fertilizers, dates of planting, etc. In connection with the farm the station maintains and owns 40 acres which are devoted to a four-course rotation of maize, oats, wheat, and clover.

FIG. 1.—INDIANA STATION—AGRICULTURAL BUILDING.

FIG. 2.—INDIANA STATION—BARNS.

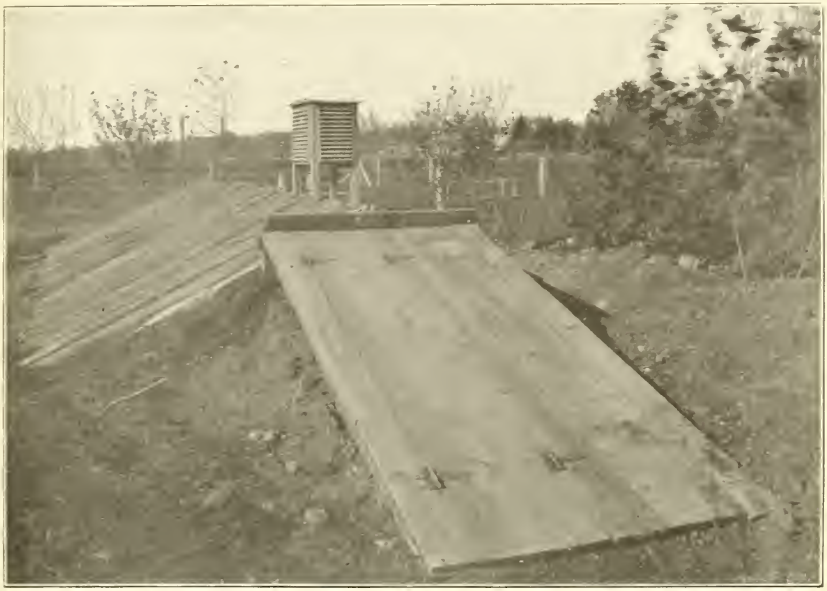


FIG. 1.—INDIANA STATION—MUSHROOM PIT.

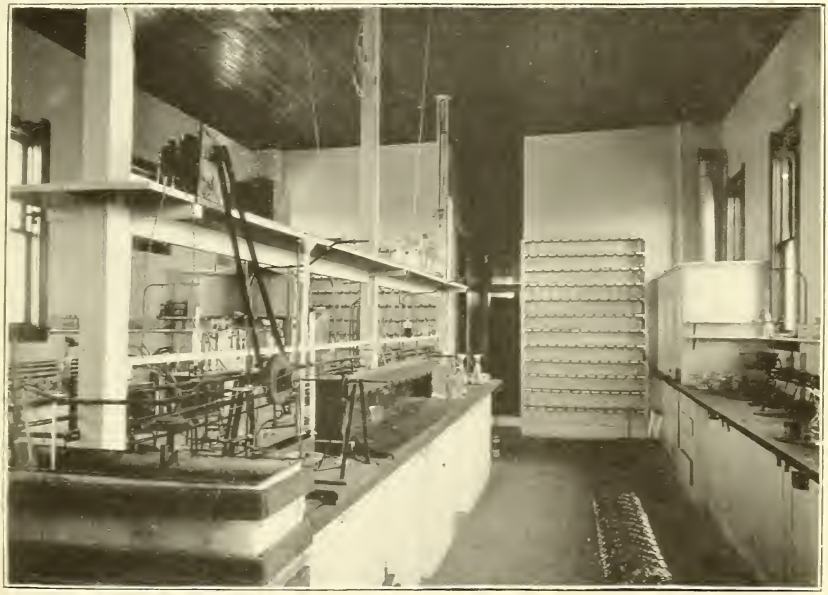


FIG. 2.—INDIANA STATION—CHEMICAL LABORATORY.

FIG. 1.—INDIANA STATION—EXPERIMENTAL PLATS.

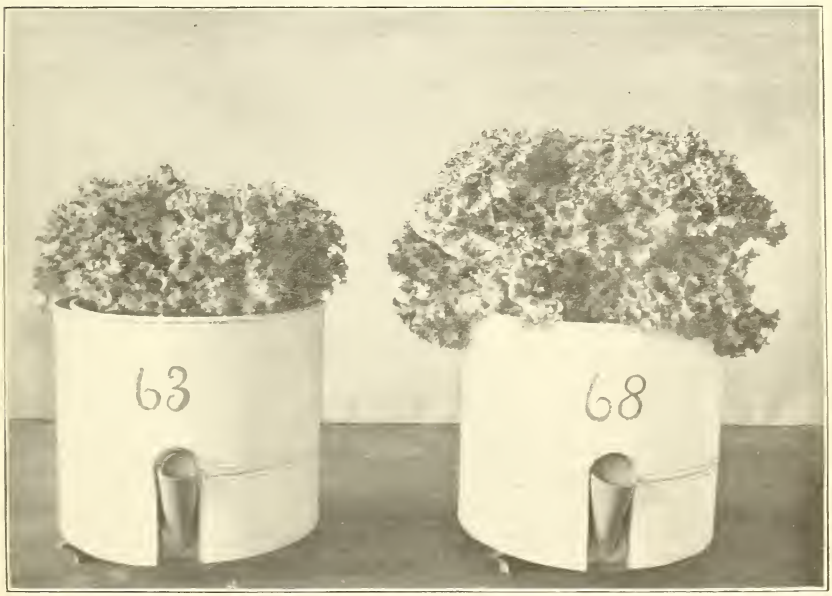


FIG. 2.—INDIANA STATION—FERTILIZER EXPERIMENTS WITH LETTUCE.

The university furnishes most of the live stock used by the station. The combined live stock of university and station comprises 7 horses, 27 head of cattle, 46 sheep, 39 pigs, and some poultry. The station purchases individual animals from time to time as needed for special experiments.

The collections of specimens in the chemical division comprise about 200 samples of feeding stuffs, as well as preservatives, etc. In the botanical division there is a collection of about 600 samples of weed seeds and about 1,000 herbarium specimens of plants of economic interest. The veterinary division has about 1,050 microscope slides, 30 specimens of embryos in alcohol, 150 bottles of miscellaneous material in alcohol, and about 300 dry specimens of bones, etc. There is a small agricultural museum containing specimens of mill products, fertilizers in crude and complete form, horticultural models, botanical specimens showing plant diseases, specimens of wools, cotton, etc. The station library contains about 1,000 volumes. Station workers also have access to the university library of 9,000 volumes.

Among the pieces of apparatus owned by the station special mention may be made of an agitating machine and a mechanical precipitating and stirring apparatus designed by the station chemist, Prof. H. A. Huston. The former is a machine for treating solids with liquids under uniform conditions, which requires no attention from the time the apparatus is started until the end of the period of agitation. The mechanical precipitating and stirring apparatus differs from other forms of stirring apparatus in requiring but a single belt to drive all the stirring rods and in having all the parts of the machine protected from laboratory fumes.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	1,587.42
Balance on hand July 1, 1898	973.91
Total	17,561.33

LINES OF WORK.

The station has no inspection duties. The scientific work has been mainly along the lines of field experiments, soil studies, nutrition of plants, and investigations on diseases of plants and animals. The first investigations taken up by the college of agriculture before the organization of the station were field experiments along lines of tillage, methods of cropping, fertilizers, and tests of varieties. This work,

somewhat elaborated, has been continued by the agricultural division to the present time. Experiments with field crops have been mainly with maize, wheat, oats, and clover. With the addition of new divisions in 1887 other lines of investigation were also taken up, and these have, for the most part, been adhered to ever since.

In the division of chemistry the principal subjects of investigation have been soils and the culture of sugar beets in Indiana. Sugar beets have been grown in every county of the State, and in some of them quite extensively. This work has been carried on for over ten years. The study of soils has been carried on for about the same length of time, and has had to do principally with methods of analysis, studies of certain unproductive black soils of the State, and the white-clay soils of southern Indiana. Much attention has been given to the determination of available plant food in the soil. A method for the determination of phosphoric acid has been devised, which differs radically from all others in that the solvent used is an alkali. Observations have been made from year to year on the effect of cropping on the fertility of the experimental plats on the station farm. Determinations were made of the humus nitrogen in samples of soil from plats that had been planted to maize for eighteen successive years, and the results compared with the nitrogen content of adjacent plats under rotation. The studies of the unproductive black soils of the State showed that the principal reason for unproductiveness was lack of proper drainage, and a method of treatment was outlined in detail. The work on the white-clay soils of the southern part of the State involved a study of the fertilization of the different types of soil on which wheat and maize were to be grown, and a study of the soils themselves from both chemical and physical points of view. The station is contemplating an agricultural survey of the State, which shall include the soils, grasses, cropping conditions, timber, live stock, etc.

The botanical division has been occupied mostly in investigations of problems in plant physiology and pathology. Extended studies have been made on the smut of maize, in which it was shown that the spores of the smut will germinate immediately on ripening, and that the disease may be, in great measure, prevented by the use of Bordeaux mixture. Methods of treatment of the smuts of cereals, especially with hot water and formalin, together with observations on the effect of these treatments on the viability of the seed itself have received much attention. Extended investigations have been made on the nature and treatment of the potato scab, the formalin treatment for which was first suggested by this station. A disease of the sugar beet, attributed to bacteria, has been described and the bacterium by which it is believed to be caused has been studied. Extended studies have been made on the carnation rust and a method of treatment recommended.

In 1893 a vegetation house was erected for the division and since that time pot experiments with agricultural plants have received much attention. Among these was a series of experiments with roses grown in pots with a view to ascertaining the effect of different forms of phosphates and of different commercial fertilizers upon the plants. Extensive experiments have been made in the forcing of lettuce with especial reference to questions of soil moisture and fertility (Pl. XLVI, fig. 2). Numerous experiments have been made in the subwatering of greenhouse plants and the method was applied with marked success in the experiments with lettuce. Observations have been made on the effect of size of seed on the crop. A general study has been made of the weeds of the State, the Russian thistle receiving especial attention.

In the veterinary division a general study has been made of the prevalence of various diseases of domestic animals throughout the State. An examination was made of the waters of the principal streams of the State, indicating that contaminated water is the cause of many deaths among domestic animals. Studies have been made on the bacteria of the stable from the hygienic standpoint. Observations have been made upon the occurrence of the disease known as milk sickness. It was shown that this disease is not due to the animal's eating a poisonous weed, as commonly believed. Extended studies have been made of tuberculosis and hog cholera, and numerous animals have been tested. Observations have been made upon the relative fecundity of breeds of swine. The most important investigation in this department is an extensive study of the mammary gland and the subject of milk secretion. The director has made extended and systematic observations on the conformation of the organ and the relation of conformation to yield of milk, and the veterinarian has made investigations on its anatomy, physiology, and embryology.

In the horticultural division a prominent feature of the work has been the testing of varieties of fruits and vegetables. A study has been made of the native persimmons with a view to producing improved varieties, and the chemist has analyzed a number of specimens of the fruits. Some experimental work has been done in the interests of the melon industry of the State. The division is carrying on experiments in cooperation with the Division of Forestry of the United States Department of Agriculture to test the influence of climate on forest tree seedlings.

DISSEMINATION OF INFORMATION.

The station has issued 80 regular bulletins, 2 of which were posters, 80 press bulletins, and 12 annual reports. Previous to 1899 the annual report was merely an administrative document, but from that time on it will contain also reports of experimental work. The director,

Prof. C. S. Plumb, is the author of a "Biographical Directory of American Agricultural Scientists," 1889, and "Indian Corn Culture." The botanist, Dr. J. C. Arthur, jointly with Profs. C. R. Barnes and Stanley Coulter, is the author of a work on "Plant Dissection," and with Dr. D. T. MacDougal, of "The Properties of Living Plants." The veterinarian, Dr. A. W. Bitting, has translated "Exercises in Equine Surgery," from the French of P. J. Cadiot. The station mailing list contains about 16,512 addresses, and is kept on cards arranged by a card-catalogue system. Publications are addressed with a mailing machine. The correspondence of the director's office amounts to about 2,000 letters a year. Members of the station staff take part in farmers' institutes and other meetings of a similar nature as much as possible without interfering with university and station duties. The number of institutes attended each season averages about six for each member of the staff. Addresses are also delivered from time to time at various other agricultural meetings. Some exhibits have been made at the State fairs in the past.

GENERAL RESULTS OF WORK.

The Indiana Station has done much to improve general farm practice in the State, as regards especially the culture and rotation of crops and the use of farm and commercial fertilizers. Recently it has shown in a comprehensive way the relative adaptability of different parts of the State to the successful growing of beets for sugar. Its studies of plant diseases, especially potato scab and the rust of cereals, together with the means of their repression, have been an important factor in establishing the widespread use of fungicides for their prevention and treatment. The investigations on subirrigation in greenhouses and elsewhere have been of considerable practical value to florists. In recent years the station has materially aided the live-stock interests of the State by rendering assistance in the combating of animal diseases, especially tuberculosis and diseases of swine.

IOWA.

Iowa Agricultural Experiment Station, *Ames.*

Department of Iowa State College of Agriculture and Mechanic Arts.

GOVERNING BOARD.

Board of Trustees: Governor L. M. Shaw, *Des Moines;* R. C. Barrett (*Superintendent of Public Instruction*); W. O. McElroy (*Chairman*), *Newton;* E. W. Stanton (*Secretary*), *Ames;* Herman Knapp (*Treasurer*), *Ames;* C. F. Saylor, *Des Moines;* W. J. Dixon, *Sac City;* J. S. Jones, *Manchester;* Addis Schermerhorn, *Charles City;* J. B. Hungerford, *Carroll;* A. V. Stout, *Parkersburg;* L. B. Robinson, *Harlan;* S. H. Watkins, *Libertyville;* C. S. Barclay, *West Liberty;* W. B. Penick, *Tingley.*

STATION STAFF.

W. M. Beardshear, M. A., LL. D., *President of the College.*

C. F. Curtiss, M. S. A., *Director; Agriculturist.*

[1] James Wilson, *Dean of Agriculture.*

J. B. Weems, B. S., Ph. D., *Agricultural Chemist.*

L. H. Pammel, B. Agr., M. S., *Botanist.*

H. E. Summers, B. S., *Entomologist.*

John A. Craig, B. S. A., *Expert in Animal Husbandry.*

Joseph J. Edgerton, B. Agr., *Assistant in Agricultural Physics.*

John Craig, B. S. A., *Horticulturist.*

H. N. Grettenberg, B. Agr., *Assistant Chemist.*

J. C. Brown, B. Agr., *Assistant Chemist.*

John J. Repp, D. V. M., *Veterinarian.*

P. T. Barnes, *Assistant Horticulturist.*

James Atkinson, B. S. A., *Assistant Agriculturist.*

G. L. McKay, *Instructor in Dairying.*

John J. Vernon, B. S. A., *Assistant Horticulturist.*

——— ———, *Assistant Botanist.*

C. H. Eckles, B. Agr., M. S., *Assistant in Dairying and Dairy Bacteriology.*

Wilmon Newell, *Assistant Entomologist.*

E. R. Hodson, B. S., *Botanist.*

Geo. M. Rommel, B. S. A., *Assistant in Animal Husbandry.*

H. J. Evans, B. S. A., *Assistant in Dairying.*

C. J. Griffith, B. S. A., *Assistant in Dairying.*

Miss C. M. King, *Entomologist and Botanical Artist.*

HISTORY.

The Iowa Station is located near the center of the State in the midst of a prosperous agricultural community. The surface of the State is a gently undulating plain, with an elevation ranging from about 500 to 1,600 feet. Originally this was a vast prairie, covered with grasses, but trees have been extensively planted. Ninety-five per cent of the land is tillable and much of it is a soft black loam. The average rainfall is about 36 inches and the range of temperature during the year is about 120° F. The State was admitted to the Union in 1846 and had a rapid development as a grain-growing region. More recently the live stock and dairy interests have been very largely developed. Iowa has remained distinctively an agricultural State, and for the most part its farmers have enjoyed unusual prosperity. The college with which the station is connected is established on a broad basis and gives especial attention to education along industrial and scientific lines. It has grown to be a strong and well-equipped institution, with 800 students.

The Iowa Experiment Station was established in 1888, in accordance with the act of Congress, at Ames, Iowa, as a department of the Iowa State College of Agriculture and Mechanic Arts. Prof. R. P. Speer was the first director and served until January, 1891, when he was succeeded by Hon. James Wilson, who served until called to his present position of Secretary of Agriculture by President McKinley, March 1, 1897. The present director is Prof. C. F. Curtiss, who has served since that time.

[1] Granted an indefinite leave of absence.

ORGANIZATION.

The station is governed by the board of trustees of the college, which consists of the governor of the State and superintendent of public instruction, ex officio, and eleven members, one from each Congressional district, elected by the State legislature for a period of six years. Meetings are held semiannually and oftener when necessary. A committee of the board, consisting of six members, has immediate charge of the experiment station and the agricultural, horticultural, and veterinary departments of the college. This committee, however, meets only as a committee of the board and at the time of its regular meeting, and any action taken by it is always referred to the board for approval. The expenses of the board are met by State appropriations. The secretary and the treasurer of the college serve the station in the same capacity.

The staff is composed of the president of the college, director (who is also agriculturist), dean of agriculture, agricultural chemist, two botanists, entomologist, horticulturist, expert in animal husbandry, assistant in agricultural physics, two assistant chemists, veterinarian, two assistant horticulturists, assistant agriculturist, instructor in dairying, assistant in dairying and dairy bacteriology, assistant entomologist, assistant botanist, assistant in animal husbandry, two assistants in dairying, and entomological and botanical artist. All these officers are appointed by the board of trustees for an indefinite term. The president of the college, the director, and the heads of divisions constitute a board of direction, whose duty it is to decide on the lines of work and apportionment of funds.

EQUIPMENT.

The buildings devoted exclusively to station work are Agricultural Hall, the station barn, a greenhouse, cattle, hog, and sheep barns, and creamery. Quarters are provided for the divisions of botany and entomology in the main college building and the science building, known as Morrill Hall. Extensive barns belonging to the agricultural department of the college, valued at $10,000, are made use of by the experiment station for special investigations as occasion demands.

Agricultural Hall (Pl. XLVII, fig. 1) is a four-story brick-and-stone structure about 60 by 80 feet. In it are located among others the agricultural and veterinary offices and the veterinary bacteriological laboratory. The main college building is a brick-and-stone structure about 80 by 110 feet, four stories and basement. Morrill Hall is a brick-and-stone structure about 40 by 80 feet, three stories and basement. The cattle barn (Pl. XLVII, fig. 2) is 160 feet long and 40 to 80 feet wide. The greenhouse is shown in Pl. XLVIII, fig. 1.

The college farm contains 800 acres, about 70 of which are occupied

FIG. 1.—IOWA STATION—AGRICULTURAL HALL, USED BY COLLEGE AND STATION.

FIG. 2.—IOWA STATION—CATTLE BARN.

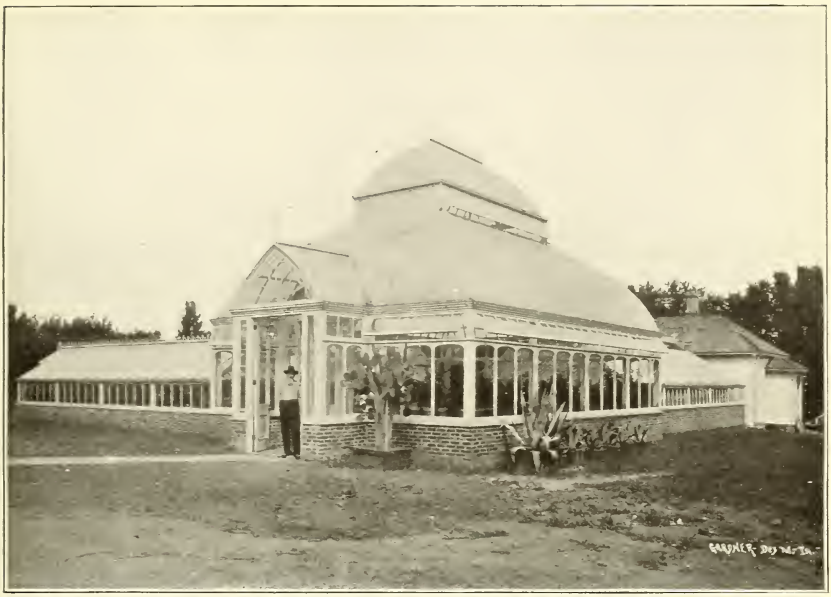


FIG. 1.—IOWA STATION—GREENHOUSE.

FIG. 2.—IOWA STATION—EXPERIMENTAL PLATS.

FIG. 1.—IOWA STATION—COWS IN PASTURE.

FIG. 2.—IOWA STATION—HOLSTEIN HERD.

FIG. 1.—IOWA STATION—BROOD MARES AND COLTS.

FIG. 2.—IOWA STATION—CULTIVATING MAIZE.

exclusively by the experiment station. About one-third of this amount is in permanent pasture, the remainder in a 5 to 7 year rotation of farm and experimental crops. (For view of plats, see Pl. XLVIII, fig. 2).

For the most part the station makes use of the college herds in its experimental work, though individual animals are frequently purchased for use in special experiments. The college live stock consists of about 120 head of cattle, representing 26 different breeds and 125 swine, representing 6 breeds. This stock is largely or wholly available for the purposes of investigation under conditions that are fair and equable to both college and station. This affords exceptional facilities for investigations in animal husbandry, especially along lines of comparative tests of breeds, without involving expenditures for live stock from station funds. (For illustrations of cows in pasture, Holstein herd, and brood mares and colts, see Pl. XLIX, figs. 1 and 2, and Pl. L, fig. 1.)

The college and station have a combined collection of about 75,000 botanical and horticultural specimens. The station has numerous photographs, drawings, models, and lantern slides illustrating various phases of its work. The college has also an extensive collection of insects, and several hundred specimens of woods and wax casts of fruits.

In the early history of the station about 3,000 volumes were purchased for the library. In 1891, however, this policy was abandoned and the station and college libraries were combined. Since then the works needed for station purposes have been purchased from the college funds, and the college library of 12,000 volumes is available to all of the station workers.

FINANCIAL SUPPORT.

The support of the station is derived mainly from the national fund supplemented by $1,500 annually from State funds, and the sale of farm products. The income of the station during the last fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	1,500.00
Fees	39.00
Farm products	1,905.06
Miscellaneous	412.13
Total	18,856.19

LINES OF WORK.

The station entomologist serves also as State entomologist and is charged with the inspection of nursery stock for San José scale and

the execution of the State law relating to that subject. No revenue is derived from this source except expenses. Aside from this the station has no inspection duties.

Natural conditions conspire to make Iowa a great agricultural State, admirably adapted for the production of field crops. In its earlier history it was one of the great grain-growing States, but more recently attention has been turned toward animal husbandry and dairying. These industries the station has labored assiduously from its organization to develop, and about them centers the largest part of its work. The first necessity was to obtain varieties of forage plants well adapted to local conditions. Most cereals and imported grasses thrive much better in a moist climate like that of England and the Atlantic coast States than in Iowa, where the summers are frequently very dry and hot. To supply this need the station explored the Northwest for promising native grasses, tested them, and determined their nutritive value by chemical analysis and feeding experiments. The best of these native grasses were introduced into cultivation. Experiments were made with reference to the time of sowing grass seed, depth of covering, and methods of making and storing hay. Some experimental work has been done on the conservation of soil moisture. Chemical studies were made of maize at different stages of ripening with a view to determining the stage of greatest nutritive value. The long continued droughts, to which Iowa is subject, result in the general drying up of pastures and great loss to owners of domestic animals. Experiments on the maintenance of pastures indicated that the grazing capacity of many pastures may be doubled by applying liquid manure and harrowing in clover and timothy seed. The droughts also make it necessary to grow crops suitable for cutting in green condition to supplement pastures. Hence the station took up the study of soiling crops and compared the values of numerous different plants in this respect.

The insects attacking forage plants in general, and especially grasses, have been the subject of extensive investigations. The importance of this work becomes apparent when it is realized that "half or probably more of the growth of grass is devoured by insects." The life histories of numerous species have been worked out, especially of the leaf hoppers (Jassidæ), the importance of which had previously been but partially appreciated, owing to their smallness and insidious methods of work. A number of new species have been described and the genus Deltocephalus monographed, a step which was rendered almost imperative by the great importance of its species as grass-feeding insects. Experiments showed that hopper dozers can be used very successfully in combating them. A general study has also been made of the insects attacking clover and the life history of the clover-seed caterpillar (*Grapholitha interstinctana*) worked out.

The leaf-spot disease has worked great destruction in alfalfa fields, the loss in the neighborhood of the station in 1891 being estimated at 50 per cent of the crop. This disease has been studied, the cause of infection determined, and preventive measures suggested.

Feeding experiments have been mainly of two kinds: Feeding for meat and feeding for milk. The former have been carried on with beef cattle, sheep, hogs, and calves. In connection with the feeding experiments comparative studies of breeds have been carried on, exceptional opportunities for which are offered by the large number in the college herd. Studies have been made of the comparative value of numerous feeding stuffs, used singly and in various mixtures, for fattening steers. In this connection much attention has been given to comparative studies of types of beef cattle. Some of the results of this work have appeared in Farmers' Bulletin 71 of the United States Department of Agriculture on "Some Essentials in Beef Production." The fact that in this country the beef of the heifer sells at a lower price than that of the steer, while in many other countries the opposite is true, led the station to undertake experiments to determine the real value of heifers as compared with steers in this respect.

An investigation of mutton and wool production was undertaken. The plan of this investigation was similar to that in the case of beef production and comprised feeding experiments and a comparative study of ten of the leading breeds of sheep. A part of the results of this work has appeared in Farmers' Bulletin 96 of the United States Department of Agriculture on "Raising Sheep for Mutton."

During the past three years the station has had under way an extensive study of the cost of producing bacon from various breeds of hogs, including those of the grain-growing States and the English bacon breeds. This investigation not only includes the cost of production under similar conditions, but also the relative quality and value of the finished product, together with a complete chemical analysis of the carcass made by the Division of Chemistry of the United States Department of Agriculture.

Experiments in calf feeding have established the superiority of the carbohydrates and fat-containing foods over the nitrogenous by-products, such as oil meal, in supplementing a skim-milk ration. This work, which has now been carried on for about five years, has attracted wide attention and the demand for bulletins has far exceeded the supply. A great many creamery officers have applied for copies enough to supply all their patrons.

Experiments in feeding for milk have been made, especially to determine the value of root crops in this respect and the effects of various foods on the flavor of milk and butter. Experiments were also made to determine the cost of producing butter from cows of different breeds, using different rations. Studies were made to deter-

mine the amount of dry matter in a ration of a given nutritive ratio required to produce a pound of butter fat; also the amount of water the dairy cow requires.

An extensive investigation has been carried on to determine the proper temperature and degree of acidity for ripening cream under conditions that will insure the highest flavor and quality of butter. Eminently successful results have been obtained, and the methods recommended by the station have been adopted by many of the leading establishments throughout the Western dairy States. A similar investigation is in progress concerning cheese making and curing as affected by temperature, acidity, and humidity.

The station has investigated the theory that good-flavored butter can not be made from the milk of stripper cows, and finds that the flavor can be controlled by the butter maker independently of the advance in the cow's period of lactation. Extensive studies have been made with bacteria as flavors in the dairy. A bacillus was isolated from rotting cabbage which had a very peculiar odor, resembling that of limburger cheese. This suggested the use of the bacillus in pure culture as a flavor in cheese making, which has been done successfully. Tainted milk was found to be due to bacteria which, when isolated, had a very characteristic odor. The station is endeavoring to ascertain whether the ill flavor of butter caused by cabbage, potatoes, and turnips can not be overcome by the use of pure cultures of bacteria.

Some attention has been given to experimental work with maize, of which Iowa produces more than any other State in the Union. (Pl. L, fig. 2, shows a field of young maize on the station farm.) As with clover and grasses, a general survey has been made of the insects attacking it, and in this case the prevention of fungus diseases has also been attempted. The food habits of the striped squirrel, which causes much loss to farmers by digging up maize, were investigated to determine whether the extermination of the animal is desirable. The growing of sugar beets in Iowa has been extensively investigated since 1891, together with their diseases and insect enemies.

The horticultural division has until recently been largely engaged in the introduction and dissemination of Russian fruits in America. Quite recently the breeding of varieties of fruits adapted to climatic conditions in the Northwest has been undertaken on an extensive scale. The horticultural division has also been interested in testing hardy stocks for fruit trees. The insect enemies of fruit trees have received attention, studies have been made of the plum curculio and plum gouger, and methods of combating them suggested. The codling moth has been similarly studied. Much attention has been given to working out a method of applying arsenites that should not lessen their effectiveness in destroying life and at the same time not injure foliage.

The botanical division has given much attention to the study of

weeds, especially those of the mustard family, their means of dissemination, and methods of eradication. A threatened invasion of the Russian thistle gave occasion for an extensive study of the weed from botanical, chemical, and economic standpoints. Another weed which has been much studied is the horse nettle, the distribution of which in America was ascertained. Experiments in exterminating it were conducted which showed that it may be successfully combated by the use of the hoe or plow, or that it may be smothered by planting a crop of rape. In connection with the work on maize culture, the weeds of maize fields received a share of attention. The kinds of weeds ordinarily found in Iowa maize fields were enumerated, their distribution in the State determined, and experiments made in destroying them.

DISSEMINATION OF INFORMATION.

Up to January 1, 1900, the station had issued 43 bulletins, a few special bulletins, press bulletins, and calendars, and 11 annual reports. Besides the usual administrative features, the annual report contains accounts of technical and scientific investigations. The mailing list contains 18,000 names. It is kept set up in linotype. Prof. Herbert Osborne, formerly entomologist, is the author of a comprehensive treatise on the "Insects Affecting Domestic Animals," which was prepared under the direction of the Entomologist of the United States Department of Agriculture and published as Bulletin No. 5, new series, of the Division of Entomology.

Considerable work in farmers' institutes and other agricultural meetings is done by the agriculturist, expert in animal husbandry, horticulturist, and their assistants. The demand for this kind of service is far in excess of what can be rendered by the station officers without injury to the station work, but as much assistance of that kind is given as their duties will permit. Members of the station staff also render considerable assistance at State and other fairs.

GENERAL RESULTS OF WORK.

The work of the Iowa Station has been an important factor in the recent development of the live-stock interests of the State through its introduction of new crops and improvement of existing ones, its studies of forage plants, and practical investigations regarding the feeding of animals. Its investigations on the grass-eating insects have made important contributions to our knowledge of these pests, both from economic and systematic standpoints. In dairying it has done much toward building up the creamery business and establishing a high uniform grade for dairy products. Its horticultural investigations have aided materially in the development of fruit growing in the Northwest. A considerable portion of its work has had results of wide application beyond the borders of the State.

KANSAS.

Kansas Agricultural Experiment Station, *Manhattan.*

Department of Kansas State Agricultural College.

GOVERNING BOARD.

Board of Regents: E. T. Fairchild (*President*), *Ellsworth;* J. S. McDowell (*Vice-President*), *Smith Center;* W. T. Yoe (*Treasurer*), *Independence;* William Hunter (*Loan Commissioner*), *Blue Rapids;* Mrs. Susan J. St. John, *Olathe;* Carl Vrooman, *Parsons;* J. M. Satterthwaite, *Douglass.*

STATION STAFF.

E. R. Nichols, M. A., *Acting President of College and Chairman of the Station Council.*
J. T. Willard, M. S., *Director; Chemist.*
A. S. Hitchcock, M. S., *Botanist.*
Paul Fischer, B. Agr., D. V. M., *Veterinarian.*
H. M. Cottrell, M. S., *Agriculturist.*
E. A. Popenoe, M. A., *Entomologist and Horticulturist.*
Lorena E. Clemons, B. S., *Secretary.*
D. H. Otis, M. S., *Assistant in Dairying.*
P. J. Parrott, M. A., *Assistant Entomologist.*
R. W. Clothier, M. S., *Assistant Chemist.*
J. M. Westgate, M. S., *Assistant Botanist.*
Albert Dickens, B. S., *Assistant Horticulturist.*
J. G. Haney, B. S., *Assistant in Feeding and Field Work.*
A. T. Kinsley, B. S., *Assistant Veterinarian.*

HISTORY.

The Kansas Station is located in the northeastern part of the State, near the confluence of the Blue and Kansas rivers. The surface of the State is an undulating prairie rising from an elevation of about 1,000 feet in the east to 4,000 feet in the west. Originally this was a treeless region except along the river courses in the east, but numerous trees have been planted since the settlement of the State. The soil is largely a dark fertile loam. In the eastern half of the State the rainfall is sufficient to insure good crops, but in the western half it is too scanty to make agriculture regularly successful without irrigation. Hot dry winds in the summer are a serious menace to standing crops over a large portion of the State. Very large crops of maize are grown and much wheat, oats, Kafir corn, hay, and potatoes. Large numbers of cattle, sheep, and other live stock are grown, the western portion of the State being especially a grazing region. The college with which the station is connected has developed largely along industrial lines, and is a strong and well-equipped institution with over 900 students.

Although considerable agricultural investigation had been carried on by several departments of the Kansas State Agricultural College since its organization, no experiment station as such existed in the State prior to the passage of the act of Congress of March 2, 1887. The conditions of this act were accepted by the legislature in a resolution dated March 3, 1887, by which the disposition of the appropria-

tion was placed under the control of the board of regents of the college. February 8, 1888, the board of regents in special session organized the Kansas Agricultural Experiment Station as a department of the college, and in a series of resolutions defined the duties of its officers and the work of its several divisions. The most characteristic feature of this organization was the provision that "the general executive management of the station shall be under the control of a council, to consist of the president of the college, the professors of agriculture, horticulture and entomology, chemistry, botany, and veterinary science, and such other officers of the college as the board may designate." Each member of the council was to have full control of experiments assigned to his division, and to choose his own assistants, subject to ratification by the council. All bulletins were to be issued "by order of the council." These provisions, and others of the organizing resolutions, have been more or less modified by later actions and practices of the board of regents, but the central idea of government by a council rather than by a director is still in force.

Under this arrangement Prof. E. M. Shelton, the agriculturist, was ex officio director of the station. Upon his resignation, December 31, 1889, to accept the position of instructor in agriculture under the government of Queensland, Australia, the office of director was abolished, and most of the time since then the executive duties of the station have been divided between the president and the secretary. September 1, 1897, Prof. G. T. Fairchild who, as president of the college, had served as chairman of the station council since the organization of the station, was succeeded by Prof. Thomas E. Will in the same capacity. In July, 1899, the presidency being vacant, Prof. J. T. Willard, the chemist of the station, was made chairman of the council by the board of regents. In January, 1900, a change was made in the organization by which the president of the college became ex officio chairman of the station council. At the same time it was determined that a member of the council, named by the board, should be designated as director, and Professor Willard was appointed to the position. The station council is still the governing power, however, the director being merely the executive.

In 1894 a substation was established at Garden City, Finney County, about 70 miles from the west line of the State, where experiments were carried on with crops under irrigation. This station was maintained but two years. In cooperation with the State board of irrigation another substation was established in 1896 at Oakley, Logan County, farther north than Garden City, and at the same distance from the State line. This was maintained but a single year. It was intended to establish another at Oberlin, Decatur County, but so much difficulty was encountered in getting water that no planting was done there. All these outlying stations have been abandoned.

ORGANIZATION.

While the station is a department of the college, its accounts are kept separate and its property is carefully listed in separate inventories. Apparatus belonging to the college is not, as a rule, available for station work except in the case of expensive pieces. In such cases special care is taken that neither institution profits at the expense of the other. The lands, buildings, museums, herds, and plantations of the college are used without charge by the experiment station. Any additional expenditures in connection with such use are made from station funds.

The board of regents consists of seven members appointed by the governor for terms of four years and confirmed by the State senate. The board has taken an active interest in the station work but has usually deferred to the judgment of the council in respect to the lines of work that should be taken up or continued, and to the distribution of funds among the different divisions.

Assistants, contrary to the original practice, are now appointed by the board, but usually upon the recommendation of the head of division. The board meets regularly about once in three months, but always has an additional meeting in June, at the time of the college commencement, and, as occasion requires, holds special meetings. Members receive $3 per day for the time required for meetings, and 10 cents for each mile necessarily traveled in attendance upon them. The State makes an appropriation to meet these expenses.

The staff consists of the acting president of the college (who is also chairman of the station council), director (who is also chemist), botanist, veterinarian, entomologist and horticulturist, agriculturist, secretary, assistant in dairying, assistant chemist, assistant entomologist, assistant botanist, assistant horticulturist, assistant in feeding and field work, and assistant veterinarian.

EQUIPMENT.

The work of the station is carried on in the college buildings. The station has one small office building for the division of horticulture and entomology and two propagating houses with an insectary attached.

The college buildings made use of by the station consist of the main college building, agricultural hall, chemical laboratory, armory, library and agricultural science hall, the farm barn, a dairy barn, and horticultural barn. All of the buildings are of stone, of simple but neat styles of architecture and well suited to their purposes. The offices of the president and secretary are located in the main college building, which is 152 by 250 feet in its extreme dimensions. The division of agriculture is located in agricultural hall, a two-story structure,

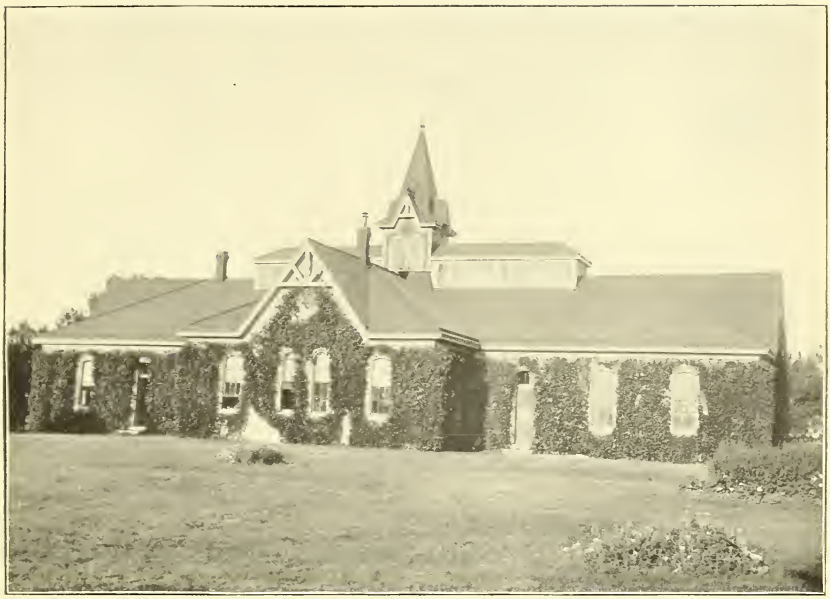


FIG. 1.—KANSAS STATION—CHEMICAL LABORATORY, USED BY COLLEGE AND STATION.

FIG. 2.—KANSAS STATION—HORTICULTURAL HALL, USED BY COLLEGE AND STATION.

FIG. 1.—KANSAS STATION—GREENHOUSES.

FIG. 2.—KANSAS STATION—ARMORY, USED BY COLLEGE AND STATION.

FIG. 1.—KANSAS STATION—LIBRARY AND AGRICULTURAL SCIENCE HALL, USED BY COLLEGE AND STATION.

FIG. 2.—KANSAS STATION—BARN.

90 by 95 feet. Chemical work is carried on in the chemical laboratory (Pl. LI, fig. 1), which is a one-story building in the form of a cross. Horticultural Hall (Pl. LI, fig. 2) is a one-story building with greenhouses attached. The horticultural laboratory is a separate building and has five greenhouses (Pl. LII, fig. 1) and an insectary attached. The armory (Pl. LII, fig. 2) is a two-story building, 46 by 96 feet. In it, among others, are the rooms of the veterinary division. The library and agricultural science hall (Pl. LIII, fig. 1) is a four-story building, 100 by 140 feet, in which are located the laboratories of the divisions of botany and entomology. (The farm barn is shown in Pl. LIII, fig. 2.)

About 325 acres of land in all are used for experimental purposes. Much of it is in permanent plantations or orchards, vineyards, and meadows. All of the land belongs to the college. So much of it as is under cultivation is handled mainly in large fields or blocks at present. Most of the permanent plantations belong to the college, but are used by the experiment station.

The station does not maintain permanent herds, but uses stock belonging to the college, which includes at present about 45 head of cattle and a large number of hogs, varying from 60 to 435. Animals are also purchased by the station for the purposes of special experiments.

The station makes use, for the most part, of the museums and collections belonging to the college. In the herbarium of the botanical division there are nearly 57,000 mounted specimens of flowering plants, and over 10,000 specimens of cryptogams. In its general museum nearly 2,000 specimens are on exhibition, and there are 400 more in a museum of cultivated plants. In the entomological division there are about 18,000 specimens of insects, and in the horticultural division there are 100 models of fruits, 270 bottled specimens of varieties of peas and beans, over 200 specimens of fruits, leaves and woods affected by fungus diseases, and 142 varieties of grapes illustrated by mounted specimens of leaves, canes, seeds, and photographs of the fruit. The botanical division maintains a garden of the native grasses of the State. The arboretum, nursery, large experimental vineyard and apple orchard, smaller orchards of other fruits, and berry plantations afford ample opportunities for horticultural investigations.

The libraries of the college and station are distinct from each other, but are not separately housed at present. The combined libraries contain nearly 20,000 bound volumes and many thousand pamphlets. The station laboratories are well equipped for their special lines of work. Special mention may be made of a siphoning apparatus for fat extraction devised by the chemists, Professors Failyer and Willard. It is constructed wholly of glass, and is less complicated and less fragile than Soxhlet's.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	713.43
Total	15,713.43

LINES OF WORK.

The station is not directly charged with any inspection duty. The veterinarian of the station is, however, also State veterinarian, and the professional adviser of the State live stock commission which is charged with the control of infectious diseases of cattle. The entomologist is often called upon to give certificates in reference to the condition of nursery stock to be shipped to States requiring inspection of such stock.

The station is not identified with any complete surveys of the State, but the botanical division has done much incidental work toward ascertaining the range and prevalence of weeds in the State and the distribution of native grasses.

In the early years of the station large numbers of plat experiments, variety tests, etc., were carried on, but in recent years that has been almost entirely abandoned, and as far as possible crops are grown on a large scale. So, too, in feeding experiments it is the aim of the farm division to conduct them on such a scale as to lead to results that will be received by the farmers of the State as practical and reliable. The farm division, since the organization of the station, has tested thousands of varieties of maize, wheat, oats, sorghum, soy beans, and other forage plants, and has found that most of them are not adapted to Kansas conditions. In recent years the attention of this division has been devoted chiefly to growing drought-resisting crops and utilizing them in the production of milk, beef, and pork, and in the raising of young stock. The station has aided much in the general introduction of cultivated grasses, clovers, and alfalfa throughout the State, and to it belongs the credit for sowing the first package of red Kafir corn ever planted in the State, of which the station distributed thousands of packages through the State. Farmers found it satisfactory, and as a result, in 1899, the total area of Kafir corn of both white and red varieties grown in the State was about 600,000 acres. Feeding experiments made at the station have shown that an acre of Kafir corn will produce on the average more beef, pork, and milk than an acre of maize.

The botanical division has investigated the blight of sorghum and the smuts of grain. It has made extensive experiments on the pre-

vention of smuts, being foremost in the introduction into America of the hot-water treatment for stinking smut of wheat and loose smut of oats. It was first demonstrated at this station that the uredo stage of wheat rust survives the winter and infects the new crop without the intervention of a different host plant. An extended study has been made of the propagation of weeds by underground parts and of methods of eradication based thereon. The division has made a large number of crosses of maize, wheat, and oats. In connection with the farm division, it made an extended study of alfalfa in respect to seeding, cutting, utilization, etc.

The veterinary division has conducted investigations on a number of diseases of animals, among which may be mentioned actinomycosis, staggers, tuberculosis, swine plague, Texas fever, blackleg, and poisoning by potassium nitrate. Blackleg vaccine has been introduced into quite general use among cattle owners of Kansas. The veterinarian has shown that it is much safer to make inoculations for it at the tip of the tail than at any other convenient part of the body. The veterinary division is conducting cooperative experiments in the use of blackleg vaccine for preventive inoculation. Similar experiments are being made in swine-plague protective inoculation. A special study is being made of the sporulation of *Bacillus chauvoei*.

The work of the division of horticulture and entomology has included a large amount of experimentation with vegetables and small fruits, especially strawberries; an extended study of the efficacy of spraying in combating the codling moth; observations on the growth of artificial forests; studies of the native grapes of the State; a study of effects of differences in the length of scion and stock in the grafting of the apple; and studies of many of the injurious insects of the State.

Much of the work of the chemical division during the early years of the station consisted in testing and improving varieties of sorghum by seed selection based on chemical analyses of individual canes. This idea originated at the Kansas Agricultural College, the first work in this line being done in 1885. On the organization of the station it was taken up much more extensively. In the course of six years the average percentage of sugar in the juice of certain varieties was raised from 12.6 to 16.1, and the maximum in single stalks from 14.2 to 19.9. This improvement is believed to have been largely due to the selection by analysis. Thousands of packages of seed from improved strains of sorghum were distributed to farmers of the State. Numerous analyses of maize, by varieties, single ears, and single kernels, have been made looking to the improvement of this cereal.

Determinations were made for four years of the total nitrogen brought down in rain and snow, and for three years that in the form of ammonia was separately estimated. Cooperative experiments with sugar beets have been conducted for several seasons with the farmers

of the State. The latest plan of recording followed is that of having each grower's name, with the more important data, recorded on a single card, which also indexes the more extended record. These cards then may be arranged in any order to facilitate study of the results, as by regions of the State represented, by date of planting, by manner of preparation of soil, kind of soil, etc.

DISSEMINATION OF INFORMATION.

The station had issued up to January 1, 1900, 89 regular bulletins and 11 annual reports. Each year's issue of bulletins is paged consecutively, and at the close of the period 1,000 sets are bound together with the annual report, which is merely an administrative document, and a title-page and index are added. In August, 1898, the station commenced the issue of press bulletins, and 54 were issued up to January 1, 1900. These are intended to present brief and popular statements of certain phases of work in progress and minor investigations. The station has also been sending mimeograph copies of short articles, similar to press bulletins, to a limited number of the agricultural papers.

The mailing list contains about 14,000 names, which are classified in several groups, and each group kept by card-catalogue system. These lists are kept set up in linotype and revisions made and proofs taken as necessary. Bulletins are addressed with a mailing machine. The correspondence amounts to about 10,000 letters a year. Members of the station staff have taken a prominent part in farmers' institute work, which has now grown to such an extent as to threaten to interfere seriously with the college and station duties of those engaged in it unless especially provided for. Members of the station staff also take an active part in meetings of the State Horticultural Society, State board of agriculture, State Dairy Association, and other organizations of agricultural or scientific nature.

GENERAL RESULTS OF WORK.

The Kansas Station has done a great work in aiding in the determination of the varieties of maize, wheat, oats, sorghum, and forage plants best adapted to the agricultural conditions of the State, and in showing the farmers how the feeding stuffs which they grow may be most economically utilized for the production of beef, pork, and milk. The 600,000 acres of Kafir corn alone grown in 1899, for the successful introduction of which the station is largely responsible, yielded a crop worth over $5,000,000. Through the advice of the station the cultivation of alfalfa in the State has been much extended. The investigations on the smuts of wheat and oats and the means for their repression have also given very important practical results.

KENTUCKY.

Kentucky Agricultural Experiment Station, *Lexington*

Department of the Agricultural and Mechanical College of Kentucky.

GOVERNING BOARD.

Board of Control: Hart Boswell (*Chairman*), *Lexington;* R. S. Bullock (*Treasurer*), *Lexington;* J. K. Patterson, *Lexington;* M. A. Scovell, *Lexington;* J. T. Gathright, *Louisville;* Thos. Todd, *Shelbyville.*

STATION STAFF.

James K. Patterson, PH.D., *President of the College.*

M. A. Scovell, M. S., *Director; Chemist.*
A. M. Peter, M. S., *Chemist.*
H. E. Curtis, M. S., *Chemist.*
H. Garman, *Entomologist and Botanist.*
C. W. Mathews, B. S., *Horticulturist.*
Edward Rohrer, *Stenographer and Secretary to Director.*
J. N. Harper, B. S., *Agriculturist.*
W. H. Scherffius, B. S., *Assistant Chemist.*
W. A. Beatty, M. S., *Assistant Chemist.*

HISTORY.

The Kentucky Station is located in the central part of the State, in the fertile blue-grass region. The surface of the State is, in general, an undulating plateau, with an average elevation of somewhat less than 1,000 feet, which slopes very gradually from the Appalachian Mountains on the east to the Ohio and Mississippi rivers on the northwest and west. Over one-third of the State is still covered with forests. The soil is generally fertile, that of the limestone region in the north central part of the State (the blue-grass region) being especially productive. The climate is relatively equable, the mean annual temperature being about 56° F. The annual rainfall is about 45 inches. Very large crops of maize, tobacco, and hay are grown. The other principal crops are wheat and oats. The breeding of fine horses has been an important industry. Large numbers of swine, sheep, cattle, milch cows, and mules are also maintained. Agriculture has been practiced in the State about one hundred years. The manufacturing interests have been greatly developed in recent years.

The college with which the station is connected was established in 1865, and has been developed largely along technical and scientific lines.

The Kentucky Agricultural Experiment Station had its origin in a resolution of the executive committee of the board of trustees of the Kentucky Agricultural and Mechanical College, passed in September, 1885, by which it was determined to establish an agricultural experiment station in connection with the college, the professors of natural science and agriculture being expected to take part in the work as far

as consistent with their college duties. At a meeting of the executive committee on September 25, 1885, Melville A. Scovell, M. S., at that time in the employ of the United States Department of Agriculture as a special agent in sugar experiments, was elected director of the proposed experiment station, and assumed his duties in November of the same year. One large room in the basement of the college building was assigned to the station, and this, by subdivision into three, was made to serve as office, balance room, and chemical laboratory.

The first publication of the station was a circular issued December 4, 1885, announcing its organization, and the first bulletin, issued December 23, 1885, gave an account of an experiment with fertilizers on tobacco made in the previous summer by the professor of agriculture. The first chemical work actually done in the laboratory of the station was the analysis of some maize fodder, the results of which were published January 4, 1886, as Bulletin No. 2 of the station. The executive committee of the college at this time was the governing board of the station.

The resources of the station were at first exceedingly limited, but early in 1886 the State legislature passed an act, approved April 13, by which the law regulating the sale of commercial fertilizers in the State was so changed as to put the experiment station in charge of the fertilizer control of the State, and all the fees pertaining thereto were required to be paid into the treasury of the college, to be expended in meeting the legitimate expenses of the station, including analyses of fertilizers and experimental work. In this act the station was formally recognized as the Kentucky Agricultural Experiment Station. In the spring of 1886 what tillable land the college had, being about 12 acres, was assigned to the use of the station for field experiments, and a series of variety and fertilizer tests with field crops was begun. In June of this year the working force of the station was increased by the election of Prof. Alfred M. Peter assistant chemist. Before this time the director was the only person whose time was devoted exclusively to the work of the station.

The passage of the act of Congress of March 2, 1887, gave a strong impulse to the growth of the station, and although the Government appropriation did not become available until the next year, the trustees of the college began immediately to increase the working facilities of the station and to put it upon a more independent basis. In the fall of 1887 a farm of 48½ acres, with brick residence, large barn, and other buildings was purchased for the use of the station. The residence was occupied by the director and the farm was tile-drained and laid out for experimental purposes. By resolution of the executive committee the general management of the station was vested in a board of control, composed of the executive committee of the board of trustees,

the director of the station, and the president of the college. This board had its first meeting on April 29, 1888, when committees were appointed to purchase books and apparatus and to consider plans for a station building. The contract for this building was let in May, 1888, and it was completed and occupied in February, 1889. In June, 1889, the services of Prof. Harrison Garman were secured as entomologist and botanist of the station, and he established his laboratory in the station building.

On the night of February 22, 1891, the station building suffered from a disastrous fire, which destroyed the whole of the second and most of the first floors, including the chemical laboratories both of the station and college and the laboratory of entomology and botany. Fortunately the library and office were saved and also the contents of the laboratory of entomology and botany, but the chemical laboratory was almost a total loss, including the laboratory records. This building was rebuilt and the laboratories again equipped.

In 1898 the station's facilities for field and feeding experiments were much increased by the purchase of a second farm of about 64 acres, situated near the one already owned.

ORGANIZATION.

The governing board of the station is the board of trustees of the college, which consists of the governor of the State and the president of the college, ex officio, and 15 members appointed by the governor for terms of six years. One-third of the members are appointed biennially. The board of trustees appoints a committee called the board of control, which has charge of the experiment station. It consists of three members of the board of trustees, the president of the college, and the director of the station. It elects a chairman and secretary. The board of control also appoints from its members a finance committee, which supervises the expenditures of the station, meeting for this purpose bimonthly. None of the members of the board of trustees or board of control receive any compensation. Their traveling expenses are paid.

The station staff consists of the president of the college, director (who is also chemist), two other chemists, entomologist and botanist, horticulturist, agriculturist, two assistant chemists, and stenographer and secretary to the director. They are appointed by the board of trustees of the college. When first appointed their tenure of office is for one year. If reelected at the end of the year, their appointment is permanent, or at the pleasure of the board of trustees. The director plans the work and the experiments to be undertaken, attends to the correspondence, and has general supervision of station affairs.

EQUIPMENT.

The station buildings comprise a main building, dairy building, storage barn, tobacco barn, dairy barn, insectary or vivarium, and greenhouse. The main building (Pl. LIV, fig. 1) is a brick structure 54 by 70 feet, two stories and basement. In this building are the offices and laboratories of the station, occupying all the first floor and basement, comprising eight and seven rooms, respectively, one room on the second floor, and the entire attic. The dairy building (Pl. LIV, fig. 2) contains an office and workroom, churning room, cream and milk room, and a cold-storage room. (The vivarium is shown in Pl. LV, fig. 1.)

The station has two tracts of land, one of about 48½ acres (Pl. LV, fig. 2), more than half of which has been divided into one-tenth acre plats for experimental purposes. The other tract, containing about 64 acres, which was recently purchased, is now mostly in pasture, but some of it will be laid out in plats for experimental purposes. The college has no farm or live stock. The station owns a herd of 16 Jerseys. (One of them, Dollie's Valentine, is shown in Pl. LVI, fig. 1. This cow has a record of 10,218.3 pounds of milk and 676.5 pounds of butter in one year, which is an average of 27.99 pounds of milk and 1.85 pounds of butter a day for the period.)

In the entomological division there are mounted 2,349 species of insects represented by 7,656 specimens, besides about 19,000 duplicates and undetermined specimens. There are also about 37,000 miscellaneous specimens classified by the plants on which they were collected. In alcohol there are 9,451 determined and undetermined specimens of insects, 600 specimens of Myriapoda, 940 specimens of Arachnida, 300 specimens of Vermes, 450 specimens of Mollusca, and 2,150 specimens of Crustacea. In the herbarium are 1,250 species of flowering plants represented by 2,000 mounted specimens, 2,000 determined duplicates, 975 species of cryptogams, and samples of the seeds of 800 species of plants. The chemical division has a collection of the typical soils of the State, fertilizer materials, etc., a complete collection of the commercial fertilizers sold in the State, and a small collection of lantern slides illustrating the principal breeds of milch cows, etc. The State geological cabinet, located at the college, and the geological and mineralogical collections of the college are accessible to station workers.

The station library contains 2,215 bound volumes and about 4,800 unbound volumes and pamphlets. The college library is accessible to station workers, as is also the valuable public library of the city of Lexington. The laboratories of the station are well equipped with such apparatus as is required in their work. Special mention may be made of an overflow pipette designed at the station and used for measuring standard acid in nitrogen determinations.

FIG. 1.—KENTUCKY STATION—MAIN BUILDING.

FIG. 2.—KENTUCKY STATION—DAIRY BUILDING.

FIG. 1.—KENTUCKY STATION—VIVARIUM.

FIG. 2.—KENTUCKY STATION—EXPERIMENTAL FARM.

FIG. 1.—KENTUCKY STATION—DOLLIE'S VALENTINE.

FIG. 2.—KENTUCKY STATION—FIELD EXPERIMENT WITH TOBACCO.

FIG. 1.—KENTUCKY STATION—FIELD EXPERIMENT WITH HEMP.

FIG. 2.—KENTUCKY STATION—HEMP STACK.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund, fees for the analyses of fertilizers, foods, etc., and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Fees for inspection of foods	1,990.77
Fees for fertilizer analyses	11,525.00
Farm products	2,470.34
Balance on hand July 1, 1898	5,328.22
Total	36,314.33

LINES OF WORK.

The station is charged by law with the inspection of fertilizers and foods. In the case of fertilizers a tag is put on each package sold in the State and signed by the director of the station, giving the minimum guaranteed percentages of total phosphoric acid, available phosphoric acid, nitrogen, and potash. The entomologist also serves as State entomologist, and makes a general inspection of the nurseries throughout the State for insect pests once a year. In cooperation with the Division of Chemistry of the United States Department of Agriculture the station has examined, unofficially, numerous samples of honeys, candies, sugars, and sirups, with reference to their purity.

In the early years of the station the scientific work was confined almost entirely to chemical analyses and investigations and field experiments. The analyses included fertilizers, products of experimental fields, and forage crops. At the same time a series of field experiments was instituted to study the needs of the soils of the State. These soon yielded the striking result that potash is needed on the worn bluegrass soils, although analyses show them to contain a comparatively large percentage of this constituent. In cooperation with the State Geological Survey the station has analyzed a number of samples of the marls of the State to determine their value as fertilizers. Determinations have been made of the amount of arsenic and copper that remains on cured tobacco in those cases in which spraying with Paris green is resorted to for protection against the tobacco worm. Considerable studies have been made upon the solubility of phosphoric acid and potash of the soil in dilute organic acid with a view to devising a chemical method for determining their availability that will give results comparable to those of field and pot experiments. This station was the first to suggest the use of salicylic acid in place of carbolic or benzoic in the Kjeldahl method for estimating nitrogen in nitrates. Numerous analyses have been made of sugar cane in the course of experiments in the selection of seed.

Fertilizer experiments have been carried on with tobacco to determine the effect of the different elements and the form in which each

should be applied. (A field of tobacco experimented with is shown in Pl. LVI, fig. 2.) Similarly, experiments have been made with commercial fertilizers on hemp to determine the effect of the various fertilizing elements and of different combinations on the production of fiber. (A hemp field and hemp stack are shown in Pl. LVII, figs. 1 and 2.) Experiments were also carried on with maize to ascertain the effect of the principal elements of plant food and their various combinations; to study the permanency of effect of potash fertilizers, and to ascertain the effect of fertilizers on shrinkage and on the ratio of cob to kernel. Variety, cultural, and fertilizer tests have been carried on to a considerable extent with wheat and potatoes.

Pig-feeding experiments have been carried on, the object of which was to test the relative value of the most common local feeding stuffs, shelled maize, and maize meal, in the production of pork. In the same experiment tests were made of the relative value of maize-cob meal as compared with shelled maize and maize meal. Observations were also made upon the length of time that these feeds might be used profitably. Experiments have been made with sheep to determine the digestibility of English blue grass. Studies on the variation of fat in the milk of cows by the use of different kinds of food have been carried on for several years, and systematic and elaborate records have been kept.

Along lines of entomology studies have been made on the Orthoptera of Kentucky, and in the course of this work four new species were discovered. A list of the night-flying moths of the State has been prepared. Observations have been made on a considerable number of insect and fungus pests, among which may be mentioned the codling moth, tobacco worm, cabbage plusia, rose aphis, June bug, and bean weevil. Experiments have been carried on in the treatment of these and other pests. In the course of the work on cutworms it was found that they are subject to the attacks of a fungus parasite that may be cultivated and possibly utilized for their destruction. Investigations have been made on the gape disease of poultry.

Along lines of botany investigations have been made on the broom rape of hemp and tobacco. It was found in the course of this work that the broom rape seed can be detected by the aid of the microscope in the hemp seed. Observations have been made on various plant diseases and their treatment, among them the rot of apples, tomato rot, and potato blight. For a number of years observations have been made on the rate of growth of different species of grass in plots, their value for pasture and for meadow, and their hardiness. Considerable attention has been given to studies of the woolly mullein and methods of eradicating it. Studies have been made of ginseng, and experiments have been made in the cultivation of the plant. In the horticultural division the work has been mainly along lines of testing fruits and vegetables. Strawberries and grapes have received the most attention.

DISSEMINATION OF INFORMATION.

The station has issued 83 bulletins and 10 annual reports. The annual report contains, besides the usual administrative features, sundry results of experimental work. To it are appended the bulletins published during the year. The station mailing list contains about 6,600 names. Names are kept on cards according to counties. Station officers cooperate with the State board of agriculture in farmers' institute work.

GENERAL RESULTS OF WORK.

The Kentucky Station has done a very important work in regulating the sale of commercial fertilizers in the State and in teaching farmers how to use them with discrimination. Its experiments with potash have given results of great practical value. It has also aided the development of dairying on a scientific basis.

LOUISIANA.

No. 1. Sugar Experiment Station, *Audubon Park, New Orleans.*
No. 2. State Experiment Station, *Baton Rouge.*
No. 3. North Louisiana Experiment Station, *Calhoun.*

Department of Louisiana State University and Agricultural and Mechanical College.

GOVERNING BOARD.

State Bureau of Agriculture and Immigration: Governor Murphy J. Foster, *Baton Rouge;* Wm. Garig (*Vice-President*), *Baton Rouge;* Leon Jastremski (*Commissioner*), *Baton Rouge;* Thos. D. Boyd (*President State University*), *Baton Rouge;* and Wm. C. Stubbs (*Director State Experiment Station*), *Baton Rouge.*

Jno. Dymond, *Belair;* Emil Rost, *St. Rose;* A. V. Eastman, *Lake Charles;* E. T. Sellers, *Walnut Lane;* Chas. Schuler, *Keatchie;* H. P. McClendon, *Amite.*

STATION STAFF.

T. D. Boyd, M. A., LL. D., *President of the College* (*Baton Rouge*).

Sugar Experiment Station, *Audubon Park, New Orleans.*

Wm. C. Stubbs, M. A., Ph. D., *Director.*
R. E. Blouin, M. S., *Assistant Director; Chemist.*
H. E. Wright, B. S., *Chemist.*
S. Baum, B. S., *Chemist.*
Geo. Chiquelin, *Sugar Maker.*
W. D. Clayton, M. S., *Farm Manager.*
Jas. K. McHugh, *Secretary.*

State Experiment Station, *Baton Rouge.*

Wm. C. Stubbs, M. A., Ph. D., *Director.*
——— ———, *Assistant Director.*
Charles E. Coates, jr., Ph. D., *Chemist.*
J. F. Harp, B. S., *Assistant Chemist.*
Robt. E. Glenk, B. S., *Assistant Chemist.*
A. C. Veatch, M. S., M. A., *Geologist.*
W. R. Dodson, M. A., *Botanist and Mycologist.*
W. H. Dalrymple, M. R. C., V. S., *Veterinarian.*
H. A. Morgan, B. S. A., *Entomologist.*
F. H. Burnette, *Horticulturist.*
J. Clayton, *Farm Manager and Tobacconist.*

North Louisiana Experiment Station, *Calhoun.*

Wm. C. Stubbs, M. A., Ph. D., *Director.* M. Bird, B. S., *Chemist.*
J. G. Lee, B. S., *Assistant Director.* Thos. I. Watson, *Farm Manager.*
Eugene J. Watson, *Horticulturist.*

HISTORY.

The surface of Louisiana consists of lowlands along the Gulf of Mexico, and in the valley and delta of the Mississippi River and of higher lands farther away from the Gulf and River, which rise in the northwestern part of the State to an elevation of about 400 feet. The soils are generally fertile, those in the alluvial lands in the Mississippi delta being unusually productive. The climate is mild and the winters are brief. At New Orleans frost does not usually occur until about the middle of December, but in the northern part of the State it occurs a month earlier. The annual rainfall ranges from 56 inches on the coast to 48 inches in the north. The forests are extensive. The principal crops are sugar cane, cotton, rice, and maize. The growing of early vegetables and small fruits for Northern markets has become an important industry. Numerous swine, cattle, milch cows, horses, and mules are maintained. Agriculture has been practiced in the State for one hundred and fifty years and was rapidly developed with slave labor after Louisiana was admitted to the Union in 1812.

The university with which the stations are connected was established in 1860 and is giving much attention to instruction in technical and scientific lines.

The State of Louisiana has a system of three experiment stations, all coordinate in rank and under the same directorship. One is located at Audubon Park, New Orleans, and is known as Sugar Experiment Station, No. 1; the second is at Baton Rouge and is known as the State Experiment Station, No. 2; the third is at Calhoun and is known as the North Louisiana Experiment Station, No. 3.

In September, 1885, the Sugar Experiment Station was started as a private enterprise, with Dr. William C. Stubbs as director, by endowment of the sugar planters of the State, and continues to be supported in part by them, although largely maintained by appropriations from the State and National governments. The State Experiment Station was organized at Baton Rouge in 1886 by the State bureau of agriculture, and was partially supported by funds from that department until it was relieved by the State and National governments. Upon passage of the act of Congress of March 2, 1887, a third station was established in north Louisiana.

ORGANIZATION.

The three stations constitute a department of the Louisiana State University and Agricultural and Mechanical College. The governing board of all the stations is the Louisiana State Bureau of Agriculture

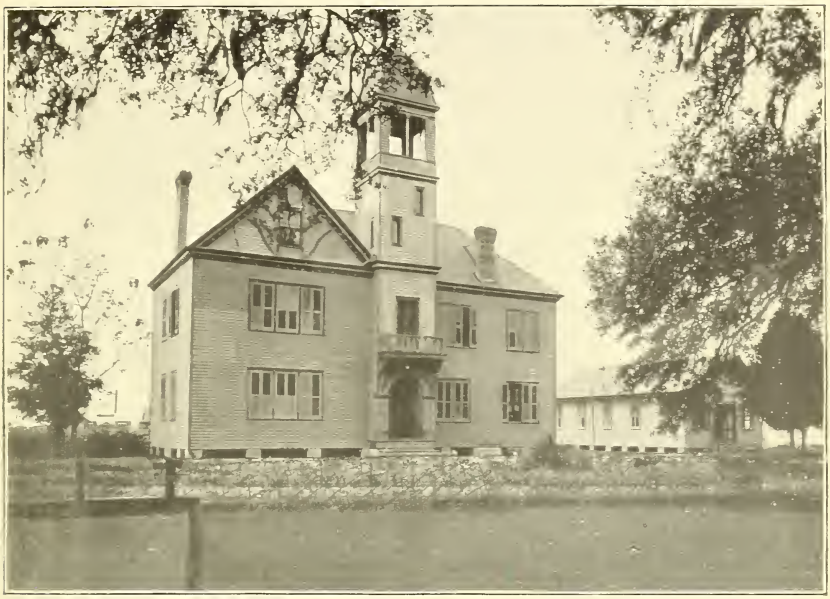


FIG. 1.—LOUISIANA STATIONS—SUGAR LABORATORY, NEW ORLEANS.

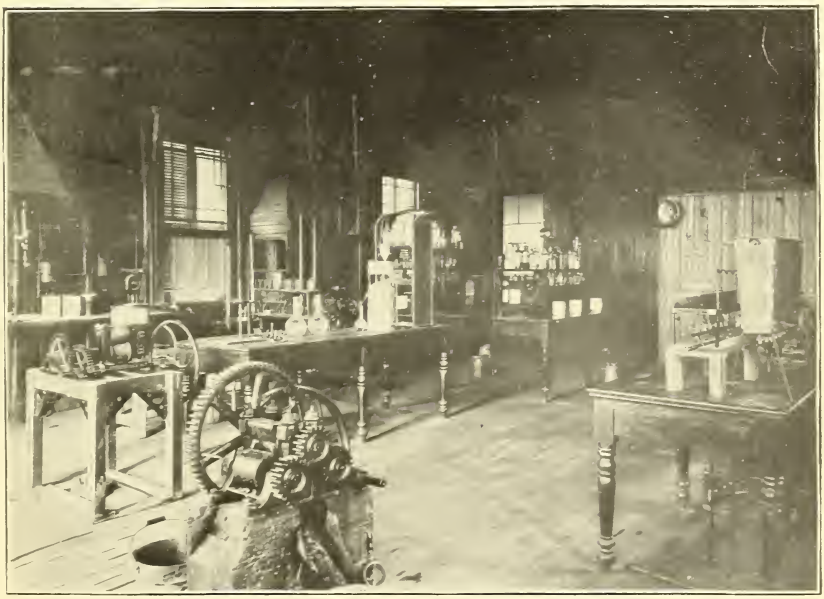


FIG. 2.—LOUISIANA STATIONS—SUGAR LABORATORY, INTERIOR.

FIG. 1.—LOUISIANA STATIONS—SUGAR HOUSE AND BARNS, NEW ORLEANS.

FIG. 2.—LOUISIANA STATIONS—DIRECTOR'S RESIDENCE NEW ORLEANS.

FIG. 1.—LOUISIANA STATIONS—TOBACCO BARN, BATON ROUGE.

FIG. 2.—LOUISIANA STATIONS—ASSISTANT DIRECTOR'S RESIDENCE, BATON ROUGE.

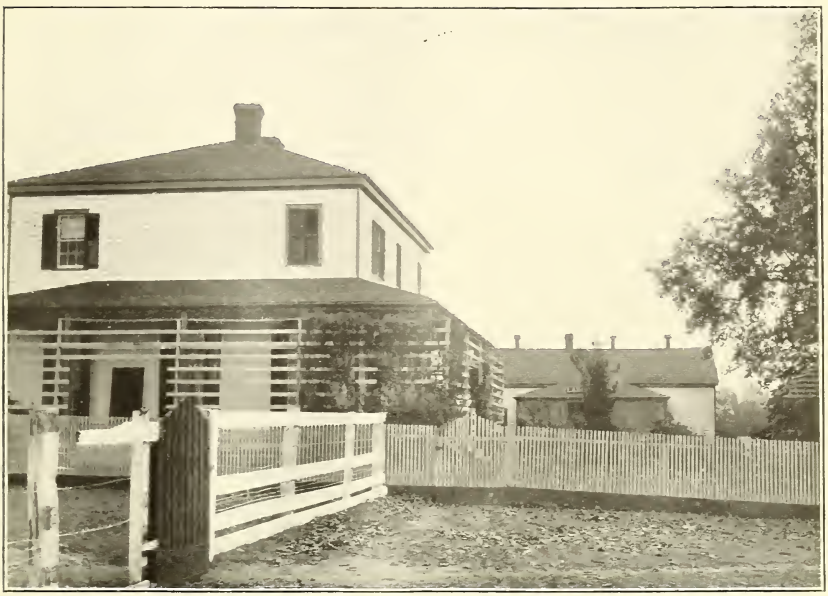


FIG. 1.—LOUISIANA STATIONS—ASSISTANT DIRECTOR'S RESIDENCE, CALHOUN.

FIG. 2.—LOUISIANA STATIONS—ASSEMBLY HALL, CALHOUN.

and Immigration, which consists of the governor of the State, the vice-president of the board of supervisors of the Agricultural and Mechanical College, the commissioner of agriculture and immigration, the president of the State University, and the director of the State Experiment Station ex officio, and six members appointed by the governor, one from each Congressional district, for terms of six years. This board meets on the call of the governor, and members receive no compensation, their traveling expenses alone being paid.

The president of the college is ex officio a member of each of the station staffs, and the same person is director of all the stations. The staff of the Sugar Experiment Station is composed of a director, an assistant director (who is also chemist), second and third chemists, sugar maker, farm manager, and secretary. The staff of the State Experiment Station is composed of a director, assistant director, chemist, two assistant chemists, geologist, botanist, mycologist, veterinarian, entomologist, horticulturist, farm manager, and tobacconist. The staff of the North Louisiana Experiment Station is composed of a director, assistant director, chemist, farm manager, and horticulturist. Members subordinate to the director are appointed by him, by and with the consent of the governing board, and hold office during good behavior. The duties of the director are the control of the three stations, subject to the approval of the State Bureau of Agriculture and Immigration, and he distributes, as occasion demands, lines of work to the different members of the staff.

EQUIPMENT.

At New Orleans the buildings of the Sugar Experiment Station consist of a two-story laboratory (Pl. LVIII, figs. 1 and 2), with a complete outfit for all kinds of work pertaining to the station, including an agricultural laboratory for work upon commercial fertilizers, soils, etc.; a sugar house (Pl. LIX, fig. 1), abundantly supplied with all the latest machinery for the manufacture of sugar, the whole costing over $100,000; a boiler house, furnishing ample power for all the work of the station; a large iron barn, stables, tool houses, and a stabler's house, and a residence for the director (Pl. LIX, fig. 2).

At Baton Rouge the buildings consist of a two-story laboratory, 56 by 30 feet, with wing 30 by 20 feet, recently completed, with outfit for the chemist, bacteriologist, veterinarian, entomologist, horticulturist, and library; a large barn with steam power attached, a stable, tobacco barn (Pl. LX, fig. 1), with curing room, residence for the assistant director (Pl. LX, fig. 2), and house for the farm manager.

At Calhoun the buildings consist of a large and commodious residence for the assistant director (Pl. LXI, fig. 1) and several smaller houses for other members of the station force; a large iron barn; a large iron stable and tool room combined, and a chemical laboratory with library

attached; an assembly hall capable of seating 800 people (Pl. LXI, fig. 2); an auditorium capable of seating 2,500 people; two tobacco barns, a model dairy and dairy barn, and a poultry and incubator house, together with other small houses for the various purposes of the station.

At New Orleans the station controls 50 acres of land. The general character of the land is alluvial. It is devoted to field experiments. While the prime object of the station is the investigation of sugar cane, other crops, such as alfalfa and forage crops, fiber plants, etc., receive attention. At Baton Rouge the station makes use of about 90 acres of the college farm, which contains about 200 acres. The character of the soil is a brown loam of the bluff formation of the State. At Calhoun the station owns 330 acres, of which about 75 are devoted to experiments and 100 acres to pasture, etc. On all three of these farms the fields are divided into plats of one-half acre, with drives running between them, so as to make every part of the farm accessible to visitors in carriages and on horseback. At Baton Rouge there is a plat of 10 acres especially devoted to orchard and garden, and at Calhoun, a similar area; while at New Orleans, from 1 to 2 acres are devoted to the growth of tropical and subtropical fruits and plants. The land occupied by the stations at Baton Rouge and Calhoun is owned by the university, but is under the control of the station and is cultivated exclusively for station purposes.

Each station owns 4 mules. At Baton Rouge there are 5 head of Jersey cattle and 15 Berkshire hogs. Besides these, cattle and hogs are purchased from time to time for special experiments either in feeding or for treatment for various diseases and for immunization of Northern animals from Texas fever. The university owns no stock. At Calhoun there are four breeds of dairy cattle, Guernsey, Jersey, Devon, and Holstein. Besides these, two beef breeds, Herefords and Shorthorns, are under experiment with a view to determining the best breed for that section of the State. There are 32 sheep of four breeds, 28 hogs of five breeds, and chickens of several breeds.

At Baton Rouge there is a botanical garden of 8 or 10 acres, which is rich in plants that can be grown in Louisiana. There is also a large agricultural museum.

Each station maintains its own library separate and distinct from the university library. The total number of volumes at the three stations will approximate 5,000. Station officers also have access to the college library of about 20,000 volumes.

FINANCIAL SUPPORT.

The financial support of each of the stations is derived from the national fund, a State appropriation, fees for analyses of fertilizers

and Paris green, and sales of farm products. During the last fiscal year the total income of the three stations was as follows:

United States appropriation	$15,000.00
State appropriation	18,000.00
Fees	5,202.31
Farm products	664.44
Miscellaneous	690.56
Balance on hand July 1, 1898	9,088.95
Total	48,646.26

LINES OF WORK.

The station makes analyses of commercial fertilizers and Paris green under the direction of the State Bureau of Agriculture and Immigration.

The station has direction of an agricultural and geological survey of the State, which is supported by a State appropriation. It is proposed in this survey to map geologically, agriculturally, and topographically the townships of the State, and establish the north and south line at each county seat of the different parishes (counties); to collect soils, clays, recent and fossil shells, recent and fossil plants, fungi, etc., and to establish the dividing lines of the different formations and their differences in sylvæ. Analyses are made of samples of all soils, waters, and minerals collected.

The Sugar Experiment Station at New Orleans is engaged mainly in investigations in the interest of the sugar industry, and experiments have been carried on in the field, sugar house, and laboratory since the organization of the station. The work in the field has included experiments with fertilizers and different methods of cultivation and extensive trials of seedling canes. In the sugar house many experiments in the "carbonation process" have been carried on. In the laboratory studies have been made upon the composition of cane juices, and the changes induced in them by different methods of clarification and evaporation. A physiological study has been made of the sugar cane and the character of the organic solids not sugars contained in its juices. Much time has been given to studying the bacteria of the sugar house, and the ferments which destroy the cane after it is killed by frost. Special experiments have been made looking to the sterilization of sirups and molasses on a large scale. Determinations have been made of the relative amounts of solids left in the juice by the different processes of filtering and settling.

Some attention has been paid at this station to the culture of other crops than sugar cane. These are principally citrus fruits; fiber crops, comprising ramie, jute, and several varieties of hemp, and alfalfa and other legumes. A large number of varieties of maize have been

grown, including several from Mexico, Brazil, Cuba, and Peru. Also a large number of varieties of sorghum, both saccharine and non-saccharine, and various recently imported forage crops have been tested. The culture of rice has received attention.

At the State Station at Baton Rouge, field experiments with cotton, maize, tobacco, sugar cane, forage crops, grasses, etc., have been carried on, the subject of tobacco growing receiving special attention. Experiments have been made both at this and the other stations in the culture of Egyptian cotton, with a view to introducing, if possible, the culture of that type of cotton in this country. In the horticultural division Northern or Eastern grown seed has been compared with that grown within the State. Experiments have been carried on in growing winter vegetables, especially cucumbers, under glass. Chemical and botanical studies have been made on the sweet potato. Investigations are in progress on Texas fever, especially with reference to the relation of different species of ticks to the disease. Studies have been made on the insects attacking citrus fruits.

At the North Louisiana Station at Calhoun, field experiments have been conducted with Spanish peanuts, velvet beans, and cowpeas, which have been followed by ash and food analyses of the crops. Field experiments have been carried on with various other agricultural and horticultural crops, most noteworthy among which are experiments in growing yellow leaf tobacco with the purpose of introducing this as a general money crop to take the place of cotton. Experimental work in animal industry looking to the extension of this industry in the State is receiving considerable attention.

DISSEMINATION OF INFORMATION.

From the organization of the Sugar Experiment Station to 1890, the stations issued 28 bulletins. At that time a second series was begun, in which 58 had been issued up to January 1, 1900.

The annual reports, 11 of which have been issued, are merely administrative documents. Dr. W. H. Dalrymple, the veterinarian, is the author of a treatise on obstetrics, and the director, Dr. W. C. Stubbs, is the author of a work on sugar cane in two volumes, the first of which treats of its history, botany, and agriculture, and the second of its chemistry and manufacture. The mailing list contains 7,000 names. It is kept on index cards arranged alphabetically by post-offices and parishes (counties). The correspondence amounts to about 5,000 letters a year. All members of the staff are actively engaged in work at farmers' institutes, farmers' clubs, and other agricultural organizations not only in Louisiana, but in adjoining States. Each of the stations has organized an agricultural club, which meets upon its grounds once a month.

GENERAL RESULTS OF WORK.

The Sugar Experiment Station has materially benefited the sugar industry in the State by the development of new methods for the manufacture of sugar, and by the introduction of new varieties and improved culture of the sugar cane. The three stations have done much to promote the diversification of agriculture, the maintenance or restoration of the fertility of soils, and the discriminating use of fertilizers. The growing of leguminous plants for forage and green manuring has been greatly stimulated. The development of tobacco growing and dairying has been materially augmented. Much progress has also been made in a survey of the soils and agricultural capabilities of the State.

MAINE.

Maine Agricultural Experiment Station, *Orono.*

Department of University of Maine.

GOVERNING BOARD.

BOARD OF TRUSTEES OF THE UNIVERSITY.

Station Council: A. W. Harris (*President*), *Orono;* Chas. D. Woods (*Secretary*), *Orono;* Edward B. Winslow, *Portland;* Voranus C. Coffin, *Harrington;* Arthur L. Moore, *Camden;* J. M. Bartlett, *Orono;* L. H. Merrill, *Orono;* F. L. Russell, *Orono;* W. M. Munson, *Orono;* G. M. Gowell, *Orono;* B. W. McKeen, *Fryeburg;* C. S. Pope, *Manchester;* Otis Meader, *Albion.*

STATION STAFF.

A. W. Harris, M. A., D. Sc., *President of the University.*
Chas. D. Woods, B. S., *Director.*
J. M. Bartlett, M. S., *Chemist.*
L. H. Merrill, B. S., *Chemist.*
——— ———, *Botanist and Entomologist.*
F. L. Russell, B. S., V. S., *Veterinarian.*
W. M. Munson, M. S., *Horticulturist.*
G. M. Gowell, M. S., *Expert in Stock Breeding and Aviculture.*
L. J. Shepard, B. S., *Assistant Agriculturist.*
O. W. Knight, B. S., *Assistant Chemist.*
A. J. Patten, B. S., *Assistant Chemist.*
E. R. Mansfield, *Assistant Chemist.*
Miss Mary Hutchinson, *Stenographer.*

HISTORY.

The Maine Station is located in the southern part of the State, near Bangor, on the Penobscot River. A large portion of the State consists of mountains and lakes. The forests are extensive, and lumbering is a large industry. Fisheries, manufactures, and commerce engage the attention of a large share of the population. Agriculture is pursued mainly in the river valleys in the southern part of the State and in Aroostook County in the north. There is a great variety of soils. Farm manures and commercial fertilizers are extensively used. Agriculture has been practiced in a regular way for more than two hundred

years. The winters are severe and the summers cool. The principal crops are oats, potatoes, and hay. Dairying is an important agricultural industry. The college with which the station is connected has been developed mainly along technical and scientific lines. In recent years it has grown very rapidly, and is being broadened into a State university.

The Maine Agricultural Experiment Station was established in accordance with an act of the State legislature approved March 3, 1885, with Prof. W. H. Jordan as director and chemist, James M. Bartlett, assistant chemist, and Gilbert M. Gowell, superintendent of field and feeding experiments. Soon afterwards L. H. Merrill was also appointed assistant chemist. Prof. Jordan was director of the station until June, 1896, when he resigned to accept the directorship of the New York State Station. Otherwise the members of the station staff appointed at this time have been associated with the station continuously to the present. The station made use of the buildings and lands of the Maine State College. Its revenue prior to the reorganization under the act of Congress was $5,000 a year from the State, and fertilizer fees, or a total income of a little over $6,000.

In June, 1887, the station was reorganized in accordance with the act of Congress as a department of the college, and immediately afterwards the State legislature repealed the State act of March 3, 1885, to take effect October 1, 1887. As the national appropriation did not become available until February, 1888, the station was thus left without means of support. Under these circumstances the college advanced sufficient money to pay the station's expenses until January 1, 1888, after which it was compelled to discontinue work for a time. Operations were resumed February 16, 1888. In 1897 the Maine State College became the University of Maine.

ORGANIZATION.

The governing board of the experiment station is the board of trustees of the college. The immediate management is delegated to a station council, consisting of the president of the university, the director, heads of divisions, three members from the board of trustees, and one member each from the State board of agriculture, State Grange, and State Pomological Society. The station council meets once a year and the traveling expenses of its members are paid.

The staff consists of the president of the university, director, two chemists, botanist and entomologist, veterinarian, horticulturist, expert in stock breeding and aviculture, three assistant chemists, assistant in agriculture, and stenographer. Appointments are made by the board of trustees on recommendation of the director and president, assistants usually for a definite period of time, but heads of divisions indef-

FIG. 1.—MAINE STATION—LABORATORIES AND GREENHOUSES.

FIG. 2.—MAINE STATION—DAIRY BUILDING.

FIG. 1.—MAINE STATION—FARM BUILDINGS.

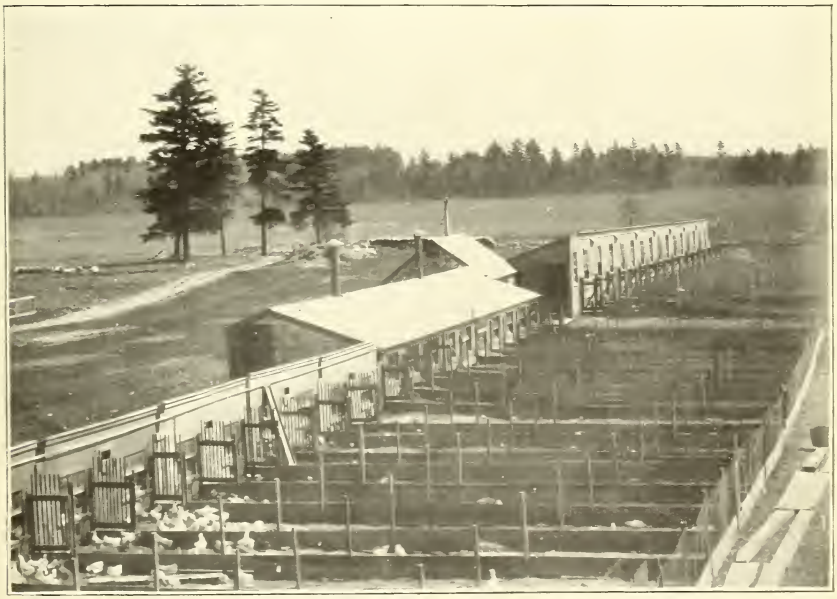


FIG. 2.—MAINE STATION—POULTRY HOUSES AND YARDS.

FIG. 1.—MAINE STATION—GREENHOUSES.

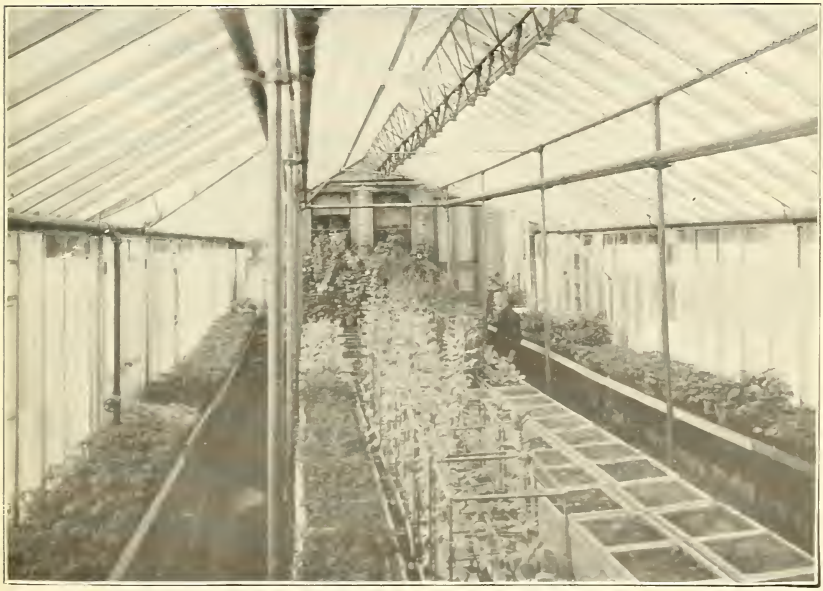


FIG. 2.—MAINE STATION—POT EXPERIMENTS IN GREENHOUSE.

initely. At the annual meeting of the station council the director reviews the work which has been undertaken in the past year and makes recommendations for the following year. The director is charged with carrying out the plans of work approved by the council, and, in general, acts as the executive officer of the station.

EQUIPMENT.

The station buildings consist of an office and laboratory building (which, with the horticultural building and greenhouses, are shown in Pl. LXII, fig. 1), horticultural building and greenhouses, dairy building (Pl. LXII, fig. 2), one barn 40 by 100 feet, one barn 50 by 100 feet, with a 100-ton silo, a hospital barn, a two-story tool house, a horse barn, a sheep barn 20 by 120 feet, a poultry house 16 by 150 feet, and 12 brooder houses. (Pl. LXIII, fig. 1, gives a general view of the farm buildings, and Pl. LXIII, fig. 2, shows the poultry houses in particular.) The office or laboratory is a two-story brick structure with granite trimmings, consisting of a main part 60 by 25 feet, and a wing 20 by 22 feet. The basement and first floor are occupied by the chemical laboratory, and on the second floor are the laboratory of the veterinarian and the station offices. The horticultural building is of wood, and has three greenhouses and a potting house attached. (Pl. LXIV, fig. 1, gives a nearer view of the greenhouses, and Pl. LXIV, fig. 2, shows pot experiments in them.) In it are the offices of the professor of horticulture and his assistant, a workroom, storeroom, photographic rooms, and rooms for the janitor and meteorologist.

The entire college farm, consisting of 80 acres under cultivation and about 40 acres in pastures and paddocks, is now under the management of the station, although prior to 1897 it occupied but 30 acres. The farm is, however, so managed that the station funds are not involved in its maintenance further than is required for experimental purposes. Any part of the farm not needed for purposes of instruction or experiment is conducted on a commercial basis. The station owns 5 horses, 62 head of cattle, 40 swine, 56 sheep, and 500 head of poultry, all available for experimental purposes.

The station has a collection of about 1,000 specimens illustrating the economic botany and entomology of the State. The library contains about 3,000 volumes. Officers also have access to the scientific library of the university, containing about 21,000 volumes, and to the State library at Augusta. The station officers have access to the mineralogical, geological, zoological, and botanical collections of the university, containing many thousand specimens illustrative of the mineral resources of the State and its fauna and flora. The chemist, Prof. J. M. Bartlett, has devised an improved form of the Babcock test, in which the base portions of the milk and cream bottles are graduated so that no acid measure is required and the base portion of the cream bottle is reduced in size.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, fees for analyses of fertilizers and feeding stuffs, sales of farm products, and miscellaneous sources. For the last fiscal year it was as follows:

United States appropriation	$15.000.00
Fees for inspection service	4,359.49
Farm products	1,582.28
Miscellaneous	400.00
Balance on hand July 1, 1898	798.54
Total	22,140.31

LINES OF WORK.

The station is charged by State laws with the inspection of fertilizers, feeding stuffs, and chemical glassware used in creameries. The director of the station is the executive officer for the administration of these laws, and the State secretary of agriculture is the prosecuting officer. The expenses of the fertilizer inspection are defrayed by a tax on the different brands sold in the State; the expenses of the feeding-stuffs inspection by a tonnage tax, and the expenses of inspecting chemical glassware by a charge for calibrating.

The scientific investigations have been along lines of the nutrition of plants, animals, and man, economic botany and entomology, and horticulture. Investigations on animal nutrition have comprised digestion experiments, experiments in feeding for milk, for growth, and for other purposes.

Since the organization of the station digestion experiments with sheep have been a prominent feature of the work. These experiments have been mainly with the forage crops of the State, although several mill products have been tested in connection with other work. In addition to determining digestion coefficients, other problems have often been studied, such as the digestibility of early and late cut hay, of green and dried grasses, of mature and immature maize fodder and silage, of fodder and silage from different varieties of maize, of different combinations of rations, and of hay made from the oat plant at different stages of maturity.

In feeding for milk and butter production, an experiment was made to test the effect of wide and narrow rations on the quantity and quality of the milk produced. Comparative tests were made with breeds of dairy cows comprising Holsteins, Ayrshires, and Jerseys, with reference to the quantity and cost of the food consumed by each, and the yield of milk, solids, fat, cream, and butter. Comparisons have been made of the mineral ingredients and of the relative size and number of fat globules in whole and skim milk from cows of different breeds. Tests were made to compare Maine maize silage with Southern

maize silage, to compare a heavy ration of hay with a medium ration, and to compare a number of feeding stuffs. The effect of liberal rations of maize gluten containing large and small amounts of fat on the hardness of butter and butter fat has been studied.

Comparisons have been made of maize meal and whole maize and raw and boiled potatoes in feeding swine. A feeding experiment with swine was carried out to determine the most efficient ratio of nutrients in a ration. The same experiment included also investigations on the relation between the nutritive ratio of the food, and character of the growth; the equivalents of different classes of nutrients; the relative value of animal and vegetable protein, and the effect of large amounts of water in food upon assimilation.

An important experiment in feeding for growth was one that had for its object a study of the effect of widely different rations upon the rate of growth and composition of the bodies of steers. The entire bodies of the animals, except the skin and contents of the stomach and intestines, were subjected to chemical analysis. Other experiments in feeding steers were made to compare a ration of hay and maize meal with a ration of oat straw, maize meal, and cotton-seed meal. In feeding for growth investigations were made with steers on the economy in quantity and composition of various foods. Comparisons have been made of liberal feeding and moderate feeding for growing early lambs, and other comparisons have been made of oats and other mixed grain foods in raising colts.

Closely related to work in animal feeding were investigations to determine the amount of digestible dry matter produced by various fodder and root crops. Analyses were made of maize harvested at different stages of growth to determine the influence of maturity upon the composition of the plant. Determinations have been made of the value of the manurial residue from maize meal and cotton-seed meal when fed to sheep.

The station has cooperated for several years with the Office of Experiment Stations in investigations on the nutrition of man. The studies of cereal foods, including experiments in digestibility and metabolism, which are in progress at several experiment stations and colleges, are under the immediate charge of the director of this station. The lines of work followed have been experiments on the digestibility of bread with milk, more especially the digestibility of the protein; experiments on the digestibility of bread alone; dietary studies; an experiment designed to show the increased value of bread in which skim milk has been substituted for water, and studies with a view to correcting the coefficient of digestibility of protein of feeding stuffs by treatment of the feces with ether, alcohol, and hot water, and by the same treatment followed both by cold limewater and by pepsin solution. These experiments have involved, besides the study of the nutrients,

the estimation of the fuel values of the foods and of the undigested residues. Investigations on metabolism of matter form an important part of the work. Extended studies on the effects of milling were begun in 1897 in cooperation with the Minnesota Agricultural Experiment Station. These investigations, consisting of chemical analyses and digestion experiments, are carried out in duplicate at both stations. The results of the nutrition investigations are published by the United States Department of Agriculture.

Some work has been done on the nutrition of plants. Studies have been made on methods of determining the character and value of the organic nitrogen in fertilizers; box experiments have been carried on with feldspar as a source of potash, and similar experiments with various phosphatic materials as sources of phosphoric acid. Field experiments have been made to test the practical value of different forms of phosphoric acid in crop production.

Some experimental work has been done with poultry. The station is endeavoring to establish families of hens that shall excel as egg producers. As an aid in making selections, a special nest box has been devised by the station for obtaining an accurate record of the eggs laid by each hen. Tests have been made to determine the number of laying hens that can profitably be kept in one pen.

The work of the division of botany and entomology has been mainly studies of weeds, seeds, and various fungi and insects of economic importance. The life histories of *Trypeta pomonella* and *Epochra canadensis* have been worked out, and observations have been made on the habits of many other insects. Examinations have been made of garden seed offered for sale in the State with reference to germinative power and percentage of impurities. The methods of propagation and distribution of the more important weeds of the State have been studied.

The work of the horticultural division has had to do principally with plant breeding, cultural experiments, prevention of plant diseases, and the repression of injurious insects. Investigations have been made on the fertilization of flowers, with especial reference to the secondary effects of pollination. The subjects receiving attention thus far are the immediate influence of pollen on the mother plant, the stimulative effects of pollen and the effects of different amounts, and agamic development of fruit. Various culture methods with garden vegetables, particularly the tomato, cabbage, eggplant, cauliflower, and radish, have received attention. Preliminary studies have been made on the acquisition of atmospheric nitrogen by plants. A bibliography of the subject has been compiled, and the special feature of soil inoculation has been studied. A systematic study of the blueberry in the wild state and under cultivation is in progress. This work is being carried on in cooperation with farmers in several parts of the State.

DISSEMINATION OF INFORMATION.

Prior to the reorganization under the act of Congress, the station issued 28 bulletins and 3 annual reports, the former being published only as newspaper bulletins, and the latter as a part of the report of the State board of agriculture. At its reorganization in 1887 a new series was begun, in which the station had issued up to January 1, 1900, 56 bulletins and 14 annual reports. The annual report covers the operations of the station for the year and contains a complete record of its work. A regular monthly newspaper bulletin is issued containing the meteorological observations for the month, and from time to time other newspaper bulletins also, which are very generally published by the press of the State. A few posters have been sent out. The station officers have been frequent contributors to the agricultural press. The mailing list, containing about 9,000 names, is kept in linotype, and is revised about once in eight months.

The correspondence amounts to about 7,500 letters a year. The director and three members of the station staff take part in farmers' institutes and deliver other lectures as much as possible without interfering with the work of investigation. The station holds a "farmers' field day" on its grounds in June of each year, on which occasion it entertains from 1,600 to 2,000 people.

GENERAL RESULTS OF WORK.

The inspection of fertilizers conducted by the Maine Station has been of much practical benefit to the farmers, and the newly established inspection of feeding stuffs has been quite successful. The investigations of the station on the nutrition of animals have been of general value to the agriculture of the country as an aid to the establishment of rational methods of feeding. In horticulture an important work has been done in the development of apple growing, especially in Aroostook County, where a most promising industry in this line has been built up within a few years.

MARYLAND.

Maryland Agricultural Experiment Station, *College Park.*

Department of Maryland Agricultural College.

GOVERNING BOARD.

Board of Trustees—Agricultural Committee: Governor Walter Smith, *Annapolis;* Charles H. Stanley, *Laurel;* Charles W. Slagle, *Baltimore;* David Seibert, *Clear Spring;* Murray Vandiver, *Havre de Grace;* W. Scott Whiteford, *Whiteford;* Allen Dodge, *Washington, D. C.*

STATION STAFF.

R. W. Silvester, *President of the College.*
Harry J. Patterson, B. S., *Director; Chemist.*
James S. Robinson, *Horticulturist.*
Milton Whitney, *Physicist.*
Willis G. Johnson, M. A., *Entomologist.*
Samuel S. Buckley, D. V. S., *Veterinarian.*
Charles O. Townsend, M. S., PH. D., *Plant Pathologist.*
W. T. L. Taliaferro, B. A., *Agriculturist.*
E. O. Garner, *Farm Superintendent.*
Thos. M. Price, B. S., *Assistant Chemist.*
F. P. Vietch, M. S., *Assistant Soil Physicist.*
H. P. Gould, M. S., *Assistant Entomologist.*
C. F. Doane, B. S., *Assistant in Dairying and Bacteriology.*
G. L. Stewart, *Assistant Plant Pathologist.*
Jos. R. Owens, M. D., *Treasurer.*
Donald Eversfield, B. S., *Clerk.*

HISTORY.

The Maryland Station is located in the western part of the State, just outside the District of Columbia. The State is divided into two regions by Chesapeake Bay. The region east of the bay consists of lowlands extending in the southeast to the Atlantic Ocean. West of the bay the land rises toward the northwest to the Appalachian Mountain system, which crosses the State from north to south in three ranges, with intervening valleys, the peaks in some places attaining a height of over 3,000 feet. The soils are varied and often very productive. The climate is comparatively mild. The mean annual temperature ranges from 52° F. in the west to 56° F. in the south. The annual rainfall is about 45 inches. Considerable areas are covered with trees, especially in the hill regions. The principal crops are maize, hay, wheat, potatoes, tobacco, and oats. Truck farming and fruit growing are important and increasing industries. Numerous swine, milch cows, cattle, sheep, and horses are maintained. Agriculture has been practiced in the State for over two hundred years. Commercial fertilizers are widely used. The college with which the station is connected is being developed along technical and scientific lines.

While the Maryland Agricultural Experiment Station was not organized as a separate institution until 1888, experimental work in agriculture had been provided for by the State legislature as early as 1856. In that year a bill was passed establishing and endowing an agricultural college, one section of which reads as follows:

> It shall be the duty of the said board of trustees to order and direct to be made and instituted on said model farm annually a series of experiments upon the cultivation of cereal and other plants adapted to the latitude and climate of the State of Maryland and cause to be carefully noticed upon the records of said institution the character of said experiments, the kind of soil upon which they were undertaken, the system of cultivation adopted, the state of the atmosphere, and all other particulars which may be necessary for a fair and complete understanding of the result of said experiments.

It is believed that this is the first act of a State legislature providing expressly for experimental work in agriculture in America. The first

FIG. 1.—MARYLAND STATION—LABORATORY, DAIRY AND FARM BUILDINGS.

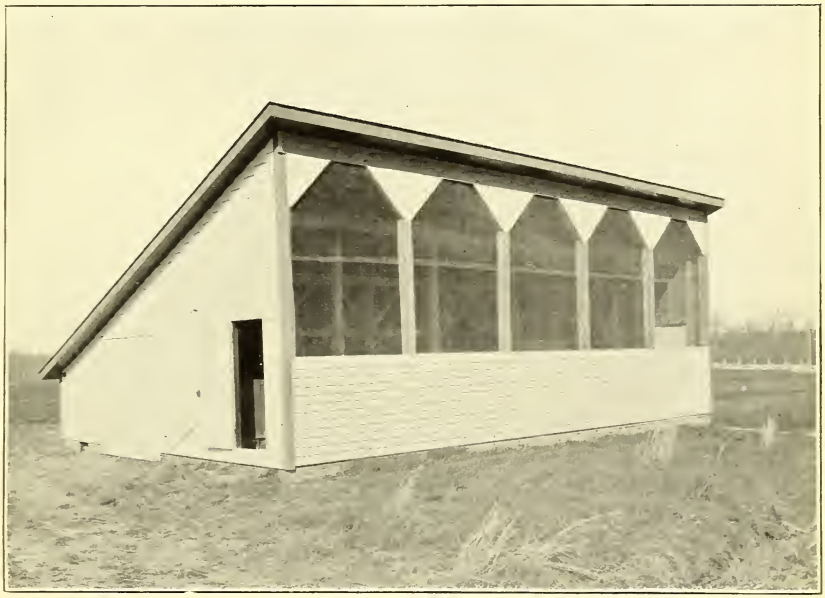


FIG. 2.—MARYLAND STATION—PIGGERY.

FIG. 1.—MARYLAND STATION—GREENHOUSES.

FIG. 2.—MARYLAND STATION—TOBACCO BARNS.

FIG. 1.—MARYLAND STATION—EXPERIMENT IN CURING TOBACCO.

FIG. 2.—MARYLAND STATION—YOUNG CATTLE IN STATION HERD.

work undertaken was a test of the relative value of the different manures offered for sale in the cities of Baltimore and Washington as applied to maize, oats, and potatoes. Financial depression, followed by the disturbed condition of the country during the civil war, necessitated the suspension of experimental work at the college soon after its inauguration.

The Maryland Agricultural Experiment Station was organized as a department of the Maryland Agricultural College March 9, 1888, with the president of the college, Maj. H. E. Alvord, now chief of the Division of Dairying of the Bureau of Animal Industry of the United States Department of Agriculture, as director. The resolutions of the board of trustees of the college organizing the station were offered by Hon. N. J. Colman, then Commissioner and later first Secretary of the United States Department of Agriculture. In 1892 the offices of the president of the college and director of the station were separated. Prof. Robert H. Miller became director, serving until 1898, when he was succeeded by the present incumbent, who had previously served the station as chemist since its organization. In 1898 the State legislature passed an act providing for the inspection of orchards and nurseries and for experimental work in horticulture, and making an appropriation of $10,000 for the first year and $8,000 annually thereafter.

ORGANIZATION.

The college is a combined State and stockholder institution and, with its experiment station, is governed by a board of trustees which consists of the governor of the State, the president of the senate, the speaker of the house of delegates, attorney-general, State treasurer and comptroller, ex-officio, 6 members appointed by the governor of the State, one from each Congressional district, for a term of six years, and 5 members elected by the stockholders and serving for one year or until their successors are elected. The governor of the State is ex-officio president of the board. The entire board of trustees elect officers and fix salaries, but all other expenditures are directed by a station committee consisting of five members of the board appointed by the governor for a term of one year.

The staff consists of the president of the college, director (who is also chemist), horticulturist, soil physicist, agriculturist, entomologist, veterinarian, plant pathologist, treasurer, clerk, farm superintendent, assistant dairyman, assistant soil physicist, assistant chemist, and assistant plant pathologist. These officers are elected for terms of one year.

EQUIPMENT.

The station buildings (Pl. LXV, fig. 1) comprise a main office and laboratory building, main barn, cow barn, implement and sheep shed, creamery, piggery (Pl. LXV, fig. 2), horticultural building, green-

houses (Pl. LXVI, fig. 1), and tobacco barns (Pl. LXVI, fig. 2). The main office and laboratory building is a three-story brick structure 35 by 45 feet, in which are the offices of the director, chemist, dairyman, and general office, chemical laboratory, dairy laboratory, mailing room, and library.

At the present time there are about 60 acres of land under cultivation by the experiment station. Of this, 20 acres are devoted to orchards and other horticultural work and 20 acres are laid out in plats of one-tenth acre each for fertilizer, cultural, and variety tests. At the meeting of the board of trustees in June, 1899, the college farm, consisting of 125 acres, which had been independent of the station farm, was transferred to the control of the station.

The permanent herd of live stock consists of 30 head of cattle and 4 horses. A few pigs and steers are also purchased from time to time for particular experiments.

The museums contain about 50 samples of soils and about 150 samples of marls, fertilizers, and feeding stuffs. The herbarium contains about 1,000 specimens, and the entomological division has about 3,000 specimens of insects. The station is located only 8 miles from Washington, D. C., and has communication with that city by both electric and steam railway. Hence the collections owned by the United States Government are easily accessible to station officers. The Johns Hopkins University, of Baltimore, has also assisted the station by allowing its officers the use of specimens, apparatus, etc.

The station library contains about 2,000 volumes. Station officers have access to the college library and make use of the libraries of the United States Government in Washington.

FINANCIAL SUPPORT.

The financial support of the station is derived from the United States fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	1,856.07
Balance on hand July 1, 1898	522.89
Total	17,378.96

LINES OF WORK.

The station has no control duties. The work of the station in the early days of its existence was confined to subjects relating to fertilizer, rotation, culture, and variety tests with agricultural and horticultural crops; feeding experiments with cows, steers, and swine, and studies of laboratory methods. These lines of work have been continued to the present time.

In 1890 the station took up the study of soils from the mechanical and physical side, a line of investigation which was comparatively new, not only in this country, but in the world. The investigations have had a threefold object: to determine the cause of the distribution of plants and crops in the State—that is, why some soils are better suited to certain crops than others; to outline the area of these different soils on a map, and to study the cause of the deterioration of the wheat and tobacco lands of southern Maryland. This work has all been covered in a preliminary way, except that part relating to the soils of the region east of the Chesapeake Bay. The soil survey of the State is to be followed by a general agricultural and horticultural survey. With the cooperation of Johns Hopkins University, the United States Biological Survey, the United States Weather Bureau, and the Maryland State Weather Service, a large colored map has been prepared showing the different geological formations in the State and the different soil formations. In cooperation with the Maryland State Weather Service a series of investigations was recently commenced upon the moisture and temperature conditions of some of the different types of soils in the State. The method used is one devised by the physicist, who is also chief of the Division of Soils of the United States Department of Agriculture. The observations are taken by reading the resistance which is offered to a current of electricity forced through the soil. Likewise, in cooperation with the Maryland State Weather Service, a series of meteorological stations has been established to study the influence of Chesapeake Bay on the trucking interests and the effect of elevation upon the peach industry in the Hagerstown Valley. A series of investigations has been taken up in connection with various fertilizer tests in progress at the station, the object of which is to determine, if possible, the effect of various fertilizers in modifying the physical conditions of the soil. These fertilizer experiments are with nitrogen, phosphoric acid, potash, and lime in numerous different forms. The work with lime has received the most attention. It has been shown that it may be used very economically in the renovation of worn soils in many of the soil formations of the State.

The culture of tobacco is an industry of importance in Maryland and has received considerable attention at the hands of the station, especially along the line of adaptation to soils. Laboratory investigations carried on by the physicist have indicated that the deterioration of the tobacco and wheat lands of southern Maryland is due to a change in the physical condition of the soil, in consequence of which the soils have become less retentive of moisture than formerly. The physicist has called attention to the close similarity between the texture of the soils and the amount of soil moisture in the truck soils of Maryland and in the bright tobacco soils of Virginia and North Carolina. For this reason the physicist believes that many of the

truck soils of the State, which for lack of transportation facilities have little value for truck farming, could be profitably devoted to this bright tobacco industry. The agricultural division also has been studying the culture of tobacco systematically, the work comprising fertilizer, culture, curing (Pl. LXVII, fig. 1), and variety tests. Preliminary experiments conducted by the division indicate the possibility of the culture of some of the cigar types of tobacco on Maryland soil.

Experimental work in dairying has been along the lines of feeding tests, creamery tests, and breeding tests. The most important feeding experiments carried on by the station are a series of studies on the feeding value of maize, which have been carried on since 1899. The discovery in recent years that the pith of the maize plant is a material of value in the arts, especially in the construction of war vessels, led to an extensive investigation on the feeding value of the waste resulting in the manufacture of this material. The experiments were of two kinds, comprising tests of digestibility and determinations of feeding value. The results showed that this waste product is superior in feeding value to shredded maize fodder or the entire plant in its natural condition.

The breeding experiments have been carried on to demonstrate the feasibility of grading up a dairy herd from common stock by the use of a blooded sire. (Pl. LXVII, fig. 2, shows some of the results.) Experiments in pig and calf feeding have been carried on incidentally to dairy work.

In the horticultural division, variety and fertilizer tests have been made with the leading vegetables and fruits of the State, and cooperative experiments are now in progress with the United States Department of Agriculture and with other experiment stations to study the relative growth of some kinds of widely distributed forest trees. Cooperative tests are also being made of different varieties of foreign apples and peaches. Experimental work in spraying tomatoes for the prevention of blight has been of value to the market gardeners and the canning industry of the State.

The work in plant diseases and entomology is subsidiary to that in horticulture and was necessitated and called into existence by the passage of State laws providing for inspection along these lines. The work in plant diseases was but very recently organized and its most important work thus far published is a study of the diseases of the sweet potato. In the division of entomology a study has also been made of the insects attacking the sweet potato. The duties of the entomologist in connection with the State work necessitated by the recently passed "trees and nursery stock law" have given exceptional opportunity for becoming acquainted with the entomological conditions in the State.

The most important line of investigation in the entomological division is a study of methods of treatment of the San José scale. Very extensive experiments have been conducted with hydrocyanic-acid gas upon deciduous fruit trees both in the nursery and in bearing orchards. These experiments have proven this to be a practical and effective treatment. Tests of hydrocyanic-acid gas for exterminating plant lice on trees have also given favorable results. The entomologist has in this connection made studies from the physiological point of view of the effect of the gas on plant life. A considerable work has been done in methods of controlling the strawberry weevil and the rose bug. Much attention has been given to a study of the natural enemies, both insect and fungus, of insects in the State. Studies have been made on the black peach aphis. Considerable demonstration work has been done in spraying.

DISSEMINATION OF INFORMATION.

The station has published 62 regular bulletins, 11 special bulletins, lettered from A to K, and 12 annual reports. The special bulletins are confined mainly to reports of analyses of commercial fertilizers by the State control. The annual report at present consists of an administrative document, to which are appended the bulletins published during the year. The mailing list contains 8,000 names, kept for reference by the card-index system, but printed for mailing with a Dick mailer. The correspondence amounts to about 5,000 letters a year. In the early years of the station exhibits were made at each county fair in the State, but recently this work has been very limited in extent. All station officers take part to a considerable extent at farmers' institutes and other meetings of an agricultural nature. For about three months in the year some station officer is thus engaged every day.

GENERAL RESULTS OF WORK.

The Maryland Station has done much useful work in the promotion of the diversification of agriculture in the State and the development of more intensive methods of farming. Its soil studies have been especially important as laying a solid foundation for the rational development of agriculture. The farmers have been shown the desirability of a discriminating use of fertilizers and the advantages of more careful culture of their crops. The establishment of dairy farming and dairying on a modern scientific basis has been helped by the feeding experiments and other work conducted by the station. The horticultural interests of the State have been promoted, especially by the introduction of scientific methods for the repression of insect pests and plant diseases.

MASSACHUSETTS.

Hatch Experiment Station of the Massachusetts Agricultural College, *Amherst.*

Department of the Massachusetts Agricultural College.

GOVERNING BOARD.

James Draper (*Chairman*), *Worcester;* William R. Sessions, *Springfield;* Charles A. Gleason, *New Braintree;* William Wheeler, *Concord;* Elijah W. Wood, *West Newton;* Henry H. Goodell, *Amherst.*

STATION STAFF.

H. H. Goodell, LL. D., *President of the College and Director.*

William P. Brooks, PH. D., *Agriculturist.*

George E. Stone, PH. D., *Botanist and Mycologist.*

Charles A. Goessmann, PH. D., LL. D., *Honorary Director; Chemist* (Fertilizers).

Joseph B. Lindsey, PH. D., *Chemist* (Foods and Feeding).

Charles H. Fernald, PH. D., *Entomologist.*

Samuel T. Maynard, B. S., *Horticulturist.*

J. E. Ostrander, C. E., *Meteorologist.*

Henry M. Thomson, B. S., *Assistant Agriculturist.*

Ralph E. Smith, B. S., *Assistant Botanist and Mycologist.*

Henri D. Haskins, B. S., *Assistant Chemist* (Fertilizers).

Chas. I. Goessmann, B. S., *Assistant Chemist* (Fertilizers).

Samuel W. Wiley, B. S., *Assistant Chemist* (Fertilizers).

Edward B. Holland, M. S., *First Chemist* (Foods and Feeding).

Fred. W. Mossman, B. S., *Assistant Chemist* (Foods and Feeding).

Benjamin K. Jones, B. S., *Assistant Chemist* (Foods and Feeding).

Henry T. Fernald, PH. D., *Associate Entomologist.*

Herbert D. Hemenway, B. S., *Assistant Horticulturist.*

George A. Drew, B. S., *Assistant Horticulturist.*

Philip H. Smith, B. S., *Assistant in Foods and Feeding.*

Arthur C. Monahan, *Observer.*

George F. Mills, M. A., *Treasurer.*

HISTORY.

The Massachusetts Station is located in the western part of the State, in the valley of the Connecticut River, which is the best agricultural region of the State. A large portion of the State is hilly and covered with trees, and in the east, on Cape Cod, are long stretches of sandy, treeless flats. Except in the river valleys, the soil is naturally poor. Agriculture has been practiced regularly in the State for over two hundred years. Tobacco, potatoes, maize, and hay are the principal crops. Market gardening, apple growing, and dairying are also important industries. The winters are severe and the summers cool. The average annual rainfall is about 48 inches. As population has increased, intensive culture and the use of farm and commercial fertilizers have been more and more practiced. The more unproductive areas have in many cases been returned to woodland. Manufactures, commerce, and fisheries engage the attention of about 85 per cent of the population. The college with which the station is connected has

maintained only an agricultural course. It is an unusually well-equipped institution, with about 150 students.

Experimental work in large amount has been carried on in Amherst ever since the organization of the Massachusetts Agricultural College in 1867, important contributions to our knowledge of soils, fertilizers, plants, and the nutrition of plants being made by Dr. C. A. Goessmann, President W. S. Clark, and Hon. Levi Stockbridge before the station was organized. Experimental work upon a largely increased scale was carried out about 1877 and 1878 by Hon. Levi Stockbridge, who expended a donation of $1,500 made for the purpose of investigation, putting in a lysimeter and conducting important investigations on soil and atmospheric moisture, dew fall, etc. At this time extensive experiments in the growth of sorghum and the manufacture of sugar therefrom were conducted by President Clark and Dr. Goessmann. Later the sugar beet was thoroughly investigated as a sugar plant by Dr. Goessmann, being the first work in that line in this country.

The Massachusetts Agricultural Experiment Station was organized in 1882, with Dr. C. A. Goessmann as director. The State appropriated $5,000 a year for its support, which was subsequently increased to $10,000, besides making occasional liberal appropriations for special purposes, such as the erection of buildings, etc. This experiment station was located at the college and leased free of rental a portion of the college estate for its purposes. Its work was always largely chemical, although field and pot experiments were carried on as well as experiments in feeding domestic animals. In 1889 the division of vegetable physiology was established under Prof. James E. Humphrey. In 1892 the division of feeding, under Dr. J. B. Lindsey, was organized, and at the same time the work with domestic animals was extended by the introduction of digestion experiments.

The Hatch Experiment Station, under the directorship of President H. H. Goodell, was organized in accordance with the act of Congress in 1888 as the experiment department of the Massachusetts Agricultural College. As at first organized it included divisions of agriculture, comprising both field and feeding experiments, botany and horticulture, entomology, and meteorology. The Hatch Experiment Station did not establish a chemical division, an arrangement being made whereby the chemical work of the station was carried on in the laboratories of the State Experiment Station.

The Hatch Experiment Station was dependent solely upon funds received from the United States, although the Massachusetts Society for Promoting Agriculture made an important contribution toward the erection of an insectary, which was built in 1889, the second in America.

The two stations maintained a separate organization until 1895, when they were combined under the name of the Hatch Experiment Station

of the Massachusetts Agricultural College, under the directorship of President H. H. Goodell, with divisions of agriculture, botany and vegetable pathology, fertilizers, foods and feeding, entomology, horticulture, and meteorology.

ORGANIZATION.

The governing board of the station is the board of trustees of the college. The members of the board are appointed by the governor of the State, but the alumni of the college exercise the right of recommendation of candidates, and their recommendation has great weight. The board consists of 14 members by appointment, and the governor, the president of the college, the secretary of the State board of education, and the secretary of the State board of agriculture ex officio. The members by appointment hold office for seven years, 2 members of the board retiring each year. The duties of the board are to determine the disposition of funds, to elect experiment station workers, etc. The only committee of the board brought into special relation with the station is the committee on the experiment department, consisting of five members. This committee is consulted with regard to the experimental work which the heads of the divisions purpose to undertake, and must give its approval to their plans before the work is entered upon. The committee, moreover, has the right to suggest experimental work. As a matter of fact, this right has been but little exercised, and the approval of plans has been merely formal for the most part. It meets regularly at the close of each quarter. The full board of trustees meets regularly twice annually. It may be called together at other times whenever there is special business demanding attention. Neither the members of the board nor those of the special committee on the experiment department receive any compensation for their services, actual expenses only being paid.

The staff proper is composed of the president of the college, who is also director of the station, and the heads of the seven divisions. There are also an assistant agriculturist, assistant botanist and mycologist, three assistant chemists (fertilizers), three assistant chemists (foods and feeding), associate entomologist, two assistant horticulturists, assistant in foods and feeding, observer, and treasurer. Members of the staff are appointed by the board of trustees and hold office as long as their services are satisfactory. The duties of the director are almost exclusively executive, although he may suggest lines of investigation.

EQUIPMENT.

The principal buildings of the station are the chemical laboratories (Pl. LXVIII, fig. 1), laboratory of the division of vegetable physiology and pathology (Pl. LXVIII, fig. 2.), plant house of the division of horticulture, plant house of the division of vegetable physiology and

FIG. 1.—MASSACHUSETTS STATION—CHEMICAL LABORATORIES.

FIG. 2.—MASSACHUSETTS STATION—LABORATORY OF VEGETABLE PHYSIOLOGY AND PATHOLOGY, USED BY COLLEGE AND STATION.

FIG. 1.—MASSACHUSETTS STATION—VEGETATION HOUSE AND POT EXPERIMENTS.

FIG. 2.—MASSACHUSETTS STATION—INSECTARY.

FIG. 1.—MASSACHUSETTS STATION—VETERINARY LABORATORY AND HOSPITAL, USED BY COLLEGE AND STATION.

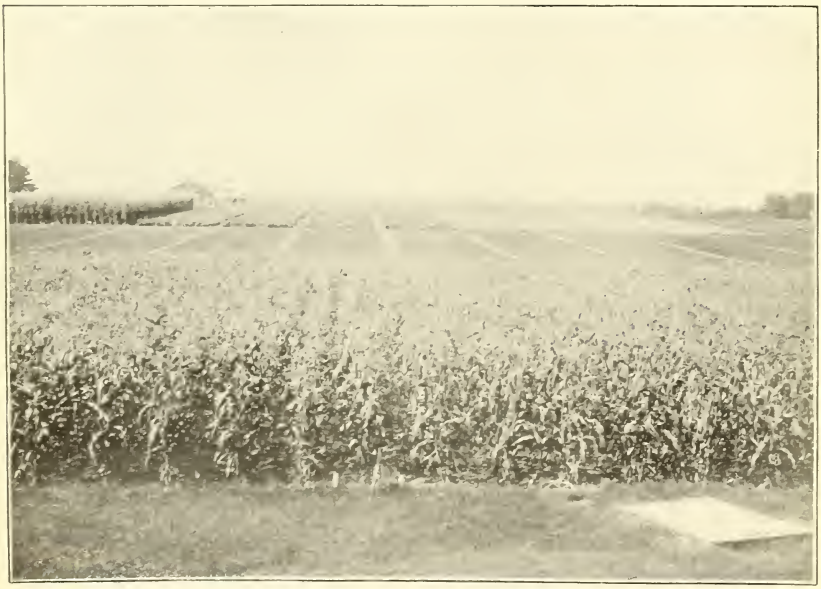


FIG. 2.—MASSACHUSETES STATION—FIELD PLATS.

pathology, vegetation house (Pl. LXIX, fig. 1), farmhouse, general storage barn, seed rooms, cold-storage rooms, smaller storage barn, barn for feeding and digestion experiments, barn for the storage of fertilizers, dairy building, and insectary (Pl. LXIX, fig. 2). The college has recently erected a veterinary laboratory with hospital (Pl. LXX, fig. 1) with a State appropriation of $25,000. The State also appropriated $1,000 a year for their maintenance. These buildings will be used in part by the station.

The laboratories of the divisions of fertilizers and of foods and feeding are in one building. It is a two-story brick structure with two wings running to the rear. The central building contains the offices and the wings the two laboratories, each separate and distinct from the other. The laboratory of the division of vegetable physiology and pathology is a separate building, two stories high, containing eight rooms, each about 18 feet square. The plant houses of the division comprise three glass structures covering 1,824 square feet of surface. These are piped for different temperatures for special work with various greenhouse crops.

The station is located upon the estate of the Massachusetts Agricultural College, which embraces 400 acres, any part of which may be used for experimental purposes. The land occupied exclusively by the station embraces about 40 acres. The area devoted to field experiments is variously laid out, the size, arrangement, and form of the plats exhibiting considerable variation. The size of plats varies from one-twentieth of an acre to three acres. (Pl. LXX, fig. 2.) There are two soil-test acres laid out according to the plan adopted by the convention of experiment stations at Washington in 1889 (see p. 96), two acres divided into quarters for experiments in manuring maize, and 12 to 15 acres occupied by orchards, small fruits, vineyards, market gardens, etc.

The station does not keep permanent herds, but purchases animals from time to time as they may be needed for special experiments. The college farm keeps on an average about 100 head of cattle, 30 sheep, 30 swine, and 16 horses, comprising several breeds of each. Accurate records are kept showing the growth and products of all these animals. They are kept primarily for educational purposes, to illustrate the different breeds and crosses, but the work with them is made more or less experimental, and animals selected from the college herd are often used by students in carrying out special investigations upon which graduation theses are written.

The agricultural division has a collection of specimens in cabinets, museums, and botanic gardens; a collection of about 360 samples of grains and seeds of cultivated plants; samples of seeds of all weeds commonly found in meadows; 140 specimens of dried grasses, both cultivated and wild; collections of maize, millets, and dried samples of crops

of various kinds, amounting to about 230 specimens, and a collection of roots showing development of tubercles as affected by fertilizers, soils, etc. Besides these objects belonging to the station there is available in the college museum a very large collection of fertilizing materials, fertilizers, models of live stock, seeds, dried grasses, grains, implements, etc.

The fertilizer division has a very complete collection of materials used for fertilizing purposes, numbering about 150 samples. This collection was exhibited at the World's Fair in Chicago in 1893. The division has also several hundred photographs illustrating results of experiments.

The division of foods and feeding has a collection of the important grains and seeds comprising wheat, maize, oats, rye, barley, cotton seed, and linseed and their manufactured products and by-products; various samples of salt, both rock and refined; photographs of various grain crops and of the station herd taken individually; digestion apparatus for sheep, and about 140 samples of concentrated cattle foods.

The botanical division has collections of seeds, weeds, both native and foreign; a herbarium containing some 12,000 specimens of field plants, about 8,000 specimens of fungi, and 1,000 species of other cryptogamic plants. There is also a collection of preserved pathological material and a few models of plant diseases.

The entomological division has a collection of mounted specimens of insects, injurious or beneficial, numbering 18,524. In addition, there is the private collection of the entomologist, Prof. C. H. Fernald, which is said to be, in some respects, unsurpassed in the world. The division has also a catalogue numbering 45,000 cards, containing references to the literature of North American insects.

In the horticultural division there is a collection of standard varieties of fruits, vegetables, and flowers, all distinctly labeled, so they may be easily studied and all conditions of growth or variation easily noted, and collections of new and improved tools and fruit packages. Besides these there are available to station workers the collection of the zoological museum of the college, which contains about 11,000 specimens, and the museums of Amherst College, which are especially complete in the departments of geology and mineralogy.

The college and station have a combined library of 20,000 volumes, mostly upon agriculture and related sciences. A part of these books are purchased with experiment station funds, though chiefly with funds drawn from other sources. Besides the general library the divisions of fertilizers and foods and feeding have small collections of books, such as are needed for frequent reference. The division of entomology has the use of the extensive private library of the entomologist.

All divisions of the station are well equipped with apparatus. Special mention may be made of a nitrogen apparatus designed by the

assistant chemists, H. D. Haskins and C. I. Goessmann, and used in the determination of nitrogen according to the Kjeldahl method. The apparatus proper is constructed wholly of glass. Each flask is connected with a separate glass condenser, the inside tube of which is made up of five elliptical-shaped bulbs to provide a greater condensing surface than would be obtained by the ordinary condenser having only a straight glass tube of smaller diameter. Each condenser is provided with a separate shut-off for convenience in taking down and setting up the apparatus. The "Goessmann" trap is used in the stopper of the flask in which the distillate is collected. The apparatus available to the botanical department is largely of a physiological nature. Many pieces were devised by the botanists, and are largely used in teaching. Among these may be mentioned four specially constructed Leyden jars; a special germinating apparatus for seeds on the Leyden jar principle; a rheocord for modifying electrical resistances; a Weston millimeter; four induction coils, one of which is of the Du Bois-Reymond pattern; a specially made galvanometer for detecting small currents; glass boxes of different sizes for electrically stimulated plants; rheostats; metronomes; and an apparatus devised for the purpose of producing variation in the number of alternations in a current.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, an annual appropriation by the State, license fees from fertilizer manufacturers and dealers, and the sale of farm products. The State has also made such special appropriations as were needed for the erection of buildings and for making any other improvements. The income for the last fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	11,200.00
Fertilizer fees	3,585.00
Sale of farm products	1,641.78
Miscellaneous	1,906.71
Total	33,333.49

LINES OF WORK.

The examination of commercial fertilizers has been carried on at Amherst by Dr. C. A. Goessmann since 1873, when the first law for the inspection of fertilizers was enacted. The expenses are covered by analysis fees charged to the manufacturers. The examination of foods and feeding stuffs was also carried on by the same chemist until the establishment of the Hatch Station, when these duties were transferred to the newly created division of foods and feeding. The inspection work of this division now comprises State inspection of feeding

stuffs; analyses of cattle foods and dairy products; sanitary analyses of water for citizens of the State, and analytical work for the State dairy bureau. The expenses are met by annual appropriations from the State.

The investigations of the Massachusetts Station have been mainly along lines of fertilizer experiments; feeding and digestion experiments; selection, testing, and acclimatization of forage plants; observations on industrial crops, such as sugar beets, flax, and tobacco; investigations in plant diseases; entomological investigations; horticulture, including tests of varieties of fruits, vegetables, and flowers, cultural methods, and spraying, and meteorological observations.

Investigations on the effects of special fertilizers on fruits, vegetables, and general field crops have been carried on by Dr. Goessmann from 1873 to the present time. Cooperative experiments have been carried on to determine the effect of different combinations of plant food on the quality and quantity of tobacco raised in different parts of the Connecticut River Valley. In the same category are investigations on the effect of different forms of potash, nitrogen, and phosphoric acid on the general character of farm and garden crops; observations in regard to the availability of the different forms of phosphoric acid for a number of important farm crops; observations in regard to the different methods of determining the availability of phosphoric acid in soils; and studies of the transformations of commercial chemical manures in the soil as determined by the analysis of drainage waters. In the agricultural division soil tests at the station and others carried on in cooperation with farmers throughout the State have demonstrated the varying fertilizer requirements of different soils and of different crops.

Fertilizer experiments have been conducted to determine the relative value of different phosphates, potash salts, and sources of nitrogen. Pot experiments have been made to determine the effect of the continued use of fertilizers in the field upon soils and the relative value of different phosphates and potash salts. Set cylinders have been used in soil tests and to determine the relative value of different phosphates, the extent of variation due to the individuality of plants experimented with, and the effect of liming on the growth of clovers and timothy. These experiments demonstrated that with potatoes sulphate of potash produces superior results, both in yield and quality; that nitrate of soda constitutes the best source of nitrogen for small crops, especially those making their growth chiefly in the early part of the season; that sulphate of ammonia and muriate of potash used together almost invariably give very small crops, undoubtedly due to the formation of ammonium chlorid, and that the continued use of muriate of potash appears to deplete the soil of lime, so that the product decreases. The yield may be increased again by the use of lime. Dr. Goessmann has

made trials of forage crops new to the State, particularly leguminous crops. As a result the culture of a number of them, especially millet and the soy bean, has been established in the State.

Feeding experiments conducted by Dr. Goessmann at the State Station during its existence comprised observations on the effects and economy of maize silage and mixed silage as compared with other coarse fodders, and observations on the nutritive value of certain fodders in the production of milk and beef and the effect of various new concentrated feeding stuffs. These observations were made on steers, cows, sheep, and pigs.

The experimental work of the division of foods and feeding has comprised feeding and digestion experiments with sheep, cattle, and pigs; a study of the effect of feed on character of butter; original work on methods of determination of starch, pentosans, and galactan, and on the occurrence of pentosans and galactan in agricultural products, etc.

Experiments with poultry conducted by the agricultural division have shown that for laying hens condition powders are of no value; that vegetable protein is inferior to animal protein; that dry animal meal is preferable to cut fresh bone; that fresh cabbage is superior both to dry clover and to lawn clippings, number of eggs only being considered, but that the quality of the eggs is superior when the clover is used; and that maize appears to exceed wheat in value for production of eggs.

Experiments with milch cows have shown that soy-bean meal is superior to cotton-seed meal for purposes of milk production, and that artificial heat in the stable does not increase the milk yield sufficiently to pay cost.

The investigations conducted by the botanical division are largely of a pathological and physiological nature. Lettuce forcing has received much attention. Experiments have been conducted with a view to controlling the "drop" of lettuce, and studies have been made on the "topburn" of this crop. Observations have been made on the effect of different mechanical conditions of the soil on the growth of lettuce and on the effect of subirrigation on diseases of lettuce. The forcing of cucumbers has also received considerable attention. Experiments have been made to determine the effect of pruning on maturity and production of fruit, and observations have been made on the various fungus diseases of the crop and the conditions that favor their development. Similar work has been done with the tomato. Violets have been grown in sterilized soil and nematode-infested earth to determine the effect of each on size, maturity, production of flowers, and development of leaf spot. Experiments have been made with various gases and chemical solutions for the disinfection of greenhouses and the repression of fungi. The effect of electricity on plant growth has been studied. A large amount of pathogenic material sent in for identification is examined by this division.

Besides a large amount of work in the determination and observation of numerous species of insects, the entomological division has cooperated with the State government in the extermination of the gypsy moth, brown-tail moth, and San José scale. Important monographs have been published on the Orthoptera of New England, the Crambidæ, Pterophoridæ, the Coccid genera Chionaspis and Hemichionaspis, the gypsy moth, and *Chermes abietis*. The life histories of 959 species have been worked out more or less fully, and the results kept in manuscript form.

In the horticultural division the lines of work to which the most time is given are testing of varieties of fruits, vegetables, and flowers; originating new varieties; studying and testing methods of pruning, fertilizing, and cultivating; and testing spraying apparatus, insecticides, and fungicides.

In the meteorological division investigations are in progress on the relations of soil moisture and atmospheric conditions to plant growth. Observations have been made on the percentage of moisture in the soil by the electrical method. Careful determinations of the resistance of the electrodes under known conditions of temperature and moisture were made by burying them in pots where the conductors were under control. The electricity thus standardized enabled the station to deduce more reliable results from the resistance observed when the same electrodes were afterwards used in the field. In this work the division of botany has cooperated to some extent. The means of the various weather elements for each month and year for the ten years from 1889–1898, inclusive, have been tabulated, and normal conditions for the period deduced.

DISSEMINATION OF INFORMATION.

The State Experiment Station issued during its existence 57 bulletins and 12 annual reports. The Hatch Station has issued 62 general bulletins, 5 special bulletins, 133 meteorological bulletins, and 11 annual reports. The annual report contains a short general survey of the station's operations by the director, and a brief report of the more important finished work by each of the heads of divisions. The mailing list contains about 16,000 names and is kept by the card catalogue system. The agriculturist, Prof. W. P. Brooks, is the author of "Das Nährstoffbedürfniss verschiedener in Fruchtfolge auf demselben Felde angebauter Pflanzen." The horticulturist, Prof. S. T. Maynard, is the author of "The Practical Fruit Grower" and "Landscape Gardening as applied to Home Ornamentation." The chemist, Dr. C. A. Goessmann, is the author of a very large number of articles in scientific journals and other periodicals and reports. The station's correspondence, both domestic and foreign, amounts to about 12,000 letters a year. Station officers take part in farmers' institute work generally,

the number of institutes addressed each year by college and station officers being about 100, besides those on special topics held at the college.

GENERAL RESULTS OF WORK.

The Massachusetts Station has taken a leading part in the establishment of fertilizer inspection in this country, and in investigations regarding the rational use of fertilizers, which have been of great practical value to our farmers. Its work in determining the comparative nutritive value of different crops and the adaptability of numerous introduced forage and other plants to the agriculture of the State has also been important. The studies of varieties of horticultural plants and the methods of pruning, fertilizing, culture, and combating insect and fungus pests have been of great practical assistance to market gardeners, florists, and fruit growers. The State government has very largely relied on the station entomologist in its extensive efforts to suppress the inroads of the gypsy moth.

MICHIGAN.

Experiment Station of Michigan Agricultural College, *Agricultural College.*[1]

Department of Michigan Agricultural College.

GOVERNING BOARD.

State Board of Agriculture: T. F. Marston (*President*), *Bay City;* Franklin Wells, *Constantine;* Charles J. Monroe, M. S., *South Haven;* Gov. Hazen S. Pingree, *Detroit;* Jonathan L. Snyder, M. A., Ph. D. (*President of the College*), *Agricultural College;* E. P. Allen, *Ypsilanti;* H. F. Marsh, *Allegan;* L. W. Watkins, B. S., *Manchester.*

STATION STAFF.

Jonathan L. Snyder, M. A., Ph. D., *President of the College.*

Clinton D. Smith, M. S., *Director.*
J. D. Towar, B. S., *Agriculturist.*
Robert C. Kedzie, M. A., M. D., *Chemist.*
L. R. Taft, M. S., *Horticulturist.*
Herbert W. Mumford, B. S., *Assistant Agriculturist.*
M. L. Dean, *Assistant Horticulturist.*
L. H. Van Wormer, B. S., *Assistant Chemist.*
George A. Waterman, V. S., *Consulting Veterinarian.*
R. H. Pettit, B. S. A., *Entomologist.*
Charles F. Wheeler, B. S., *Consulting Botanist.*
Mrs. L. E. Landon, *Librarian.*
C. E. Marshall, Ph. B., *Bacteriologist.*
S. H. Fulton, B. S., *In Charge of Substation (South Haven).*
A. C. Bird, B. S., M. Agr., *Secretary and Treasurer.*
Louzena D. Kellum, *Clerk and Stenographer.*

HISTORY.

The Michigan Station is located at the capital, in the southern part of the State. Michigan is divided into two peninsulas, each of which is

[1] Freight and express address, *Lansing.*

bounded on three sides by lakes and their connecting waters. The surface of the State consists very largely of lowlands interspersed with numerous small lakes. The soils are varied and over large areas are highly productive. The climate is made comparatively mild and equable by the influence of the surrounding waters. The annual rainfall is about 30 inches. The forests are still extensive, though in recent years they have been rapidly depleted by lumbering. The principal crops are hay, wheat, maize, oats, and potatoes. Fruits, especially apples and peaches, are largely grown. Large numbers of sheep, swine, milch cows, cattle, and horses are maintained. Agriculture has been practiced in the State about 100 years. Michigan was made a Territory in 1805 and admitted to the Union as a State in 1837.

The college with which the station is connected was the first agricultural college in the United States. In recent years its scope has been broadened to include instruction in mechanic arts and other industrial lines, as well as in agriculture. It is a well-equipped institution with about 500 students.

Experimental work in agriculture has been carried on at the Michigan Agricultural College since the establishment of that institution in accordance with an act of the State legislature approved February 12, 1855. The same act provided for the purchase of a farm for the college and made it a duty of the secretary to keep a full record of all experiments made on it. The college was formally dedicated May 13, 1857, and the first president, Hon. Joseph R. Williams, in his inaugural address advocated experiments in all branches of agriculture and in the sciences that minister to it. March 15, 1861, an act of the State legislature was approved which provided for the reorganization of the college and expressly provided for agricultural experiments and for reports concerning them. The first account of experiments at the college appeared in the annual report of the State board of agriculture for 1863, and similar reports of experiments have continued to appear every year since.

May 11, 1885, an act of the State legislature was approved which authorized the college to issue bulletins and distribute them. This law, which is still in force, provides for publishing at least 12 bulletins a year on "the results of experiments made in the different departments of the agricultural college and such other information as they may deem of sufficient importance to require it to come to the immediate knowledge of the farmers and horticulturists of the State." From this time the reports of experiments, instead of appearing only in the annual reports of the board of agriculture, were issued first in bulletins, which were widely circulated throughout the State. The work of this period consisted principally of studies and experiments in botany, entomology, and horticulture; studies of various diseases of farm animals; cultural experiments with potatoes and cereals;

experiments with early amber sorghum as a forage crop; feeding experiments with steers; and chemical examinations of the marls of the State with reference to their utilization as fertilizers.

The experiment station of Michigan Agricultural College was organized under the act of Congress February 26, 1888, with Prof. Edwin Willits, more recently Assistant Secretary of the United States Department of Agriculture, as director. He was succeeded the next year by the president of the college, Prof. O. Clute, who served until 1894. His successor was President L. G. Gorton, who served temporarily as director until the appointment of the present incumbent in 1895.

ORGANIZATION.

The governing board of the Agricultural College, with its experiment station, is the State board of agriculture, which consists of the governor of the State and the president of the college, ex officio, and six members appointed by the governor for terms of six years. The officers of the board are a president, elected from its members, and a secretary and a treasurer appointed by the board. The president of the board is ex officio member of each of its standing committees, of which one on experiments, consisting of two members, has immediate oversight of the station.

The staff consists of the president of the college, director, agriculturist, horticulturist, chemist, secretary and treasurer, assistant agriculturist, assistant horticulturist, assistant chemist, consulting veterinarian, entomologist, consulting botanist, bacteriologist, librarian, clerk and stenographer, and superintendent of South Haven substation. These officers are appointed by the State board of agriculture for terms of one year each, except the members of the station council, who are appointed for indefinite periods and who retain their positions as long as their work is satisfactory. The station council consists of the director, agriculturist, horticulturist, and chemist, and as ex officio members the president of the college and the secretary. The director is the executive officer of the station, has immediate control of its finances and selects lines of work to be pursued in the different divisions of the station, which are approved by the council. He has the general supervision of the affairs of the station. The station council is the body to which the director refers matters for advice and legislative action.

Three substations are maintained with the aid of State appropriations. One at South Haven, in the peach belt of the State, is devoted exclusively to testing varieties of fruits (Pl. LXXI, fig. 1). The land consists of 5 acres deeded and 10 acres rented. The equipment comprises a house and suitable barns and outbuildings for the housing of the tools used and for the examination and packing of the fruits har-

vested. This substation is under the immediate management of the horticulturist of the station.

At Grayling the State owns 80 acres of land. It is managed directly by the director of the station, the experiments heretofore having been directed toward determining means of rendering loose sandy soils fertile without excessive financial outlay. In the future it has been determined to study the possibilities of utilizing such lands for the keeping of live stock. By an act of the State legislature passed in the spring of 1899 a sum of money was appropriated for the purchase and maintenance of an agricultural experiment station in the Upper Peninsula. The oversight of this station was also vested in the State board of agriculture, and has been by them placed in the hands of the director and council of the experiment station. A tract of 160 acres, heavily timbered with maple, has been selected near Munising. Experimental work will be begun there in the spring of 1900.

EQUIPMENT.

Most of the work of the station is carried on in the college buildings. Those made use of by the station are as follows: (1) The agricultural laboratory (Pl. LXXI, fig. 2), a brick building 50 by 56 feet, three stories. In this building are the offices of the director, agriculturist, expert in animal husbandry, and the assistant in dairy husbandry. In the half basement are the dairy rooms. (2) The horticultural laboratory (Pl. LXXII, fig. 1), a brick building 40 by 50 feet, three stories. Here are the offices of the horticulturist and his assistants, storage rooms for fruit reserved for future examination, and a museum containing wax models of the principal fruits and vegetables of the State. (3) The botanical laboratory (Pl. LXXII, fig. 2). In this building is the office and workroom of the botanist, and the herbarium. (4) The chemical laboratory (Pl. LXXIII, fig. 1). In this building the station uses exclusively one laboratory with adjacent supply rooms. Here also are the offices of the chemist and his assistant. (5) The office of the entomologist and the entomological collection are in the second story of the main administration building and library of the college. (6) The veterinary laboratory (Pl. LXXIII, fig. 2), a brick building 60 by 35 feet, two stories. In this building are the offices of the veterinarian and bacteriologist, a workroom and operating room for a veterinarian, and a bacteriological laboratory. (7) A side-hill greenhouse for experiments in vegetable forcing with a minimum of artificial heat. (8) Two connected forcing houses for experiments in floriculture and forcing vegetables. (9) A cold-storage warehouse constructed with multiple walls for experiments in the preservation of fruit and vegetables.

The station makes use of such parts of the college farm, which consists of 676 acres, as are needed for experimental purposes. At

FIG. 1.—MICHIGAN STATION—PEACH TREES AT SOUTH HAVEN SUBSTATION.

FIG. 2.—MICHIGAN STATION—AGRICULTURAL LABORATORY, USED BY COLLEGE AND STATION.

FIG. 1.—MICHIGAN STATION—HORTICULTURAL LABORATORY, USED BY COLLEGE AND STATION.

FIG. 2.—MICHIGAN STATION—BOTANICAL LABORATORY, USED BY COLLEGE AND STATION.

FIG. 1.—MICHIGAN STATION—CHEMICAL LABORATORY, USED BY COLLEGE AND STATION.

FIG. 2.—MICHIGAN STATION—VETERINARY LABORATORY, USED BY COLLEGE AND STATION.

present the station uses 100 acres for the production of fruit and general field crops. Sixty acres are devoted to plat experiments, and 40 acres are assigned to the horticultural division, all of which is planted to orchards or small fruits. Twenty-three acres are devoted to permanent plats of grasses, forage plants, and cereals and to experiments in testing rotations of crops and influence of drainage. The remainder of the station fields are devoted to experiments either temporary in nature or directed toward a definite answer to some question of immediate importance.

The live stock belonging to the college is used by the station for experimental purposes. It consists of 10 horses, 68 head of cattle, from 25 to 30 head of swine, and from 100 to 150 sheep. The station owns its own work team, and purchases from time to time the cattle and sheep needed for certain feeding experiments. The station has also a colony of tuberculous cows, which in the progress of experimentation is rapidly decreasing in number. It has also pens of swine for use in experiments relating to tuberculosis, and from 150 to 350 guinea pigs are constantly on hand for similar purposes.

There are in the herbarium over 50,000 pressed specimens of flowering plants, and over 10,000 specimens of fungi. In the entomological collection there are 75,000 specimens of insects, all properly mounted in suitable cases. The station also owns a large collection of photographs and lantern slides for purposes of record and illustration. The college uses, with the station, a weed garden in which are studied the life history and behavior of weeds, new and old. A large botanic garden also serves the purposes of both institutions. The station library contains 1,884 volumes, and the college library, to which the station workers have free access, contains 21,000 volumes.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, fees for fertilizer inspection, and sales of farm and horticultural products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Fees for fertilizer inspection	1,460.00
Farm products	865.40
Miscellaneous	37.67
Balance on hand July 1, 1898	1,700.52
Total	19,063.59

LINES OF WORK.

Under the State law the station has complete control of the fertilizer inspection, a work which receives its financial support from the fees paid by the fertilizer manufacturers. Without the support of legislative enactment imposing penalties the station carries on an

inspection of the garden and grass seeds sold in the State, the samples being forwarded by purchasers. No charges are made for work of this kind. The station carries on, either at its own expense or at the expense of the stock owner benefited, tests of cows on dairy farms. The feed and yields are weighed by representatives of the station, and records kept of the feed consumed and the milk and butter fat yielded by each of the several cows under test.

In cooperation with the United States Department of Agriculture and the farmers throughout the State, the station has made extensive studies of the adaptability of the different parts of the State to the culture of the sugar beet.

The botanist has prepared a complete catalogue of the flora of the State, and the chemist has made a soil survey. This work of the chemist was instrumental in the exploitation of extensive marl beds, which are now utilized in the manufacture of cements.

In the agricultural division much attention has been paid to feeding experiments, especially with dairy cattle, sheep, and swine. The results of four years' work in feeding dairy cattle showed that a safe standard ration for a normal dairy cow producing one and two-tenths pounds of butter fat daily, and weighing, approximately, 1,000 pounds, was 2.06 pounds protein, 12.5 pounds of carbohydrates, and 0.89 of a pound of fat per day. The nutritive value of silage, roots, gluten meal, rape silage, sorghum silage, and various other cattle foods was demonstrated. Studies were made of the influence of potatoes and roots on a normal ration. A record of the milk and fat yields of the college herd and of the food eaten by the animals for four years forms the basis of studies of the influence of age, breed, and lapse of the period of lactation on the performance of the dairy cow.

Feeding experiments with sheep have been an important feature of the work. Rape was tested as a forage crop for sheep and the station has aided materially in its widespread introduction in the State. A number of other forage plants, including alfalfa, soy bean, cowpea, horse bean, sand lucern, *Lathyrus silvestris*, and the English grasses, have been tested for a number of years on the station plats, and those varieties that have proved the most promising have been introduced. A special study of the history and distribution of millet was made, together with extensive experiments with varieties. Studies have been made on the chemical life history of the maize plant and the distribution of the food constituents in the different parts of the plant. Rotations of forage crops for sheep have also received attention. The influence of various rotations of crops on the fertility and productiveness of the soil is being studied on a series of 72 tenth-acre plats. Much work has been done in the reclamation of swamp soils by means of application of barn manures, or fertilizing elements alone or combined. This work has been carried on both at the station and at

numerous points in the State. Similar experiments on loose sands have shown the advantage of infrequent plowing, and of the utilization, as far as possible, of such lands for the pasturage of stock, since the tramping of the ground by the animals increases the compactness of the soil.

Experiments in wheat growing have led to the introduction of new varieties, improved methods of preparing the ground for the crop, new methods of treating seed for smut, and to the improvement of existing varieties by selection.

In the horticultural division an important line of work has been the testing of varieties of fruits and vegetables, and this the station has conducted on quite an extensive scale. A large amount of experimental work has been done on the irrigation of orchard and garden crops, and spraying. Numerous culture and fertilizer tests have been made with fruit and vegetables. The horticulturist has given much attention to questions of greenhouse management.

The station has recently engaged in forestry investigations. A pine forest of 7 acres area was planted in 1895, and records are kept of the growth of the trees in height and in diameter.

The chemical division has been conducting investigations on wheat, determining changes in chemical composition as the plant matures. It has also studied flour with reference to detection of adulteration and to variation in quantity and kind of gluten. It has made considerable investigations on the production of sugar from beets, and the manufacture of sirups from sorghum.

The bacteriological division has carried on extensive investigations with a herd of twenty tuberculous cows. It has studied methods of killing the bacillus of tuberculosis in milk by heat; also the cause and methods of prevention of ropiness in milk, and the cause of crown gall on the roots of the peach. A leading subject of investigation has been the disease known locally as hog cholera. The observations of the bacteriologist indicate that this disease is not the same throughout the State, and that the different forms are caused by different though perhaps closely related germs.

Entomological investigations have resulted in working out a remedy for foul brood of bees, in discovering insect enemies of field and orchard, and in suggesting remedies. The apiarist is endeavoring to breed bees with long tongues with a view to developing a race that shall be able to extract nectar from the clover blossom.

Observations have been made on the amount of shrinkage to which grain and hay are liable in storage.

DISSEMINATION OF INFORMATION.

Up to January 1, 1900, the station had issued 176 regular bulletins, 12 special bulletins, 12 press bulletins, 25 or more circulars and other

fugitive pamphlets sent out in response to a demand for immediate knowledge on some specific point, and 10 annual reports. The special bulletins are issued for the purpose of giving information of immediate importance on some new point in the agricultural development of the State. When a new insect appears, for instance, a special bulletin is issued, giving its life history and means of combating it. The annual reports of the station form a part of the annual report of the State board of agriculture, and are published in that volume. Besides the usual administrative features, the annual report contains accounts of experiments.

While botanist of the station, Dr. W. J. Beal published his "Grasses of North America," in two volumes; the chemist, Dr. R. C. Kedzie, is the author of a "Handbook of Chemical Analysis;" the horticulturist, Prof. L. R. Taft, is the author of "Greenhouse Construction" and "Greenhouse Management." The present botanist, Prof. C. F. Wheeler, is the author of "The Flora of Michigan."

The mailing list contains about 20,000 names. It is kept set up in printed form. The director is superintendent of farmers' institutes, and is in charge of the college extension work. In this dual capacity he delivered, during the year 1899, 167 addresses at meetings of farmers. The interest of the farmers in the station is further stimulated by excursions to the station grounds each year during the month of August, the number of visitors thus brought to the college in 1899 exceeding 8,000.

GENERAL RESULTS OF WORK.

The Michigan Station has materially benefited the agriculture of the State by the introduction of improved varieties of wheat and forage plants. The adaptability of portions of the State to the successful culture of beets for sugar has been definitely determined, and as a result nine beet-sugar factories have been established. The station has been largely instrumental in persuading the farmers of the State to adopt more careful and rational methods of culture. The horticultural interests of the State have been promoted by the introduction of better varieties of small and orchard fruits and vegetables. The Ignotum tomato, which has been widely grown in this country, was originated at this station. The practice of spraying with fungicides and insecticides has been largely introduced by the efforts of the station. The entomological work, much of which was carried on by the college prior to the establishment of the station, has been very important. In agricultural botany, especially with respect to grasses, the investigations of the college and station have been of much general value. Feeding experiments, especially with sheep, have done much to improve the practice of farmers, and the development of dairying in the State has been efficiently promoted by the work of the station.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota, *St. Anthony Park, St. Paul.*

Department of University of Minnesota.

GOVERNING BOARD.

Board of Regents: John S. Pillsbury, *Minneapolis;* Governor John Lind, *New Ulm;* Cyrus Northrop, LL. D. (*President of the University*), *Minneapolis;* J. H. Lewis (*Superintendent of Public Instruction*), *Hastings;* Stephen Mahoney, B. A., *Minneapolis;* Sidney M. Owen, *Minneapolis;* Thomas Wilson, *St. Paul;* W. M. Liggett, *St. Anthony Park;* A. E. Rice, *Willmar;* Elmer E. Adams, B. A., *Fergus Falls;* Greenleaf Clark, M. A., *St. Paul;* Samuel G. Smith, D. D., *St. Paul.*

STATION STAFF.

Cyrus Northrop, LL. D., *President of the University.*

Wm. M. Liggett, *Director.*

Willet M. Hays, M. Agr., *Agriculturist.*

Samuel B. Green, B. S., *Horticulturist.*

Otto Lugger, Ph. D., *Entomologist and Botanist.*

Harry Snyder, B. S., *Chemist.*

T. L. Haecker, *Expert in Dairy Husbandry.*

M. H. Reynolds, M. D., V. M., *Veterinarian.*

Thomas Shaw, *Expert in Animal Husbandry.*

Andrew Boss, *Assistant in Agriculture* (*University Farm*).

T. A. Hoverstad, B. Agr., *Assistant in Agriculture* (*Crookston*).

R. S. Mackintosh, *Assistant in Horticulture* (*University Farm*).

H. H. Chapman, B. S. A., *Assistant in Agriculture* (*Grand Rapids*).

J. A. Vye, *Secretary.*

HISTORY.

The Minnesota Station is located in the eastern part of the State, near the Mississippi River, between the cities of Minneapolis and St. Paul. The surface of the State consists of an elevated plateau in the north-central portion, from which the land slopes gradually in all directions toward the boundaries. The average elevation is 1,275 feet. The State contains the head waters of the Mississippi and Red rivers and some 10,000 small lakes. The forests are extensive, especially in the north. The summers are comparatively cool and the winters are severe. The average annual rainfall is about 26 inches. The soil is very largely a black loam, originally capable of producing large yields of wheat. Minnesota was made a Territory in 1849, and the beginning of the regular practice of agriculture in any large way dates from about that time. The principal crops are spring wheat, oats, maize, barley, potatoes, and hay. These are frequently grown in large areas, and farm machinery is much used.

Large numbers of cattle, milch cows, horses, sheep, and swine are produced. Dairying has grown to be an extensive industry. With the decline of fertility, due to continuous wheat growing, there has been an increasing diversification of agriculture. The manufacture of

wheat flour is a very important industry. The university, with which the station is connected, has grown rapidly in recent years, and is now one of the strongest institutions for higher education in the country, with over 3,000 students.

Experimental work in agriculture has been carried on in connection with the Minnesota Agricultural College since its establishment in 1868. In 1878 the State legislature authorized the purchase of a tract of land on the shores of Lake Minnetonka for the purpose of establishing an experiment station for the propagation, trial, and dissemination of new varieties of fruits adapted to local climatic conditions, and placed the management of the station under the direction of the board of regents of the university. Peter M. Gideon was appointed superintendent. This station was in operation until 1888. Reports of its work were published in the biennial reports of the board.

In 1885 the State legislature passed a bill providing for the establishment of an experiment station by the board of regents of the University of Minnesota, of which the professor of agriculture should be general superintendent. This experiment station was virtually the experiment farm of the college of agriculture which had been in operation since 1868. Unfortunately, no funds were placed at the disposal of the university to carry out the objects of the act, and the station was but partially organized. The same year the legislature also passed an act to establish a trial station to test hardy varieties of forest trees in connection with the State School for Orphans, at Owatonna, and placed its direction under the control of the board of regents of the university, but made no appropriations for its expenses. The only way in which this trial station could be established and its expenses met was by placing it under the supervision of the director of the experiment station which was accordingly done.

In 1888 the Agricultural Experiment Station of the University of Minnesota was organized under the act of Congress as a department of the university, and was located on the university farm, a tract of 250 acres midway between Minneapolis and St. Paul and about 3 miles from the university campus, where the college and school of agriculture are located. The first director was Prof. E. D. Porter, who had been professor of agriculture in the university since 1881. He was succeeded in April, 1889, by Prof. N. W. McLain, LL. B. October 5, 1890, the station suffered the loss of its office building by fire, which, however, was soon replaced by the present structure. In 1891 Prof. C. D. Smith became director and served until 1893, when, upon his resignation, the office of director was temporarily discontinued, and Col. W. M. Liggett, who had been chairman of the agricultural committee of the board of regents of the university since the organization of the station, was made chairman of the station staff. In 1896 Colonel Liggett was appointed dean of the agricultural college and director of the experiment station.

In 1894 a substation was established in Lyon County, on Coteau farm, the homestead of Mr. O. C. Gregg, superintendent of State farmers' institutes. In 1895 the State legislature passed a bill appropriating $30,000 with which to procure, equip, and for the two following years conduct two substations. One of these, the Northwest Subexperiment Farm, was located the same year at Crookston, Polk County, on land donated by the Great Northern Railway. The city of Crookston and the county of Polk also contributed $1,000 each, which was used in draining and improving roads around and through the farm. In June, 1896, the other substation was located at Grand Rapids, Itasca County, in the northeastern part of the State, on 374 acres of land donated for the purpose. The university, however, paid $3,500 for the buildings and improvements made on the land.

ORGANIZATION.

The State delegates the government of the station to the board of regents of the university, which body supplements the funds accruing from the national appropriations with others from its own "current-expense" fund. The State legislature provides special funds for buildings and for the equipment and support of the substations.

The board of regents of the university consists of ex-Governor Pillsbury, who is a life member, the governor of the State, the superintendent of public instruction, and the president of the university, ex officio, and nine members appointed by the governor for terms of six years each. The board has the general management of the entire university, of which the college of agriculture is a part. The agriculture committee of the board of regents directs the general policy of the station. The executive committee passes upon all requisitions and audits the accounts, and it is empowered to act for the board when it is not in session. The board has four meetings each year and the members give their time gratuitously.

The staff consists of the president of the university, director, agriculturist, horticulturist, entomologist and botanist, chemist, expert in dairy husbandry, veterinarian, expert in animal husbandry, assistant in agriculture at the university farm, assistant in agriculture in charge of the Crookston subexperiment farm, assistant in agriculture at the Grand Rapids subexperiment farm, assistant in horticulture at the university farm, and secretary. All these officers are elected by the board of regents, and the term of office has no stated limit.

The director is the executive head of the staff and is the medium of communication between members of the staff and the governing board, of which he is a member. He has full consulting and advisory powers with all the heads of divisions, and to them he distributes and delegates the technical research work and the publishing of reports of experiments.

The three substations were established to test field and horticultural crops, and to study farm management, forestry, and local conditions and requirements in other parts of the State, and to enable the station to breed new races of plants suited to their respective localities, which differ widely in soil and climate. At two of the substations has been placed an assistant agriculturist as superintendent, who, under the director and agriculturist, has local charge of the work. The work at Coteau farm is in charge of a student of the college of agriculture. These superintendents employ a force of laborers. The substations receive $3,500 to $5,000 each annually from the State, besides the proceeds of sales from their respective farms.

EQUIPMENT.

The experiment station buildings, except as otherwise indicated, are located on the university farm, which, as has already been said, is 3 miles from the university campus. The buildings comprise an agricultural-chemical building, dairy building, veterinary building, poultry building, abattoir, barn, sheep barn, three silos, swine barn, greenhouses, and residence of the agriculturist, with seed house attached.

The chemical building (Pl. LXXIV, fig. 1) is a three-story frame structure, the first floor of which is occupied by the experiment station laboratory and office. The abattoir, a two-story frame building, is a new feature in American experiment station work which is proving a very practical and useful portion of the equipment. The university barn (Pl. LXXIV, fig. 2) is a frame structure consisting of a three-story main part 100 by 60 feet, with one wing 42 by 100 feet and one wing 30 by 100 feet, each two stories. The sheep barn is 40 by 100 feet and two stories high. The swine barn is 20 by 100 feet. The dairy hall (Pl. LXXV, fig. 1), a brick structure 106 by 66 feet and three stories high, is fully equipped for experimental and instruction work. There are two greenhouses (Pl. LXXV, fig. 2), 24 by 100 feet, with 4,000 square feet under glass. They are provided with special arrangements for irrigation and the growing of water plants. There is now in course of erection a horticultural building, which, when finished, will cost with equipment $35,000. One-half of this is to be used for experimental work in horticulture, the other half for instruction work. The building is of stone and brick, 50 by 80 feet, with a greenhouse laboratory 24 by 50 feet. The laboratories are well equipped with microscopes and photographic apparatus. In another building (Pl. LXXVI, fig. 1) a special seed-testing room has been provided and equipped with the most modern seed-testing apparatus. Special cellars have been provided for storing fruits and vegetables and for wintering nursery stock. The botanical and entomological division is located in the armory building, which is 100 by 75 feet, three stories high, and made of brick.

The university farm contains 250 acres, 200 of which are made use

FIG. 1.—MINNESOTA STATION—CHEMICAL BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—MINNESOTA STATION—BARNS, USED BY COLLEGE AND STATION.

FIG. 1.—MINNESOTA STATION—DAIRY HALL, USED BY COLLEGE AND STATION.

FIG. 2.—MINNESOTA STATION—GREENHOUSES.

FIG. 1.—MINNESOTA STATION—RESIDENCE OF AGRICULTURIST, AND SEED BUILDING.

FIG. 2.—MINNESOTA STATION—EXPERIMENTAL WHEAT FIELD.

FIG. 1.—MINNESOTA STATION—PROTECTING TREES AGAINST SUN SCALD.

FIG. 2.—MINNESOTA STATION—SCREEN FOR EVERGREEN SEEDLINGS.

of by the station, together with 65 acres of adjacent leased land. The northwest farm contains 480 acres, the northeast farm 374 acres, and the Coteau farm 40 acres of leased land. All the arable fields of the several farms are permanently planted in series of plats 8 rods wide. About 300 acres are in forests or in permanent grasses. About 200 acres are devoted to plat experiments. When an arable field, or a portion of it, is not in use for plat experiments, it is farmed under a rotation which will prepare it for future experiments. For experimental purposes the 8-rod series of plats are divided crosswise or lengthwise, making the plats from one-twentieth to one-half acre each in area.

The live stock owned by the station comprises 60 head of cattle of the beef types, more than one-half of which are used in feeding and breeding experiments, 16 to 30 steers used in stall-feeding experiments, 15 steers used in pasturing experiments, 20 to 30 head of cattle of beef breeds used mainly for demonstration purposes in connection with the school and college, 200 sheep and 50 to 100 hogs used in feeding and breeding experiments, and 25 horses, several of which are used each year in feeding experiments. The horses are kept partly for the station and partly for the school of agriculture, and the expense is divided between them. Individual animals are sometimes purchased for special experiments. The school and college of agriculture own, besides, 75 head of dairy cattle, which are used for demonstration purposes.

The museums of the agricultural college and the experiment station contain 14,000 entomological specimens and a collection of stuffed wild animals and birds of Minnesota. There are also collections of agricultural, horticultural, and dairy machinery and implements, 1,000 to 2,000 lantern slides, about 4,000 photographs, a limited collection of manakins and other models, and a considerable collection of veterinary instruments. At the university the models, charts, and other illustrative materials are available for the use of the station workers.

The libraries of the station and the college of agriculture are combined and contain 5,000 volumes, mostly special agricultural works. The university library of 60,000 volumes and the libraries of St. Paul and Minneapolis are available to station workers, there being direct street-car connections with both cities.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, a State appropriation, and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
State appropriation	12,623.13
Farm products	5,976.50
Total	33,599.63

LINES OF WORK.

The Minnesota Station has but few inspection duties. The veterinarian has charge of the veterinary work of the State board of health, and the entomologist is employed by the State to assist in the control of certain insects. Unofficially the station has analyzed numerous samples of flour collected in large trade centers. The data thus obtained have thrown much light on the nature and extent of adulteration of these products.

The work of the Minnesota Station has been mainly along lines of breeding experiments with both plants and animals, soil studies, animal production and dairying, horticulture, entomology, and nutrition investigations. In the agricultural division there are a number of lines of work, prominent among which may be mentioned field management, pastures of annual crops, testing varieties, breeding, and propagation of new kinds of grains and forage crops, and distribution of the same throughout the State; tillage, study of flax for fiber as well as for seed, irrigation, drainage, road making, and the erection of buildings and fences. This work is so arranged as to serve the double purpose of demonstration and experimentation. The characteristic feature of the work in farm management is a system of plat experiments, each of which is to be confined for a number of years to a single rotation or method of farming. Another feature of the work is the investigation of methods of experimenting with pastures and meadows in rotations. The chemist is making a study of the effect of different rotations of crops upon the fertility and humus content of soils and the production of humus from manure. Investigations are being made on the losses which occur in the handling of manures, and the comparative value of different barnyard manures is being determined. Studies are being made on the influence of different methods of cultivation upon the moisture content of soils, and for demonstration purposes analyses have been made of soils from farms where the fertility has been kept up and from farms that have declined in crop-producing power. Analyses have been made of the soil water at the university and Coteau farms, and observations have been made on the habits of growth of various field crops.

Much attention is being given to determining the varieties of the field crops best adapted to each section of the State and to disseminating them. In this work the three substations render much valuable assistance. The improvement of the staple crops of the State by breeding is being carried on systematically and on an extensive scale. One variety of maize of superior merit has already been originated and distributed, and other varieties are now being bred, both for yield and for other desired characteristics. In the same way improved varieties of wheat, flax, timothy, field peas, and *Bromus inermis* have been

produced. A considerable work of a technical nature is being done on methods of breeding plants, accompanying which are detailed studies of the floral organs and the gross anatomy of the stems and roots of the principal cultivated plants of the State. Methods of planting, cultivating, and harvesting are receiving attention, especially with reference to conserving soil moisture in seasons of deficient rainfall. In this connection varieties are being selected which will best withstand drought, and an effort is being made to determine successions of crops which will prove most profitable under conditions of drought both on light and heavy soils. (Pl. LXXVI, fig. 2, shows an experimental wheat field at the station.)

Among special crops flax is of increasing importance, and is now grown more extensively in Minnesota than in any other State. In 1890 it was shown that numerous failures of the crop were due not to lack of fertility, but to old flax straw left in the soil from previous crops. More recently the draft of this crop upon the soil has been ascertained, and analyses have been made of the plant at different stages of growth, also of different types of Minnesota and imported seed. Determinations have been made of the amount of oil yielded by the seed of different varieties, of the composition, digestibility, and food value of linseed meal, and of the loss of fertility from the soil in the production of flax for oil. Experiments in sugar-beet culture have been carried on since the organization of the station. The horticulturist has made tests and comparisons of numerous varieties of potatoes and of potato machinery.

The object of the work in the division of animal industry has been to determine the most economical methods of producing beef, mutton, and pork under local conditions. Comparisons have been made of light and heavy rations for fattening range steers, and steers of different types have been fed to demonstrate the influence of type on meat production. Experiments have been conducted in fattening home-grown and range lambs on similar foods, to determine the cost in each case and the relative suitability of the same food for the different kinds of animals. Extensive and highly successful experiments have been conducted in growing summer forage, especially rape, for sheep. Other experiments in growing winter fodders for sheep are now in progress. The chemist has made a study of the different factors, such as seeds, soils, and culture methods, in their relation to composition and feeding value of forage plants. The chemist has also demonstrated the need of careful attention to ventilation in barns by analyzing and comparing samples of air from poorly and well ventilated stables.

The work of the dairy division has been directed chiefly toward determining the cost of milk production. Experiments have been carried on to determine, if possible, the causes of difference in yield by different animals under similar conditions. In determining the amount

of food required for body maintenance several cows were used that had passed the period of usefulness in the dairy and were entirely dry. This method gave excellent results. Experiments in raising dairy calves are in progress. Many data have been accumulated for the purpose of determining, if possible, the type of cow that gives the best returns in the dairy.

In the veterinary division considerable work has been done in fighting hog cholera. At the same time studies have been made of the relations of food and care to the causation of the disease. Inoculation experiments with hog-cholera serum have been carried on in cooperation with the Nebraska Station and with the Bureau of Animal Industry of the United States Department of Agriculture. Studies have also been made on bovine tuberculosis, as a result of which it was shown that the effect of the tuberculin test on nontuberculous cows is practically negative as regards general health and milk yield; that the effect on tuberculous cows is rather favorable than otherwise, and that the effect on fattening steers is negative.

In the division of horticulture extended studies have been made of varieties of orchard and small fruits and their adaptation to different sections of the State. Considerable work has been done in the breeding of varieties of orchard fruits. At the same time problems of culture and management have not been neglected. (Pl. LXXVII, fig. 1, shows how orchard trees are protected against sun scald.) Successful experiments have been carried on in the destruction of the plum aphis by fumigating with tobacco smoke. Forestry is receiving considerable attention, and experiments have been made in the reforesting of cut-over timber lands. A method of starting evergreen seedlings employed at the station is shown in Pl. LXXVII, fig. 2.

The division of entomology has published extensive and detailed accounts of the injurious insects found in the State. Among those on which original investigations have been made are the frit fly, wheat-stem maggot, and Hessian fly, and means of repression have been suggested. It has been observed that the Hessian fly, which was at one time a serious pest, has been more than decimated by parasites.

Nutrition investigations are being carried on in cooperation with the United States Department of Agriculture, the principal subjects studied being bread and flour, the changes caused by the cooking of vegetables in their composition, the determination of balanced rations for people, and the fuel value of different kinds of food. The investigations on bread and flour have been on the food value and digestibility of different kinds of bread, loss of nitrogen during bread making and the cause of it, the gluten of wheat, the difference in composition between good and poor samples of wheat, and the composition of home and foreign grown wheats.

DISSEMINATION OF INFORMATION.

The station has issued 63 regular bulletins, a few press bulletins, and 8 annual reports. The annual report consists of an administrative document, to which are appended the bulletins published during the year. The mailing list contains about 9,000 names, and the correspondence amounts to about 20,000 letters a year. The State has provided a special corps of farmers' institute and dairy instruction workers, but nevertheless there is a large and growing demand for the assistance of station officers at farmers' meetings. The work of the station is so extensive and exacting, however, that only a limited number of such calls can be responded to. A limited amount of aid is given to fairs and agricultural societies.

GENERAL RESULTS OF WORK.

The station has done a very important work in showing the effects of continuous wheat growing on the soil, and in this and other ways promoting the diversification of agriculture in the State. The breeding, testing, and dissemination of varieties of grain, grasses, and forage plants have greatly assisted farmers in obtaining varieties especially adapted to different localities. The feeding experiments have done much to aid in the more economical production of beef, mutton, and pork. The introduction of rape for sheep and the demonstration of the economy of growing this and other forage plants for the summer feeding of sheep have been important factors in improving the methods of sheep feeding in this and other States. The studies on types of dairy cows have brought out many valuable facts to aid in the selection of cows for milk production. The horticultural work has greatly aided the introduction of horticultural varieties suited to the State. In entomology, much valuable work has been done in the repression of injurious insects. The soil investigations made by the division of chemistry have been of value in pointing out the ways by which the fertility of the soil may be conserved, while the human food investigations have contributed to our knowledge of the chemistry of bread and flour.

MISSISSIPPI.

Mississippi Agricultural Experiment Station, *Agricultural College.*[1]

Department of Mississippi Agricultural and Mechanical College.

GOVERNING BOARD.

Board of Trustees: Governor A. H. Longino (*President*), *Jackson;* H. M. Street, *Meridian;* R. C. Lee, *Madison Station;* W. H. Morgan, *Sheppardtown;* Jno. R. Dinsmore, *Macon;* J. B. Bailey, *Conehatta;* W. B. Montgomery, *Starkville;* T. C. Dockery, *Love Station;* J. H. Sharp, *Penn;* J. J. Coman, *Jackson;* J. M. Stone (*President of College*), *Agricultural College;* W. L. Hutchinson, *Agricultural College.*

[1] Freight and telegraph address, *Starkville.*

STATION STAFF.

J. M. Stone,[1] *President of the College.*

W. L. Hutchinson, M. S., *Director; Chemist.*
E. R. Lloyd, M. S., *Assistant Director; Agriculturist.*
G. W. Herrick, B. S., *Botanist and Entomologist.*
A. B. McKay, B. S., *Horticulturist.*
J. C. Robert, D. V. M., *Veterinarian.*
W. R. Perkins, M. S., *Associate Chemist.*
E. B. Ferris, M. S., *Assistant Chemist.*
J. S. Moore, M. S., *Assistant Botanist and Meteorologist.*
C. T. Ames, B. S., *Assistant Horticulturist.*
R. C. King, B. S., *Treasurer.*
J. A. Turnipseed, *Stenographer.*

HISTORY.

The Mississippi Station is located in the eastern part of the State. The land of the State slopes gradually in a general way from the northeast to the Mississippi River, but there is a broad low ridge running north and south through the center of the State. Near the Mississippi River and east of the central ridge are great areas of very fertile land. Forests are still extensive, especially on the higher lands. There is a considerable variety of soils, most of which are naturally fertile. The summers are long and warm and the winters brief. The average annual rainfall is about 56 inches. In 1800 the population was only about 10,000, but with the great development of cotton growing with slave labor between 1820 and 1860 population rapidly increased, and large areas were continuously used for this crop. (Pl. LXXVIII, fig. 1, is a typical scene in a cotton field.) This led to rapid exhaustion of the soil. In recent years there has been much diversification of agriculture, especially in the direction of live-stock production and the growing of early vegetables and small fruits for northern markets. The college with which the station is connected has been one of the most successful of its class in the country.

The Mississippi Agricultural Experiment Station was organized under the act of Congress as a department of the Mississippi Agricultural and Mechanical College in accordance with the act of legislature of January 30, 1888. Prof. S. M. Tracy was the first director, serving until April 20, 1897, when he was succeeded by the present incumbent.

ORGANIZATION.

The station is under the management of the board of trustees, of which the governor of the State is ex officio chairman, and the president of the college. Immediate oversight of the station is intrusted to a governing board, consisting of the local trustee, the president of the college, and the director of the station. The business of the station is directly managed by the president and director, subject to the approval of the board of trustees at their annual meeting in June.

[1] Deceased.

FIG. 1.—MISSISSIPPI STATION—COTTON FIELD.

FIG. 2.—MISSISSIPPI STATION—BUILDINGS AND GROUNDS.

FIG. 1.—MISSISSIPPI STATION—BARNS AND CATTLE.

FIG. 2.—MISSISSIPPI STATION—CATTLE BARN.

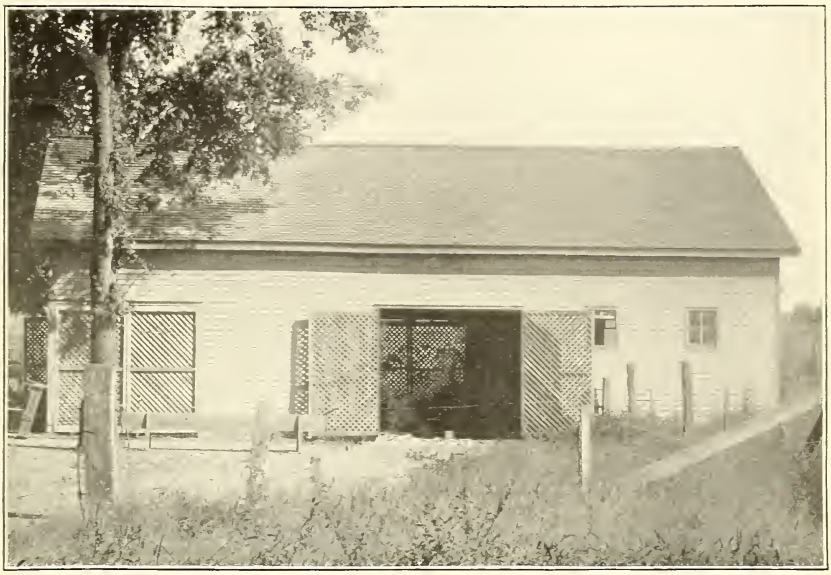


FIG. 1.—MISSISSIPPI STATION—TOOL BARN.

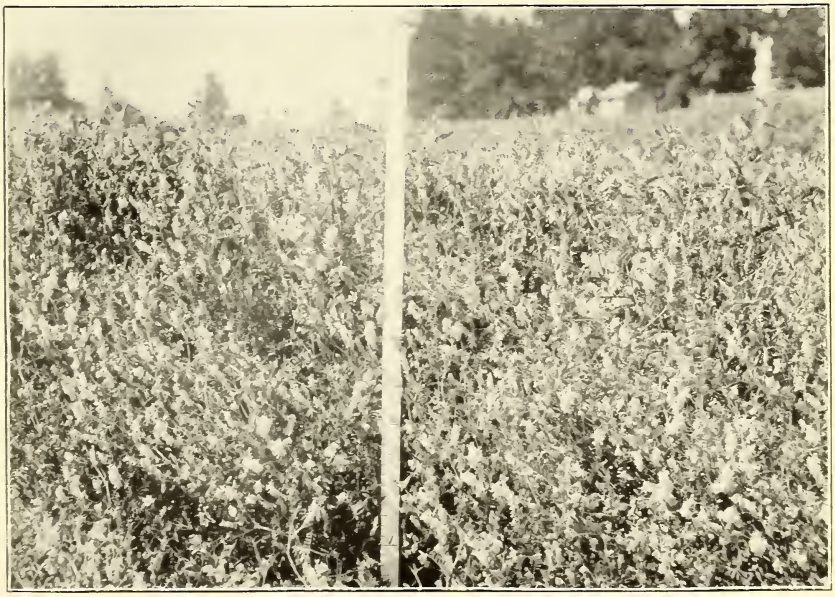


FIG. 2.—MISSISSIPPI STATION—FIELD EXPERIMENT WITH HAIRY VETCH.

The staff consists of the president of the college, director (who is also chemist), assistant director and agriculturist, botanist and entomologist, horticulturist, veterinarian, associate chemist, assistant chemist, assistant botanist and meteorologist, assistant horticulturist, treasurer, and stenographer. The director is responsible to the president of the college for the station work and property. He supervises the work of the other members of the staff and attends to most of the station's correspondence. Proposed new lines of work are submitted to the president and local trustee by the director for approval.

EQUIPMENT.

All the station's buildings are inexpensive, but as a rule are well suited to the purposes for which they were built. (Pl. LXXVIII, fig. 2, gives a general view of the station buildings and grounds.) The buildings comprise an office building, chemical laboratory, dairy barn, mule barn, tool barn, ginhouse, cattle barn, sheep barn, greenhouse, vegetation house, and other buildings of minor importance, and three dwellings for employees. (Pl. LXXIX, fig. 1, gives a general view of the station barns with the herd in the foreground. The cattle barn is shown in Pl. LXXIX, fig. 2, and the tool barn in Pl. LXXX, fig. 1.) Two of the dwellings are one-story cottages, and one, a two-story structure, is occupied by the director. The chemical laboratory is a brick structure owned by the college, and built before the station was organized. The station occupies four rooms on the first floor of this building. All the other buildings are frame structures. The office is a two-story building, with four rooms on each floor. There is a small creamery in course of construction.

The station makes use of about 150 acres of college land. More than half of this is pasture; about 25 acres are used for experiments, and the remainder for growing forage crops. The live stock comprises 27 head of beef cattle, 12 thoroughbred Jerseys, 33 sheep, and a few hogs. This stock is owned by the station and is kept separate from the college stock.

The station has a collection of 1,523 specimens of grasses, 2,000 specimens of fungi, and 5,000 specimens of insects of the State. The separate station library contains 1,325 volumes. Station workers also have access to the college library.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	956.29
Balance on hand July 1, 1898	52.93
Total	16,009.22

LINES OF WORK.

The station has no inspection duties. The work of the Mississippi Station was outlined by the director in the first annual report as follows:

> In Mississippi the sudden and abrupt changes in the management of land and labor which were brought about by the war have placed our farmers in such a condition that an almost wholly new system of farming has been inaugurated, and now the production of beef, butter, grain, and other farm products is fast becoming an important part of our agricultural industry, while cotton still remains our most valuable single crop.
>
> Under these conditions the station has undertaken to work upon some of the problems which are of the greatest immediate practical importance to the farmers of the State. Our soils have become exhausted through long cultivation of cotton, and to restore their fertility is the only means by which we can hope for prosperity. To ascertain how this can be done most economically is the primary object of this station.
>
> The application of manures is but one of the many ways by which we can accomplish this purpose; crop rotations, the plowing in of green crops, fallowing and pasturing are all valuable, if not indispensable, aids. How and when each of these methods should be used, together with the most economical manner of making manures and fertilizers, is the most important problem which we have before us. To make manure we must have cattle; to grow cattle we must feed grass and grain, and for the grain, at least, we must depend upon some form of fertilizer. This seems to indicate very clearly the work which should be undertaken first.

The plan thus outlined has been consistently adhered to throughout.

A rational scheme of fertilization presupposes a knowledge of the soil to be treated. The soil problem is one of great importance in the South generally, and in Mississippi has received much attention. Extensive studies were made of the soils of the State by Dr. E. W. Hilgard, formerly State geologist for Mississippi, but now director of the California Station. This work was reported in the Tenth (1880) Census in the work on "Cotton Production." In making fertilizer tests the station has made use of as great a variety of soils as possible.

In 1888 the station commenced a series of experiments with grasses and forage plants, in cooperation with the United States Department of Agriculture, with a view to determining what plants will restore fertility to the soil most rapidly and at the same time give fair returns in hay or pasture; what plants will make the most permanent meadows; what plants will make the best permanent pastures, especially for winter grazing; and what hay-producing plants are best for temporary use. Hairy vetch proved to be one of the most desirable crops for Mississippi thus tested. A view of one of the station's field experiments with this crop is presented herewith (Pl. LXXX, fig. 2). In all 586 species were grown on soils differing widely in character and fertility. Some results of this work were published in Farmers' Bulletin No. 18 of the United States Department of Agriculture.

The station is endeavoring to promote the interests of animal husbandry and dairying. Feeding experiments have been made to determine the most economical ration for the production of milk and butter,

using the forage crops found to be best adapted to local conditions. In this connection analyses were made of a great variety of grasses and other forage plants, grains, hays, and concentrated feeding stuffs. Artificial digestion experiments were also made with many of these, and in some cases digestibility was further determined by tests with sheep.

The veterinarian has studied a number of diseases of domestic animals, including Texas fever, charbon, glanders, colic, lamenesses of several kinds, tuberculosis, and insects injurious to live stock.

Ever since its establishment the station has given much attention to testing different fertilizers on cotton as grown on a variety of soils. The station has tested all the varieties of cotton of which seed could be procured in the Southern States. A number of types and varieties have been imported and some work has been done in hybridization. The chemical development of the cotton plant has been traced. Samples of the different parts of the plant were taken every ten days, proximate analyses made of each, and complete analyses made of the ash. With maize the work has comprised selection of seed and tests of varieties, fertilizers, and cultural methods. Other crops that have received attention are wheat, ramie, flax, jute, Sunn hemp, canaigre, and castor beans.

In the horticultural division a large number of varieties of fruits have been planted and compared as to their adaptability to local conditions. The former entomologist, Prof. H. E. Weed, devised a modification of the apparatus for the mechanical mixing of kerosene and water, as originally devised by Professor Goff, of the Wisconsin Station, and considerable attention has been given to tests of the new apparatus. Tests have been made of methods of controlling the horn fly and of kerosene as a remedy for mosquitoes. The botanical division has prepared a preliminary list of the fungi of the State. Prof. B. D. Halsted, of the New Jersey Stations, working under a special commission from the Mississippi Station, has worked out the nature of the Southern tomato blight, and has shown that it is probably due to the same cause as the potato blight and a blight of cucurbits. Meteorological observations are made by the chemical division.

DISSEMINATION OF INFORMATION.

Up to January 1, 1900, the station had issued 11 annual reports, 59 regular bulletins, 1 technical bulletin, and a few press bulletins. A part of the annual reports are merely administrative documents, while others contain a full discussion of the work of the station from its organization to the date of issue. The mailing list, which is kept on cards arranged alphabetically by post-offices, contains about 14,000 names. The correspondence amounts to about 1,500 letters a year. About 20 farmers' institutes are held under the auspices of the station annually.

GENERAL RESULTS OF WORK.

The most important results of the work of the Mississippi Station have been the demonstration of the fact that numerous varieties of nutritious grasses and forage plants could be successfully grown in the State and the aid given to the development of animal husbandry. In connection with this the studies of fertilizers, methods of culture, and green manuring with reference to the maintenance or restoration of fertility have been of much practical importance. And in general the station has had increasing influence in promoting the diversification of agriculture.

MISSOURI.

Missouri Agricultural College Experiment Station, *Columbia.*

Department of the College of Agriculture and Mechanic Arts of the University of the State of Missouri.

GOVERNING BOARD.

Board of Curators—Executive Committee: Noah M. Givan (*President*), *Harrisonville;* Walter Williams, *Columbia;* Campbell Wells, *Platte City.*
Advisory Council—The Missouri State Board of Agriculture.

STATION STAFF.

R. H. Jesse, LL. D., *President of the University.*
Henry J. Waters, B. S. A., *Director.*
Paul Schweitzer, PH. D., *Chemist.*
J. C. Whitten, B. S., *Horticulturist.*
J. M. Stedman, B. S., *Entomologist.*
J. W. Connaway, M. D. C., *Veterinarian.*
——— ———, *Meteorologist.*
N. O. Booth, B. AGR., *Assistant in Horticulture.*
T. I. Mairs, B. AGR., *Assistant in Agriculture.*
W. B. Cady, B. S., *Assistant in Chemistry.*
C. Thom, PH. D., *Assistant in Botany.*
John Schnabel, *Gardener.*
J. G. Babb, *Secretary.*
R. B. Price, *Treasurer.*
C. L. Willoughby, *Clerk and Stenographer.*

HISTORY.

The Missouri Station is located in the north central portion of the State, not far from the Missouri River. The State has a varied surface, embracing prairies, river bottoms, and hills. Forests are extensive. The soils are of different kinds, but there are large areas of alluvial and black prairie loam. The summers are long and warm and the winters brief but sometimes comparatively cold. The average annual rainfall is about 38 inches. The mining, manufacturing, and commercial interests of the State are very large. The regular practice of agriculture in the State dates from about 1815 and the agricultural and horticultural interests have grown to be very large and varied. Maize is the principal crop, but wheat, oats, tobacco, potatoes, and hay are grown in large amounts. Numerous cattle, milch cows, horses, sheep, swine, and poultry are raised. Dairying is a very important

industry. Market gardening and fruit growing are extensive. The university with which the station is connected is a strong and well-equipped institution with 1,500 students.

As early as 1856 attention was given by the University of Missouri to the composition, structure, and distribution of the different types of soils in Missouri, and their adaptability to different agricultural and horticultural purposes. In 1859 a treatise on the adaptability of south Missouri to fruit growing was published, to which was appended a list of the wild native grapes of the State. The portion of this treatise relating to the grape was translated into French and circulated quite extensively in France in 1859–60.

In 1870 the agricultural college was organized and systematic tests of varieties of farm crops were begun by the professor of agriculture. Experimental work in horticulture was begun in 1877, investigations in stock feeding in 1882, in veterinary science in 1885, and in agricultural chemistry in 1886.

The Missouri Agricultural College Experiment Station was organized January 31, 1888, in accordance with the act of Congress, as a department of the College of Agriculture and Mechanic Arts of the University of Missouri, with Dr. P. Schweitzer as director. July 6, 1888, the station was reorganized with Prof. J. W. Sanborn as director and Dr. Schweitzer as chemist. Professor Sanborn was succeeded in 1889 by Prof. E. D. Porter, who was, in turn, succeeded in 1895 by the present incumbent. With the organization of the experiment station the lines of experimental work in agricultural chemistry, crops, feeding, veterinary science, and horticulture were greatly extended. A division of entomology was added in 1895.

ORGANIZATION.

The control of the station is vested in the board of curators of the university, which consists of nine members, appointed by the governor from different political parties for periods of six years. The term of office of one-third of the board expires every two years. Meetings are held twice a year. The members serve without compensation, excepting the members of the executive committee, who receive $5 per day for the time actually spent at the meetings. In the intervals between board meetings the immediate oversight of station affairs is delegated to an executive committee of the board, consisting of three members, who hold monthly meetings. The Missouri State Board of Agriculture is an advisory council, the duties of which are to examine into the work and management of the station and suggest to the board of curators of the university lines of experimental work.

The staff consists of the president of the university, director, chemist, horticulturist, entomologist, veterinarian, meteorologist, assistant in horticulture, assistant in agriculture, assistant in chemistry, assistant

in botany, gardener, secretary, treasurer, and clerk and stenographer. All are appointed by the board of curators on the recommendation of the president and director, and hold office at the pleasure of the board. The director is responsible to the president and board for the policy, management, and success of the station in all its departments. The station council, consisting of the chief officers of the station, the director, and president, meets once each year and recommends to the board a tentative distribution of the station funds among the different divisions of the station and the lines of experimental work that should be carried on during the ensuing year.

EQUIPMENT.

The station buildings comprise the horticultural building, Agricultural Hall, greenhouses, residence of the director, residence of the horticulturist, farm barns, and sheds for experiments in animal nutrition. The chemical laboratories of the station occupy five rooms and a part of the basement in the chemical laboratory (Pl. LXXXI, fig. 1) of the university, which is a two-story brick building, 132 by 90 feet. The horticultural building (Pl. LXXXI, fig. 2) is a brick structure, 20 by 50 feet, two stories, in which are located the laboratories of entomology (Pl. LXXXII, fig. 1) and horticulture. Agricultural Hall is a brick structure, 50 by 120 feet, three stories, in which are the administrative offices, station library, weather bureau, veterinary laboratories, two agricultural laboratories, and the agricultural museum. The greenhouses (Pl. LXXXII, fig. 2) consist of a central building, 30 by 30 feet, with two wings, and a secondary wing used as a propagating house. (The barns and implement sheds are shown in Pl. LXXXIII, fig. 1.)

The entire college farm of 640 acres, or any part of it, is at the disposal of the station for experimental work. At present the horticultural and entomological divisions are making use of 30 acres for experiments with vegetables, fruits, nursery stock, ornamentals, and insects; and the agricultural and chemical divisions are using 40 acres, which are divided into plats varying in size from one one-hundredth to one-tenth acre.

The station maintains no permanent herd of live stock. For cattle and hog feeding experiments, special animals are bought as necessary and are sold again as soon as the experiments have been concluded. The station is at present using 60 steers and 30 hogs in such experiments. The station is permitted to make free use of any live stock belonging to the college. This college live stock at present consists of 49 head of registered cattle of several breeds, 20 pure-bred hogs, and 50 grade sheep representing types producing fine, medium, and coarse wool, respectively. All experimental work in breeding and dairying is carried on with the college herd. The experimental work in the veterinary division is conducted either with college live stock or with animals

FIG. 1.—MISSOURI STATION—CHEMICAL LABORATORY, USED BY UNIVERSITY AND STATION.

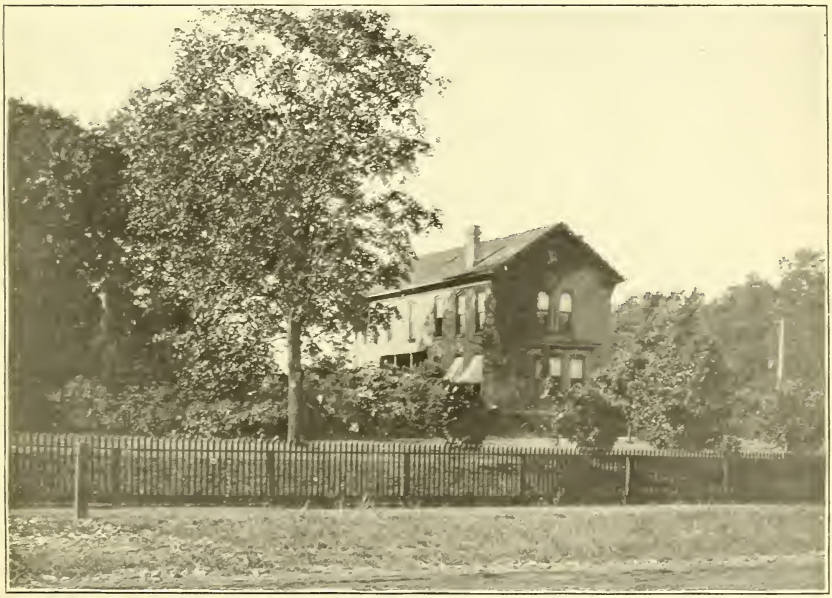


FIG. 2.—MISSOURI STATION—HORTICULTURAL BUILDING.

FIG. 1.—MISSOURI STATION—ENTOMOLOGICAL LABORATORY.

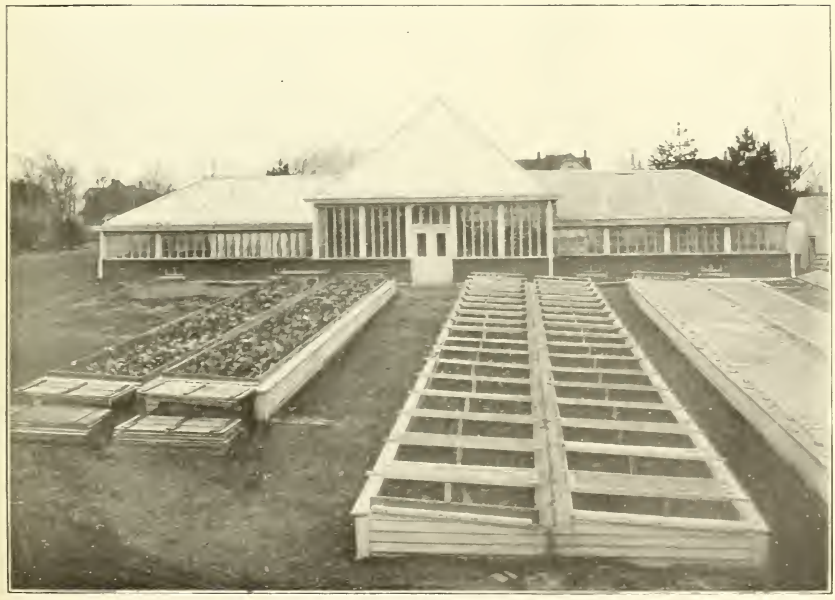


FIG. 2.—MISSOURI STATION—GREENHOUSES AND HOTBEDS.

FIG. 1.—MISSOURI STATION—BARNS AND IMPLEMENT SHEDS.

FIG. 2.—MISSOURI STATION—PROTECTION OF PEACH TREES. UNPROTECTED TREE IN BLOOM, WHITEWASHED TREE RETARDED FIVE DAYS.

furnished for the purpose by the State board of agriculture. At present the station has under experiment 240 registered Shorthorn, Hereford, Red Polled, and Devon cattle, which are being inoculated against Texas fever and are to be sent into the fever district of Texas.

All of the collections of specimens of the university, including those of the college of agriculture, are available to the officers of the station. In the entomological division there is a collection of over 6,000 species of insects of economic importance, and collections of spraying apparatus and standard insecticides. In the veterinary division there is a collection of about 100 photographs of diseased animals or organs and about 200 specimens and models. In the agricultural division there are collections of the different types and grades of wool produced in North America, and a collection of wools especially illustrating the effect of breeding; a large assortment of cotton fibers and of fiber plants of the different countries; about 200 specimens of the grasses of the United States; about 2,500 samples of seeds of weeds and cultivated plants of the United States; 300 lantern slides of typical animals of the different classes of live stock; charts, diagrams, etc., illustrating various important agricultural problems; and collections of types and varieties of farm crops and the products manufactured therefrom.

In the horticultural division there are about 400 photographs illustrating the development of plants under different methods of treatment; a horticultural herbarium containing 500 specimens of native and cultivated fruits in health and disease; a herbarium collection of grapes, illustrating the evolution of the cultivated forms; 1,000 jars of fruits, vegetables, etc., preserved in liquids; a collection of garden seeds and edible nuts; models of edible and poisonous fungi, and specimens of diseased fruits. There are extensive collections of orchard fruits, berries, grapes, figs, persimmons, oriental and native nut trees, miscellaneous wild fruits, ornamental shrubbery and herbaceous plants, types and varieties of vegetables, and 300 species of greenhouse plants.

The station library contains 1,200 bound volumes, and the college of agriculture has 2,500. Station officers also have access to the university library, which contains 16,000 volumes.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund, fees for fertilizer analyses, and sales of farm products. During the last fiscal year the income was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	636.95
Farm products	1,943.80
Miscellaneous	12.02
Balance on hand July 1, 1898	1,146.14
Total	18,738.91

LINES OF WORK.

By act of the State legislature the station is required to administer the law regulating the manufacture and sale of commercial fertilizers in the State. The station voluntarily assists the State board of agriculture in regulating the sale of artificial butters, as well as in the enforcement of the State statutes against tuberculosis, Texas fever, and other infectious diseases of live stock. The station also cooperates with the State Horticultural Society in inspecting nursery stock for shipment to other States. In all this work the function of the station is to furnish scientific information on which these boards base their action. The expenses of the fertilizer control are defrayed by the fees for fertilizer analyses and licenses. The assistance rendered to the boards of agriculture and horticulture is gratuitous, except that the actual expenses incurred by the station are met by the State.

It is the policy of the station to restrict its efforts to thorough and continuous work on a few problems of most immediate importance to the agriculture of the State. These problems are those of soil fertility, beef and pork production, and fruit growing. In the studies of soil fertility the station has undertaken to ascertain to what extent the use of commercial fertilizers is profitable in the State on fairly productive land; to determine in what forms the necessary plant food may be most advantageously supplied, and in what amounts. In all cases the returns from the use of barnyard manure are contrasted with those obtained from commercial fertilizers. An extensive study is being made of the effect of different crop rotations upon the fertility and productiveness of different soils. In these experiments the station is endeavoring to devise rotations which will enable the land to be covered with a growing crop of some sort throughout the year, and to determine upon a crop for green manuring that may be successfully and easily grown between the ordinary field crops. In this connection a test of different plants for green manuring in general is being made.

Similar, though less extensive, studies are being made on worn-out soils. A small tract of naturally poor land on which maize had been grown without fertilizer for the past fifty years has been leased for a period of years for these experiments. This land was originally incapable of producing more than 6 to 8 bushels of maize per acre in exceptionally favorable seasons. Different combinations of commercial fertilizers and of barnyard manure and different rotations, involving the use of clover and cowpeas as crops for green manuring, are being tested as fertilizers for maize and wheat on such lands. Tests are being made of the value of tile drainage for moderately rolling upland clay soils, and of the value of subsoiling on tile-drained stiff clay soil.

The production of beef and pork constitutes one of the largest agri-

cultural industries in the State. The station has, on this account, confined its feeding experiments to cattle and hogs. Feeding experiments with pigs have been undertaken in order to ascertain the influence of nutritive ratio upon the economy of growth, to compare the feeding value of maize and wheat middlings in this respect, and to ascertain in what proportions these materials should be mixed to obtain the best results. Essentially the same problem—that of the economy of different nutritive ratios in the fattening of steers and in raising young cattle—has been attacked. In seasons when maize is high in price, and cotton-seed meal and linseed meal are relatively low, a large quantity of these materials is used by farmers in connection with maize, for fattening steers. The station has undertaken to ascertain whether or not this practice is advisable and profitable. The most important question confronting the stockmen of Missouri is that of the proper utilization of the stover or fodder. The station is comparing the value of this material with that of timothy hay for wintering yearling steers, and is endeavoring to ascertain in what form this material may be most profitably used. Comparison has been made of the feeding value of whole, cut, shredded, and ensiled stover. The question of the effect of maturity upon the yield, palatability, and digestibility of timothy is a matter of considerable importance to the entire country. The station has undertaken to investigate this problem by making cuttings at five different stages of development, noting carefully the yield of dry matter per acre in each case, and determining the digestibility of each cutting with steers.

The chemist has made a study of the digestibility of feeding stuffs by artificial methods as compared with animals, and a study of the crude fiber in common feeding stuffs. Observations have been made on the effect of crossing different grades of sheep with native ewes, and upon the weight and quality of the wool and carcasses of the offspring.

Forage crops have naturally received considerable attention. Numerous tests have been made of varieties of grasses and of the adaptability of new forage plants to local conditions. Tests are being made to determine the best methods and seasons of sowing grasses and clovers. Determinations and comparisons are being made of the digestibility of the common forage plants of the State when grown under similar conditions. Observations are being made on the effect of closeness of cropping on the yield of pasture grasses.

Maize is by far the most important field crop of the State, and since the organization of the station has received much attention. During the first year of the station's existence, extensive investigations were made upon the life history of the maize plant and on the physical conditions of climate, soil, and atmosphere, and chemical conditions of soil necessary for its profitable production. From time to time various

cultural experiments have been made, and breeding experiments have been carried on continuously since the establishment of the station, to determine to what extent the type of ear and stalk may be modified by selection.

Another branch of experimental work in the interests of the live-stock industry is that on animal diseases, principally Texas fever. The investigations on Texas fever may be comprised in the two categories of dipping experiments and immunizing experiments. Experiments have been carried on in cooperation with the Missouri State Board of Agriculture and the Texas Station in dipping Southern cattle to free them from the cattle tick with a view to rendering them incapable of transmitting Texas fever, so that they may enter the Northern feed lots, pastures, and markets without restriction and without communicating disease to native cattle. Experiments have also been carried on in cooperation with the Texas, Louisiana, and Mississippi stations, in the inoculation of susceptible Northern cattle with sterile serum and with fresh blood procured from immune Southern cattle. Experiments have further been made to determine whether the natural or tick method of immunizing could be made practical for the breeder. A careful study was made of the movements of mature and larval ticks to determine the probable distance of the spread of the infection from roadways, railways, cattle yards, or experiment pens over adjacent pasture land. Observations have been made on the effect of winter weather in disinfecting pastures and on the permanence of immunity in Texas cattle.

In the horticultural division the most important investigations have been along lines of manuring and culture of the apple, introduction of nut culture, breeding of fruits better adapted to local conditions, winter protection of the peach, and forcing asparagus in the field. An extensive study is being made of the application of fertilizers to bearing apple orchards in different sections so as to include the typical soils of the State. The value of commercial fertilizers in forcing winter vegetables under glass is also being investigated. A series of experiments designed to determine the practicability and cost of forcing asparagus in the open field in winter yielded information of much value to the market gardener. Tillage experiments with orchards have recently been accorded a prominent place. The horticultural division is also making a study of the influence of iron salts in coloring apples, and the chemical division has made a careful study of the effect of such applications upon the composition of the leaves and fruit. Investigations on the winterkilling of the peach have shown that in many cases it may be prevented by coating the branches of the tree with whitewash to retard growth during the warm days in early spring. (The effect of whitewash in retarding growth in early spring is shown in Pl. LXXXIII, fig. 2.) The amelioration of the native persimmon

has received some attention along lines of selection of superior native strains and hybridization with the Japanese or Chinese species. The station is also doing experimental work in the culture of a number of kinds of introduced nuts.

In the division of entomology the laboratory work has been confined to a study of the life histories of a few of the most injurious insects of the State and methods of combating them. Among these are the woolly aphis of the apple, the lesser apple-leaf folder, the leaf crumpler, army worm, oyster-shell bark-louse, strawberry crown borer, peach-tree borer, apple-tree borer, San José scale, cabbage worm, harlequin cabbage bug, gouger, cutworms, and tarnished plant bug. The life history of a new and hitherto undescribed insect, the fringed-wing apple-bud moth, which has been doing a large amount of damage to the orchards and nursery interests of western Missouri and eastern Kansas has been worked out and a treatment prescribed.

Systematic tests have been made of the influence of width of tire upon the draft of wagons upon dirt, gravel, and macadam roads, and in cultivated fields, meadows, and pastures. Observations have also been made on the effect of height of wheels on the draft of farm wagons.

DISSEMINATION OF INFORMATION.

The station has issued 48 bulletins and 11 annual reports, and prior to its establishment the college of agriculture had issued 34 bulletins. The annual report contains a record of the receipts and expenditures of the station, a report on the enforcement of the fertilizer control law, all the bulletins issued during the year, and the results of such other experimental work as may be deemed proper. It is essentially a repository of all the scientific results published by the station, and includes details of methods and results not published in the bulletins. Newspaper bulletins embodying the practical points of each bulletin are issued at the same time the bulletin is published, and sent to all the papers of the United States that maintain an agricultural department, and to all the newspapers of Missouri.

The number of addresses on the mailing list is 11,000. The station correspondence amounts to over 10,000 letters a year. Some member of the station staff is present at each farmers' institute, and at every important agricultural or horticultural meeting held in the State. It is not the policy of the station to make general exhibits at fairs or farmers' meetings, although frequently the results of some special line of experimental work are exhibited, especially if any new or important lesson may be taught in that way.

GENERAL RESULTS OF WORK.

The results of the investigations of the Missouri Station on the nutrition of animals have been an important factor in improving the

practice of feeding, especially of young, growing animals and hogs for bacon. The demonstration of the feeding value of cotton-seed meal and maize stover has led to the more economical production of beef, pork, and milk. The successful efforts of the station to extend the growth of cowpeas as a substitute for clover have had very beneficial effects, especially in the southern part of the State. The studies of Texas fever and the perfecting of methods of immunizing northern-bred cattle have done much to promote the live-stock interests of the South, as well as to benefit the breeders of cattle in the North. The discovery that whitewashing is an effective method of protecting peach trees in winter has already benefited peach growers in a number of States. A method devised by the station for growing asparagus in the open field in winter has been successfully tried by market gardeners in different localities. Cheap and effective methods for combating the woolly aphis and fringed apple-bud moth have been found, which have been of much practical value. The station has also had much success in promoting the practice of spraying for insect and fungus enemies of cultivated plants.

The experiments showing the advantages of using wagons with broad tires on various kinds of roads and farm surfaces have attracted wide attention in this and other countries.

MONTANA.

Montana Agricultural Experiment Station, *Bozeman.*

Department of Montana Agricultural College.

GOVERNING BOARD.

Executive Board: L. S. Willson (*President*), *Bozeman;* Peter Koch (*Secretary and Treasurer*), *Bozeman;* John M. Robinson, *Bozeman;* Geo. Kinkel, jr. (*Vice-President*), *Manhattan;* Walter S. Hartman, *Bozeman.*

STATION STAFF.

Rev. James Reid, B. A., *President of the College.*
S. M. Emery, *Director; Horticulturist.*
F. W. Traphagen, Ph. D., *Chemist.*
Robert S. Shaw, B. S. A., *Agriculturist.*
W. M. Cobleigh, *Assistant Chemist.*
J. W. Blankinship, Ph. D., *Botanist.*
Robt. A. Cooley, B. S., *Zoologist.*

HISTORY.

The Montana Station is located in the southwestern part of the State in the valley of the Gallatin River, a rich agricultural region between ranges of lofty mountains. The eastern half of the State consists of rolling table-lands which are generally treeless. The western half is mountainous and contains extensive forests. The winters are a mean between the severity of the Upper Mississippi Valley and the mildness of the Pacific coast States and the summers are brief and cool. The

average annual rainfall is less than 18 inches. The hillsides and plains are covered with nutritious grasses. Agriculture with irrigation is practiced in numerous valleys. Large crops of wheat, oats, barley, and potatoes are grown. Numerous cattle, sheep, and horses are produced on the ranges. Montana became a separate Territory in 1864, but was not admitted to the Union as a State until 1889. Mining and stock growing have been the principal industries. Agriculture has been practiced in an extensive way only about twenty years. Compared with the great area of the State, the population is small. The college, with which the station is connected, was not organized until 1893, and only recently has been provided with suitable buildings.

The Montana Agricultural Experiment Station was organized in accordance with the act of Congress as a department of the Montana Agricultural College, with Mr. S. M. Emery as director. The college and the station were created by the same act of the State legislature, February 16, 1893.

ORGANIZATION.

Both college and station are under the general supervision of the State board of education, the members of which are nominated by the governor and confirmed by the State senate. Immediate control of these institutions is delegated to an executive board appointed for four years by the governor with the consent of the board of education and consisting of 5 members, at least 3 of whom must be residents of the county in which the institutions are located. Board meetings are held on the first Friday of each month. Special meetings are called by the president of the board. Three of the present members, the president, vice-president, and secretary, have served continuously since the organization of the institutions.

The staff is composed of the president of the college, director (who is also horticulturist), chemist, agriculturist, botanist, assistant chemist, and zoologist, elected by the executive board, and holding their positions during good behavior. The director has general supervision of the work of the staff, calls staff meetings, administers the general affairs of the station, acts as purchasing agent, and verifies all bills and accounts against the station for the auditing committee. The staff hold regular monthly council meetings. All matters of station policy are referred to the executive board and all work is subject to its approval. Recommendations of new lines of work are made to the board by the director. Each member of the staff is responsible for the work in his division.

EQUIPMENT.

The station buildings comprise a main building, two poultry houses, three tool houses, granary and root cellar, barn, swine house, two hay barns, two greenhouses, and a farm cottage. The main building (Pl.

LXXXIV, fig. 1) is a two-story brick structure, in which are located the offices of the director, agriculturist, and irrigation engineer, and the botanical and entomological laboratories. The chemical building (Pl. LXXXIV, fig. 2), a two-story brick building, 60 by 90 feet, is used jointly by the station and the agricultural college, about one-third of the building being devoted to station work. The main laboratory room is 24 by 55 feet, and there are other rooms for nitrogen work, balances, sugar-beet saccharometer readings, and for preparation and storage of samples.

The college farm contains 160 acres. Of this area 6 acres are used as public highways on three sides of the farm, 14 acres are used for pasture, and the remaining 140 acres are under cultivation. The whole tract is devoted exclusively to station use. Eighty acres were donated by the commissioners of Gallatin County in 1893. The other 80 acres were purchased by the college for the nominal price of $1 per acre, the money being donated by the faculty of the college and members of the station staff. The entire arable area is planted to crops in such a manner as to furnish a comparison between land farmed continuously and by the system of alternate fallowing, as commonly practiced in Montana. Twelve acres are devoted exclusively to experimental work with special crops or rotations, 4 acres are devoted to grain plats, ranging in area from one-fourth to one one-hundredth of an acre, and 6 acres are planted with orchards and small fruits.

The station live stock comprises 8 horses, 2 colts, 8 pure-bred Shropshire sheep, 28 head of grade Merinos, 75 swine, including some pure-bred Berkshire and Poland Chinas; 200 head of poultry, and 10 cows and heifers.

The station has about 500 samples of the grains, soils, woods, and foods of the State. A separate station library of about 800 volumes is maintained, but most of the books on agricultural subjects are kept in the college library, to which all station workers have access.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, a small State appropriation made to aid in paying the traveling expenses of the director, and the sale of farm products. The last item is, by resolution of the board, devoted exclusively to farm improvements. The income during the last fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	787.50
Farm products	1,242.61
Total	17,030.11

FIG. 1.—MONTANA STATION—MAIN BUILDING.

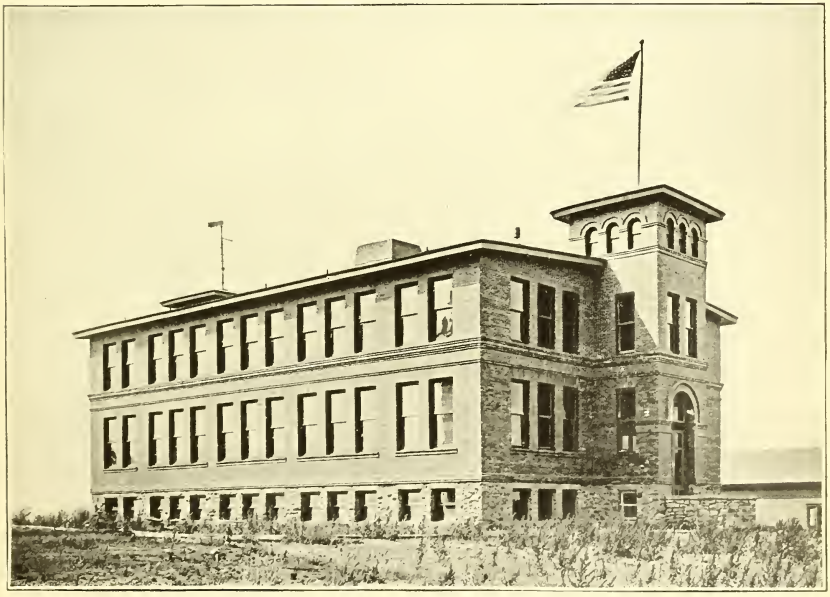


FIG. 2.—MONTANA STATION—CHEMICAL BUILDING, USED BY COLLEGE AND STATION.

FIG. 1.—MONTANA STATION—SASKATCHEWAN FIFE WHEAT.

FIG. 2.—MONTANA STATION—IRRIGATION OF SUGAR BEETS.

LINES OF WORK.

The inspection of kerosene oil and food products is carried on in connection with the State bureau of agriculture and labor, by which the expense is borne. The station entomologist is also State inspector for the State board of agriculture, by which the expense of the work of inspection is defrayed from a State appropriation for the purpose.

The larger part of Montana lies in the great arid region, and hence the problems of irrigation and alkali are of fundamental importance. The station is making a general study of the soils of the State with respect to their origin, development, geographical distribution, and agricultural adaptability. The chemist has given much time to an effort, in connection with the committees on analysis of soils and of ash of the Association of Official Agricultural Chemists, to secure analytical methods which will give harmonious results in the hands of different chemists, and which will at the same time give a fair idea of the available plant food contained in various soils.

Irrigation in Montana presents peculiar difficulties, economically, since land is so cheap that the usual treatment of alkali lands by underdrainage is not practicable. Experiments have been made with different devices for obtaining a constant flow in laterals with variable heads in the main canals or reservoirs. Some work has been done in measuring the water in various canals with a view to collecting information concerning the value of coefficients of friction, determining proper velocities from observation of scours, deposit of sediment and economic construction, compiling data on the duty of water, and determining the value of the Montana statutory inch expressed in feet per second for openings of various sizes. Irrigation waters from different sources taken under different conditions have been analyzed. Of special importance is a series of investigations of waters from the tailings dams of silver mills, which are commonly believed to be very injurious to vegetation on account of the mineral salts, especially sodium chlorid and sulphate, which they contain. Investigations on the effect of these salts in solution on plant growth have shown that the injury is not so great as commonly believed, and that with proper precautions on the part of miner and farmer, these solutions can be used with safety. Numerous samples of drinking water have been analyzed.

The most important agricultural industry in Montana is stock raising, and the station is, therefore, making special efforts to promote this industry. Tests have been made with a number of cultivated forage and root crops to determine their adaptability to the State. On the ranges there has been much loss of stock caused by poisonous plants, which led to an investigation of poisoning of sheep by larkspur. The symptoms were described and preventive and remedial measures suggested. The active principle was extracted and shown to be an alkaloid.

Feeding experiments have been carried on with pigs and sheep. The station has also planned a series of feeding experiments with steers. It is the intention to develop this work in the future. Poultry experiments have been undertaken on a quite extensive scale. They have comprised investigations on the causes of sterility in eggs, the effect of different kinds of food in egg production, and the cost of producing flesh.

The veterinary division has made investigations on a disease of sheep, previously undescribed in America, called parasitic ictero-hæmaturia. This division has also made investigations on other diseases of sheep due to animal parasites, especially those due to the larvæ of the gadfly and to tapeworms; a disease of fowls due to an intestinal parasite (*Cytodites nudus*), and the spaying of mares.

Grain growing is the industry second in importance in the State. Tests and chemical analyses have been made of numerous varieties of small grains, and experiments in cultural methods have been carried on with reference to fall seeding of spring wheat, thick and thin seeding, and treatment of smuts. (Pl. LXXXV, fig. 1, shows a field of one of the varieties of wheat that the station finds well adapted to the State.) Tests and chemical analyses of varieties of barley grown by the station show that this grain as grown in Montana is of superior value for malt. Much attention is being paid to rotation of crops as a remedy for continuous grain production and the practice of summer fallowing.

Investigations with potatoes include tests of varieties, methods of planting, treatment of scab, and chemical analyses of a number of varieties. The station has shown the incorrectness of a prevalent belief that potatoes grown by irrigation contain a relatively large percentage of water and are of inferior quality. Experiments have shown that Montana conditions are favorable to the production of sugar beets of high quality.

The station is endeavoring to develop fruit growing in the State. Tests of orchard and small fruits are being carried on especially with reference to hardiness. Various points in strawberry culture have been considered, including a comparison of the yield of a bed in the second year with that in the first and third years, and the proper proportion of pistillate plants to alternate with the staminate to insure the best results. The station is planning experiments to determine the effect of irrigation upon the flavor of fruit. A preliminary study has been made of late spring frosts as affecting strawberries, in which it was found that in some cases differences in hardiness are correlated with differences in anatomical characters.

Cooperative experiments have been carried on with sugar beets. (Pl. LXXXV, fig. 2, shows one method of culture.) The station is cooperating with the United States Department of Agriculture in work with grains, shrubs, and forest trees, and with that Department and the Hydrographic Division of the United States Geological Survey in irrigation investigations and water measurements.

DISSEMINATION OF INFORMATION.

The station has published 21 regular bulletins, a few press bulletins, and 5 annual reports. The annual report is merely an administrative document. The mailing list contains 4,270 names kept by the card catalogue system. The correspondence amounts to about 2,000 letters a year. The members of the station staff take part in farmers' institute work, and have made many addresses before local improvement societies, stock growers' meetings, etc. In all such cases the body addressed pays the traveling expenses of the speaker.

GENERAL RESULTS OF WORK.

The work done by the Montana Station in promoting the use of better varieties of barley and demonstrating their value for malting has led to large exports of barley grown in the State and materially increased the value of the crop to the producers. The investigations of the station have also awakened wheat growers to the evils of continuous cropping and promoted the diversification of agriculture. Studies on irrigation, especially as related to alkali soils, have shown the necessity for great carefulness in the use of water and indicated ways in which injurious effects may be diminished. The station has also promoted the better organization of stock growing by pointing out how the ranges may be utilized and at the same time preserved, and by experiments with forage plants which may be grown with or without irrigation to supplement the native grasses.

NEBRASKA.

Agricultural Experiment Station of Nebraska, *Lincoln.*

Department of The University of Nebraska.

GOVERNING BOARD.

Regents of the University: Charles H. Morrill (*President*), *Lincoln;* H. L. Goold, *Ogallala;* E. von Forell, *Kearney;* George F. Kenower, *Wisner;* Edson C. Rich, *Omaha;* John L. Teeters, *Lincoln.*

STATION STAFF.

C. E. Bessey, Ph. D., LL. D., *Acting Chancellor of the University.*

T. L. Lyon, B. S. A., *Acting Director; Agriculturist.*
H. H. Nicholson, M. A., *Chemist.*
C. E. Bessey, Ph. D., LL. D., *Botanist.*
Lawrence Bruner, B. S., *Entomologist.*
E. H. Barbour, Ph. D., *Geologist.*
A. T. Peters, D. V. M., *Animal Pathologist.*
G. D. Swezey, M. A., *Meteorologist.*
O. V. P. Stout, C. E., *Irrigation Engineer.*
R. A. Emerson, B. S., *Horticulturist.*
E. A. Burnett, B. S., *Expert in Animal Husbandry.*
G. A. Loveland, B. S., *Assistant Meteorologist.*
W. D. Hunter, M. A., *Assistant Entomologist.*
A. L. Haecker, *Assistant Agriculturist.*
R. W. Thatcher, B. S., *Assistant Chemist.*
Wm. H. Tuck, *Laboratory Assistant in Animal Pathology.*
S. W. Perin, *Foreman of Farm.*
John B. Meserve, *Treasurer.*
W. W. Marshall, *Executive Clerk.*

HISTORY.

The Nebraska Station is located in the southeastern part of the State. The State is a part of the Great Plains, with an elevation of about 1,000 feet in the east along the Missouri River, which gradually increases to about 4,000 feet along the western boundary. This was originally a treeless region covered with nutritious grasses, but since the establishment of an annual tree planting on what is called Arbor Day (inaugurated by Hon. J. Sterling Morton, former Secretary of Agriculture), millions of trees have been planted. The western half of the State is still very largely devoted to grazing, but agriculture is very extensively practiced in the eastern half. A black prairie soil of great fertility covers almost the entire State. The average annual temperature is somewhat less than 50° F. The annual rainfall varies from 19 inches in the west to about 30 inches in the east. Hot winds and drought are the most serious difficulties against which agriculture has to contend. Very large crops of maize are grown. Wheat, oats, barley, potatoes, and hay are also important crops. Large numbers of cattle, swine, milch cows, horses, and sheep are produced. The regular practice of agriculture dates from about 1850. The university with which the station is connected has grown very rapidly in recent years and is a strong and well-equipped institution with over 2,000 students.

Experimental work in agriculture has been carried on at the industrial college of the University of Nebraska since 1873, the first published report of which, however, did not appear until 1880. This was a pamphlet of 31 pages, containing a short description of the farm and its equipment, results of experimental work, and a statement of instruction offered in agriculture. The experiments reported comprised a comparison of dry and soaked maize for pig feeding, cost of raising an acre of sorghum and of manufacturing it into sirup, test of varieties of wheat, depth of sowing grain, test of varieties of potatoes, test of varieties of sugar beets for feeding purposes, and a record of rainfall and temperature. There is no other published record of experimental work in agriculture until the organization of the experiment station under the provisions of the act of Congress.

In 1884 Prof. Charles E. Bessey, dean of the industrial college, presented a report to the chancellor of the university, in which he recommended the prosecution of investigations bearing upon agriculture. This report was adopted by the board of regents, and may be said to be the first attempt to conduct systematic experiments in agriculture and its related sciences at the University of Nebraska. The scheme provided for both popular and scientific experiments.

A scientist, whose entire time was devoted to research, was first employed in 1886. At that time Dr. F. S. Billings undertook investi-

gations on the nature and treatment of hog cholera. During the same year an animal house was erected on the university farm, and laboratories were set apart in the university buildings for the use of the investigator of animal diseases. Other lines of research and popular experiments were continued at the university and farm, which, although not published by the industrial college, yet furnished material which afterwards appeared in the publications of the experiment station.

The Agricultural Experiment Station of Nebraska was organized in accordance with the act of Congress as a department of the University of Nebraska in December, 1887, with Dr. Charles E. Bessey, professor of botany, as director. He was succeeded in 1889 by Dr. Lewis E. Hicks, the professor of geology, who was in turn succeeded the next year by the chemist, Prof. H. H. Nicholson. In 1893 Prof. C. L. Ingersoll became director and served until July 1, 1895. He was succeeded by the chancellor of the university, Prof. George E. MacLean, LL.D., since whose resignation in 1899 the agriculturist, Prof. T. L. Lyon, has performed the duties of the office, in the capacity of acting director. In 1896 the university refitted a building on the university farm to be occupied exclusively by the agricultural-chemical laboratory and the office of the agriculturist. The State legislature of 1899 made an appropriation of $35,000 for buildings and permanent improvements on the university farm. This appropriation is being used for the erection of an experiment station building.

ORGANIZATION.

The governing board of the station is the board of regents of the university, which consists of six members, elected by popular vote for terms of six years. By an act of the State legislature of 1899 the funds accruing to the State for the maintenance of the station are paid into the State treasury and must be reappropriated to the station by the legislature biennially. By the same act the State treasurer is made treasurer of the experiment station. The board makes all appropriations of funds to divisions of the station, and the president of the board approves all bills. There are four regular meetings of the board each year. Special meetings are very infrequent, except in the case of certain committees of the board. Members receive no compensation, but their traveling expenses are paid from State funds. By resolution of the board of regents at the organization of the experiment station the State Agricultural Society is requested to appoint two of its members and the State Horticultural Society one of its members, the three to constitute a visiting committee to visit the station at least once each year, and to submit its report thereon to the board of regents and the governor.

The staff is composed of the acting chancellor of the university, acting director (who is also agriculturist), chemist, botanist, entomologist,

geologist, horticulturist, investigator of animal diseases, meteorologist, expert in animal husbandry, irrigation engineer, assistant meteorologist, assistant entomologist, assistant chemist, assistant agriculturist, laboratory assistant in animal pathology, foreman of the farm, treasurer, and executive clerk. These members are appointed by the board of regents, and tenure of office has no specified limit. The executive clerk is appointed on nomination of the director. The director has general supervision of the work of the station. The station council is composed of the president of the board of regents, the chancellor of the university, the director, and heads of divisions. The director is ex officio president of the council. The duties of the council are to determine lines of work to be pursued by the station and the general methods under which such work shall be carried on. Meetings are held at stated times or at the call of the director. If the council can not agree as to the work or methods, the final decision lies with the executive committee, but this committee may refer such questions to the governing board, and are required so to refer them if thus requested by a majority of the station council in writing.

There is no permanent substation. Sugar-beet experiments have been conducted on the farm of the Standard Cattle Company, at Ames, Nebr., since 1897. It was decided by the governing board to remove the sugar-beet experiments to that point, as the soil there represents much better the typical sugar-beet soil of the State than does that on the university farm. The company built a laboratory for this work, and allows the station the use of five acres of land free of charge. The station also has for experimental purposes the benefit of 2,000 acres of beets which the company raises on its farm. This includes a very large number of varieties, grown on different kinds of soil. An assistant is kept at the laboratory at the expense of the station, but all labor bills connected with the experiments are paid by the company.

EQUIPMENT.

The buildings occupied exclusively by the station are a main building, chemical laboratory, patho-biological laboratory, animal house, sugar-beet laboratory, and sheds for steer feeding. All buildings are on the university farm, 3 miles from the university buildings, except as otherwise indicated. The station makes use, jointly with the university, of the college barn, greenhouse, and dairy building.

The main building, known as Nebraska Hall, is on the university campus, and contains the offices of the station, the museums of natural and physical sciences, and the divisions of botany, entomology, geology, horticulture, and meteorology.

There is now in course of erection a new station building (Pl. LXXXVI, fig. 1). It is a brick structure, 55 by 108 feet, two stories and basement. The cost, including heating plant, will be $35,000.

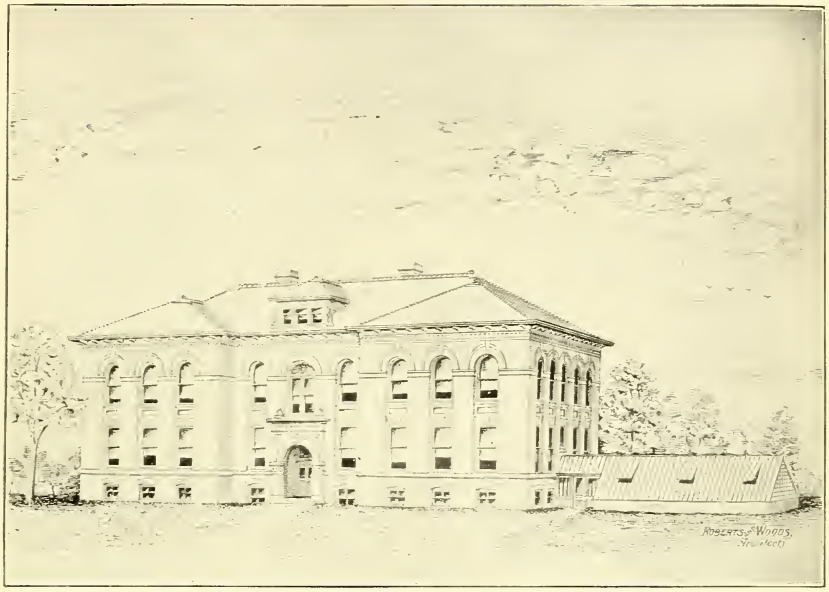


FIG. 1.—NEBRASKA STATION—BUILDING IN COURSE OF CONSTRUCTION.

FIG. 2.—NEBRASKA STATION—CHEMICAL LABORATORY.

FIG. 1.—NEBRASKA STATION—DAIRY BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—NEBRASKA STATION—BARNS.

FIG. 1.—NEBRASKA STATION—EXPERIMENTAL PLATS.

FIG. 2.—NEBRASKA STATION—IRRIGATION PUMP AND RESERVOIR.

On the first floor will be the offices of the agriculturist, animal pathologist, horticulturist, assistant chemist, the station library, and the soil and chemical laboratories; on the second floor, the offices of the expert in animal husbandry and assistant entomologist, and the botanical and entomological laboratories. In the basement are horticultural workrooms, a sampling room, a storeroom, etc. Connected with the horticultural workroom is a greenhouse.

The chemical laboratory (Pl. LXXXVI, fig. 2) is a one-story stone building with loft and cellar for storage. In it are the offices of the agriculturist and the chemical laboratories. The patho-biological laboratory is a one-story brick building containing a well-equipped laboratory for bacteriological work. The animal house is a one-story brick building used by the division of animal pathology for housing animals, for making post-mortem examinations, and for cremating carcasses.

The Standard Cattle Company's sugar-beet laboratory at Ames is a frame building, and is at the disposal of the station as long as the experiments are continued at that point. The building contains three rooms, and is supplied with water. It is well adapted to its purpose. The dairy building (Pl. LXXXVII, fig. 1) is a two-story brick structure with wing. It contains eight rooms. The station has a greenhouse covering 1,500 square feet of ground on the university campus. (The barn and accompanying buildings are shown in Pl. LXXXVII, fig. 2.)

The university farm consists of 320 acres of gently rolling land located 3 miles from the university buildings. The area permanently devoted to experiments is about 40 acres. Fifteen acres of this is in orchard, 10 acres in forestry plantations, and 15 acres in permanent plats. A view of a part of the experimental plats is given in Pl. LXXXVIII, fig. 1. Heretofore the entire farm has been under the charge of the experiment station, but after July 1, 1900, the farm will be turned over to the industrial college of the university, and only land actually used for experimental purposes will be maintained by the station.

No live stock is owned or maintained by the station except during such periods as it is being used for experimental purposes. There are at present on the farm 22 milch cows, 2 bulls, 20 steers, 150 sheep, 16 horses, and 10 hogs. Most of the milch cows are kept to demonstrate the feasibility of grading up ordinary stock toward the dairy type. The steers and sheep were bought in the fall and will be sold in the spring. They were purchased with college funds, but are maintained by the station. Ten horses are kept for producing serum used in the serum treatment for hog cholera. Ten hogs are also kept for the use of the investigator of animal diseases.

The collections of specimens in the agricultural department of the

university are owned partly by the college and partly by the station. They comprise microscope slides showing post-mortem lesions of diseased animals, slides showing bacteria, and lantern slides showing diseased parts of animals. The herbarium contains about 90,000 specimens, including especially extensive collections of grasses and fungi. The collection of fungi is rich in sets of specimens contributed by specialists, among which are Ellis and Everhart's "North American Fungi," Ellis and Everhart's "Fungi Columbiani," Ravenel's "Fungi Americani," Seymour's "Economic Fungi," and various sets of European fungi. The cabinets in the entomological division contain about 100,000 specimens. A considerable part of these are mounted in single or double cork-lined boxes. The division has also 75 display cases of injurious or beneficial insects, showing the different stages of development, certain special host plants with their principal insect enemies, and about 400 mounted specimens of insects on microscope slides. The station has collections of about 80 samples of the typical soils of the State and about 100 varieties of grains and grasses locally adapted to cultivation. A horticultural herbarium contains approximately 800 mounted specimens of fruit, vegetable, and ornamental plants, and a garden of the wild plants of the State which give promise of value for ornamental purposes. The horticultural division has 200 negatives and about the same number of lantern slides illustrating various phases of its work.

The station is well equipped with apparatus needed in its lines of work, the equipment of the division of animal pathology being especially extensive. Included among the apparatus for mechanical soil analysis is a special form of sampling tube for taking the soil samples from the ground, and a special form of drying oven for determining soil moisture, which were devised at this station.

FINANCIAL SUPPORT.

The revenue of the station is derived mainly from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	1,791.55
Balance on hand July 1, 1898	127.60
Total	16,919.15

LINES OF WORK.

The station has no inspection duties. The live stock industry of the State is of much importance, and the losses by diseases among domestic animals are great; consequently investigations on the cause and treatment of these diseases have always been an important feature of the station's work. Extensive studies have been made on hog

cholera and the serum treatment. In the course of the study of this disease, as also blackleg, numerous experiments were conducted in cooperation with the Bureau of Animal Industry of the United States Department of Agriculture. Other diseases on the treatment of which investigation has been made are anthrax, tuberculosis, actinomycosis, cornstalk disease, calf cholera, ergotism, glanders, keratitis, rabies, Texas fever, parasitic diseases, and diseases of chickens.

In 1889 the station undertook an investigation of the suitability of the State for sugar-beet growing, and this soon became a leading line of work. Cooperative experiments with farmers have been conducted on an extensive scale. As a result of this work the station has been instrumental in bringing about the establishment of three beet-sugar factories in the State. Tests have been made for four years with various commercial fertilizers on sugar beets. The entomologist has given attention to the insect enemies of the sugar beet. A four years' test has been made of sugar-factory waste, lime, gypsum, and barnyard manure as fertilizers on sugar beets, maize, and alfalfa.

The production of field crops in Nebraska is dependent largely upon water supply, for other elements of fertility are present in abundance. Rainfall is not deficient, but evaporation is excessive. The fundamental problem, then, of crop production is the conservation of soil moisture. The deficiency of water supply has been a determining factor in deciding on the main lines of work, especially in recent years. Experiments directed mainly toward the retention of moisture in the soil have been conducted on field plats prepared by tillage in different ways. A three years' test has been made of cultivating small grain to retain moisture and to increase yield. A study is being made of the effect of changes in the arrangement of particles in the soil upon its crop-producing power, especially with reference to the effect of soluble salts upon the soil structure. It is desired especially to ascertain the manner in which the arrangement of soil particles affects the fertility of the soil. The station has demonstrated the injurious effect of stirring light soils during the growing season in increasing evaporation and the failure of such treatment to liberate plant food. The effect of wind-breaks in lessening evaporation has also been demonstrated. Records are kept of air and soil temperatures, rainfall, and evaporation.

The subject of irrigation has received some attention. The irrigation engineer has made careful measurements of the water available for irrigation in the streams of the State. A record is made of the amount of water diverted for irrigation from certain parts of the North Platte River and of the methods and results on the fields to which this water is applied. Irrigation experiments have been carried on in cooperation with the United States Department of Agriculture, the Hydrographic Division of the United States Geological Survey, the State board of irrigation, and the State board of agriculture. The windmill has been

used experimentally in irrigation (Pl. LXXXVIII, fig. 2), and experiments have been carried on in the irrigation of the principal garden vegetables. Studies have been made of methods of windmill construction.

The botanist has made a study of the ecological conditions on the high plains, especially with reference to the grassy covering of the surface and the distribution of forest trees, and has conducted experiments relating to the water supply of plants. In cooperation with the United States Geological Survey, the geologist has made investigations on the wells and artesian waters of the State with reference to their utilization for domestic purposes and for irrigation.

In the horticultural division several methods of culture of apple trees are being tried, and experimental work in the improvement of varieties of fruits, vegetables, and ornamental plants is in progress. Experiments are being made in pruning apple trees at different seasons of the year, and various methods of treating wounds are being compared. A study is being made of the principles of hybridization and of the effect of environment on plants. The horticulturist is giving some attention to the experimental planting of forest trees. Different mixtures of trees, different distances of planting, and the growth of conifers under shelter of both large and small deciduous trees and in the open are being studied.

The entomologist has made extensive experiments in combating chinch bugs and grasshoppers with fungus diseases. Investigations on methods of combating the codling moth have been carried on for several years. A study is being made of the insects injurious to young trees growing on tree claims.

Under the direction of the botanist a botanical survey of the State has been made, which has been accompanied by a special study of the native grasses of the prairies, plains, sandhills, and foothills, and of the weeds of the State, and a descriptive catalogue of the Nebraska flora is nearly ready for publication. This work has included a general study of the fungi of the State. Experiments have been made in connection with investigations on the rusts of wheat and other cereals in cooperation with the Division of Vegetable Physiology and Pathology of the United States Department of Agriculture.

Considerable attention has been given to demonstrating the possibility of diversifying crops by the introduction of numerous plants not heretofore raised in the State. The practicability of pasturing annual forage crops has been shown, and the results of this work have gone far toward solving the question of summer food supply for dairy stock. For the last five years an experiment has been under way having for its object the increase of the nitrogen content of cereals. The attempt is being made to connect a variation in the specific gravity of the kernel with a corresponding variation in its nitrogen content, and

then to ascertain whether these variations are transmitted. The experiments thus far made have indicated that a high nitrogen content may become, to some extent at least, hereditary, despite a strong tendency toward reversion.

Experiments have been carried on for the last three years in the culture of chicory. The station's work along this line has been instrumental in securing the establishment of two chicory factories in the State.

DISSEMINATION OF INFORMATION.

The publications of the station are an annual report, regular bulletins, press bulletins, press bulletins—circular series, and a column of experiment station work and matters of interest to farmers, which is published in the University News-Letter and sent to all papers in the State. The regular bulletins of the station are made as short as is consistent with the subject treated, and are written in popular form. The press bulletins are in the nature of emergency bulletins. They are generally issued on short notice, and have to do with some matter of interest to farmers which must reach them without delay. They are sent only to newspapers of the State and to experiment stations. The press bulletins of the circular series are intended not only for newspapers but for distribution to other parties interested. The annual report is merely an administrative document. Thus far, 61 regular bulletins and 12 annual reports have been issued. The mailing list, consisting of 7,000 addresses, is kept on printed galley sheets.

The botanist, Prof. Charles E. Bessey, Ph. D., LL. D., is the author of a text-book of "Botany," "The Essentials of Botany," and "Elementary Botanical Exercises." Prof. Lawrence Bruner, entomologist, is the author of "A Preliminary Introduction to Entomology," and the investigator of animal diseases, Prof. A. T. Peters, has translated F. Fischoeder's "Leitfaden der practischen Fleischbeschau."

The correspondence amounts to about 10,000 letters a year. Station officers take part in farmers' institute work generally, and station workers also appear frequently at meetings of the various agricultural associations of the State.

GENERAL RESULTS OF WORK.

The efforts of the Nebraska Station to promote the growing of winter instead of spring wheat have been one of the important factors in putting this State among the foremost wheat-growing regions in the United States. The investigations regarding subsoiling and other methods for conserving soil moisture have done much to increase the average annual yield of maize and other crops. The promotion of the introduction of alfalfa, brome grass, and other forage plants adapted to the semiarid region has been a great aid to the extension

of agriculture in the State. The thorough work on sugar beets has not only caused the successful inauguration of the manufacture of beet sugar in the State, but has also done much to promote interest in this matter on a rational basis in other States. The efforts to combat the chinch bug and codling moth have been so far successful as to have saved the farmers of the State from much financial loss. The investigations on the prevention of hog cholera, and more recently of blackleg, partly in cooperation with the United States Department of Agriculture, have shown that the new treatments may be utilized on a wide scale with very great reduction of the losses which now annually amount to millions of dollars in Nebraska alone.

NEVADA.

Nevada Agricultural Experiment Station, *Reno.*

Department of Nevada State University.

GOVERNING BOARD.

J. N. Evans (*President*), *Reno;* W. E. F. Deal, *Virginia City;* H. S. Starrett, *Battle Mountain.*

STATION STAFF.

Joseph E. Stubbs, M. A., D. D., *President of the University and Director.*

Fred. H. Hillman, M. S., *Entomologist and Botanist.*

Ransom H. McDowell, B. S., *Agriculturist and Horticulturist.*

Nathaniel E. Wilson, M. S., *Chemist.*

Walter McN. Miller, M. D., *Bacteriologist and Pathologist.*

Samuel B. Doten, *Meteorologist and Climatologist.*

Theodore Clark, *Foreman of Farm.*

Hannah K. Clapp, M. A., *Librarian.*

HISTORY.

The Nevada Station is located in an irrigated valley in the western part of the State. The surface of the State consists of mountains and elevated valleys. The general elevation is about 4,000 feet, and the mountains rise above this, in some cases reaching a height of over 10,000 feet. The winters are comparatively mild and the summers comparatively warm. The precipitation is scanty, the annual average being about 6.44 inches. Irrigation is essential to successful agriculture. The soil in the valleys is fertile and quite productive where sufficient water can be obtained and there is not too much alkali. The principal crops are alfalfa, barley, wheat, and potatoes. There are large areas of grazing lands, on which numerous sheep and cattle are produced. The State is for the most part a treeless region. Mining, especially of gold, silver, and copper, is the principal industry. Agriculture has been practiced for about thirty years and is confined to limited areas. Nevada was admitted to the Union in 1864. The university with which the station is connected was established in 1886, and is giving much attention to industrial and scientific instruction.

FIG. 1.—NEVADA STATION—LABORATORY BUILDING.

FIG. 2.—NEVADA STATION—MORRILL HALL, USED BY UNIVERSITY AND STATION.

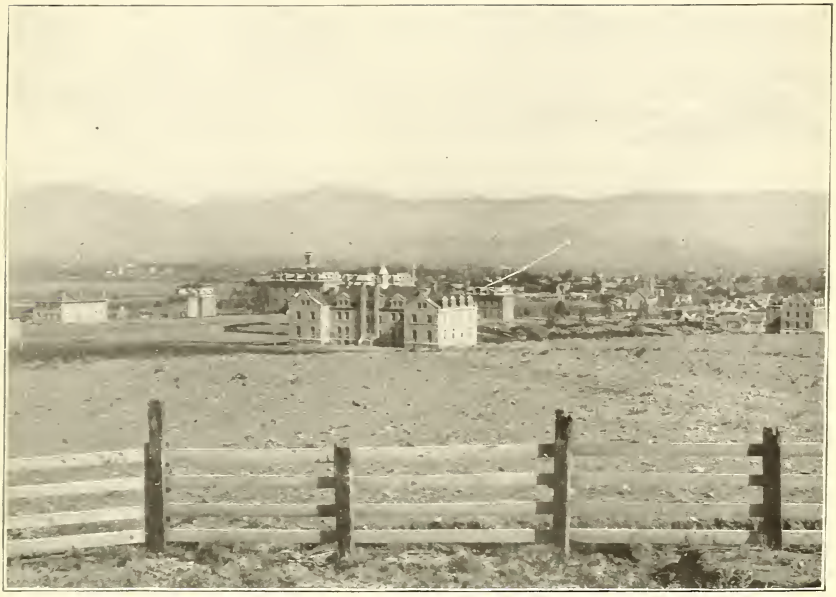


FIG. 1.—NEVADA STATION—BUILDINGS AND GROUNDS OF UNIVERSITY AND STATION.

FIG. 2.—NEVADA STATION—IRRIGATION DITCH.

The Nevada Agricultural Experiment Station was organized as a department of the Nevada State University under the act of Congress in December, 1887, with Prof. LeRoy D. Brown, president of the university, as director. He was succeeded in 1890 by Prof. S. A. Jones, Ph. D., who was in turn succeeded in 1894 by the present incumbent. When the station was organized no land was provided for its exclusive use. Consequently the experimental work in agriculture and horticulture has been done on a piece of rented land 2 miles from the university. The buildings erected upon this land were of temporary construction. The distinctive efforts of the station have been given to experimental work in general agriculture, with a view to encouraging the cultivation of a greater variety of farm crops upon the ranches in the fertile valleys of the State.

In April, 1899, a new station farm, comprising 60 acres of choice land, with 90 inches of water, located near to the university campus, came into the possession of the station by gift of the people of the county in which the station is located. The acquisition of this farm opens the way for the station to advance its work upon new and broader lines. Divisions of animal industry and irrigation will be established at an early day. The station will undertake to meet the requirements of the stock industry of the State, and will further carry on investigations of the waters and water rights of the State, with the laws pertaining thereto.

ORGANIZATION.

The board of control of the station is the board of regents of the university, which consists of three members elected at a general election, two for a long term of four years and one for a short term of two years. Regular meetings are held four times a year and special meetings as often as desired. Members receive no compensation for their services but are allowed actual expenses in attending meetings.

The staff consists of the president of the university (who is also director), entomologist and botanist, agriculturist and horticulturist, chemist, bacteriologist and pathologist, meteorologist and climatologist, farm foreman, and librarian, appointed by the director and confirmed by the board of control. Tenure of office is conditional upon satisfactory service. The duties of the director are administrative.

EQUIPMENT.

The principal station building is the laboratory building (Pl. LXXXIX, fig. 1), which consists of a main part, 30 by 40 feet, containing 11 rooms, and an annex, 20½ by 30½ feet. The main building contains the chemical laboratory, botanical laboratory, rooms of the division of agriculture, office of the meteorologist, and one lecture room. The annex contains the bacteriological laboratory and the

station library. Morrill Hall, one of the university buildings used to some extent by the station, is shown in Pl. LXXXIX, fig. 2. A general view of the university and station buildings and grounds is given in Pl. XC, fig. 1. Upon the farm are an implement house and a seed house. A stock barn and a residence for the farm foreman are in course of erection.

The rented land which has been in use by the station for the past ten years has a total area of 29.8 acres. The soil is largely sand, with considerable gravel and a small amount of clay. The experiment plats on this farm consist of half-acre, fourth-acre, and smaller plats. They were surveyed in 1891, and are well laid out with driveways and foot-paths. Samples of soil from the plats have been analyzed.

The station has 4 horses used for work on the experiment plats, and a few head of cattle used in experimental feeding. The cattle are not maintained as a permanent herd, but individual animals are bought from time to time as needed for the purposes of special experiments.

The collections of specimens in the agricultural division comprise 70 varieties of miscellaneous grains, samples of seeds and of straw in bundles, different kinds of grasses in bundles, and a collection of photographs illustrating breeds of cattle, horses, and sheep. In the chemical division there are 130 soil samples, representing the typical soils of the State, and miscellaneous photographs of stock and sugar beets. In the botanical and entomological division there are between 1,000 and 2,000 specimens of insects, illustrating the general economic fauna; between 2,000 and 3,000 specimens of plants, representing the local flora, and special collections of native forage plants in bundles. There are also under the charge of this division 35 plats of growing native forage plants. The station library contains about 1,000 volumes, besides pamphlets. Station workers also have access to the general university library.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	522.25
Balance on hand June 30, 1898	56.25
Total	15,578.50

LINES OF WORK.

The station has no inspection duties. The State is located in the arid region, and agriculture is thus far an industry of secondary importance. The work of the station is consequently of a pioneer

nature and has had to do principally with studies of natural conditions and the introduction of agriculture. There is now in progress a survey of the soils and waters of the State. When this survey is completed it is the intention to prepare a soil map which shall show as far as possible the location and extent of types of soils. The botanist has given attention to the native forage plants and the chemist has made fodder analyses of some of them. A preliminary catalogue has been prepared of the flora of the Truckee Valley. Considerable attention has been given to testing the adaptability of different parts of the State to the culture of the sugar beet. Systematic meteorological observations have been made since the organization of the station.

In the division of agriculture and horticulture the experimental growing of field crops has been a leading feature. The subject of irrigation is necessarily of primary importance. (An irrigation ditch is shown in Pl. XC, fig. 2). Field experiments have been carried on with wheat, oats, barley, maize, potatoes, tobacco, peas, sorghum, flax, hemp, and a number of garden vegetables, and variety tests have been made with some of these. For three years experimental work in the culture of hops has been in progress to test the suitability of the State to the production of this crop. Chemical analyses have been reported of alfalfa, maize fodder, wheat, buckwheat, and beet leaves. The entomologist and botanist has made experiments with arsenites as a treatment for the apple worm, and studies have been made on the early life history of the codling moth and on other injurious insects, among them an insect enemy of the elm new to the State. Notes have been made on the more common weeds, and some of them have received more careful attention, among them dodder, parasitic on alfalfa. A very complete collection has been made of the seeds of domestic weeds, and the chemist has studied certain plants believed to be poisonous to stock with a view to isolating the active principle of each.

DISSEMINATION OF INFORMATION.

The station has issued 43 bulletins, 27 press bulletins, 1 special bulletin, and 11 annual reports. The annual report is merely an administrative document. The mailing list contains about 2,000 names. The correspondence amounts to about 500 letters a year. An exhibit is made at the State fair annually.

GENERAL RESULTS OF WORK.

The Nevada Station has done considerable useful work in the nature of an agricultural survey of the State, and has aided in the development of the live-stock industry through the combination of pasturing on the ranges with the feeding of alfalfa and other forage crops grown under irrigation in the valleys.

NEW HAMPSHIRE.

New Hampshire College Agricultural Experiment Station, *Durham.*.

Department of New Hampshire College of Agriculture and the Mechanic Arts.

GOVERNING BOARD.

Board of Control: John G. Tallant (*Chairman*), *Pembroke;* George A. Wason, *New Boston;* Charles W. Stone, M. A. (*Secretary*), *Andover;* Chas. S. Murkland (*President*), *Durham;* Henry W. Keyes, M. A., *Haverhill.*

STATION STAFF.

Chas. S. Murkland, M. A., Ph. D., *President of the College and Acting Director.*
Fred W. Morse, B. S., *Vice-Director; Chemist.*
Frank Wm. Rane, B. Agr., M. S., *Horticulturist.*
Charles W. Burkett, M. S., *Agriculturist.*
Charles H. Pettee, M. A., C. E., *Meteorologist.*
Herbert H. Lamson, M. D., *Bacteriologist.*
Frederick S. Johnston, B. S., *Associate Agriculturist.*
Clarence M. Weed, D. Sc., *Entomologist.*
Harry P. Richardson, B. S., *Assistant Agriculturist.*
Harry A. Clark, B. S., *Assistant Chemist.*
William F. Fiske, *Assistant Entomologist.*
Roscoe H. Shaw, B. S., *Assistant Chemist.*
Clarence W. Waid, B. S., *Assistant Horticulturist.*
Frederick C. Keith, *Clerk.*

HISTORY.

The New Hampshire Station is located near the seacoast in the eastern part of the State. The surface of the State is generally hilly and mountainous, containing the White Mountain region, the highest peak of which (Mount Washington) has an elevation of over 6,000 feet. About half the State is covered with forests. The cultivated areas are limited in extent and there is much pasture land. The soil generally is not of high fertility and fertilizers in considerable amounts are required. The winters are long and severe and the summers brief and cool. The average annual rainfall is about 40 inches. Hay, potatoes, oats, and maize are the principal crops. There are considerable numbers of milch cows, sheep, cattle, horses, and swine in the State. Dairying is an important industry. Agriculture has been practiced for over two hundred years. The college with which the station is connected is a new institution and is developing along technical and scientific lines.

Previous to the establishment of the New Hampshire College Agricultural Experiment Station experimental work with field crops, fertilizers, cattle food, and farm implements had been carried on at Hanover by the college of agriculture since 1876. The results of these experiments were published annually in the report of the board of trustees. The organization of the New Hampshire College Agricultural Experiment Station as a distinct department of the New Hampshire College of Agriculture and Mechanic Arts was begun, in

accordance with the act of Congress, by the appointment of a director, Prof. G. H. Whitcher, February 22, 1888, and was completed April 21 of the same year, when divisions of agriculture, dairy husbandry, chemistry, microscopy, and meteorology were established. The college farm was then transferred to the station, and rooms for laboratories were provided in the college buildings. A suitable station building was begun in June and finished before the close of the year. The work of the first two years was confined almost wholly to the problems relating to the dairy industry, especially the influence of food on the production of milk and butter. In 1890 the study of fungus diseases of plants was taken up, and in January of the same year an entomologist was added to the staff.

April 10, 1891 the legislature voted to remove the college and experiment station from Hanover to Durham. This action was occasioned by the fact that a citizen of Durham had bequeathed to the State a large estate on which to found an agricultural college in his native town. Building was begun in Durham in October, 1891, but the removal of the station was not completed until the end of 1892. November 1, 1894, the station staff was reorganized. Professor Whitcher resigned the directorship, and the division of dairy husbandry was discontinued. The president of the college, Prof. Charles S. Murkland, was made acting director, and has been continued in the office until the present time. May 1, 1896, the chemist, Prof. F. W. Morse, was appointed vice-director and a portion of the director's duties assigned to him. November 4, 1894, the station suffered the loss of its barn by fire, and a few weeks later it was obliged to slaughter most of its dairy herd on account of tuberculosis. In 1895 the duties of the agriculturist were extended to include investigations in horticulture, and the double division was thus continued until September, 1898, when two distinct divisions were created. From the organization of the station until November, 1897, the college farm was managed entirely by the station, but since that time the station has been responsible for only such parts of it as are needed in experiments.

ORGANIZATION.

The governing board of the experiment station is a standing committee of 5 members of the board of trustees of the college, known as the board of control. When once chosen they have always held their positions as long as they remained on the superior board, two of them having thus served since the organization of the station in 1888. Their policy has always been to give the director the widest possible latitude in the management of the station and to allow him to take the initiative in outlining plans of work. Meetings are held quarterly. The compensation of members is $3 per day and mileage, paid out of college funds.

The staff consists of the president of the college (who is also acting director), vice-director (who is also chemist), horticulturist, agriculturist, meteorologist, bacteriologist, entomologist, associate agriculturist, assistant agriculturist, two assistant chemists, assistant entomologist, assistant horticulturist, and clerk. All members are appointed by the board of control and their tenure of office is at the discretion of the board. There is a station council, which is made up of the acting director and heads of divisions. It holds semimonthly meetings for discussion of station affairs, but the directing officer is not bound by any action that may be taken. The acting director has general management of station affairs, and is responsible to the board of control. The vice-director has the immediate oversight of experimental work subject to the acting director.

EQUIPMENT.

The station occupies exclusively a two-story brick structure (Pl. XCI, fig. 1) 48 by 70 feet, known as Nesmith Hall, in which are located the offices of the vice-director, agriculturist, horticulturist, and assistants, and the laboratories of the chemist and bacteriologist. The station has the use of the college barn (Pl. XCI, fig. 2) and dairy building and occupies most of the space in the two greenhouses, the larger one of which (Pl. XCII, fig. 1) consists of a frame structure containing a potting room and photographic room, to which is attached a forcing house divided into three sections, each 33 by 25 feet. The smaller greenhouse contains an insectary. Both houses are heated by steam from a central steam plant. The temperature in each apartment is controlled automatically. (Pl. XCII, fig. 2, gives a general view of the station buildings and grounds.)

The station makes use of such portions of the college farm as are needed in experimental work. The land is not well adapted to plat experiments and only about 5 acres are thus laid out. These are in field and garden crops and small fruits.

For experimental purposes the station uses the college live stock, which consists of 58 head of cattle, 5 horses, and 70 swine, reimbursing the college for actual expenses. The museum contains about 2,000 specimens of New Hampshire flowering plants, 10,000 specimens of New Hampshire insects, 1,000 specimens of fungi of economic importance, seeds of the principal field and garden crops, and the collection of weed seeds sent out by the United States Department of Agriculture. There is a collection of 500 photographs and a considerable number of photo-micrographs. The station library contains about 2,400 volumes. Station workers also have access to the college library. The chemist has devised a special oven for drying substances in an atmosphere of hydrogen at the temperature of boiling water.

FIG. 1.—NEW HAMPSHIRE STATION—MAIN BUILDING.

FIG. 2.—NEW HAMPSHIRE STATION—BARN.

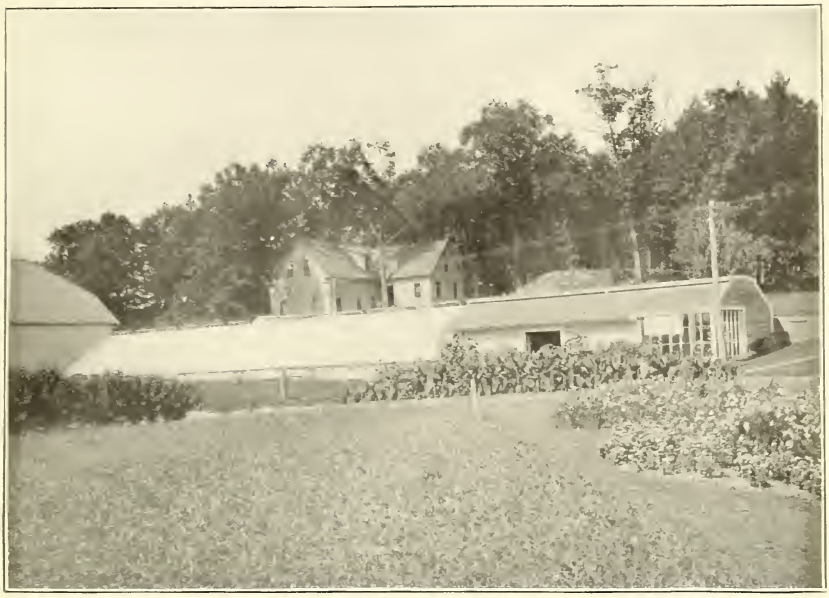


FIG. 1.—NEW HAMPSHIRE STATION—GREENHOUSE.

FIG. 2.—NEW HAMPSHIRE STATION—BUILDINGS AND GROUNDS.

FIG. 1.—NEW HAMPSHIRE STATION—FIELD EXPERIMENT WITH SOY BEANS.

FIG. 2.—NEW HAMPSHIRE STATION—LETTUCE UNDER GLASS.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and from fees for fertilizer analyses. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	656.25
Balance on hand July 1, 1898	340.55
Total	15,996.80

LINES OF WORK.

The station cooperates with the State board of agriculture in the inspection of fertilizers and the enforcement of the laws against oleomargarine. It does the necessary chemical work at cost, which is about $600 a year.

The investigations of the New Hampshire Station have been mainly along lines of dairy farming and dairying, studies in maple sugar production, experimental and demonstration work in road making and maintenance, horticulture, entomology, and plant diseases. At the organization of the station it was determined to make investigations in the interest of the dairy industry of first importance, and thus they were until the station was reorganized, November 1, 1894, when the division of dairy husbandry was discontinued. The investigations in dairy farming were mainly on the effects of food stuffs on composition and yield of milk and composition of butter fat, together with investigations on silage. Studies were made on the effect of food upon milk, as determined by breed and individual characteristics, by changes of food, and by other changes aside from food. A series of experiments was carried on which was designed primarily to test the relative value of a ration containing a large amount of albuminoids as against one containing a large amount of starch. Experiments were also carried on to determine the effect of some of the coarse fodders upon the quantity and quality of milk and upon the resulting butter product. Similar experiments were made to determine the effects of different oils upon quantity and quality of milk and butter. Tests have been made of various forage crops (one of which is shown in Pl. XCIII, fig. 1). Investigations were made on methods of production and storage of silage, and its bacteriology and chemistry. Maize was analyzed at different stages of growth to determine at what stage it may be cut most economically for silage. The chemical composition of certain other crops has also been studied. Experiments were made to determine the most economical fertilizers for maize grown for silage. Other fertilizer experiments were made to test the requirements of New Hampshire soils in general and to determine the effect of differ-

ent fertilizer constituents on various field crops. Some demonstration work has been done in rotation of crops and methods of tillage.

The work in dairying consisted principally of milk testing at creameries and tests of dairy apparatus. In connection with it tests were made of the effect of skim milk on the digestibility of rations in pig feeding. Other experiments in pig feeding were made to demonstrate the effect of proper rations on growth.

In the horticultural division methods of spraying have received attention, and comparisons have been made of formulas and machinery. The chemist has analyzed samples of several insecticides. The horticulturist has shown that the forcing of sweet corn and pole beans under glass is practicable. The forcing of lettuce (Pl. XCIII, fig. 2) has received attention. Tests have been made from an economic standpoint of the practicability of irrigation in the garden and orchard in a humid climate. Variety tests have been carried on with different fruits and vegetables, and general studies have been made in the growing of tomatoes, strawberries, sweet corn, and muskmelons in the State, together with experiments in hybridizing and studies in classification of the muskmelons. The potato, which is a crop of much importance in the State, has been studied with reference to varieties, fertilizers, and diseases. Experiments have been carried on in the treatment of various diseases of fruit.

In the division of entomology observations have been made on the habits and life histories of various insects as they occur under local conditions, and experiments have been conducted in methods of repression. Among the insects studied may be mentioned the horn fly, flea-beetle, white maggot, tussock moth, sugar-maple borer, codling moth, apple maggot, tent caterpillar, army worm, cankerworm, and forest tent caterpillar and spiny caterpillar. The last-named has been found to produce but one brood a year, instead of two as commonly stated. Observations on the feeding habits of the chipping sparrow and the chickadee show that they assist the farmer by consuming a large number of injurious insects, and therefore should be protected.

For several years investigations of maple sap, sirup, and sugar were carried on. Determinations were made of the variation in composition and flow of sap during the season and of the differences in sap from the outer and the inner layers of wood. Observations were made on the variations in quality and composition of sap resulting from tapping the tree on different sides. Numerous determinations were made of the variation in percentage of sugar in sap under different conditions. The station has carried on experimental work to some extent in grading and surfacing highways. In the course of this work a simple level was devised which is intended to take the place of a surveyor's level in ordinary work on country roads.

The station has carried on some of its work through cooperative experiments. These have comprised a limited number of fertilizer

experiments, a large number of variety tests of potatoes conducted in all sections of the State, and spraying experiments in the vicinity of the station.

DISSEMINATION OF INFORMATION.

The station has issued 68 regular bulletins, 2 special bulletins describing weather signals, 46 press bulletins, and 10 annual reports. The first six annual reports were issued as parts of the college report and contained all the bulletins of the year, a financial statement, and reports of sundry investigations. Beginning with 1895, the annual reports have been issued as bulletins in the regular series and have contained, besides administrative matter, sundry short articles.

The station entomologist, Prof. Clarence M. Weed, D. Sc., is the author of "Insects and Insecticides," "A Practical Manual Concerning Noxious Insects and Methods of Preventing Their Injuries," "Fungi and Fungicides," "A Practical Manual Concerning the Fungus Diseases of Cultivated Plants and Means of Preventing Their Ravages," "Spraying Crops: Why, When, and How," "Ten New England Blossoms and Their Insect Visitors," "Stories of Insect Life," "Seed Travelers," "Studies of the Methods of Dispersal of Various Common Seeds," and "Life Histories of American Insects." The entomologist is the editor of "The Insect World," and "A Reading Book of Entomology." Jointly with Miss Mary E. Murtfeldt, he is the author of "Stories of Insect Life."

The mailing list contains about 9,700 names. It is divided into sublists for New Hampshire, other States, foreign countries, press, public institutions, and State officials. The New Hampshire list is arranged by post-offices; all others in alphabetical order of names. The different sublists are kept in self-binding covers to facilitate the correction of the list by removing or adding new sheets. The station correspondence amounts to about 700 letters a year. Members of the staff attend institutes whenever requested, cooperating with the board of agriculture in nearly all its meetings. The agriculturist and horticulturist serve as judges of live stock and garden products at the State and several county fairs.

GENERAL RESULTS OF WORK.

The New Hampshire Station has done considerable useful work for the promotion of the dairy industry of the State by demonstrating the value of balanced rations in milk production, the best varieties of maize for silage, and the effects of various concentrated feeds on the quality of butter. It has also done much to introduce the use of separators in creameries and the payment for milk on the basis of its fat content. The investigations of this station on injurious insects and the means for their repression have had important practical results.

NEW JERSEY.

New Jersey State Agricultural Experiment Station, *New Brunswick.*

At Rutgers College.

GOVERNING BOARD.

Board of Managers: Governor Foster M. Voorhees, *Trenton;* Austin Scott, *New Brunswick;* Edward B. Voorhees, *New Brunswick;* Theo. F. D. Baker, *Bridgeton;* Elwood Evans, *Haddonfield;* Samuel B. Ketcham (*Vice-President*), *Pennington;* John E. Darnell, *Masonville;* David D. Denise, *Freehold;* James Neilson, *New Brunswick;* George Fritts, *Pattonburg;* Elias N. Millen, *Deckertown;* Samuel R. Demarest, jr. (*President*), *Hackensack;* George H. Blakeley, *Paterson;* L. H. Muller, *195 Ferry street, Newark;* C. L. Jones, *8 Milford arenue, Newark;* Rynier J. Wortendyke, *76 Montgomery street, Jersey City;* George E. De Camp, *Roseland;* George W. Doty, *Union;* John B. Williams, *New Durham.*

STATION STAFF.

Edward B. Voorhees, M. A., *Director.*
Irving S. Upson, M. A., *Chief Clerk; Secretary and Treasurer of Board of Managers.*
Louis A. Voorhees, M. A., *Chief Chemist.*
John P. Street, M. S., *Chemist.*
Alva T. Jordan, B. S., *Assistant Horticulturist.*
Clarence B. Lane, B. S., *Assistant in Dairy Husbandry.*
Mary A. Whitaker, *Stenographer and Typewriter.*
Vincent J. Carberry, *Laboratory Assistant.*

New Jersey Agricultural College Experiment Station, *New Brunswick.*

Department of Rutgers College.

GOVERNING BOARD.

Board of Trustees—Executive Committee: Austin Scott (*Chairman*), *New Brunswick;* George C. Ludlow, *New Brunswick;* Henry W. Bookstaver, *14 East Sixty-seventh street, New York City;* Henry R. Baldwin, *New Brunswick;* James Neilson, *New Brunswick;* Paul Cook, *Troy, N. Y.*

STATION STAFF.

Austin Scott, Ph. D., LL. D., *President of the College.*
Edward B. Voorhees, M. A., *Director.*
Julius Nelson, Ph. D., *Biologist.*
Byron D. Halsted, D. Sc., *Botanist and Horticulturist.*
John B. Smith, D. Sc., *Entomologist.*
James A. Kelsey, M. S., *Field Assistant.*
Irving S. Upson, M. A., *Disbursing Clerk and Librarian.*
Augusta E. Meske, *Stenographer and Typewriter.*

HISTORY.

The New Jersey Experiment Stations are located in the north-central portion of the State between the hilly region which constitutes the northern third of the State and the southern plain between the Delaware River and the Atlantic Ocean. "The soil is a sandy loam, easily tilled, and lighter in the southern than in the middle and northern parts of the State." About one-third of the State is covered with forests. The average annual temperature is about 52° F. and the

rainfall about 48 inches. Agriculture has been practiced in the State for over two hundred years. The principal crops are hay, maize, potatoes, oats, and wheat. Large numbers of milch cows, horses, and swine are kept in the State. With the great cities of New York and Philadelphia lying just outside the State and numerous manufacturing cities and towns within its own borders, dairying, market gardening, fruit growing, and floriculture have naturally been greatly developed. The growing of seeds is also an important industry. The college with which the stations are connected is one of the older institutions for higher education in the United States, and on a classical basis has in recent years developed strong scientific courses.

In New Jersey there are two independent stations, one maintained entirely by the State, the other mainly by the national appropriation. The State institution, the New Jersey State Agricultural Experiment Station, was organized in connection with the State agricultural college in April, 1880, in accordance with an act of the State legislature, and Dr. G. H. Cook was elected director. The New Jersey Agricultural College Experiment Station was organized early in 1888 as a department of the agricultural college in accordance with the act of Congress, also under the directorship of Dr. Cook. On organization of the College Station the lines of experiment were divided, the chemical work being assigned to the State Station, and entomology, botany and horticulture, biology, and chemical geology to the College Station, the policy being that the work of each station should supplement that of the other.

The annual appropriation of $5,000 to the State Station, provided for in the original enactment, was increased in 1881 to $8,000, in 1894 to $11,000, and in 1895 to $15,000. During this period appropriations have been made for special purposes, as, for example, $1,500 in 1894 for printing bulletins and collecting statistics of fruits; in 1896, $1,000 for special investigations of the San José scale, and in 1899 an appropriation of $1,000 for the publication of the bulletins of the station. The State legislature of 1888 also appropriated $30,000 for the erection of a laboratory building, which was ready for occupancy early in the spring of 1889.

On the death of Dr. G. H. Cook in 1889, Dr. M. E. Gates, president of the college, was elected acting director of both the State and college stations. He served about one year, when Mr. James Neilson, a prominent member of the board, was elected acting director of both institutions, serving until April, 1893. At that time Prof. Edward B. Voorhees, chemist of the State Station, was made director of the State Station, and Dr. Austin Scott, president of the State agricultural college, was elected director of the College Station. In February, 1897, Professor Voorhees was elected director of the College Station also.

The two stations being located at the same college and closely united in their organization, equipment, and work, they can best be described together.

ORGANIZATION.

The State Station is controlled by a board of managers, consisting of the governor of the State and the board of visitors of the State agricultural college, appointed by him for a term of two years, and composed of two members from each Congressional district, together with the president and professor of agriculture of the college. This board holds a meeting at least once a year to act upon the report of the director and upon such recommendations as he may make. The policy has been to relegate the direction and management of the work of the station to the director. The officers consist of a president, vice-president, secretary, and treasurer. Members of the board are reimbursed for actual expenses.

The College Station is under the control of the board of trustees of the agricultural college. The management of the station is delegated to an executive committee of the board consisting of seven members. This committee meets at least twice each year, and members receive their actual expenses. This committee supervises in a general way the work of the station.

The staff of the State Station consists of a director, chief clerk (who serves also as secretary and treasurer of the board of managers), chief chemist, chemist, assistant horticulturist, assistant in dairy husbandry, stenographer and typewriter, and laboratory assistant, all appointed by the director.

The staff of the College Station consists of the president of the college, director, biologist, botanist and horticulturist, entomologist, field assistant, disbursing clerk and librarian, and stenographer and typewriter, appointed by the board of control on the recommendation of the director. No removals are made from either staff except for cause. The director indicates to heads of divisions the lines of work they are expected to carry out.

EQUIPMENT.

The station buildings comprise a laboratory building, greenhouses, and dairy house. The laboratory (Pl. XCIV, fig. 1) is a three-story building, 50 by 100 feet, with basement and attic. The basement is of rough stone, the superstructure of brick. It was planned especially for the stations, is well equipped for the lines of work carried on, and provides ample accommodations for offices and laboratories of the chemist, botanist (Pl. XCIV, fig. 2), entomologist (Pl. XCV, fig. 1), biologist, geologist, and other specialists who may be engaged in experimental work. The stations make use of the college barns

FIG. 1.—NEW JERSEY STATIONS—LABORATORY BUILDING.

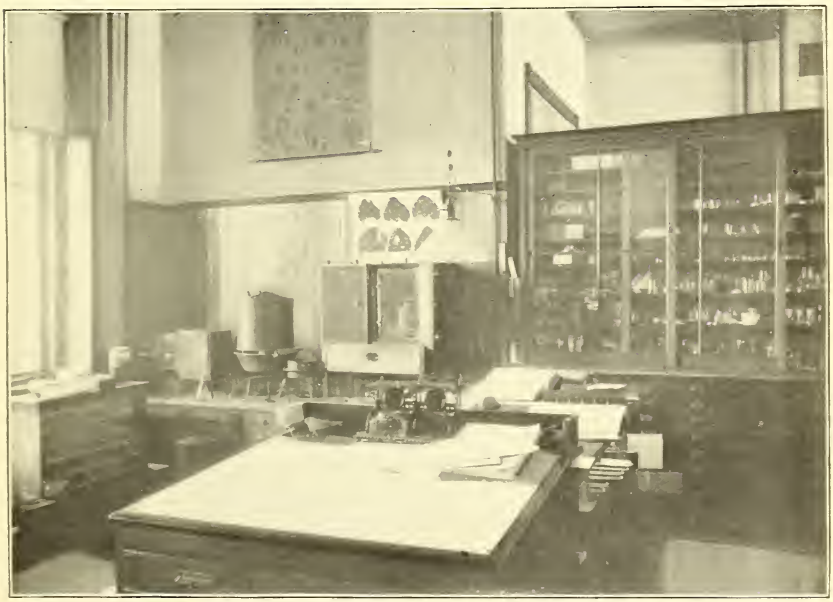


FIG. 2.—NEW JERSEY STATIONS—BOTANICAL LABORATORY.

FG. 1.—NEW JERSEY STATIONS—ENTOMOLOGICAL LABORATORY.

FIG. 2.—NEW JERSEY STATIONS—BARNS.

FIG. 1.—NEW JERSEY STATIONS—ROUND SILO.

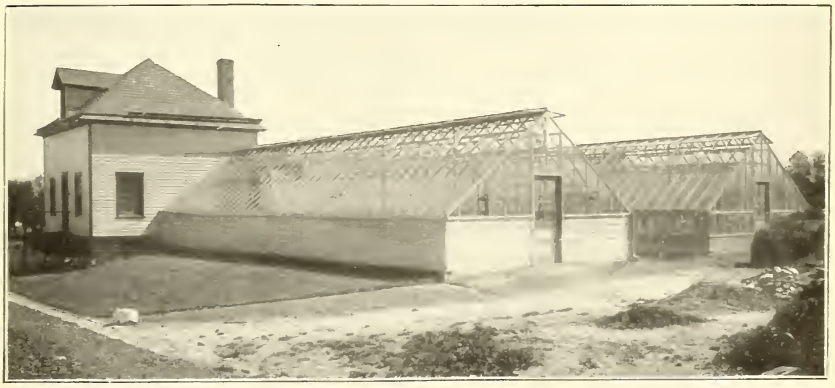


FIG. 2.—NEW JERSEY STATIONS—FORCING HOUSES.

(Pl. XCV, fig. 2). The silo is shown in Pl. XCVI, fig. 1, and the forcing-houses of the greenhouse plant in Pl. XCVI, fig. 2.

Five acres of land are used in field experiments with fruits and vegetables and two acres in experiments with plant diseases. These areas were tranferred by the college authorities to the authorities of the stations in 1895, no compensation being paid by the stations. In addition the college authorities transferred to the stations the remainder of the farm (about 85 acres) in April, 1896. This land is used for experiments in dairy farming. The business of the farm is kept as a separate account and the income is sufficient to pay running expenses and contribute to the cost of experiments.

The stations own but little live stock. They make use, however, of the college herd of about 35 cows in their experimental work in dairy farming. Permanent herds are maintained, though individual animals are purchased from time to time for use in special experiments.

The collection of specimens in the botanical division consists of a nearly complete set of the vascular plants of the State represented by 7,000 specimens, a catalogued mycological herbarium of about 40,000 specimens, and a set of the weeds of the world with the seeds of several hundred kinds arranged in cases. The mycological herbarium contains, besides the better known sets of European fungi, complete sets of Ellis and Everhart's "North American Fungi," Seymour and Earle's "Economic Fungi," and Arthur and Holway's "Uredineæ Exsiccatæ et Icones." The collection in the division of entomology is in two parts—a systematic series and an economic series. In the systematic series are over 4,000 species, represented by at least 25,000 specimens. The economic series is very complete, and represents all of the usual injurious insects occurring in the State, in all stages, with specimens of the injury caused by them. Each subject studied is illustrated as far as possible or necessary by microscopic slides, and of these between 2,500 and 2,600 have been accumulated. The division has also nearly 900 lantern slides, illustrating a great range of subjects in economic entomology. Station workers have access to the college museum, which is very well supplied with mineralogical specimens. The library contains 2,855 works on agriculture and related sciences, besides all the leading American and foreign scientific journals, and the college library contains 60,000 volumes.

The stations are well equipped with apparatus, a number of pieces of which have been devised by station officers. These comprise an apparatus for drying in hydrogen, an apparatus for fat extraction, a bath for the digestion of phosphates in ammonium citrates, pipettes of special volume for the simplification of calculations, and a device for the use of compressed air in transferring wash solutions. The apparatus for drying in hydrogen may be briefly described as a double-walled water oven of copper, opening at the top with a heavy brass lid, which

screws down upon a rubber gasket, with the inner wall removable from the outer for the more convenient opening and closing of the apparatus. A special feature of the apparatus for fat extraction is the tapering form of the inner tubes, whereby the rising of the substance during the extraction is effectually prevented. In the division of biology a number of pieces of apparatus have been devised, chiefly for the isolation and study of the bacteria of milk. Among these are a strainer bulb for delivering germ-free air, an apparatus for delivering measured quantities of sterile liquid without contaminating the supply stock, a pipette for transferring culture media without contamination in preparing plate cultures and for "tubing" culture media, a simple thermometer not affected by variations in gas pressure, etc., and a tube carrier for hand centrifuge. The botanist is the inventor of the Solandi process of photography.

FINANCIAL SUPPORT.

The income of the State Station is derived from an appropriation by the State for maintenance. The income of the College Station is derived from the national fund.

The State also makes an appropriation of $1,000 a year which is not included in this statement, for the benefit of the State Station to be spent in printing. The income of the stations during the last fiscal year was as follows:

State Station, State appropriations	$15,000.00
College Station, United States appropriation	15,000.00
Total	30,000.00

LINES OF WORK.

The State Station is charged with the inspection of commercial fertilizers. The expenses of this work are met by special State appropriation. The station devotes considerable time and attention to analysis of standard fertilizing materials, waste products, and special fertilizer mixtures. The primary purpose of this work is to inform the farmers of their composition and the relative cost of the constituents in them and in regular brands of commercial fertilizers. The New Jersey stations were the first American stations to advocate the home mixing of fertilizers. Inspection of nursery stock has recently been added to the duties of the entomologist. At various times an unofficial inspection has been made of the feeding stuffs of the State for the purpose of learning the extent of the distribution of these products, to obtain definite information concerning the variations in the composition of genuine products, to discover whether any adulterations were practiced, and to point out the advantages of a guaranteed composition of such feeds.

The scientific investigations of the stations have been mainly in the

interests of dairy husbandry and horticulture, which are the principal branches of agriculture in the State. A division of horticulture was not organized as such until 1895, although investigations in the interest of this industry along the lines of plant diseases and entomology have received a great deal of attention since the organization of the College Station. Immediately upon the organization of the horticultural division it set about making a statistical survey of the fruit interests of the State preliminary to determining upon lines of experimental work. Field experiments have been quite extensively engaged in with the primary object of studying the fertilizer requirements of fruits and berries, the influence of different kinds and forms of fertilizer materials upon the yield and the quality of the product, and the advantages or disadvantages of different methods of cultivation and management. A number of vegetables are also being studied to determine their fertilizer requirements and the quality and relative earliness of each. In the greenhouse, soils, fertilizers, cultural methods, and subirrigation are receiving attention. In cooperation with the United States Department of Agriculture irrigation in the southern part of the State has been made a subject of investigation. Experiments have been made showing the need of irrigation and the practicability of employing it on certain garden crops.

The entomologist has made important original investigations on the peach borer, strawberry roller, asparagus beetle, rose bug, sinuate pear borer, certain katydids, the horn fly, potato-stalk borer, pear midge, and tulip soft scale. Monographic accounts have been published of the insects attacking the cranberry, blackberry, cultivated Cucurbitaceæ, sweet potato, city shade trees, and a general history of plant lice with methods of treatment has been prepared. The life history of the squash bug, apple-plant louse, and a number of the more usual garden pests have been worked out, and means of repression suggested. Experiments have been carried on to ascertain if possible the reasons for the resistance of wireworms to insecticides. The occurrence of brood XVII of the periodical cicada in certain parts of the State in 1898 afforded opportunity for studying the exact distribution of the insect in New Jersey, and a map was prepared showing this graphically. An extensive study has been made of the San José scale and its natural enemies. These were found to be ineffective against it in New Jersey, but it was shown that, under proper conditions, undiluted kerosene could be effectually employed. Considerable attention has been paid to the study of insecticides as such. Experiments have been made with fertilizers as insecticides; and potash, in the form of muriate or kainit, was found to be a very good remedy for the pear midge. An examination was made of the different brands of Paris green in the State, showing great differences in chemical composition. It was demonstrated that the farmer can make whale-oil soap at home equal

to the commercial article at a saving of the cost of labor at least. A study of the action of kerosene on plant life showed that it could under certain conditions be used undiluted without injury to the plants, and with great effectiveness against insects. Further experiments were made to determine the effects of crude oil and various other petroleum products on both trees and San José scale with very satisfactory results. Several kinds of mechanical protectors have been tested. Investigations were made on the durability of hydraulic cement made with skim milk, in which it was shown that this substance can be used as a preventive for apple and peach borers, even under the most unfavorable conditions of weather.

In the botanical division the most attention has been paid to investigations of diseases of the sweet potato and of greenhouse plants. It has been shown that probably the blight of the eggplant is identical in nature with one of the diseases of the sweet potato. Experiments in the treatment of the sweet potato decay have shown that sulphur or kainit may be effectively used. Among the diseases of greenhouse plants that have been studied may be mentioned a fungus disease of the violet and root galls. Field experiments have been made with various substances with a view to finding a remedy for the cranberry scald. A serious disease of the bean was shown to be due to bacteria. A common disorder of cultivated roses was found to be due chiefly to root galls and anthracnose.

The diseases of the sugar beet have been studied, and it has been shown that Bordeaux mixture will in a large measure prevent the leaf spot. Experiments in pruning and the application of manures and fertilizers for eradication of pear blight are in progress. Field and laboratory experiments have been made with the asparagus rust, and Bordeaux mixture has been shown to be an effective remedy. Experiments in the partial shading of garden crops showed that different species behave differently under the treatment. Salad plants appeared to be benefited by it. The botanist is the author, solely or jointly, of the descriptions of a number of fungi, among which may be mentioned: Black rot of sweet potato (*Ceratocystis fimbriata*), scab (*Monilochætes infuscans*), stem rot (*Nectria solani*), eggplant blight (*Phoma solani*), spinach mold (*Entyloma ellisii*), violet mold (*Zygodesmus albidus*), tomato anthracnose (*Colletotrichum nigrum*), and orchid blight (*Colletotrichum belletiæ*). The botanist has recently erected a genus of mildews (Erysiphopsis). The causes of the above and many other diseases were first worked out at this station.

Experiments have been made with different fungicides on a large number of fruits, vegetables, and ornamental plants. Bordeaux mixture was taken as a standard, with which three other compounds were compared, the lime being replaced by sulphur, potash, and ammonia, respectively. Experiments made to test the susceptibility of various plants to disease showed that they differ greatly in this respect.

A study has been made of the weeds of the State, particularly with reference to their means of dissemination, including propagation by underground parts, and a check list of the weeds of North America has been prepared. The relative aggressiveness of different weeds is being tested experimentally on a small plat. Experiments have been made with a fungus enemy of the thistle. The subject of poisonous plants has received some attention.

The work in dairy husbandry is along lines of economics of the dairy. It has had to do with the crops best suited for dairy farming, the cost of production, their relative value, rotations, and methods of preservation. Considerable attention has been paid to the more strictly business side of dairying, such as the influence of quality as represented by cleanliness, etc., upon the salability of milk and cream. A large number of feeds, fodders, and farm crops have been analyzed, among which were a number of the newer forage crops grown especially for soiling purposes.

Feeding experiments have been carried on with work horses. It was shown that the substitution of dried brewers' grains for oats, pound for pound, resulted in the saving of about 5 cents a day in cost of ration, while at the same time the weight and vigor of the animal was maintained. Comparisons of wet and dried brewers' grains as feed for milch cows have also been made.

The station has introduced the culture of crimson clover into the State. Field experiments with fertilizers on the principal crops of the State have been an important line of work. Experiments in improvement of soils by green manuring have been made on the light soils of the State with excellent results, and these were extended to include a study of crop rotations for such soils.

The biologist has made original investigations on tuberculosis. The question of what constitutes a tuberculous reaction has been studied and a revision of previous practice made in the direction of greater accuracy. Observations on the normal temperature variations in cows led to a more accurate determination of the extent to which the injection of tuberculin affects individual animals. In experiments to determine whether healthy cattle are injuriously affected by being subjected to the tuberculin test no such effect was observed. It was also shown by experiment that with cattle in the first stages of tuberculosis repeated injections of tuberculin tend to cure the disease. The prevalence of milk fever and infectious abortion in the State have been investigated. Studies have been made on the germ content of milk as found in the udder and at various stages from the time it is drawn from the cow until it is bottled.

Numerous analyses of experimental crops grown in the course of investigations on plant nutrition have been made with a view to determining with exactness the food requirements of the crops generally grown in the State on its two representative soils, the loamy and the

sandy. Experiments have been carried on with a view to determining some of the differences in the physical conditions of heavy or clay soils. Mechanical analyses have been made of a number of typical soils and the relation between coarseness of grain and fertility has been studied.

The station has always taken a prominent part in the development and improvement of chemical methods having for their object the shortening of chemical processes without lessening the accuracy of the results. Among such have been studies on methods for determining total nitrogen from nitrates and on the availability of organic nitrogen. In cooperation with the United States Department of Agriculture the station investigated the changes which occur in the composition of maize, oats, wheat, and buckwheat in breakfast foods in the various methods of preparation. Studies were made on the bread supply of a few of the larger cities of the State, the object of which was to secure information concerning the chemical composition of bread, to ascertain the relation of the weight of bread to the selling price of the loaf, and to study the changes which occur in the baking of bread and the relative cost of nutrients in bread and in flour.

For several years the attention of the biologist was devoted mainly to a study of the principles that govern successful oyster culture, with a view to the development and introduction among oyster planters of more certain methods of propagation. Studies have been made of the conditions needful for the most successful impregnation of the egg of the oyster by the sperm cells of the male in water differing in degrees of saltness and of temperature. Observations have been made on the "crystalline rod" as a parasite *nidus*, on the keeping of oysters alive in a limited amount of sea water, on the conditions of fixation and growth of spat, on the raising of spat in *claires*, and on artificial fecundation. Nearly all these lines of investigation yielded positive results, and indicated lines along which the more practical questions concerned in oyster culture might be investigated. A microscopic study of tissue changes in the oyster has been made.

DISSEMINATION OF INFORMATION.

The bulletins of both stations are issued in the same series. In the regular series 140 have been issued, and in a special series 18, lettered from A to R, inclusive. The State Station has issued 19 annual reports and the College Station 11, which, however, have been bound in the same volume since the establishment of the latter station. The reports contain a full account of all work to be reported on for the year.

The mailing list contains about 9,000 names, all of which were placed there by the personal request of persons receiving the bulletins. The director, Prof. Edward B. Voorhees, is the author of a work on "The First Principles of Agriculture" and another on "Fertilizers." The entomologist, Dr. John B. Smith, is the author of a work on

"Economic Entomology." The correspondence amounts to about 7,000 letters a year. Members of the staff take part quite commonly in farmers' meetings throughout the State.

GENERAL RESULTS OF WORK.

The New Jersey stations have taken a leading part in the establishment of fertilizer control in the United States and their work in this line in their own State has been of great advantage to the farmers. They have also made important investigations regarding the use of fertilizers, especially with plants for which intensive culture is desirable. By definitely showing the advantages of the home mixing of fertilizers they have done much to improve farm practice in this regard wherever commercial fertilizers are used in this country. By demonstrating how dairy farming in the State could be improved by more careful methods of culture, the use of new plants for forage and green manuring, and by a system of feeding based on the actual nutritive value of feeding stuffs as related to their cost, and how dairying could be made more profitable by making the purity and quality of the product the basis of its sale, and by attention to modern methods in the conduct of the business, these stations have accomplished a great work for these industries. The studies regarding plant diseases and injurious insects, together with the means for their repression, have had widespread practical results.

NEW MEXICO.

Agricultural Experiment Station of New Mexico, *Mesilla Park.*

Department of New Mexico College of Agriculture and Mechanic Arts.

GOVERNING BOARD.

Board of Regents: L. Bradford Prince, LL. D. (*President*), *Espanola;* P. H. Curran (*Secretary and Treasurer*), *Las Cruces;* G. A. Richardson, *Roswell;* A. A. Jones, *Las Vegas;* Prisciliano Moreno, *Las Cruces;* Governor Miguel A. Otero, *Santa Fe;* Manuel C. de Baca (*Superintendent of Public Instruction*), *Santa Fe.*

STATION STAFF.

Frederic W. Sanders, Ph. D., *President of the College and Director.*

Arthur Goss, M. S., A. C., *Vice-Director; Chemist.*

T. D. A. Cockerell, *Entomologist.*

——— ——— *Agriculturist and Horticulturist.*

E. O. Wooton, M. A., *Botanist.*

John D. Tinsley, B. S., *Soil Physicist.*

R. Fred Hare, M. S., *Assistant Chemist.*

Fabian Garcia, B. S., *Assistant Agriculturist and Horticulturist.*

Alfred M. Holt, M. S., *Second Assistant Chemist.*

Humboldt Casad, *Assistant Agriculturist and Horticulturist.*

Frank E. Lester, *Registrar.*

Helen M. Macgregor, *Stenographer.*

Jos. F. Bennett, jr., M. S., *Assistant Botanist.*

Charles E. Mead, B. S., *Superintendent of Substation* (*Aztec*).

John S. Thornhill, *Superintendent of Substation* (*Las Vegas*).

HISTORY.

The New Mexico Station is located in the southern part of the Territory, in the Rio Grande Valley, near the base of the lofty Organ Mountains, at an elevation of about 4,000 feet. The surface of the Territory is a lofty table-land, from which rise numerous chains and peaks of the Rocky Mountains, and on which there are large arid plains and a few river valleys. There are considerable forests among the mountains, and nutritious native grasses in great abundance. Irrigation is essential to successful agriculture, except at high altitudes in the mountains. The principal crops are wheat, maize, and oats, which, however, are grown only in limited areas. Large numbers of cattle and sheep are produced on the ranges. The summers are warm and the winters mild. The average annual rainfall is about 14 inches. New Mexico was inhabited by a comparatively large Indian population who practiced agriculture on a considerable scale when the American Continent was discovered by the Spaniards four hundred years ago. The Territory became a part of the United States at the close of the war with Mexico in 1848. Its population is sparse, and is still very largely Mexican and Indian. The college with which the station is connected was established in 1889, and is being developed mainly along industrial and scientific lines.

The New Mexico College of Agriculture and Mechanic Arts and the Agricultural Experiment Station of New Mexico were created by an act of the Territorial legislature, approved by the governor, February 28, 1889. The citizens of the Mesilla Valley, having agreed to donate land for the institution, and that portion of the Lower Rio Grande Valley, known as the Mesilla Valley, being one of the leading agricultural districts of the Territory, the college and station were located there. The location is the extreme eastern edge of the valley, at the junction of the valley and "mesa," or elevated plain, sloping up to the mountains. The land donated consists of a tract of about 270 acres, which was acquired at a cost of about $7,500.

The first director was Prof. Hiram Hadley, who was appointed in November, 1889. He was succeeded July 1, 1894, by Prof. S. P. McCrea, who served until July 1, 1896, when Prof. C. T. Jordan became director. He was in turn succeeded July 1, 1899, by the present incumbent.

In the spring of 1893 the Territorial legislature made provision for the establishment of three substations in connection with the central station, to be under the control of the board of regents of the agricultural college. One of these was to be in San Juan County, in the northwestern part of the Territory; one in the northeastern portion, and one in the Pecos Valley. The establishment of these substations was conditioned on the gift, in each locality, to the Territory for the

use of the substations, of not less than 100 acres of land under irrigation. The exact location was left to the board of regents, who located one at Aztec, in the Animas Valley, in San Juan County; one at Las Vegas, in San Miguel County, and the other at Roswell, in Chaves County.

At the time the substations were established, the Territorial legislature appropriated $5,000 for the one at San Juan, and $2,500 for each of the others. Provision was also made at that time for the application by the board of regents for the support of the substations of as much of the United States funds received under the act of Congress "as can be applied by the said board of regents in justice to the agricultural college of New Mexico." As no further Territorial support for the substations was provided for by the Territory until 1899, portions of the national fund, amounting sometimes to one-half of the total, were used, thus very materially crippling the central station. In 1899, however, the Territory assumed the support of the substations for the next two years, making an annual appropriation of $1,000 for each.

The substation farms are of from 100 to 200 acres each in area, and are located in widely separated regions, all remote from the home station. Only a small portion of each farm is used at present, the work so far having been confined to testing the adaptability of various crops to their respective localities. The substations are under the management of the division of agriculture and horticulture.

ORGANIZATION.

The governing board of the station is the board of regents of the agricultural college, which consists of five active members appointed by the governor for five years each, and confirmed by the legislature. Besides the active members, the governor and superintendent of public instruction of the Territory are also advisory members. The duties of the board, besides the appointment of members of the staff, consist of a general supervision of the affairs of the station, financial and otherwise. The board audits all bills for material ordered by the heads of the different divisions and approved by the director. The general policy of the board is to leave the selection of lines of work entirely to the staff. The regular meetings of the board occur quarterly.

The staff consists of the president of the college (who is also director), vice-director (who is also chemist), entomologist, agriculturist and horticulturist, botanist, soil physicist, assistant chemist, two assistant agriculturists and horticulturists, second assistant chemist, registrar, stenographer, assistant botanist, superintendent of the substation at Aztec, and superintendent of the substation at Las Vegas. The director assumes general supervision of the executive affairs of the

station and makes recommendations in regard to expenditures, general policy, etc., to the board of regents for approval. The details of the work of the different divisions are left entirely to their respective heads, but the general plan of the work and the policy to be pursued is discussed and passed upon by the station council, which consists of the director and heads of the different divisions. The tenure of office of members of the staff is at present but one year.

As has already been said, substations are at present maintained at Las Vegas, Aztec, and Roswell. The two former are under the immediate charge of a resident superintendent, but their work is supervised by the agriculturist and horticulturist of the station. At the San Juan substation there is a brick house, a barn, and a fair amount of general farm equipment. At Las Vegas the substation was supplied with a barn with stone basement and root cellar, a small dwelling house, and a few farm implements. The barn and contents were destroyed by fire in 1898, and have been replaced only in small part. There is practically no equipment at the Roswell substation, and very little work has been done there.

EQUIPMENT.

The first building, used for station purposes, to be erected was the main college building, which was put up in 1890. This building is of brick, 65 by 110 feet, two stories and basement, and contains 16 rooms. It accommodated all the divisions of the station, except one, prior to 1897, at which time the present station building (Pl. XCVII, fig. 1) was erected. This is also of brick, 72 by 87 feet, two stories high, and contains 17 rooms. All the divisions of the station formerly in the college building, with the exception of the director's office and the library, have been moved into it. (Pl. XCVII, fig. 2, gives a view of the chemical laboratory, and Pl. XCVIII, fig. 1, of the biological laboratory.) The only large farm building used for station purposes is an adobe structure used by the division of agriculture and horticulture. This is the oldest of the college buildings, having been on the land when acquired. From time to time additions have been made to it. There is a greenhouse and a barn, and a corral is in process of erection. (A view of the barn and grounds is given in Pl. XCVIII, fig. 2.)

All the college farm, consisting of 270 acres, except the portion occupied by the college buildings, is under the control of the station. The part of the station farm under irrigation, and suitable for ordinary agricultural purposes, comprises about 100 acres. Of this about 35 acres are at present used for experimental work, 15 acres for garden and field crops, and 20 acres for orchard. The area devoted to experimental work is increased or diminished from year to year as occasion requires. That portion of the farm under irrigation which is not used for experimental purposes is occupied by college buildings, or mostly planted to alfalfa.

FIG. 1.—NEW MEXICO STATION—MAIN BUILDING.

FIG. 2.—NEW MEXICO STATION—CHEMICAL LABORATORY.

FIG. 1.—NEW MEXICO STATION—BIOLOGICAL LABORATORY.

FIG. 2.—NEW MEXICO STATION—BARN AND GROUNDS.

Besides the horses used in cultivating the land the station owns no live stock, as no experiments in stock feeding or dairying have as yet been attempted.

The division of agriculture and horticulture has one of the most extensive collections of wheat in the United States. It contains nearly 800 samples of straw and threshed grain, and represents about 550 varieties. A collection of fruits preserved in formalin was commenced in 1899. An herbarium of cultivated plants is also in course of preparation.

In the botanical division the herbarium contains about 1,500 specimens of the flowering plants of New Mexico and about 1,000 other specimens. There is also in this division a collection of about 400 specimens of economic fungi, containing all the species that have so far been collected in the Territory. The division of entomology contains two fine sets of insects, a collection of wild bees and one of coccids. The collection of scale insects is said to be the best in the United States with the exception of the one in the National Museum at Washington. It contains about 500 species. This division has also quite an extensive collection of insects which have been collected in connection with a study of life zones. In the division of soil physics and meteorology a collection of the typical soils of the Territory has been begun.

Up to the present time there has been no well-defined separation of the college and station libraries. The general college library, including the station library, contains about 4,000 bound volumes.

FINANCIAL SUPPORT.

The principal source of revenue is the national appropriation. The income of the station for the last fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	249.45
Total	15,249.45

LINES OF WORK.

The station has no inspection duties. New Mexico is located in the arid region and agriculture is comparatively little developed. Hence the task of the station has been to ascertain the natural conditions prevailing in the Territory, to study agricultural methods in an arid region with especial reference to irrigation, and to determine and aid in the introduction of varieties adapted to local conditions.

In the agricultural and horticultural division the principal line of work is at present that of the management of water and studies of its effects on the soil, and the combined energies of this division and the division of soil physics are being devoted to these problems. Intimately connected with them is tillage as applied to various crops. An

effort is being made to increase the variety of forage crops grown in the Territory and new plants of possible utility are being introduced. Heretofore the principal lines of work conducted by this division have been the improvement of wheat, the culture of alfalfa, the sugar beet, canaigre, and other plants of special interest to this section, and a study of different kinds of orchard fruits.

In the chemical division analyses have been made of irrigation waters, alkali, and forage plants. During 1895–1897 investigations were conducted in cooperation with the Office of Experiment Stations on the food of the native people and the composition of native beef. This division is also at present cooperating with the same Office in irrigation investigations, studying the Rio Grande and Pecos river waters. Considerable research work has been done on methods of analysis of soils and feeding stuffs, especially in cooperation with the Association of Official Agricultural Chemists. In the botanical division quite extensive studies have been made of the flora of the Territory. The principal lines of work of an economic nature have been on the local weeds and principal forage plants. Some studies of plant diseases have also been made. In the entomological division a large amount of time has been devoted to a study of the life zones of the insects of the Territory and to systematic work on scale insects. The wild bees of the Territory have also been studied as a part of the college work. Much time has been devoted to a study of the codling moth. This division has done considerable work in cooperation with the Division of Entomology of the United States Department of Agriculture. The entomologist has taken up an investigation of the injurious insects of the Salt River Valley of Arizona for the Arizona Station.

In the division of soil physics and meteorology a study is being made of the physical characters of the local soils, especially in their relation to moisture. Soil-moisture determinations have been made in order to ascertain the amounts of moisture in the soil under the present system of irrigation. A study is being made of alkali and subirrigation, and of the reclamation of alkali and subirrigated soils. The division is cooperating with the Division of Soils of the United States Department of Agriculture in this work.

DISSEMINATION OF INFORMATION.

The station has issued 30 bulletins and 9 annual reports. The latter are merely administrative documents. Besides these, weekly press bulletins are issued from the division of agriculture and horticulture to the newspapers of the Territory on timely topics of agricultural interest as developed in the experiments of the division. These are printed by almost every newspaper in the Territory, the result being a wide publicity of the work of the division and the station in general. Other divisions have also made a practice of writing articles

for the press of the Territory at irregular intervals. A large number of articles have been written by members of the staff for various scientific publications. The director, Dr. Frederic W. Sanders, is the author of a work on "The Standard of Living in Its Relation to Economic Theory and Land Nationalization." The mailing list is kept in card-catalogue form. The number of names is about 2,000. The correspondence amounts to about 3,000 letters a year. Addresses on subjects relating to agriculture are occasionally made by members of the staff at various places in the Territory and elsewhere, but, owing to the long distances necessary to be traveled and the high railroad rates prevailing, farmers' institute work is not much developed. Exhibits have been made a number of times at the Territorial fair at Albuquerque.

GENERAL RESULTS OF WORK.

The New Mexico Station has accomplished considerable useful work in the nature of an agricultural survey. Its studies of the soils, irrigation waters, insects, and varieties of native and cultivated plants of the Territory have been important factors in the determination of the actual agricultural conditions and capabilities of this region. Recently it has shown the adaptability of irrigated portions of the Territory to the economical production of beets for sugar.

NEW YORK.

New York Agricultural Experiment Station. *Geneva.*

GOVERNING BOARD.

Board of Control: Martin V. B. Ives (*President*), *Potsdam;* W. O'Hanlon (*Secretary and Treasurer*), *Geneva;* Governor Theodore Roosevelt, *Albany;* William C. Barry, *Rochester;* S. H. Hammond, *Geneva;* A. C. Chase, *Syracuse;* F. O. Chamberlain, *Canandaigua;* F. C. Schraub, *Lowville;* Nicholas Hallock, *Queens;* Lyman P. Haviland, *Camden;* G. Howard Davison, *Millbrook.*

STATION STAFF.

W. H. Jordan, D. Sc., *Director.*
Geo. W. Churchill, *Agriculturist and Superintendent of Labor.*
Wm. P. Wheeler, *Expert in Animal Industry.*
H. A. Harding, B. S., *Bacteriologist.*
F. C. Stewart, M. S., *Botanist.*
L. L. Van Slyke, Ph. D., *Chemist.*
C. G. Jenter, Ph. C., *Assistant Chemist.*
W. H. Andrews, B. S., *Assistant Chemist.*
J. A. LeClerc, B. S., *Assistant Chemist.*
A. D. Cook, Ph. C., *Assistant Chemist.*
Fred D. Fuller, B. S., *Assistant Chemist.*
Charles W. Mudge, *Assistant Chemist.*
E. B. Hart, B. S., *Assistant Chemist.*
Geo. A. Smith, *Dairy Expert.*
Frank H. Hall, B. S., *Editor and Librarian.*
Victor H. Lowe, M. S., *Entomologist.*
F. A. Sirrine, M. S., *Entomologist (Jamaica, N. Y.).*
S. A. Beach, M. S., *Horticulturist.*
Wendell Paddock, B. S., *Assistant Horticulturist.*
Frederick H. Blodgett, M. S., *Assistant Botanist and Entomologist.*
L. A. Rogers, B. S., *Student Assistant in Bacteriology.*
Frank E. Newton, *Clerk and Stenographer.*
Jennie Terwilliger, *Clerk and Stenographer.*
A. H. Horton, *Computer.*

HISTORY.

The New York State Station is located in the western part of the State, at the northern end of Seneca Lake, in the midst of a prosperous agricultural and horticultural region. The surface of the State is varied, including the valleys of the Hudson, Mohawk, St. Lawrence, and Delaware rivers, numerous lakes, and mountains extending through the entire eastern part, the peaks of which rise in many cases to a height of from 3,000 to 5,000 feet. "About one-half of the area of the State is adapted to cultivation, and the products include nearly all those of the temperate zone." In the hill regions the forests are extensive. The average annual temperature ranges from 40° F. in the north to 51° F. in the south, and the annual rainfall from 40 to 52 inches. The soils are of various kinds and in many localities of comparatively high fertility. Agriculture has been practiced from 100 to more than 200 years in different parts of the State and the extensive use of farm and commercial fertilizers is now required. Besides its vast commercial and manufacturing industries New York has very large agricultural and horticultural interests. The principal field crops are hay, potatoes, maize, oats, wheat, barley, buckwheat, and rye. Very large numbers of milch cows are kept, as well as numerous sheep, cattle, horses, and swine. In the production of milk, butter, and cheese New York is a leading State. Fruit growing, market gardening, and floriculture are extensive industries.

The New York Agricultural Experiment Station was organized in accordance with an act of the State legislature in March, 1882. Legislative assent to its organization had been given in 1880, but a defect in the law made funds unavailable at that time. A farm of 125 acres, located 1½ miles west of Geneva, was secured, and Dr. E. Lewis Sturtevant was chosen director.

The station has received liberal support, the appropriation for its maintenance having increased from $18,000 in 1883 to $68,000 for 1899. In addition to this regular increase of revenue for work liberal special appropriations have been made for new buildings and additional equipment as required. Among the most important of these appropriations have been the following: In 1888, $8,000 for construction of barn, etc.; in 1889, $10,860 for poultry house, piggery, etc.; in 1890, $10,000 for special dairy and poultry work, etc.; in 1891, $15,000 for laboratory for fertilizer control; in 1892, $6,000 for completion of laboratory; in 1893, $2,000 for cold storage and ice houses; in 1894, $5,000 for forcing houses, and in 1898, $41,000 for biological and dairy building.

The station receives only $1,500 per annum from the national fund, and no reorganization was made when the act of Congress of March 2, 1887, went into effect. The extension of the free-mailing privilege

to the station publications was the principal gain to the station from the act.

During the years of Dr. Sturtevant's directorship the station was doing pioneer work in testing methods of investigation and training workers. More specifically the principal lines of work carried on during this period (1882–1887) consisted in testing seeds, testing varieties of field and garden crops, and establishment of their botanical relationships; investigation of the merits of alfalfa, silage, brewers' grains, and other new feeds and feeding methods; study of milk production, secretion, composition, testing, and handling, and treatment of plant diseases.

In 1887 Dr. Sturtevant resigned and Dr. Peter Collier, formerly chief chemist of the United States Department of Agriculture, was chosen director. Experimental work was extended in lines already carried on, and much attention was given to the study of dairy problems, including tests of breeds, care and management of herds, dairy chemistry, butter making and cheese making, the relation between milk constituents and dairy products, pig breeding and feeding, the poultry industry, testing varieties of fruits, forcing-house work, plant diseases, and entomology.

The control of fertilizers was intrusted to the station during the latter part of Dr. Collier's directorship and has been continued in slightly modified form since that time. The legislature of the State also granted the station special appropriations during the last year of Dr. Collier's service for work in connection with the market gardening and other horticultural interests of the sections of the State near New York City.

In 1895 and 1896, during Dr. Collier's illness and after his death, Dr. L. L. Van Slyke served as acting director and carried on the work of the station on much the same lines as before. July 1, 1896, Dr. W. H. Jordan, formerly director of the Maine Station, became director. The lines of work already in progress were continued, with especial emphasis on investigations in the interest of the dairy industry. Under the director's personal supervision increased attention is being paid to problems of feeding and digestion and utilization by plants of fertilizing ingredients.

ORGANIZATION.

The station is a State institution, nominally a part of the State department of agriculture, but directly under the supervision of a board of control, which consists of the governor of the State, ex officio, and nine other members, whom the governor appoints. The term of office is three years. The duties of the board consist of the appointment of the director and all other persons to carry on the work of the station and of general oversight of all expenditures. It must make an

annual report to the commissioner of agriculture of its proceedings, receipts, and expenditures.

The officers of the board consist of a president and secretary. The board appoints three standing committees—executive committee, auditing committee, and legislative committee. Four regular meetings are held annually and such other meetings as seem necessary. The members of the board receive no compensation other than traveling expenses. The present policy of the board appears to be to leave the determination of the work of the station and of the details of administration fully in the hands of the director and his staff.

The staff is composed of the director, agriculturist and superintendent of labor, expert in animal industry, bacteriologist, botanist, chemist, 7 assistant chemists, dairy expert, editor and librarian, 2 entomologists, horticulturist, assistant horticulturist, assistant botanist and entomologist, student assistant in bacteriology, 2 clerks and stenographers, and computer. These are appointed by the board from lists provided by the State civil-service commission. For most of the places competitive examinations are required, in which scientific or practical ability is made the chief requirement. The members of the staff hold office during good behavior and satisfactory performance of duty. The director is charged with the administration of the station, and outlines or sanctions work after consultation with the head of each division. There is no station council. Cooperation of divisions is secured through the director.

One branch station has been established on Long Island and is devoted to furthering the horticultural interests of southeastern New York. It began operations in 1894 and has been engaged mainly in investigations of insect pests and diseases of market garden crops. It has been supported by special legislative appropriations. The tendency of late has been to consolidate the scientific work at the home station, making the branch station largely a headquarters for conducting cooperative experiments.

EQUIPMENT.

The buildings of the station consist of the director's residence and office (Pl. XCIX, fig. 1), containing also the library; chemical laboratory, biological and dairy building, forcing houses (Pl. XCIX, fig. 2), cattle barn, horse barn, storage barn, piggery, three poultry houses, ice house and cold-storage building, and five dwelling houses. All of these which have been built since the establishment of the station have been planned with especial reference to the requirements of experimental work.

The chemical laboratory (Pl. C, fig. 1) is a red brick building, two stories, with basement and attic. Two wings extend to the rear from the main part, leaving a wide area for light and ventilation. The building contains four large laboratory rooms, several large office

FIG. 1.—NEW YORK STATE STATION—DIRECTOR'S OFFICE AND RESIDENCE.

FIG. 2.—NEW YORK STATE STATION—FORCING HOUSES.

FIG. 1.—NEW YORK STATE STATION—CHEMICAL LABORATORY.

FIG. 2.—NEW YORK STATE STATION—NITROGEN ROOM, CHEMICAL LABORATORY.

FIG. 1.—NEW YORK STATE STATION—BIOLOGICAL AND DAIRY BUILDING.

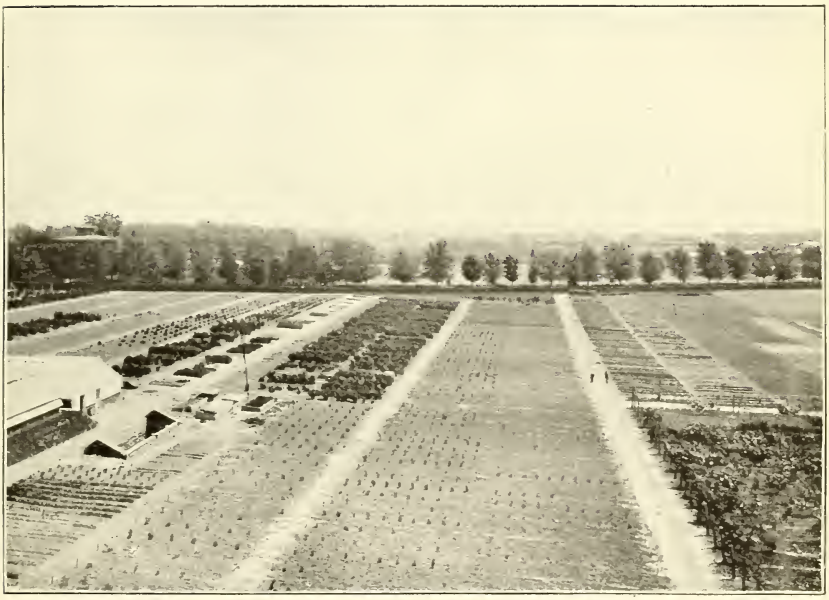


FIG. 2.—NEW YORK STATE STATION—PLATS OF SMALL FRUITS.

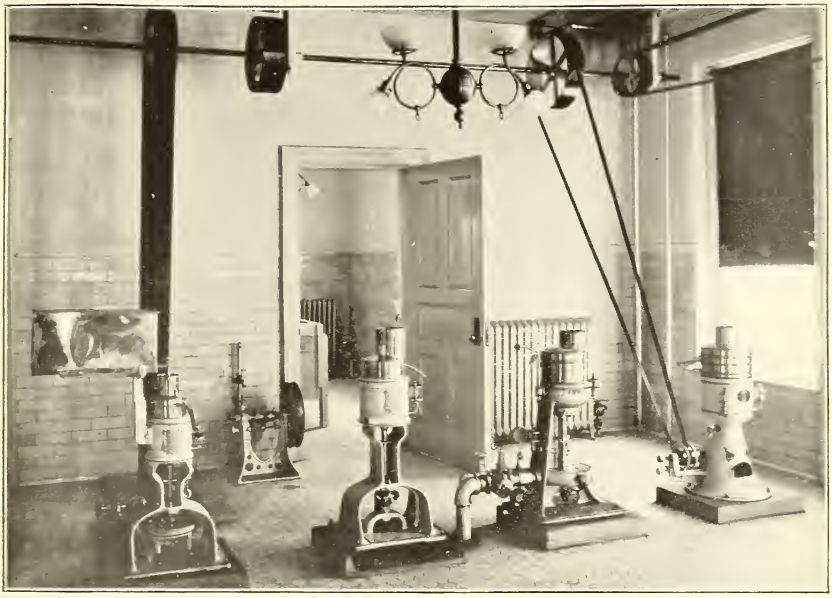


FIG. 1.—NEW YORK STATE STATION—MILK SEPARATORS.

FIG. 2.—NEW YORK STATE STATION—FERTILIZER EXPERIMENTS WITH BARLEY.

rooms, boiler and storage rooms, and sleeping rooms for several station employees. (The nitrogen room is shown in Pl. C, fig. 2.) The biological and dairy building (Pl. CI, fig. 1) is of cream-colored pressed brick, with stone trimmings, two stories high, and consists of a main building 88 by 38 feet, and two wings 33 feet wide and extending 30 feet to the rear, giving an open court 16 feet in width between the wings. The building is heated by steam, and is supplied with compressed air, hot and cold water, and gas. It has an extensive refrigerating plant for securing constant temperatures in the cheese-curing and bacteriological-culture rooms. On the first floor are the horticultural offices, laboratories and museum, and butter and cheese rooms. On the second floor are the botanist's, entomologist's, and bacteriologist's offices, laboratories and museums, a workroom, and cheese-curing rooms.

The poultry house consists of a main building 28 by 20 feet, with one wing 18 by 80 feet and one wing 18 by 52 feet. It is supplied with water and hot air. The forcing and glass houses consist of four distinct but connected ranges of glass, affording a floor space of 5,800 feet. They have been recently provided with improved heating arrangements, and now afford ample facilities for work in subirrigation, temperature regulation, bench, pot, or box culture, and all features of modern forcing-house work. A portion of one of the houses has been fitted up as an insectary.

Provision has recently been made for botanical, horticultural, and general agricultural museums; but museum material, except in entomology, has not as yet been arranged or classified. The library contains about 2,500 bound volumes.

The station now owns 136 acres of land, of which all, except about 5 acres devoted to buildings and lawns, is available for experimental work. At present about 30 acres are devoted to orchard fruits, 10 acres to small fruits (Pl. CI, fig. 2) and grapes, 15 acres to experimental plats and fields for farm crops, 50 acres to general farm crops for the maintenance of the dairy herd, and 12 acres are in pasture. As the station is connected with no other institution, it has absolute control of its farm.

The live stock consists of the horses necessary for carrying on the work, a dairy herd of about 20 head, a few sheep used in digestion experiments, and swine used for experimental purposes. All animals are available for experiment, and are used only incidentally for other purposes.

The apparatus is all of modern character. The equipment in the chemical laboratory has been especially designed for analysis of many samples of fertilizers and feeding stuffs at once. The refrigerating plant in the biological and dairy building is probably the most complete of its kind in America. (The milk separators in the biological and dairy building are shown in Pl. CII, fig. 1.)

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the State, only $1,500 being received from the national fund. The State provides three separate funds: the "general fund," which serves to maintain the work of investigation carried on at the station; the fund for the "expense of bulletins and enforcing the provisions of the fertilizer law," from which the expenses of printing bulletins and of sampling and analyzing fertilizers are paid, and the "appropriation for horticultural investigations, etc., in the second judicial department," which provides for the support of the branch station located at Jamaica, Long Island. The income of the station during the last fiscal year was as follows:

United States appropriation	$1,500.00
State appropriations	96,865.45
Farm products	2,105.20
Total	100,470.65

LINES OF WORK.

The station has charge of the fertilizer control, which is at present supported by direct appropriation from the State, the amount varying from $5,000 to $15,000 per year. In the future the control is to be supported by a brand tax of $20. Prosecutions are made by the commissioner of agriculture upon notification by the director of noncompliance with the terms of the fertilizer law. In 1899 the control of concentrated feeding stuffs, supported by a brand tax of $25, was put in charge of the station; also the inspection and control of the sale of Paris green.

The scientific investigations of this station have been for the most part in the interests of dairying and horticulture, both of which industries, on account of the proximity of home markets, occupy commanding positions in New York agriculture. Considerable experimental work has also been done in poultry culture and pig feeding.

The work looking to the furthering of the dairy interests of the State has been mainly along lines of dairying, digestion experiments, and studies of the influence of various factors on milk production with especial reference to feeding. In its work in dairying the station has devised a method for counting and measuring fat globules in milk, and an apparatus for the determination of the viscosity of milk. Methods of analysis relating to milk and its products have been studied and improved. This is true also of methods of analysis of feeding stuffs, soils, fertilizers, fruits, plants, etc.

Cheese making is a very important industry in New York and has received much attention. Studies have been made of the chemical composition of milk, whey, and cheese, of the relation between com-

position of milk and composition of cheese, and of the changes that take place in the ripening of cheese. Methods have been studied and devised for the determination of casein albumen in milk, and for identifying skim milk and skim-milk cheese. Studies have been made of losses of milk constituents, influence of composition of milk on yield and composition of cheese, and influence of removing fat and adding cream upon composition of cheese. Experiments have been made in coarse and fine cutting of curd, in the use of high temperature, and in the manufacture of Edam and Gouda cheese, and the relation of milk fat to cheese yield has been investigated. Comparisons have been made of different breeds of cattle for purposes of milk, butter, and cheese production.

Under the head of digestion experiments, comparisons have been made of the artificial and actual digestibility of feeding stuffs. Digestion experiments have been carried on with cows under various conditions, and a method has been outlined and experiments carried out indicating that milk fat is produced, to a considerable extent at least, from the carbohydrates of food. Investigations have been made on the composition of milk as influenced by breed, age, advance of lactation, feed, etc.

Feeding experiments with pigs have been carried on to ascertain the value for pork production of maize silage, clover, mangels, and oat-and-pea forage, respectively, as substitutes for part of the grain food. Experiments have been made to determine the effect of the addition of salt to the ration when different foods are used. Comparisons have been made of the rapidity of growth of pigs of several breeds and crosses, of the food cost of pork production with each, and the relative efficiency of dry and wet grain food and of maize meal and unshelled maize.

Experiments in poultry culture have included feeding experiments with laying hens, to compare rations containing different amounts of protein; experiments with chicks and capons; and experiments with capons and cockerels to determine the consumption of food, rate of growth, and cost of meat production. Feeding experiments with laying hens demonstrated that oyster shells could supply lime for the shell of the egg. Comparisons have been made of the relative efficiency of whole and ground grain rations for growing chicks and laying hens. The importance and efficiency of animal food in feeding chicks, ducklings, and laying hens has been studied, and observations have been made on the effect on egg production of keeping the male bird with laying hens.

Under the head of nutrition of plants, considerable studies have been made on the foraging power of different plants for phosphoric acid. (Pl. CII, fig. 2.) Fertilizer experiments have been carried on with various field crops and vegetables, and comparisons have been made of

barnyard manure and commercial fertilizers for maize. Highly successful experiments in growing alfalfa as a field crop have been conducted.

Investigations in the interests of horticulture have included extensive work on plant diseases and entomology. In horticulture proper an important feature of the work from the organization of the station has been the testing of varieties of cultivated plants and their classification, to which breeding has been added recently. Probably no American station is so largely engaged in the study of varieties as this one, there being now over 3,000 varieties of fruits alone under cultivation and observation. Studies have been made on the influence of plant food upon the composition of the strawberry plant and fruit. The suitability of various soil mixtures for forcing lettuce has been studied, and varieties of grapes have been shown to differ greatly in self-fertility.

From the scientific point of view the most important work in plant diseases has been the description of a bacterial disease of sweet corn and investigations on pear blight. The botanist has studied the downy mildew of cucumbers and suggested a practical treatment for it. Except for this the growing of this crop on Long Island must soon have been abandoned. The identity of the disease causing apple canker has been determined, and many comparisons of fungicides have been made. Other plant diseases on the treatment of which investigations have been made include the gooseberry mildew, pear scab, leaf spot of plum and cherry, raspberry anthracnose, bean anthracnose, and wheat smut.

In the entomological division the life histories of several insects have been worked out, among which are the New York plum lecanium, pistol-case bearer, plum and currant aphides, raspberry sawfly, cottonwood-leaf beetle, bramble flea louse, and spinach-leaf miner, and the habits of the cabbage butterfly, cabbage plutella, cabbage aphis, onion thrips, and cutworms have been studied with a view to discovering means of repression. The distribution of the army worm in the outbreak of 1896 was recorded. The potato flea-beetle was found to be the cause of pimply potatoes, and this discovery enabled the station to complete its life history. A large number of experiments have been made with various fungicides for the repression of injurious insects. Kerosene emulsion was shown to be a remedy for the New York plum lecanium, and a solution of whale-oil soap was shown to be a remedy for plant lice on currant bushes and apple and plum trees. The value of green arsenite and arsenite of lime as substitutes for Paris green as an insecticide has been demonstrated, and experiments with each of these substances have shown that they are all effectual remedies for the pistol-case bearer, cottonwood-leaf beetle, cankerworms, and apple-tree tent caterpillar. Poisoned bait has been demonstrated to be a valuable

remedy for the onion cutworm, and bisulphid of carbon a remedy for plant lice on late cabbage. The station has demonstrated the value of trap crops in combating the striped cucumber beetle. Experiments have been made in dipping nursery stock infested with the San José scale in a solution of whale-oil soap and in fumigating with hydrocyanic-acid gas. A mechanical mixture of kerosene oil and water has also been tested as a remedy for the San José scale and pear-tree psylla.

The station engages quite largely in cooperative experiments. These are wholly of a practical or business character. At present between 20 and 30 acres of land, located in various portions of the State and owned by farmers, are in use in this way. These experiments include at present fertilizer experiments with potatoes and onions; the control of insect pests on onions; the control of diseases affecting asparagus, cauliflower, and cabbages; spraying for the extermination of the San José scale; experiments in growing foreign varieties of chestnuts, and the irrigation of small fruits. A representative of the station visits the experiments frequently. These experiments are, in part, under the immediate supervision of representatives of the station and in part intrusted to the owner of the land, with whom they cooperate. The recording of data is done both by station officers and the owners of the land.

DISSEMINATION OF INFORMATION.

In the early years of the station the only bulletins issued were newspaper bulletins, of which there were 115. Beginning in July, 1885, a new series was begun in pamphlet form for general distribution. In this series 170 had been issued up to January 1, 1900. Beginning with bulletin No. 114, new series, a popular edition of each bulletin, with few exceptions, has been issued. This popular edition is sent to the general mailing list. It presents the results of investigations briefly and emphasizes points of practical bearing. The regular bulletin is sent to those interested in a full scientific discussion of the experiments and results. The annual reports, of which 16 have been issued, now contain only reprints of bulletins and the treasurer's report.

The mailing list contains about 32,000 names. It is kept printed on sheets, and publications are addressed with a mailer. Changes in address are made by pen until the list is revised, which is done every three years. The correspondence amounts to about 6,000 letters a year. The members of the staff take part regularly in farmers' institute work, the actual amount of time thus spent during the season of 1898–99 being equivalent to about fourteen weeks for one man. The station usually makes exhibits of fruits at fall and early winter fairs and meetings of horticultural societies.

GENERAL RESULTS OF WORK.

The New York State Station has accomplished a great work in the control of commercial fertilizers, its operations in this respect being more extensive than those of any other American experiment station. Its investigations in dairy farming, especially those relating to the utilization of the maize crop for silage, the nutritive value and practical utility of different concentrated feeding stuffs, and the comparative merits of breeds of dairy cattle, have done much to aid the development of this industry on a rational basis. Its studies of milk and other dairy products, and notably its elaborate investigations in cheese making, have been an important factor in the establishment of standards of value for the dairy products of the United States and in the reorganization of our dairy industry along the lines of modern business methods and on a scientific basis. The horticultural interests of the State have been greatly benefited by the station's studies on plant diseases and injurious insects, and the introduction of practical methods for their repression, as well as by the tests of varieties of orchard and small fruits which the station has been able to conduct on a sufficiently extensive scale to make them of practical usefulness.

Cornell University Agricultural Experiment Station, *Ithaca.*

Department of Cornell University.

GOVERNING BOARD.

BOARD OF TRUSTEES OF THE UNIVERSITY.

Station Council: Jacob G. Schurman (*President*), Isaac P. Roberts, John H. Comstock, Liberty H. Bailey, Franklin C. Cornell, Emmons L. Williams.

STATION STAFF.

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Isaac P. Roberts, M. Agr., *Director; Agriculturist.*
George C. Caldwell, B. S., Ph. D., *Chemist.*
James Law, F. R. C. V. S., *Veterinarian.*
John H. Comstock, B. S., *Entomologist.*
Liberty H. Bailey, M. S., *Horticulturist.*
Henry H. Wing, B. Agr., M. S., *Expert in Dairy Husbandry and Animal Industry.*
G. F. Atkinson, M. S., *Cryptogamic Botanist.*
Mark V. Slingerland, B. S., *Assistant Entomologist.*
Louis A. Clinton, B. S., *Assistant Agriculturist.*
J. L. Stone, B. S. A., *Assistant in Agriculture.*
George W. Cavanaugh, B. S., *Assistant Chemist.*
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A. R. Ward, B. S. A., *Dairy Bacteriologist.*
A. L. Knisely, M. S., *Assistant in Chemistry.*
Leroy Anderson, B. S., M. S. Agr., *Assistant in Dairy Husbandry.*
Chas. E. Hunn, *Gardener.*
G. N. Lauman, B. S. A., *Instructor in Horticulture.*
S. W. Fletcher, *Assistant in Horticulture.*
E. L. Williams, *Treasurer.*
E. A. Butler, *Clerk.*

HISTORY.

The Cornell University Experiment Station is located in the western part of the State of New York at the southern end of Lake Cayuga, on the grounds of the university. The university was established in 1869

on an unusually broad and liberal basis and has been a pioneer in the development of higher education in this country along industrial, technical, and scientific lines. It has grown to be one of our strongest universities as regards its faculty, number of students (now over 2,700), and equipment.

The Cornell University Agricultural Experiment Station was organized in February, 1879, as a department of the Cornell University. The board of control was composed of the faculty of agriculture of the university, together with delegates, one each, from the State Agricultural Society, State Grange, State Dairymen's Association, Western New York Farmers' Club, Central New York Farmers' Club, Elmira Farmers' Club, American Institute Farmers' Club, and the Ithaca Farmers' Club. The first annual meeting of the board of control was held at Cornell University, Ithaca, N. Y., June 20, 1879, and the following officers were elected: President, Prof. I. P. Roberts; director, Prof. G. C. Caldwell; treasurer, Prof. A. N. Prentiss; secretary, Prof. W. R. Lazenby. The immediate management of the affairs of the station was vested in an executive committee, which consisted of the four officers named above and President G. W. Hoffman of the Elmira Farmers' Club.

The only funds at the disposal of the station consisted of $250, which were given by Miss Jennie McGraw for the printing of the first annual report. All the work of the station at that time was voluntary and was limited to the amount of time not required for professional duties in the university. Nevertheless, many valuable experiments were carried on.

Previous to 1888 three reports were issued. The first embraced the work done in 1879–80, the second included the work of 1882–83, and the third report included the work of 1883–1885. In the second report there is an article on scale insects by Prof. J. H. Comstock, which has become the standard authority on the subject. The station was reorganized April 30, 1888, under the act of Congress, with Prof. I. P. Roberts as director, and placed under the control of the trustees of the university. The work of the station was divided into divisions of agriculture, chemistry, veterinary science, botany, horticulture, and entomology. As the experiment station had been established for several years there was already considerable work under way and nearly all these six divisions were able to begin work well equipped. Instead of erecting new buildings or hiring new men, the university allowed buildings already constructed to be used in part for experiment station purposes and allowed men who were devoting their time to the university to give a part of it to experiment station work. Each division was given assistants so that the work was really carried on without interruption from the organization of the station in 1879.

Originally the entire appropriation of $15,000 from the national fund was received by the experiment station of Cornell University, but more recently it has received but $13,500, the remaining $1,500 being allowed to the State Experiment Station at Geneva. In 1894 the State made an appropriation of $8,000 to be expended in experimental work by the station. This appropriation has been increased until now it is $35,000 a year, which is divided about equally between experimental work and educational work in agriculture.

ORGANIZATION.

The governing board of the station is the board of trustees of Cornell University. The board has delegated the immediate management of station affairs to the "agricultural college and station council," which is made up of the president of the university, the treasurer of the university, and the director of the station ex officio together with one member of the board of trustees and two members of the faculty of the college of agriculture, each elected by their respective bodies. This council recommends appropriations, changes, and appointments to a committee of the board and these recommendations are always adopted, so virtually the government of the station is in the hands of the council. The appropriation which is made by the State for extension work in agriculture and for conducting experiments throughout the State is under the control of the university, subject to the approval of the commissioner of agriculture, but no State officer has any control over the funds received from the National Government.

The staff is composed of the president of the university, director (who is also agriculturist), chemist, veterinarian, entomologist, horticulturist, expert in dairy husbandry and animal industry, cryptogamic botanist, assistant entomologist, assistant agriculturist, two assistant chemists, assistant cryptogamic botanist, dairy bacteriologist, assistant in agriculture, assistant in dairy husbandry, gardener, instructor in horticulture, assistant in horticulture, treasurer, and clerk. Heads of divisions are paid largely from university funds, in some cases entirely. The assistants devote all or nearly all of their time to station work and are paid largely from station funds.

EQUIPMENT.

The only buildings which have been erected out of station funds are an insectary and forcing houses. Otherwise the station makes use of university buildings. The insectary is a two-story cottage with greenhouses attached. On the ground floor is a laboratory for the experimenter and his artist, workshop, and dark room for photographic purposes. It is provided with a cold room for the storage of hibernating insects. It is believed to have been the first building of

FIG. 1.—NEW YORK CORNELL STATION—MORRILL HALL, USED BY UNIVERSITY AND STATION.

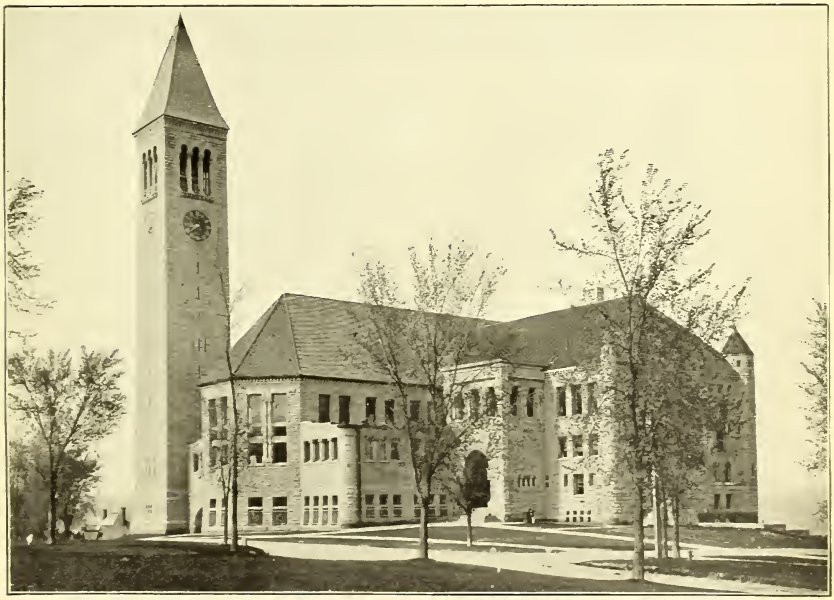

FIG. 2.—NEW YORK CORNELL STATION—UNIVERSITY LIBRARY, USED BY UNIVERSITY AND STATION.

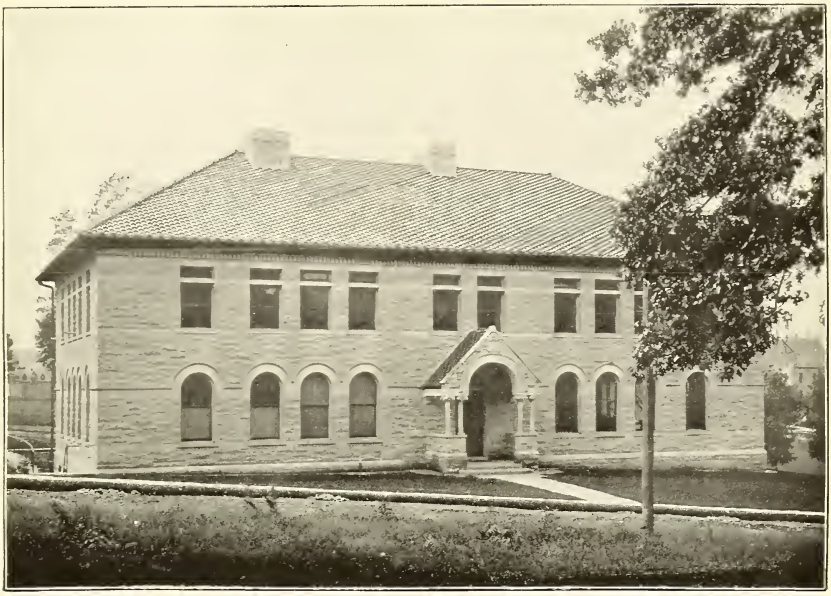

FIG. 1.—NEW YORK CORNELL STATION—DAIRY BUILDING, USED BY UNIVERSITY AND STATION.

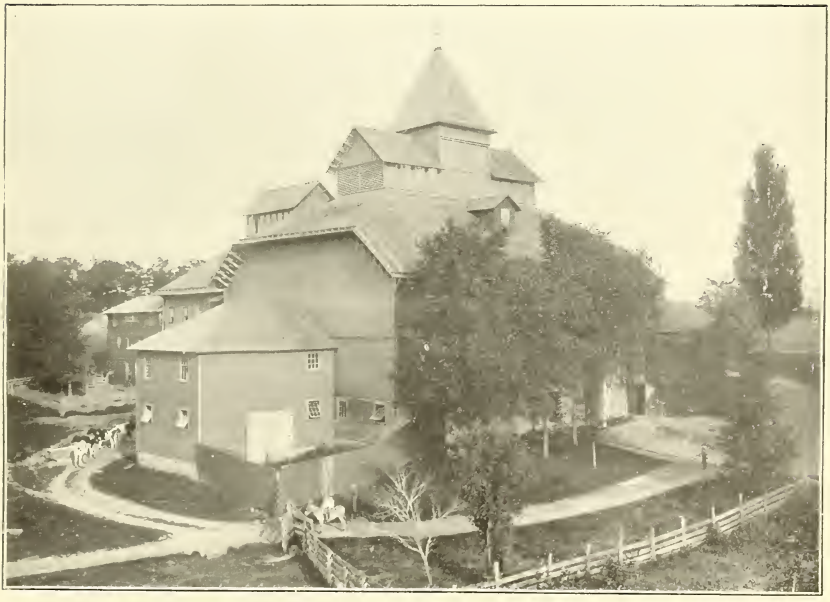

FIG. 2.—NEW YORK CORNELL STATION—BARN, USED BY UNIVERSITY AND STATION.

FIG. 1.—NEW YORK CORNELL STATION—PLATS OF FORAGE PLANTS.

FIG. 2.—NEW YORK CORNELL STATION—GRAIN PLATS.

FIG. 1.—NEW YORK CORNELL STATION—EXPERIMENTS IN HYBRIDIZING.

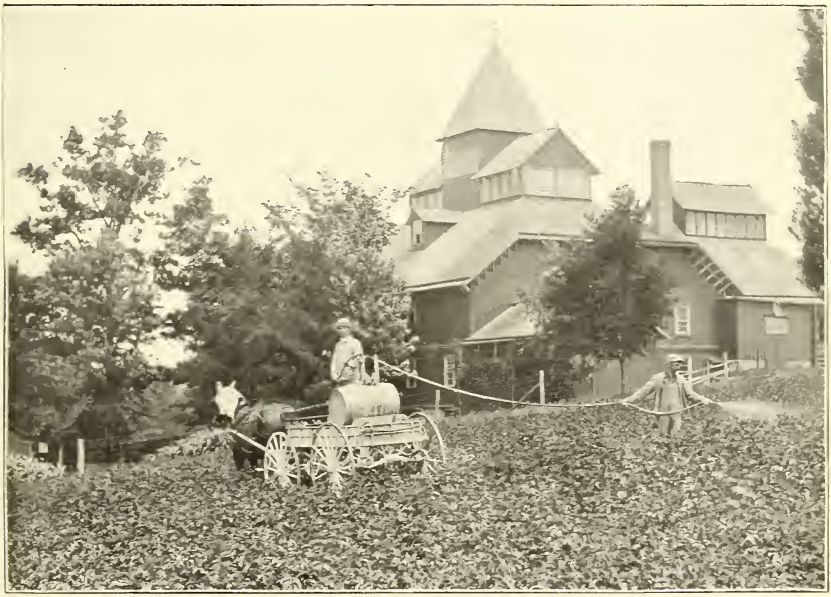

FIG. 2.—NEW YORK CORNELL STATION—SPRAYING POTATOES.

its kind, and the word by which it is now designated, "insectary," was proposed for it by the present entomologist. It is provided with various pieces of apparatus that were devised at the station, among which are a root cage, used in observing subterranean insects, and various forms of breeding cages. The forcing houses are five in number and cover 6,100 feet of ground. Among the university buildings of which the station makes use are Morrill Hall (Pl. CIII, fig. 1), in which are located the offices of the director, horticulturist, and entomologist; the university library (Pl. CIII, fig. 2), the dairy building (Pl. CIV, fig. 1), and the university barn (Pl. CIV, fig. 2).

The university farm contains 125 acres, all of which is available for station work. The crops grown on the land become university property, and are accepted as a sufficient compensation for rent of land and labor expended upon them. About 5 acres are devoted to experimental plats, upon which are grown different varieties of farm crops, and upon which careful experiments in tillage and manuring are conducted. The general farm crops are also made the subject of experiments in methods of seeding, cultivation, and varieties. The horticultural division has 10 acres in orchards, small fruits, and gardens. (A view of the plats of forage plants is given in Pl. CV, fig. 1, and of the grain plats in fig. 2 of the same plate.)

The university owns about 35 head of cattle, 10 horses, 40 sheep, and 30 hogs, all of which are available for experimental purposes. The cattle are maintained as a permanent herd, but sheep are purchased from time to time as needed for particular experiments, at the close of which they are sold.

The agricultural museum contains the Rau models, being 187 models of plows made at the Royal Agricultural College of Wurttemberg under the direction of Professor Rau; a large number of other models representing a great variety of agricultural implements; engravings and photographs of cultivated plants and animals obtained at the various agricultural colleges of Europe; a collection of the cereals of Great Britain; and a collection of agricultural seeds.

The botanical museum includes the herbarium, estimated to contain 15,000 species; two series of botanical models, the Auzoux and the Brendel; a lime lantern with 500 views; a collection of fruits, barks, cones, nuts, seeds, fibers, and various dry and alcoholic specimens; a general collection of economic vegetable products, and over 1,000 specimens of the weeds of different countries.

The museum of entomology contains, in addition to many exotic insects, specimens of a large number of the more common species of the northeastern United States. This collection includes many sets of specimens illustrative of the metamorphoses of insects.

The museum of veterinary science embraces the Auzoux veterinary models, comprising plastic models of the horse, showing the relative

position of over 3,000 anatomical parts, models of limbs, sound and with detachable pieces and their morbid counterparts, a set of obstetrical models, an extensive set of models of jaws, models of equine teeth in sections, skeletons of the domestic animals, a collection of diseased bones, skulls of domestic animals, jaws of farm animals, illustrating the growth and wear of teeth; a collection of specimens of teratology, consisting of monstrous foals, calves and pigs; a collection of tumors and morbid growths; some hundreds of specimens of parasites, etc.

The herbarium of cultivated plants in the horticultural division, containing over 12,000 specimens, is the largest in America. The station has photographs and lantern slides in the various divisions. With the exception of station publications, a separate library is not maintained. The university library, containing over 225,000 volumes, is available for station workers, as are also the apparatus and appliances owned by the university. Manufacturers of implements have been very liberal in giving to the station, and many of the appliances in use have been donated. Recently a large amount of apparatus has been purchased for use in dairy bacteriology.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, a State appropriation of $35,000 a year, of which one-half is expended in experimental work, and the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$13,500.00
State appropriation[1]	18,000.00
Farm products	627.32
Total	32,127.32

LINES OF WORK.

The station has no inspection duties. Demonstration experiments have been carried on to a considerable extent as university extension work, and several bulletins have been published, the object of which was to give information about well-known principles rather than results of experiments. The station has cooperated with several hundred farmers in experiments with sugar beets, potatoes, and fertilizers. These experiments have resulted not only in interesting the farmers throughout the State in work which is being done by the station, but also in furnishing the station with much valuable data. The station believes that its work can be brought home to the farmer perhaps better by cooperative experiments than in any other way.

[1] This is approximately the amount of the State appropriation expended for experimental work.

The scientific investigations have been mainly in the interest of horticulture and dairying, the most important agricultural industries in the State, and have been along lines of horticulture, plant diseases, entomology, feeding experiments, sugar beet and potato culture, care of barnyard manure, tillage, and veterinary science. In the horticultural division the investigations may be grouped in a general way under the heads of systematic horticulture and plant breeding, forcing of vegetables and fruits, with construction and management of greenhouses, and spraying. From the organization of the division the systematic study of cultivated plants has been a prominent line of work. Of this nature was a monograph of the native plums and cherries which laid the foundations for scientific investigations of these groups. In a similar way a number of other fruits and vegetables have been critically studied and monographed, among them the Japanese plums in America, the apricot, the dewberry, the dwarf Lima bean, and the eggplant. The work on the tomato and the eggplant included experiments in crossing different races and studies on the effect of artificial pollination on seeds. Studies in tomato culture have been of a most comprehensive nature, and have dealt with management in the field and forcing house, fertilization, classification, and breeding. In recent years ornamental plants have received much attention, and monographic accounts have been published of a number, among which are the chrysanthemum, canna, dahlia, aster, and sweet pea. Observations have been made on various new types of cultivated plants, among which are *Prunus simonii*, the Crandall currant, wineberry, dwarf juneberry, physalis or husk tomato, pepino, Spanish salsify or scolymus, *Stachys sieboldi*, for which the horticulturist suggested the common name chorogi, and a number of recently introduced Chinese vegetables. For a time an important line of work was the origination of varieties of vegetables. Much experimental work has been done along lines of hybridization (Pl. CVI, fig. 1).

The practicability of forcing numerous vegetables was first shown at this station. Such experiments have not been, however, mere tests of practicability, but have included the more difficult problems of plant culture that arise under forcing-house conditions, such as cross pollination. These experiments have in some cases resulted in the introduction of entirely new branches of the forcing-house industry. The experiments in the forcing of vegetables have in general reached a point at which the station is able to give quite definite advice on the commercial aspects of the subject. From the work of forcing vegetables the division is now entering upon a series of experiments in the forcing of fruits. The division has also attacked the problem of forcing Bermuda lilies for Easter. Important investigations have been made on the effect of electric light on greenhouse plants and the utilization of electric light on a commercial scale. Long and careful studies have been made of methods of heating greenhouses.

Spraying has been made an important subject of investigation. (A method of spraying potatoes is shown in Pl. CVI, fig. 2.) Various new spraying mixtures have been studied and a large amount of scattered information collected and reduced to systematic form. Numerous tests have been made of various fungicides and insecticides. Experiments have been made in mulching to retard the maturity of fruit and a rational explanation of the practice suggested. Studies have been made of the influence of certain conditions on the germination of seeds.

The work on plant diseases has been mostly mycological. Important contributions have been made to our knowledge of prunicolous Exoasceæ of the United States. Investigations brought to light some undescribed species and several European ones not heretofore known to exist in this country. The life history of the clover rust has been worked out and remedial measures suggested. Investigations on the diseases of forest trees have been in progress for some time and connected therewith have been studies on the development of certain of those trees, especially pines and other conifers, with a view to determining the rate of growth, distribution, and fertility of seed, as well as the conditions which influence or modify the life of these trees. Investigations have been made on a number of entomogenous fungi and the practicability of using artificial cultures of them in combating certain insect enemies of cultivated plants. Many original investigations have been made on the development and life history of the anthracnoses. The methods of technique employed in the cultivation and study of these forms resulted in demonstrating their relationship to higher forms and brought to light differential characters of closely related species not heretofore known to exist. Observations have been made on the habits and life history of various species of Cladosporium, *C. fulvum* on the tomato in particular. Various Pyrenomycetes have been studied with a view to tracing their development and polymorphy, and to ascertaining the relationship of certain pycnidial and conidial forms. The life histories of certain fungi which cause the damping off of seedlings and greenhouse plants have been worked out and preventive measures suggested. Among these was one fungus which was first described at this station. The leaf spot of the quince and pear was for several years an important subject of study. Investigation showed that a complication of disorders was grouped under this head and these were differentiated and described. It was found that Bordeaux mixture is an efficient preventive of the leaf spot. Various rots of celery have been investigated; the life histories of two of the fungi causing them have been worked out and it was shown that two quite dissimilar forms of the disease were due to the same fungus under different conditions. Investigations are in progress on the rot of greenhouse tomatoes and

the shot-hole fungus of peaches, plums, and apricots. The nature of Œdema of the tomato and of the apple has been determined and remedial measures suggested. Observations have been made on the number of bacteria in milk during different stages of pasteurization and on certain organisms which give an uneven and undesirable coloring to cheese during its curing. Investigations upon a mold growth occuring upon the parchment-paper lining and the wood of butter tubs have determined the conditions of growth of the fungus and a method of prevention has been suggested.

The energies of the entomological division have been devoted to a careful and exhaustive study of a comparatively few insects rather than to fragmentary observations upon many. It has been demonstrated that a mysterious "dying back or blighting" of the tender tips of peach nursery stock is largely if not entirely due to the punctures of the common tarnished plant bug. Extensive observations have been made on a maggot which girdles young raspberry shoots, and considerable contributions have been made to our knowledge of the life histories of some of the scale insects. Extensive experiments have been carried on for several years with different methods of preventing the attacks of the peach borer. Observations have been made on the cigar case bearer and climbing cutworms, wireworms, New York plum scale, and the army worm. New and important facts have been brought to light bearing on the habits and life history of the grapevine flea-beetle. The life histories of a sawfly borer in wheat, pear-tree psylla, apple-bud moth, and four-lined leaf bug have been worked out and means of repression suggested. An undescribed disease of the Clematis was found to be due to a nematode worm, the life history of which was also worked out. A greenhouse pest (*Aleurodes vaporariorum*) was first reported from the United States. Experiments in methods of combating wireworms were carried on for a series of years. The genus Diasteria, which includes the most common moths infesting pastures in New York, has been studied from systematic and economic standpoints, and the life histories of the two most common species worked out. These species were first differentiated at this station. The local species of Crambus, another group of moths infesting meadows and pastures, have been studied systematically and the life histories of most of them worked out. Original investigations have been made upon the habits of *Bruchus obtectus* and *B. quadrimaculatus* the two most common weevils infesting peas, beans, and other seed. The egg-laying habits of the former species were first described at this station. Extensive studies have been made on the Lecanium of peach trees, together with methods of combating it. An exhaustive study has been made of the cabbage-root maggot and means of repression.

In the feeding experiments at this station investigations have been

made on the production of lean meat in mature animals, the effect of nitrogenous and carbonaceous foods on fattening lambs and the effect of the same foods on the development and fecundity of swine. Determinations were made of the amount of food required to produce a given amount of milk and butter in different cows. The report of these experiments set forth clearly the fact of the wide variation in the cost of milk production. Considerable data has been secured bearing upon the production of milk, as related to consumption of food in cases in which animals have been forced to great production.

Comparative field and chemical tests have been made of all of the varieties of field maize recommended as valuable for silage, and studies have been made of the changes in composition that take place during growth of the plant. A determination was made of the loss in weight and dry matter in the process of ensiling. Studies have been made of crops for green soiling and of preservation of silage by different methods.

Experiments have been made in cream raising by dilution and on the effects of different foods on the hardness of butter. It was shown by experiment that a considerable part of the fat hitherto lost in whey may be saved in the form of merchantable butter. A study has been made of milk secretion on the basis of daily production of milk and butter fat in the university herd. Experiments have been carried on in the management of poultry and in feeding and breeding for quantity and quality of egg production. Experiments in raising winter lambs were carried on for a number of years. Comparisons have been made of different rations in pig feeding.

The veterinarian has studied tuberculosis and infectious abortion in cattle, and has shown that powdered soap in swill is frequently a cause of death among swill-fed hogs.

Studies have been made on the deterioration of barnyard manure by leaching and fermentation and on means of preservation. Observations have been made on the effect on crop production of barnyard manure in which shavings and straw have been used as absorbents. Experiments to determine the relation between cultivation and conservation of soil moisture have been carried on. Introculture has been a leading subject of investigation for several years. Observations have been made on the action of lime on acid soils and its value as a conserver of moisture. Experiments are in progress to determine what portion of the nitrogen stored up by clover plants is actually taken from the atmosphere and what portion from the soil. A comparative study of certain leguminous plants to determine their nitrogen-storing capacity is also in progress, and it has been shown that certain leguminous plants which in their native soil and climate produce root tubercles do not produce them in New York, and inoculation experiments to overcome this difficulty are being made.

Considerable attention has been given to methods of renovating old pastures.

Investigations of a technical nature in chemistry have had to do with the determination of albuminoid nitrogen and with studies of various methods for the determination of nitrogen in soils and of fats in fodders. Investigations have been made on the relation between chemical composition and quality of celery. Some work has been done in the estimation of pentosans.

DISSEMINATION OF INFORMATION.

Since its reorganization the station has issued 180 bulletins, 12 annual reports, and 19 circulars of information giving instructions for carrying on certain lines of cooperative work. The annual report consists of an administrative document, to which are appended all the other publications of the station for the year. The mailing list contains 18,000 names and is hereafter to be kept permanently set up in type.

The following books have been written by station officers: By Prof. I. P. Roberts, director: "The Fertility of the Land," "The Farmstead." By Prof. L. H. Bailey, horticulturist: "Cyclopedia of American Horticulture" (4 vols.), "Principles of Vegetable Gardening," "Talks Afield," "Field Notes on Apple Culture," "Annals of Horticulture" (volumes for 1889–1893, inclusive), "The Principles of Fruit Growing," "The Horticulturist's Rule Book," "The Nursery Book," "Plant Breeding," "The Forcing Book," "The Pruning Book," "Garden Making," "Amateur's Practical Garden Book," "Lessons with Plants," "First Lessons with Plants," "The Survival of the Unlike," "The Evolution of our Native Fruits," "The Principles of Agriculture," "American Grape Training," revision of Gray's "Field, Forest, and Garden Botany." By Prof. J. H. Comstock, entomologist: "Introduction to Entomology," "Manual for the Study of Insects," "Insect Life," "Elementary Laboratory Manual." By Prof. H. H. Wing, expert in dairy husbandry and animal industry: "Milk and its Products." By Prof. G. F. Atkinson, botanist: "Elementary Botany." By Dr. James Law, veterinarian: "Veterinary Advisor," "General and Descriptive Anatomy of Domestic Animals," "Veterinary Medicine" (first volume issued and second volume in press, to be completed in four volumes), "Report of the Treasury Cattle Commission." By Prof. G. C. Caldwell, chemist: "Agricultural Chemical Analysis," "Elementary Qualitative Analysis," "Manual of Qualitative and Quantitative Analysis." Professor Bailey is the editor of the series of books on agricultural subjects known as the Rural Science Series, now being issued.

The correspondence amounts to about 3,000 letters a year. Members of the staff are frequently called upon to deliver addresses

before farmers' institutes. Under the State appropriation for the extension of agricultural information throughout the State an attempt has been made to hold meetings (or "schools"), lasting several days, in which more systematic instruction is given than is possible at the ordinary farmers' institutes.

GENERAL RESULTS OF WORK.

The Cornell Station has done very much to aid in the development of a more intensive agriculture in the State. This has been required in the great growth of the urban population of the State and the competition of the States of the Mississippi Valley and the West in the growing of the staple crops. The investigations of the station in dairy farming have led to more careful tillage, more thorough use of the land by the planting of crops through the year, the more economic utilization of the maize crop in the form of silage, the better preservation and more effective use of farm manures. In horticulture a great work has been done in the establishment of economic investigations on a scientific basis, by the thorough collection and publication of data relating to fruit and vegetables, and by investigations in market gardening, greenhouse culture of vegetables, and floriculture, which have had important practical results. The studies on injurious insects and plant diseases have been very thoroughly pursued and have added much to our knowledge of the species investigated, on the basis of which practical means for their repression have in many cases been discovered.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station, *Raleigh.*

Department of North Carolina College of Agriculture and Mechanic Arts.

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STATION STAFF.

George T. Winston, LL. D., *President of the College and Director.*

W. A. Withers, M. A., *Chemist.*
B. Irby, M. S., *Agriculturist.*
W. F. Massey, C. E., *Horticulturist, Botanist, and Entomologist.*
G. S. Fraps, Ph. D., *Assistant Chemist.*
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C. W. Hyams, *Assistant Botanist and Entomologist.*
J. M. Johnson, M. S., *Assistant Agriculturist.*
J. M. Fix, *Clerk and Bookkeeper.*
Mrs. L. V. Darby, *Stenographer.*
A. F. Bowen, *Clerk.*

HISTORY.

The North Carolina Station is located at the capital, near the center of the State. The eastern half of the State consists mainly of fertile lowlands with extensive marshes near the Atlantic coast; the western half is a hill and mountain region, with 43 peaks rising above 6,000 feet, among which is Mount Mitchell (6,711 feet), the highest east of the Rockies. The climate is mild, the average annual temperature being 59° F. The annual rainfall is about 53 inches. There is a great variety of soils. The native and cultivated plants of both North and South are found within the State. The forests are extensive. The principal crops are cotton, tobacco, maize, oats, wheat, hay, and sweet potatoes. The growing of apples, peaches, and trucking crops are also important industries. Agriculture has been carried on in the State, especially in the eastern part, for over two hundred years. Commercial fertilizers are extensively used, the amount approximating 250,000 tons annually. The manufacturing interests of the State, especially the manufacture of cotton, have been rapidly developed in recent years. The college with which the station is connected was established in 1885 and opened for instruction in 1889, and is developing along industrial and scientific lines.

The North Carolina Agricultural Experiment Station was established at Chapel Hill, in the buildings of the University of North Carolina, as a division of the State department of agriculture, in accordance with an act of the State legislature passed March 12, 1877. The North Carolina Station was, therefore, the second in the United States to receive State recognition, having been preceded by the Connecticut State Station alone. Dr. Albert R. Ledoux was appointed director and chemist and work was begun April 19, 1877, in the chemical laboratory of the university. Cooperative field experiments were carried on to some extent and something was done in the way of testing seeds, but the main work of the station was, for several years, in the chemical laboratory, the fertilizer control receiving the most attention.

November 1, 1880, Dr. Ledoux was succeeded by Dr. Charles W. Dabney, jr., now president of the University of Tennessee, and formerly Assistant Secretary of the United States Department of Agriculture. In the summer of 1881 the station was transferred to rooms in the building of the State department of agriculture at Raleigh. In April, 1886, the scope of work was extended to include field experiments. For this purpose 10 acres of ground were purchased near the station and buildings were erected. The State Agricultural Society also gave the use of 13 acres additional without charge for rent. Prof. Milton Whitney, of the Connecticut State Station, now chief of the Division of Soils in the United States Department of Agriculture, was elected agriculturist. In December of the same year the State weather service, operated in connection with the United States Signal Service,

was established in connection with the station and was thus continued for ten years.

September 1, 1887, Dr. Dabney was succeeded by Dr. H. B. Battle, who had previously served for more than six years as assistant chemist of the station. During Dr. Battle's administration the station was reorganized in accordance with the act of Congress of March 2, 1887. When this act was passed the station had already been in operation for about ten years, was well equipped, and had a staff consisting of a director who was also chemist, three assistant chemists, meteorologist, and agriculturist or farm superintendent. There was little to be done, therefore, in the way of reorganization except to meet the technical requirements of the law and to enlarge the scope of work. On reorganization the control of the station was transferred from the State board of agriculture to the board of trustees of the North Carolina College of Agriculture and Mechanic Arts. From 1895 to November, 1898, the station carried on cooperative horticultural experiments at Southern Pines to test nitrogen, phosphoric acid, and potash on the various fruit and garden crops.

Another series of cooperative experiments had previously been carried on with individual farmers in a number of counties between 1887 and 1892. The object of these experiments was to test various proportions of fertilizing constituents and the adaptability of various crops to the State. In 1889 the staff was increased by the addition of a botanist and a horticulturist.

July 1, 1897, Prof. W. A. Withers, who had been professor of chemistry in the college since its foundation and who for some years previous to this had been assistant chemist in the station, became acting director, succeeding Dr. Battle. On the 4th of the same month the office of the director was removed from the building of the State department of agriculture to one of the college buildings. In September, 1897, work in horticulture, botany, and entomology was consolidated, and in October, 1898, the services of a veterinarian were added to the station, but were dispensed with again March 15, 1899. September 1, 1898, the fertilizer control work of the station, which had become very extensive, was separated from the experimental chemical work, and was organized as the fertilizer control division of the station, and in December of the same year the experimental chemical laboratory was transferred from the building of the State department of agriculture to the buildings of the agricultural college.

July 1, 1899, Dr. George T. Winston became president of the college and director of the station. At the same time the station was, by act of the State legislature, relieved of all inspection duties, and it now has no connection with them, with the exception that the director of the station is ex officio a member of the commission for controlling crop pests. The laboratory of the fertilizer control division reverted

to the board of agriculture and is now used by the State chemist. October 1, 1899, the farm that was provided for the agricultural division in 1886 was transferred to the horticultural division, and from that time the field work of the agricultural division has been carried on upon the college farm.

From its organization until 1887 the station was supported by the State department of agriculture from funds arising from the taxes on fertilizers. Since that time the fertilizer control, while connected with the station, was supported by fees received from the State department of agriculture for that purpose. The control work of the station was extended to include nursery and orchard pests. The station has also examined, unofficially, the purity and vitality of seeds and the purity of human foods offered for sale in the State and has published the results. The examination of seeds was discontinued in 1897 and of foods in 1899. The laws providing for inspection of nursery stock, prevention of infectious diseases of animals, and inspection of foods owe their existence directly to the preliminary work done by the station along these lines and to the station's active support of the bills before the legislature. July 1, 1899, all of these control duties were transferred to the State department of agriculture.

ORGANIZATION.

The governing board of the station is the board of trustees of the college, which consists at present of 21 members elected by the State legislature and the president of the college ex officio. The members of the present board were appointed for a term ending in 1901. At that time the members of the board are to be elected for terms of two, four, and six years, and their successors for terms of six years. The board holds two regular meetings each year, one in June and one in December. The compensation of members is $4 per diem and expenses. In the intervals between meetings the board is represented by an executive committee consisting of three of its members.

The staff consists of the president of the college (who is also director), chemist, agriculturist; horticulturist, botanist, and entomologist; veterinarian, two assistant chemists, assistant horticulturist, assistant botanist and entomologist, assistant agriculturist, clerk and bookkeeper, clerk, and stenographer, all elected by the board of trustees and holding office at the pleasure of the board. The director is the executive officer of the station and is responsible for its work.

EQUIPMENT.

The station makes use of the college buildings. The offices of the president and director, the station library, records and mailing room, office and library of the agriculturist, and the office, library, and laboratory of the chemist are located in the main building of the college

(Pl. CVII, fig. 1), which is a brick and stone building 70 by 60 feet, partly three stories in height and the remainder one, with basement under all. The division of horticulture, botany, and entomology is located in the horticultural building, which is a one-story brick structure 42 by 42 feet with basement to which are attached 4 glass structures. The station makes use of the college barn (Pl. CVII, fig. 2) and dairy building for experimental purposes. On the horticultural farm (Pl. CVIII, fig. 1), there are a dwelling, barn, office, poultry house (Pl. CVIII, fig. 2), and other buildings.

The station has the use of two farms, one for the agricultural and one for the horticultural division. Each contains about 25 acres. The station owns 2 horses, 6 head of cattle, 54 sheep, and 300 head of poultry, besides making use, when needed, of the college live stock, which consists of 3 horses, 2 mules, 50 head of cattle, and 25 hogs.

The station museums contain an herbarium of 3,485 species, 2,000 varieties of seeds of weeds and economic plants, 410 species of fungi, blights, rusts, mildew, and molds, 725 microscope slides representing work in vegetable histology, 1,000 specimens of insects, and 200 varieties of fruits of native plants. There is also a large collection of exotic plants contained in five greenhouses, and a collection of foreign vines in a grapery. The station library contains about 1,000 volumes, and station officers have access to the college library of about 4,000 volumes.

FINANCIAL SUPPORT.

The financial support of the station is now derived mainly from the national fund and the sale of farm products. Previous to July 1, 1899, the station also received fees for fertilizer analyses from the State department of agriculture. For the fiscal year ended June 30, 1899, the income of the station was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	14,166.66
Farm products	874.76
Miscellaneous	303.94
Total	30,345.36

LINES OF WORK.

The station now has no inspection duties (see p. 352). From its organization much attention has been given to studying the natural resources and conditions of the State. The station has discovered phosphate beds and has investigated their extent and value. It has similarly investigated the marl beds of the State. It has made analyses of agricultural chemicals, of compost and homemade fertilizers, and materials from which they can be made. The station has investigated that part of the fishing interests of the eastern part of the State that

FIG. 1.—NORTH CAROLINA STATION—MAIN BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—NORTH CAROLINA STATION—BARN AND CATTLE.

FIG. 1.—NORTH CAROLINA STATION—FARM USED BY THE HORTICULTURAL DIVISION.

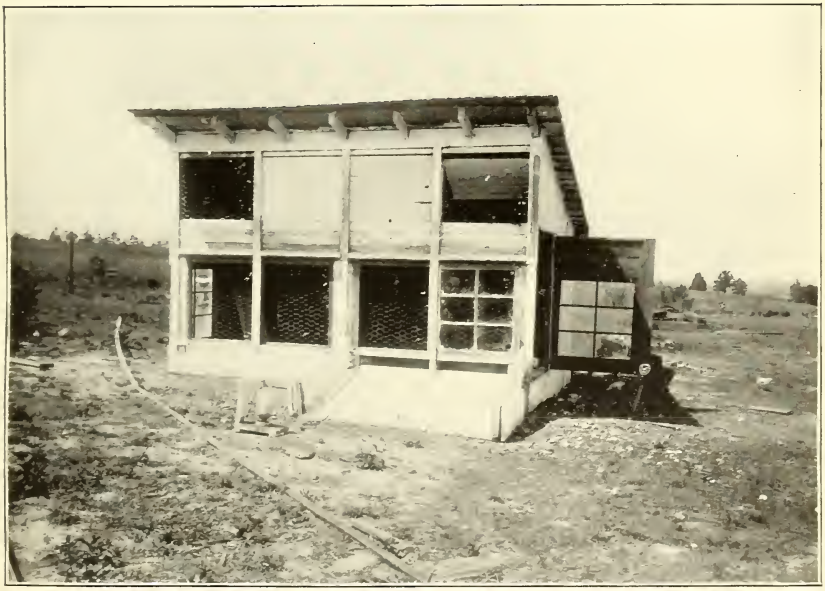

FIG. 2.—NORTH CAROLINA STATION—POULTRY HOUSE.

has to do with the catch of "fat backs," which are used in the manufacture of oil and fish scrap for fertilizer. It has explored pyrite deposits and ascertained their fitness for use in the manufacture of sulphuric acid. It has investigated the coal beds along the Deep and Dan rivers, and in cooperation with the State geologist has studied the soils of the State. In cooperation with the State board of health, it has made analyses of a large number of potable waters. With the aid of the Weather Bureau of the United States, it has made extensive meteorological observations, which have been compiled in a volume designated "The Climatology of North Carolina." Catalogues of the birds, flora, and medicinal plants of the State have been prepared, weeds have been studied and means of eradication suggested, and the native grasses, forage plants, grains, seeds, etc., have been studied from economic, botanical, and chemical standpoints. Studies have been made of the tobacco grown in different sections of the State, and of the suitability of the State for the culture of the sugar beet, crimson clover, and flowering bulbs. It has collected information in regard to methods of compost making, stock feeding, and dairying as commonly practiced, and made suggestions as to their improvement.

Among the scientific investigations at this station, work along the line of fertilizers has received most attention. Fine-ground phosphates have been critically studied with reference to their fineness and availability as fertilizers. Investigations have been made on the use of tobacco by-products as fertilizers, on the natural loss of ammonia from stable manure in drying, and on cowpeas as a fertilizer for wheat. Extensive studies have been made of the effect of different fertilizers on various soils of the State. Experiments in the improvement of worn-out land and tests of different crop rotations have received much attention.

Along lines of experiments with field and garden crops, variety and cultural tests with tobacco, garden vegetables, fruits, wheat, and cotton have been carried on, and studies made of curing tobacco. Experiments have been made looking to the improvement of existing methods of culture of these crops. The sugar content of a number of varieties of sorghum as grown on the station farm has been determined, and experiments have been made with a view to improving the crop and methods of manufacture of the sirup. Considerable attention has been given to growing crops new to the State. As a result the station has introduced the culture of clovers, vetches, and other leguminous crops, and broom corn. It has called attention to and demonstrated the possibilities of the successful culture of flowering bulbs on a commercial scale, an industry hitherto practically unknown in this country.

The station has made investigations on cotton seed and its products, and the by-products of the rice industry, showing their composition and value as feeding stuffs. Determinations have been made of the

feeding value of various field and forage grasses, of the digestibility of cotton seed, hulls, and meal, and of their value in the production of beef. Digestion experiments have also been made with most of the common cattle feeds. Experiments have been conducted to ascertain the effect of various feeds on production of milk and on the animals themselves. Analyses have been made of maize, cowpea vines, and soy beans at different stages of growth to determine the time at which they may be cut most profitably for fodder.

Along lines of botany and entomology much work of a technical nature has been done in connection with the inspection of seeds looking to the establishment of a uniform laboratory standard of quality. Field trials have been made of all obtainable varieties of cowpeas and soy beans. Studies have been made of the common insects and parasites of domestic animals of the State. Along lines of horticulture attention has been given to originating varieties of fruits and vegetables. Experiments are in progress in the culture of exotic grapes under glass. The division has introduced and distributed nearly 40 varieties of figs and has made numerous experiments in fig culture. It has originated an improved method of culture for the late crop of Irish potatoes.

Poultry culture has received some attention. Numerous tests have been made of methods of chemical analysis, especially for the Association of Official Agricultural Chemists. The station is now cooperating with the United States Department of Agriculture in the growing of Bermuda lilies.

DISSEMINATION OF INFORMATION.

Up to January 1, 1900, the station had issued 707 publications, contained in 10 series: (1) The annual report, an administrative document to which are appended copies of regular bulletins issued during the year. Twenty-two have been issued. (2) The biennial report, by law sent to the governor for transmission to the State legislature. It covers practically the same ground as the annual reports. Eleven have been issued. (3) The regular bulletins of the station, generally popular in nature. One hundred and sixty-nine have been issued. (4) Technical bulletins, issued in small editions and sent only to the station's scientific list, and to exchanges. Summaries of these bulletins appear in the regular bulletins. Seven have been issued in the separate series. This series has now been discontinued, and such publications are issued as regular bulletins. (5) Bulletins of meteorological division (State weather service). Eighty-three were issued. This series came to an end when the State weather service was discontinued in 1896. (6) The weekly weather crop bulletins, reporting the effect of weather upon crops during the growing season. Two hundred

and twenty-six were issued. This series has also been discontinued, for the same reason as in the preceding case. (7) Special bulletins, among which were classed biweekly fertilizer bulletins, giving reports of fertilizer analyses. Fifty-three were issued. (8) Press bulletins, of which eighty-five have been distributed. (9) The annual report of the meteorological division, containing various meteorological data, and reports upon the work done during the year. Nine were issued. As in the case of other meteorological publications, this series has been discontinued. (10) Information bulletins, issued from time to time, for the purpose of collecting information of a practical nature. Eight have been issued.

The mailing list contains 19,009 names, among which is at least one name from every post-office in the State. The station receives about 6,000 letters of inquiry a year, besides about 4,000 requests for bulletins. Station officers take part generally in farmers' institute work, the expenses of which are borne by the State department of agriculture. It has been customary for the station also to make an exhibit at the State fair, and usually a little folder is published to give information in regard to the exhibit. The station endeavors to have a representative present at every large gathering of farmers within the State. Members of the station staff have been instrumental in forming and maintaining the State Agricultural Society, State Horticultural Society, State Dairymen's Association, Swine Breeders' Association, and a section of the American Chemical Society.

GENERAL RESULTS OF WORK.

The North Carolina Station was one of the pioneers in the establishment of fertilizer control in the United States, and its efficient work in this line has been of much value, not only within its own State, but also wherever commercial fertilizers are used in this country. Its investigations on the manurial and feeding value of cotton seed and its products have also been of general value, and similar studies on forage plants grown in North Carolina and other parts of the South have been an important factor in the development of animal industry and dairying in that region and on the promotion of more diversified agriculture. The farmers of the State have been widely taught the desirability of more careful culture of their crops and the evils of continuous cropping, especially in the case of tobacco and cotton. They have been encouraged to make a wider use of cowpeas and other leguminous plants for green manuring, and to take effective measures to prevent the wasting of their hillside lands. Fruit growing and truck farming, with special reference to the requirements of northern markets at certain seasons of the year, have been actively promoted.

NORTH DAKOTA.

North Dakota Agricultural Experiment Station, *Agricultural College.*

Department of North Dakota Agricultural College.

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J. W. Dunham, D. V. S., *Veterinarian.*
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R. A. Shattuck, *Bookkeeper and Accountant.*

HISTORY.

The North Dakota Station is located near the capital, at the eastern boundary of the State, in the Red River Valley, the rich black bottom lands of which are productive of very large crops of wheat. The surface of the State consists very largely of great treeless plains and river valleys. There are, however, many trees in some regions. The soil is for the most part very fertile. The winters are severe and the summers comparatively cool. The atmosphere is generally dry and winds are prevalent. The annual rainfall is about 20 inches. Agriculture was begun in the State about 1860, and has taken the form of wheat growing, often on a very extensive scale on farms ranging from 3,000 to 10,000 acres. Besides very large crops of wheat, the principal crops are oats, barley, flax, potatoes, and hay. Large numbers of sheep, cattle, milch cows, and horses are produced. The State was admitted to the Union in 1889. The college with which the station is connected was established in 1890, and is developing along industrial and scientific lines.

The North Dakota Agricultural Experiment Station was organized in 1890 as a department of the North Dakota Agricultural College, with Prof. H. E. Stockbridge, now of the Florida Station, as director. He was succeeded in 1893 by Mr. J. B. Power, who was in turn succeeded in 1895 by the present incumbent.

ORGANIZATION.

The station is under the control of the board of trustees of the college, consisting of seven members appointed by the governor and confirmed by the legislature for terms of six years. Board meetings are

FIG. 1.—NORTH DAKOTA STATION—COLLEGE HALL, USED BY COLLEGE AND STATION.

FIG. 2.—NORTH DAKOTA STATION—BOTANICAL LABORATORY.

FIG. 1.—NORTH DAKOTA STATION—FRANCIS HALL, USED BY COLLEGE AND STATION.

FIG. 2.—NORTH DAKOTA STATION—BARNS.

held once a month. The compensation of members is $3 a day and mileage, paid by the State.

The staff consists of the president of the college (who is also director), chemist, agriculturist, veterinarian, arboriculturist, botanist, assistant botanist, dairyman, assistant agriculturist, farm superintendent, assistant chemist, and bookkeeper and accountant, appointed by the board of trustees for one year. The station council, consisting of the director and heads of divisions, plans lines of work, which must be approved by the board of trustees before being undertaken. Cooperative experiments are carried on, and many seeds, especially of grasses, wheat, and sugar beets, have been distributed to farmers.

EQUIPMENT.

Office and laboratory work is carried on for the most part in the college buildings. The offices of the director and the secretary are in College Hall (Pl. CIX, fig. 1), a three-story brick and stone building, 90 by 64 feet in which is also located the botanical laboratory (Pl. CIX, fig. 2). The divisions of agriculture, horticulture, veterinary science, and soil physics are located in Francis Hall (Pl. CX, fig. 1). Other buildings are the dairy building, used jointly by the college and station, a chemical laboratory, barns (Pl. CX, fig. 2), dairy, and greenhouse. College Hall is a three-story building, the first story being brown stone, the remainder cream-colored brick, with brown-stone trimmings, 90 by 64 feet. Francis Hall is a plain two-story building 128 by 48 feet, and is built of cream-colored brick. The chemical laboratory, as planned, is a three-story brick building, with brown-stone trimmings, 50 by 48 feet, with two wings each 50 by 28 feet, and two stories in height. Only one wing of this building is yet completed.

The college farm consists of 640 acres, of which 280 acres are used for general farming purposes, 40 acres for college campus, and about 140 acres for experimental fields. At the establishment of the station a tract of 40 acres was laid out in permanent plats of 1 acre each devoted to rotation experiments. Later the plats were reduced in area to one-third of an acre each. About 40 acres are also set apart for experimental work in horticulture and forestry.

The station owns 36 head of cattle, 23 horses, 15 sheep, and 15 hogs. In addition individual animals are occasionally purchased for use in special experiments.

The station has about 70 samples of the soils and 2,300 specimens of the native plants of the State. The collection of native grasses, the joint property of the college and station, is already complete. The station has a small collection of negatives and lantern slides illustrating methods and results of experimental work. The combined college and station library contains about 6,000 volumes. A separate station library is not maintained.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	2,463.77
Miscellaneous	319.14
Total	17,782.91

LINES OF WORK.

The station has no inspection duties. Its work has been mainly on the smuts of cereals and scab of potatoes, certain physiological problems of immediate importance in the production of those crops, trials of forage crops, feeding experiments, soil studies, dairying, and tests of fruits, vegetables, and forest trees adapted to the State.

The principal agricultural industry of North Dakota is grain growing. By reason of soil and climatic conditions, the State is well adapted for the production of an exceptionally fine grade of wheat for milling purposes, and this crop is by far the most important of any in the State. To the culture of this crop the station has given more attention than to any other line of experimental work. The botanical division has studied the relation of quality of seed to yield, and the effect of change of soil on the plant. It was shown that the common practice of exchanging seed is unnecessary. Some work has been done in hybridizing and selecting varieties adapted to local conditions. Variety tests have been made, and in connection with them a number of varieties were analyzed to determine their value for milling purposes. Cultural experiments have included a study of the moisture content and temperature of the soil under various methods of culture.

Cultural and variety tests with other cereals have also been carried on quite extensively. Observations have been made on different kinds of forage plants and their adaptation to local conditions. Among the forage crops which have received especial attention is broom-corn millet, which promises to be of great value, since it does not cause the so-called "rheumatism" in horses, as do the true millets. A general study is being made of the weeds of the State, the mustards receiving special attention. Observations have been made on the dissemination of weed seeds by winter winds.

The study of plant diseases has been an important line of work at the North Dakota Station from its organization. Extensive investigations have been made on the life history of the wheat smut, together with methods of combating it. A considerable number of structural studies have been made on the smuts, including the method of infection of stinking smut, oat smut, and barley smut, the period in the life of the

host plant at which infection takes place, the course of the smut filaments in the wheat plant, the formation of smut balls, and other similar problems. These studies afforded an explanation of the observed shrinkage in a crop affected by smut over and above the actual number of smutted heads. Observations have been made on the wintering of spores of stinking smut and on the influence of various treatments of seed grain. The potato scab has been much studied and experiments made with methods of prevention. The botanist, Prof. H. L. Bolley, has called attention to the fact that the fungus of potato scab may also attack sugar beets and some other roots.

The prevalence of typhoid fever led the botanist to make studies upon the growth of germs in drinking water in different localities of the State. Some work has been done on the bacteriology of milk in its relation to various phases of dairying, included in which were investigations on the relation of cheese curd inflation to the bacterial flora of foremilk and on the constancy of the species of bacteria in normal foremilk.

Various physiological problems concerned with potato growing have been investigated, especially problems connected with the selection of seed tubers and the hastening of maturity. Cooperative experiments with sugar beets have been carried on for a number of years.

The work of the horticultural division has been mainly along lines of selecting and developing hardy fruits, variety and cultural tests of vegetables, and experimental work in tree culture.

The station is endeavoring to assist in developing the stock-raising interests of the State, and to this end the chemist has made numerous analyses of Dakota-grown forage plants. The most important stock interest in North Dakota is the sheep industry. Experiments have been made by the station to obtain data as to the economy of fattening sheep on various feeding stuffs and the grain crops commonly grown in the State. A series of feeding experiments with cattle have been begun and results of feeding barley as compared with bran and shorts have been reported. The station has carried on experiments to determine the relative cost of hay and straw as coarse fodders in a winter maintenance ration for horses in North Dakota, and has made comparisons of various grain rations for work horses. Experiments in feeding millet to horses have been carried on with a view to discovering the cause of the sickness that is commonly observed to occur when horses are fed this substance exclusively as a coarse food. It was found that an infusion of blood into the joints takes place, destroying the texture of the bone, so that traction causes the ligaments and muscles to be torn loose.

The investigations by the chemical division have been confined mostly to studies of soil humus, especially the relation of the mineral constituents of the soil to humus and their transformations.

Preliminary studies have been made on the root systems of plants grown under natural field conditions, accompanied by mechanical analyses of the soil in which they have grown.

DISSEMINATION OF INFORMATION.

The station has issued 40 bulletins and 9 annual reports. The latter are administrative documents to which are appended technical articles. The mailing list contains about 5,000 names. The chemist, Prof. E. F. Ladd, is the author of a text-book on "Quantitative Analysis." He is also editor of "The Sanitary Home," a monthly publication devoted to foods and hygiene. The members of the staff take a prominent part in farmers' institute work. The director of the station has given a large number of addresses in various parts of the State on subjects of general interest to the people, especially on the work of the station and the college and their relation to the farmers of the State. An exhibit is made at the State fair each year. One of the railroads of the State has inaugurated a series of excursions, which bring 50 representative farmers from each county to the station and return them to their homes free of charge. This helps to distribute information regarding the station throughout the State.

GENERAL RESULTS OF WORK.

The North Dakota Station has done an important work in showing definitely that the fertile lands of the State are being rapidly depleted by continuous wheat growing and that by proper treatment this evil may be avoided, and in promoting the diversification of agriculture by aiding in the establishment of dairy farming and dairying, and the introduction of grasses and forage plants especially suited to different regions. Its investigations on wheat smut and potato scab and their repression have had practical results of widespread value.

OHIO.

Ohio Agricultural Experiment Station, *Wooster.*

GOVERNING BOARD.

Board of Control: J. T. Robinson (*President*), *Rockaway;* R. H. Warder (*Secretary*), *North Bend;* Luther M. Strong, *Kenton;* Governor George K. Nash, *Columbus;* Charles E. Thorne, *Wooster.*

STATION STAFF.

C. E. Thorne, *Director.*
W. J. Green, *Vice-Director; Horticulturist.*
J. F. Hickman, M. S. A., *Agriculturist.*
F. M. Webster, M. S., *Entomologist.*
A. D. Selby, B. S., *Botanist and Chemist.*
P. A. Hinman, *Bursar.*
C. W. Mally, M. S., *Assistant Entomologist.*
William Holmes, *Foreman of Farm.*
C. A. Patton, *Assistant Foreman and Meteorologist.*
Annie B. Ayres, *Mailing Clerk.*
Cary Welty, *Mechanic.*
Edward Mohn, *Superintendent of Substation (Strongsville).*
Lewis Schultz, *Superintendent of Substation (Neapolis).*

HISTORY.

The Ohio Station is located in the northeastern part of the State. The surface of Ohio is "an undulating plain, from 450 to 1,550 feet above sea level." The soils differ in different parts of the State and include limestone, sandy, clay, and swamp soils. The climate and rainfall vary considerably in different sections; the summers are warm and the winters relatively cold. The average annual temperature is about 50° F., and the annual rainfall about 40 inches. There is much woodland. The principal crops are hay, maize, wheat, oats, potatoes, and tobacco. Very large numbers of sheep and swine are maintained, and there are also numerous cattle, milch cows, and horses. The growth of very large manufacturing and commercial interests in the State, with the consequent increase of the urban population, and the increasing competition of the States farther west in grain growing and animal production, have led to increased attention to fruit growing, truck-farming, and dairying, which have now become very important industries. The practice of agriculture in a regular way in the State dates from about the time of its admission to the Union, which occurred in 1803.

Experimental work at the Ohio State University at Columbus was inaugurated with the establishment, in 1878, of a farm department, under the superintendence of Dr. Norton S. Townshend, professor of agriculture, with Charles E. Thorne as farm manager. Experiments were begun in the culture of different varieties of cereals, in the use of fertilizers, and in the feeding of animals.

April 17, 1882, the State legislature passed an act, introduced by Hon. J. H. Brigham, then State senator and now Assistant Secretary of this Department, establishing the Ohio Agricultural Experiment Station as an independent institution. By mutual agreement between the board of control of the station and the board of trustees of the university the station was located upon the university farm, about 25 acres of land being set aside for its work, and the professor of horticulture in the university, Prof. W. R. Lazenby, was made director of the station. In 1886 the professor of agriculture, Dr. Townshend, was made director and Professor Lazenby vice-director, these gentlemen both retaining their positions in the university, however, and serving the station without additional compensation.

During this period of its existence the financial support of the station was limited to annual appropriations from the State treasury which averaged $4,575 per annum. It had no income from fees nor from farm produce, the latter being turned over to the university. When the act of Congress of March 2, 1887, became operative the station was made its beneficiary in Ohio by act of the State legislature, and as it was deemed advisable by the board of control that the director should give his entire time to the work of the station, Mr. Charles E.

Thorne was called to that position and the station was reorganized under the national law April 2, 1888.

At the same time by mutual agreement between the board of trustees of the university and the board of control of the station, about 200 acres of the university farm was temporarily set apart for the use of the station without rent. This farm, however, lies entirely within the corporate limits of the city of Columbus, and at the time this agreement was entered into a member of the board of trustees of the university called attention to the possibility that the growth of the city would eventually make the farm of the university so valuable for other purposes than agriculture that it would be necessary for the station to look elsewhere for lands adapted to its work. This condition of affairs came about much more speedily than was anticipated by either party to this agreement. Within three years the city had constructed two great sewers through the farm and had paved the streets on three sides of it, and the board of control of the station realized that it would be futile to attempt to inaugurate upon this farm any line of work which would require a considerable period of time for its fruition, such as orchard planting or field experiments in the study of soil fertility, and therefore the State legislature was requested to permit the station to remove to some other location. This request was granted in an act passed in 1891 by which any county of the State was authorized to offer to the station a grant of money to be raised on bonds issued by the county for the purpose, in consideration of the location of the station within its limits. Several counties acted at once under this authority, and the offer of Wayne County of $85,000 was accepted by the board of control, lands were purchased, and the station was moved to the new location at Wooster, September 1, 1892.

Litigation followed this action and the law under which the bonds of the county were issued was declared unconstitutional on the ground that the people of a portion of the State were being taxed for an institution whose operations were general. This decision came after the purchase of lands for the relocation of the station, the removal of the station to this location, and the erection of part of the buildings required for its use. The State finally came to the relief of both station and bondholders by redeeming the bonds of the county and by making further appropriations for the erection of buildings, the purchase of live stock, etc., and the present equipment was completed on June 3, 1897, by the dedication of the administration building, several minor buildings having been previously erected.

ORGANIZATION.

There is at present no connection between the station and the college of agriculture of the State University. The station, however, still occupies about 7 acres of the university farm, which is used as a sub-

FIG. 1.—OHIO STATION—ADMINISTRATION BUILDING.

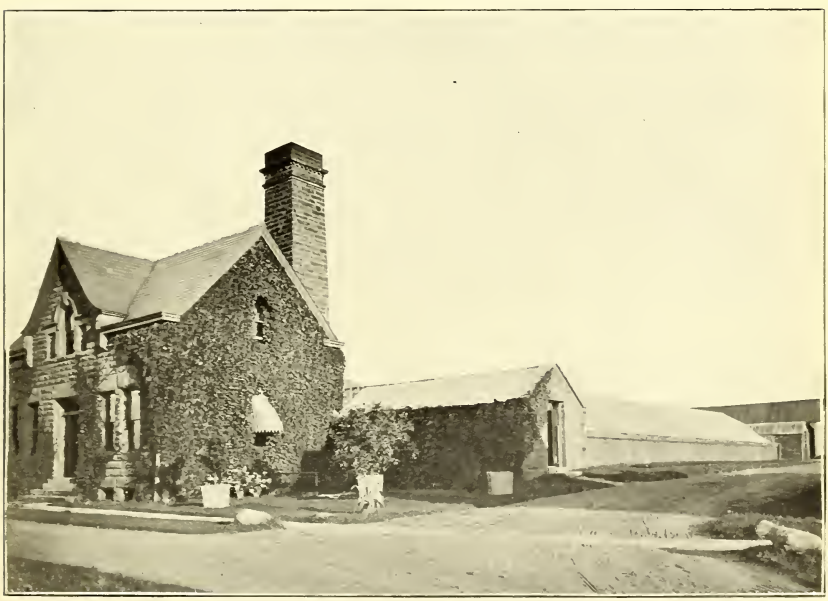

FIG. 2.—OHIO STATION—HORTICULTURAL BUILDING AND GREENHOUSES.

FIG. 1.—OHIO STATION—INSECTARY.

FIG. 2.—OHIO STATION—GRAIN AND DAIRY BARN.

FIG. 1.—OHIO STATION—FIELD EXPERIMENT WITH SOY BEANS, RAPE, AND COWPEAS.

FIG. 2.—OHIO STATION—FIELD EXPERIMENT WITH MAIZE.

station for experiments with fertilizers in continuation of work begun while the station was located on this farm.

The board of control consists of the governor of the State, 3 members appointed by him, and the director of the station. The term of office of appointive members of the board of control is three years, that of the director is indeterminate. The president of the board of control acts as auditor of the station accounts. The board of control is responsible for the general policy of the station, the director acting as the agent of the board in carrying out this policy. One annual meeting of the board is provided for by law. It meets at other times, as business requires, on call of the president. The members of the board of control are repaid from the State treasury for their actual expenses in attending the meetings, but receive no other compensation.

The staff consists of the director, vice-director (who is also horticulturist,) agriculturist, entomologist, botanist and chemist, bursar, assistant entomologist, farm foreman, assistant foreman and meteorologist, mailing clerk, mechanic, and two superintendents of substations. These officers are appointed by the board of control. Nominally the terms of office are one year, but in practice they are indeterminate.

The station maintains two substations on land leased for the purpose. In 1888 it began the continuous culture of maize, oats, and wheat with fertilizing mixtures and without any fertilizer or manure on a tract of heavy clay belonging to the State University at Columbus. That work is still carried on under the station's management. At the same time it began an experiment in the continuous culture of maize, both with and without fertilizers, on a thin shaly soil in the eastern part of the State, which is still in progress. In 1893 a tract of forest land was leased in the northwestern part of the State. The land was cleared and experiments with fertilizers were begun. The soil in this section is chiefly a yellow sand, formerly part of the lake beach, and is very unproductive, especially when first cleared. The problem here was to learn something of the treatment of the extremes of sandy soil as compared with the clays under experiment elsewhere. In 1894 another tract, quite opposite in character to that just mentioned, was leased in the northern part of the State, and extensive experiments in the use of fertilizers were begun on it. These different tests bring under observation soils of widely different character, varying from the heaviest clay to dune sand with several gradations between.

EQUIPMENT.

The station buildings comprise: (1) The administration building (Pl. CXI, fig. 1), a fireproof, stone building containing nine office rooms and libraries, a chemical laboratory of five rooms, a bacteriological laboratory, mailing rooms, printing office, assembly room, and museum. (2) Horticultural building and greenhouses (Pl. CXI, fig. 2) the latter

containing about 10,000 feet of glass. A part of one of the greenhouses is used as an insectary (Pl. CXII, fig. 1). (3) A biological laboratory containing two workrooms, with glass houses attached. (4) A grain and dairy barn (Pl. CXII, fig. 2), 41 by 250 feet, with dairy house attached, and containing stalls for about 80 cattle, three silos, a granary of several hundred drawers, holding 2 to 4 bushels each, for holding the products of the one-tenth-acre plats used in the station's field tests, machinery for thrashing, cutting silage, grinding feed, etc. The special point kept in view in building this barn was to give as uniform exposure as possible to the cattle under experiment, hence the stalls for experimental feeding are arranged in a single row. (5) A tool and implement house, 30 by 112 feet. (6) A horse barn, 40 by 100 feet. (7) A cattle and sheep barn, 40 by 100 feet, with wing 30 by 100 feet. (8) A horticultural barn with cold-storage rooms. (9) Seven dwellings. The total value of all these buildings is about $100,000.

The station owns 470 acres of land and occupies 150 more, held under lease for substation purposes. About 26 miles of tile-drains were laid on the station farm as the first preliminary to putting the land in condition for experimental work. Selected portions have been laid off into one-tenth-acre plats. The plats have been slightly ridged so as to cause the surplus water of heavy rains to flow off as uniformly as possible. They are arranged in sections of 10 to 90 plats each, and each section is now plowed across the plats in order to avoid the effect of differences in time of plowing. Including the substations, about 1,400 plats are now permanently laid out. Of these 550 are devoted to variety testing of cereals and 850 to experiments with fertilizers. In addition, numerous temporary plats are under observation each year in cultural work. (Plats of soy beans, rape, and cowpeas are shown in Pl. CXIII, fig. 1. Fig. 2 of the same plate is a view in one of the maize fields.)

The station owns about 60 pure-bred cattle of the Jersey, Guernsey, Holstein, Durham, Red Polled, and Aberdeen Angus breeds, and flocks of sheep of the Oxford, Shropshire, Southdown, Dorset, and Delaine Merino breeds. The object of the cattle test is to study the relative food cost of beef and butter production with the different breeds, after due allowance is made for the incidental products of beef in the dairy breeds and milk and butter in the beef breeds. The live stock, as a whole, is kept with the further design of studying the relation of animal husbandry to the maintenance of fertility. Additional animals are occasionally purchased for special experiments.

The station has an herbarium of about 4,000 specimens and a collection of about 4,000 insects, about one-half of which have been reared and studied at the station, and is accumulating collections of grains, photographs, etc. The station library contains about 1,600 bound volumes.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, appropriations for special purposes from the State treasury, sales of produce and rents of buildings, and fees for conducting tests of dairy cattle, chemical analyses, and nursery inspection. The appropriations by the State have varied from $2,000 to over $85,000 a year since 1889, averaging about $21,000 a year. The income of the station during the last fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	10,000.00
Farm products and rents	6,283.36
Fees	267.81
Balance on hand July 1, 1898	8,549.31
Total	40,100.48

LINES OF WORK.

The station is not permanently charged with any inspection duties. It has temporarily undertaken the inspection of nurseries until that work shall be otherwise provided for.

The leading work of the station has been to adapt the results of scientific investigations to the conditions which actually prevail on the farms of Ohio. This has been done with the expectation that by this method the farmers may the more rapidly be educated to the point where they can understand and apply for themselves the results of scientific research. To this end the station has made a specialty of field and feeding experiments conducted on the basis of actual farming operations. It has superintended the making of many experiments with fertilizers and with varieties of cereals and potatoes on farms throughout the State. It has leased large commercial orchards or has kept special agents in such orchards working in cooperation with the owners in the study of fungus diseases of orchard trees and fruits, and has continued this work for a number of years in order to learn the effects of varying seasons, and to work out the most practical methods of treatment. It has carried on similar work in the fields of commercial cucumber and melon growers. It has distributed large quantities of chinch-bug fungus in regions infested with the chinch bug, and its entomologists spend a large portion of their time in visiting regions of the State infested with destructive insects, studying methods of control, and giving personal instruction to the farmers and fruit growers. In cooperation with the United States Department of Agriculture and with farmers the station has made a survey to determine whether the climate and soil of the State are adapted to the profitable production of sugar beets.

The investigations on the maintenance of fertility now in progress

at the station include field experiments with fertilizers and manures on 850 permanent plats, chiefly of one-tenth acre each, located in five regions of the State and upon soils widely different in character. The field work is accompanied by chemical analysis of the soils under test, of the fertilizers employed, and of some of the crops produced. Some of this work has been in progress for twelve seasons and the larger portion of it for six seasons.

The experiments in cattle feeding have thrown light upon several problems, such as the relative value of roots in feeding, the comparative food cost of butter fat and increase in live weight, the effect of age and period of feeding upon the productivity of food, and that of period of lactation upon quantity and composition of milk. Additions have been made to our knowledge concerning the nature of bovine tuberculosis and the efficiency of tuberculin as a diagnostic.

The station has worked out a method of watering greenhouse plants by subirrigation which throws new light upon one of the problems of plant growth, as the plants grown by this method, though grown in water-tight, undrained beds, make a more rapid growth and are less subject to disease than those grown in the ordinary manner. The station has worked out a method of transplanting onions which has contributed to increase the profit in their culture.

In the entomological division numerous observations have been made on food and other habits of various insects. The presence of a number of species in the State was first recorded by the entomologist, and that officer has shown that the plum curculio may be controlled by the use of arsenical poisons. Considerable studies have been made of the Hessian fly, especially with reference to its habits, including hibernation, number of broods, and date of appearance of fall brood as regarding latitude. The entomologist has pointed out the existence of two races of the chinch bug and has mapped the distribution of each. It has been shown that the long-winged race attacks grain and the short-winged race timothy meadows. The division has called attention to the fact that the spraying of fruit trees with arsenites while in bloom is liable to cause the death of bees visiting them. This station first suggested applying arsenites and Bordeaux mixture at the same spraying.

Along the line of plant diseases the work of the station has been directed to the investigation of fungus diseases, including the parasites producing them and the control of these troubles on a commercial scale. In the successful control of the apple scab by the use of Bordeaux mixture the station was early in the field. It was also early shown that the anthracnose of the raspberry may be successfully controlled by Bordeaux mixture. Various diseases of the peach have been subjects of especial investigation. In the study of forcing house diseases the prevalence of nematode worms was made known and methods of treatment suggested. A new disease of forcing-house lettuce, the

anthracnose, was brought to light and described. The station has recorded the successful treatment of oat smut by shortened immersion in hot water of higher temperature than usually employed. Investigations have been made on the life history of the fungus of wheat scab.

Four bulletins have been issued in a technical series in which have been placed on record some of the results of a technical character incidental to the investigations of the station. The leading object in view in these bulletins has been the collection of material which may ultimately be utilized in a biological survey of the State. These studies have thus far included, among others, contributions to the life history of certain plant lice; a descriptive catalogue of the shells of Franklin County, Ohio; studies on the methods of oviposition in the Tipulidæ; descriptions of a number of species of Diptera and Hymenoptera and a species of Chlorops; observations on a number of new and rare Ohio plants and their distribution; a preliminary list of the Uredineæ of Ohio, and a catalogue of the Erysipheæ of the State. Observations have been made on the germination of seeds treated with various chemicals.

DISSEMINATION OF INFORMATION.

During the first six years of the existence of the Ohio Station its permanent publications were limited to its annual reports, such bulletins as were issued being intended only as advance reports for the use of the press. Their substance was afterwards incorporated in the annual reports, and no complete file of these bulletins has been preserved. Beginning with the reorganization under the act of Congress, the bulletins were given a more permanent character, those for 1888, however, being incorporated in the seventh annual report. For 1889, 1890, 1891, and part of 1892 the bulletins were numbered in annual volumes only, but with number 42 consecutive numbering was begun and has since been maintained, the last issue being No. 113. The annual report of the station is at present a brief summary of the year's work, with financial statement. It is numbered consecutively with the bulletins.

There are now about 32,000 addresses on the mailing list, which is kept by post-offices and counties. The entire list is printed for use in the mailing machine. One chief mailing clerk, one printer, and one to three assistants are employed in this work.

Occasional circulars or special bulletins have been issued for local or temporary purposes. Press bulletins have been issued occasionally since 1888, of which series No. 193 is the latest. These bulletins are now issued in regular form as two-page leaflets. Several of the station officers are regular contributors to the agricultural press.

The correspondence amounts to about 12,000 letters a year. The members of the staff have participated regularly in farmers' institute work in cooperation with the State board of agriculture, and an

exhibit is annually made at the State fair. It has been found necessary to limit the station's work in both of these directions because of interruption of the work of investigation

The station assists the Agricultural Student's Union of the State, an organization of students and alumni of the college of agriculture of the State University, in conducting experiments over the State. This organization has its director and other officers, one of whom is located at the station. The station assists in furnishing seeds, fertilizers, etc., in suggesting methods of experiment, and in publishing results.

GENERAL RESULTS OF WORK.

The Ohio Station has done much to show the farmers of the State how the fertility of their lands may be maintained by more careful culture and the discriminating use of fertilizers. They have also been taught how to reduce the cost and increase the effectiveness of the fertilizers. The work of this station has also been an important factor in the development of dairy farming and dairying in the State on the basis of modern business methods and scientific knowledge.

Many fruit growers have stated that their crops have been largely increased by following the station's advice in regard to spraying orchards with Bordeaux mixture. Cucumber and melon growers have given similar testimony. The treatment of seed grains for the prevention of smut is being largely extended in consequence of the station's work. Farmers have saved their crops from the chinch bug by timely use of the fungus furnished by the station. Many growers of vegetables and plants under glass are adopting the method of subwatering devised by this station. The variety tests of this station have been made use of to a large extent by the grain and fruit growers of the State with marked improvement of crops.

OKLAHOMA.

Oklahoma Agricultural Experiment Station, *Stillwater.*

Department of Oklahoma Agricultural and Mechanical College.

GOVERNING BOARD.

Board of Regents: F. J. Wikoff (*President*), *Stillwater;* James P. Gandy, *Alva;* Governor C. M. Barnes, *Guthrie;* C. J. Benson (*Treasurer*), *Shawnee;* J. C. Tousley, *Weatherford;* W. E. Bolton, *Woodward.*

STATION STAFF.

A. C. Scott, M. A., LL. M., *President of the College.*

John Fields, B. S., *Director; Chemist.*

E. E. Bogue, M. S., *Botanist and Entomologist.*

L. L. Lewis, M. S., D. V. M., *Veterinarian.*

F. C. Burtis, M. S., *Agriculturist and Horticulturist.*

Oscar M. Morris, B. S., *Assistant Horticulturist.*

A. G. Ford, B. S., *Assistant Chemist.*

J. G. Kerr, B. S., *Assistant Agriculturist.*

H. M. Hand, *Clerk.*

Miss G. M. Holt, *Stenographer.*

HISTORY.

The Oklahoma Station is located in the northern part of the Territory. The surface of the Territory is in general an elevated prairie, rising gradually toward the west. The soil is generally fertile. The summers are warm and the winters relatively cold. The annual rainfall is about 35 inches, but decreases toward the west. In the east trees are numerous, especially along the water courses and among the hills; the western half of the Territory is a treeless plain on which nutritious grasses grow. Hot winds and drought are obstacles to agriculture here as elsewhere in the southern half of the Great Plains. The principal crops are maize, wheat, oats, sorghum, Kafir corn, and cotton. Cattle and hogs are produced in large numbers. The Territory was opened to settlement in 1889, from which time the regular practice of agriculture dates. Population came in very rapidly for a time and now is estimated to include about 375,000 people, who are for the most part engaged in agricultural pursuits. The college with which the station is connected was established in 1890, and is being developed mainly along industrial and scientific lines.

The first legislature of the Territory of Oklahoma accepted the provisions of the act of Congress of October 27, 1890, only eighteen months after the Territory was opened for settlement, and established the Oklahoma Agricultural Experiment Station as a department of Oklahoma Agricultural and Mechanical College. August 14, 1891, Prof. J. C. Neal, who had formerly been connected with the Florida Station, was elected director, and work was begun in December of that year by plowing the prairie of the station farm. In June, 1895, Professor Neal was succeeded by Prof. G. E. Morrow, the president of the college and one of the pioneers in work in agricultural education and research in this country, who for many years had been professor of agriculture in the University of Illinois, as well as director of the experiment station in that State. In July, 1899, Prof. John Fields assumed the duties of the office.

ORGANIZATION.

The station is governed by the board of regents of the college, which consists of the governor of the Territory ex officio, and 5 members appointed by him, with the approval of the Territorial council, for a term of two years or until their successors are appointed. The law requires four regular meetings during the year and fixes the compensation at $5 a day and 10 cents a mile for travel in attending meetings, paid from Territorial appropriations.

The staff consists of the president of the college, director (who is also chemist), botanist and entomologist, veterinarian, agriculturist and horticulturist, assistant horticulturist, assistant chemist, assistant agri-

culturist, clerk, and stenographer. All members of the staff are appointed by the board of regents at its meeting in June for a term of one year. The director, in consultation with the other members of the staff, determines the lines of work to be pursued and supervises expenditures authorized by the board.

EQUIPMENT.

Previous to 1899 the station carried on all of its work in three small frame structures. Since that time the chemical division has had its quarters in a wing of the new chemistry building (Pl. CXIV, fig. 1). There are two laboratories, a balance room, library, and sample room. A basement is under the entire wing and contains a workroom, with grinding mills and motor. The offices of the director and clerk are also in this building, communicating with each other and with the laboratories. The building is heated by steam. (Pl. CXIV, fig. 2, gives a general view of the buildings and grounds of the college and station, and Pl. CXV, fig. 1, of one of the college edifices, the mechanic arts building.)

About the 1st of April, 1900, the veterinary division will have quarters on the second floor of the library building, now being erected at a cost of $20,000. This building is of brick and stone, about 80 by 80 feet, two stories and basement. The divisions of agriculture and horticulture will be located in the frame buildings formerly occupied by the chemist and veterinarian, respectively.

The station makes use of the college farm of 200 acres. Of this area a campus of about 30 acres has been set aside and is cared for with college funds. Nine acres are laid out in a series of half-acre plats devoted to tests of rotations or continuous culture of different field crops. Other plats vary with the nature of the experiment. Long, narrow plats are preferred on account of the lack of uniformity of the soil. No general field crops are grown, aside from alfalfa, and even this is as yet in the experimental stage and is hardly regarded as a staple crop. A native grass pasture of about 30 acres furnishes feed for the stock during the summer and gives means of securing data on this method of feeding.

Approximately 50 acres are assigned to the division of horticulture for use in testing varieties of orchard and small fruits, work which was begun with the establishment of the station. When the experimental features of the work are completed, it is expected that the college will assume control of the orchard.

The station keeps a small flock of sheep, and a varying number of hogs and steers are purchased from time to time for use in feeding experiments. It has no dairy herd at present. It has a collection of 2,400 specimens of native plants and a similar collection of insects. Specimens of the grain and straw of more than 200 varieties of wheat

FIG. 1.—OKLAHOMA STATION—CHEMISTRY BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—OKLAHOMA STATION—BUILDINGS AND GROUNDS OF COLLEGE AND STATION.

FIG. 1.—OKLAHOMA STATION—MECHANIC ARTS BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—OKLAHOMA STATION—SEVEN-YEAR-OLD MAPLE TREES, IRRIGATED AND UNIRRIGATED.

and a collection of native and introduced grasses are also owned by the station. The college has a small collection of minerals, lantern slides, microscope slides, models of plants and animals, and zoological specimens, which are available for the use of station workers. The station library contains, approximately, 1,000 volumes, exclusive of reports and bulletins of similar institutions. The combined library of the college and station, numbering about 5,000 volumes, is available for station purposes.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	1,046.63
Balance on hand July 1, 1898	1,275.94
Total	17,322.57

LINES OF WORK.

The station has no inspection duties. As the station was established in a region in which agriculture was just being introduced, its first task was to determine the natural conditions of climate, soil, and vegetation, and the adaptability of different varieties of cultivated plants to them. With wheat variety and cultural tests have been carried on continuously since the establishment of the station. Experiments with maize have shown that deep plowing is preferable to shallow plowing. Comparisons of drilling and listing gave results generally favorable to the former practice. Experiments in frequency and depth of cultivation, thickness, and time of planting have been carried on and numerous tests of varieties have been made. Experiments with Kafir corn were of a similar nature. They indicated that Kafir corn may be planted later than maize, and should be planted thicker. The experience and observation of the station, extending through a period of seven years, show that in general maize should be grown on bottom land and Kafir corn on upland. The station is encouraging the cultivation of cotton in the Territory as one of a number of crops in a system of general farming, and various tests of varieties and cultural methods have been made looking to this end. Experiments have been made with castor beans with reference to time and thickness of planting and the amount of plant food required by the crop. While no varieties of castor beans are distinguished, the station has pointed out that the yield may be materially increased by careful selection of seed.

Since Oklahoma is in a semiarid region, the question of forage plants adapted to local conditions is one of much importance. Repeated tests of the common cultivated grasses and clovers have shown that they are not adapted to the climate, but it has been demonstrated that alfalfa can

thrive under local conditions. Experiments have also been carried on with cowpeas as a forage crop. Tests have been made of the adaptability of the sugar beet to local conditions, and experiments have been carried on with it as a food for stock. Tests of a large number of varieties of fruits and nuts are now in progress.

The subject of cultivation in its relation to soil moisture has received considerable attention. Experiments have been made to determine the effect of manure and subsoiling on soil moisture, the effect of rolling land, and the time of plowing. The station is giving attention to methods of maintaining the fertility of the soil, which is as yet unexhausted. Looking to this end studies have been made of the staple crops of the Territory in their relation to the fertility of the soil, accompanied by studies of methods of reducing the loss of plant food to a minimum. A number of analyses have been made of drinking waters, and the waters of a number of streams have been analyzed to determine their fitness for irrigation purposes.

The station has paid considerable attention to feeding experiments with Kafir corn and studies of its digestibility, and various food analyses have been made. Experiments in dipping cattle to free them from Texas fever ticks have been carried on. Some experimental work has been done with a view to introducing the dairy industry into the Territory. The botanist has made a preliminary survey of the weeds of the Territory, and has studied their means of dissemination. Experiments in growing forest trees are being carried on in cooperation with the Division of Forestry of the United States Department of Agriculture. (Pl. CXV, fig. 2, shows some seven-year old maple trees on the station farm and incidentally the superior results obtained by irrigating forest trees in the climate of this Territory.)

DISSEMINATION OF INFORMATION.

Up to January 1, 1900, the station had issued 42 bulletins and 10 annual reports. Press bulletins are prepared monthly and sent to the newspapers of the Territory. They are made of as general and popular interest as possible, and serve chiefly to call attention to the work of the station. The annual report now contains accounts of experimental work in addition to the usual administrative features, though up to 1898 it was an administrative document exclusively. The mailing list contains 13,120 names and the correspondence amounts to about 3,500 letters a year. The station cooperates with agricultural associations when possible, but this feature of the work is as yet quite limited. Exhibits are made at fairs when possible.

GENERAL RESULTS OF WORK.

The Oklahoma Station has already done considerable useful work in aiding farmers in the introduction of crops suited to the Territory, especially alfalfa, cowpeas, sweet potatoes, and Kafir corn as food for

live stock, and improved varieties of wheat, maize, and oats. It has also shown the benefit of more careful culture of crops and the desirability of increasing humus in the soils of the Territory. Its investigations on the culture and nutritive value of Kafir corn have been one of the important factors in demonstrating the great value of this crop in promoting the development of animal husbandry in those portions of the West where hot winds and drought make the successful growth of maize uncertain.

OREGON.

Oregon Experiment Station, *Corvallis.*

Department of Oregon State Agricultural College.

GOVERNING BOARD.

Board of Regents: J. T. Apperson (*President*), *Oregon City;* John D. Daly (*Secretary*), *Corvallis;* B. F. Irvine (*Treasurer*), *Corvallis;* W. E. Yates, *Corvallis;* J. K. Weatherford, *Albany;* Governor T. T. Geer, *Salem;* F. I. Dunbar (*Secretary of State*), *Salem;* J. H. Ackerman (*State Superintendent of Public Instruction*), *Salem;* W. M. Hilleary, *Turner;* W. P. Keady, *Portland;* Benton Killin, *Portland;* J. M. Church, *Lagrande;* B. S. Pague, *Portland.*

STATION STAFF.

Thomas M. Gatch, M. A., Ph. D., *President of the College and Director.*

James Withycombe, V. S., *Vice-Director; Agriculturist.*
George Coote, *Florist and Gardener.*
A. B. Cordley, B. S., *Entomologist.*
E. R. Lake, M. S., *Horticulturist and Botanist.*
G. W. Shaw, M. A., Ph., D., *Chemist.*
John F. Fulton, B. S., *Assistant Chemist.*
C. M. McKellips, Ph. C., *Assistant Chemist.*
F. L. Kent, B. S. Agr., *Assistant Agriculturist and Dairy Instructor.*
E. F. Pernot, *Bacteriologist.*
T. H. Crawford, *Clerk and Purchasing Agent.*
Helen Holgate, *Stenographer.*

HISTORY.

The Oregon Station is located in the western part of the State in the fertile valley of the Willamette River between the Coast Range and the Cascade Mountains. The State is divided into two quite distinct regions. Western Oregon is a mountainous region, with peaks often rising above 10,000 feet, interspersed with fertile valleys having alluvial soils. The rainfall is abundant and the climate mild in both winter and summer. There are very extensive forests. Eastern Oregon is very largely a high arid table-land, with mountains especially in the northern part, among which are well-watered valleys. The soil is of volcanic origin and wherever sufficient water can be obtained is very productive. The summers are relatively hot and dry and the winters colder than in western Oregon.

The principal crops are hay, wheat, oats, and potatoes. Numerous sheep, cattle, and horses are produced. Fruits, especially grapes,

peaches, and prunes, are being extensively grown. Oregon was made a Territory in 1848, from about which time the regular practice of agriculture in this region dates, and was admitted to the Union in 1859. The necessity of clearing the land of trees and the lack of transcontinental railroad facilities until recent years have made the growth of population and the development of industries comparatively slow. The college with which the station is connected was established in 1868 and has developed chiefly along industrial and scientific lines.

The Oregon Agricultural Experiment Station was organized July 2, 1888, in accordance with the act of Congress as a department of the Oregon State Agricultural College, with Prof. E. Grimm as director. In 1889 the board of regents created a station council, of which the president of the college is ex officio president. Since 1891 the president of the college has served also as director of the station. At that time Prof. B. L. Arnold became director, being succeeded, however, the next year by Prof. J. M. Bloss in the same capacities. In 1897 Prof. H. B. Miller was appointed to these positions, but served only a few months. He was succeeded the same year by the present incumbent.

ORGANIZATION.

The governing board of the station is the board of regents of the college, which consists of the governor, secretary of state, superintendent of public instruction, and the master of the State grange, ex officio, and 9 members appointed by the governor for terms of nine years, and confirmed by the senate. This board has general management of all station affairs. Immediate control of the station is exercised through three of its committees—those on agriculture and chemistry, horticulture and entomology, and institutes—which committees submit reports on the station to the board of regents at their regular meetings. Considerable freedom is granted to the director and heads of divisions in the choice of lines of work. Meetings of the board are held regularly twice a year. The secretary receives $500, the treasurer $400, and other members traveling expenses only, paid by State appropriation from local income.

The staff consists of the president of the college (who is also director), vice-director and agriculturist, florist and gardener, entomologist, horticulturist and botanist, chemist, two assistant chemists, assistant agriculturist and dairy instructor, bacteriologist, clerk and purchasing agent, and stenographer. These officers are appointed by the board of regents. The station council, consisting of the director of the station, agriculturist, botanist, chemist, entomologist, and bacteriologist, prepares plans of scientific work, with financial estimates for carrying out the same, and submits them to the board of regents for approval. It prepares and submits to the board the drafts of bulletins which it is proposed to publish, and assists in the farmers' institute work held

FIG. 1.—OREGON STATION—ADMINISTRATION BUILDING, USED BY COLLEGE AND STATION.

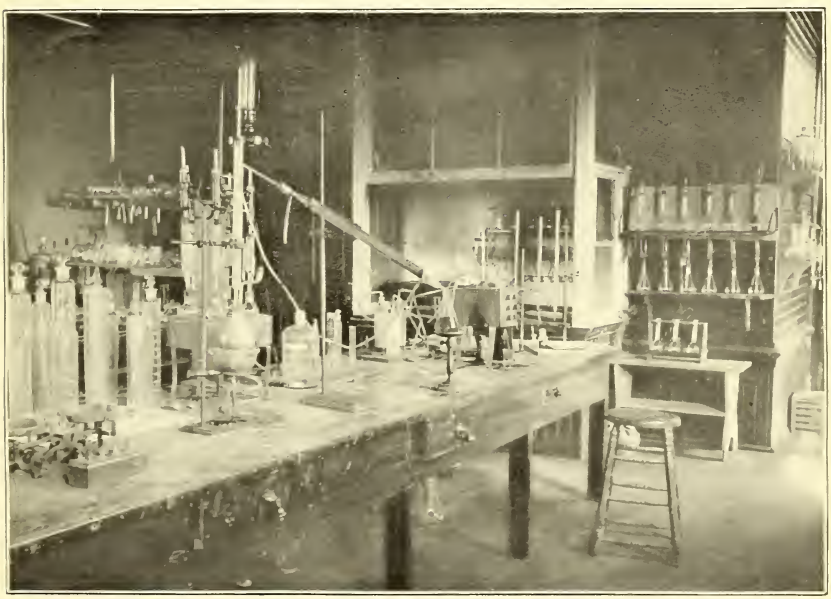

FIG. 2.—OREGON STATION—CHEMICAL LABORATORY.

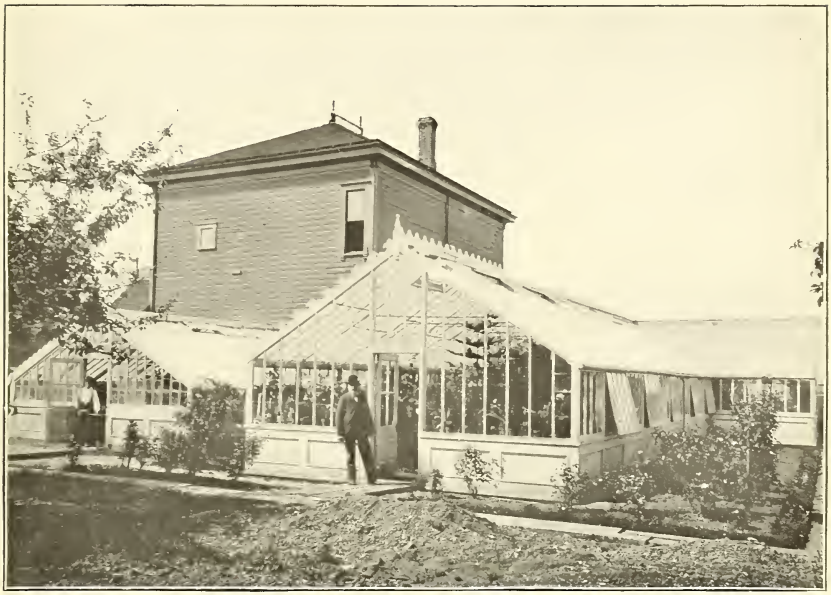

FIG. 1.—OREGON STATION—HORTICULTURAL BUILDING.

FIG. 2.—OREGON STATION—INSECTARY.

under the direction of the agricultural college. The director presides at the meetings of the station council, distributes the work, receives reports, and, in conjunction with the treasurer and board of regents, audits all accounts.

At its regular biennial sessions the State legislature appoints a committee, composed usually of five of its members, to examine into the condition of college and station and to ascertain their needs.

EQUIPMENT.

The buildings occupied by the experiment station, wholly or in part, comprise an administration building, chemical laboratory, Mechanical Hall, horticultural building, insectary, and barn. The administration building (Pl. CXVI, fig. 1) is a three-story brick structure, 75 by 100 feet, in which, besides class rooms, there are the offices of the director and vice-director and two chemical laboratories used in part for experimental purposes. The chemical laboratory, proper, is a one-story building with stone basement. The office of the station chemist (Pl. CXVI, fig. 2) is in this building. Mechanical Hall, known also as Morrill Hall, is a two-story stone building. Located in it are the station printing office and the botanical division. The horticultural building (Pl. CXVII, fig. 1) is a wooden structure, in which are located the office and laboratory of the horticulturist, photographic room, and the bacteriological laboratory. The insectary is shown in Pl. CXVII, fig. 2.

The station makes use of the college farm, which consists of about 131 acres of arable and pasture lands. Ten acres are set apart for field work in horticulture and investigations of fungus diseases and insect pests. Ninety-five acres are devoted almost entirely to growing experimental crops, consisting mainly of grasses, legumes, cereals, vegetables, maize, and fiber plants, and 25 acres are in permanent pasture.

The station live stock comprises 20 head of Jersey cattle, 3 Shorthorns, 21 sheep, 10 hogs, and 7 horses. The Jerseys are kept for experimental work in dairying and for the purpose of studying the influence of environment upon milk secretion. The Shorthorns are used in experimental work in beef production. The sheep are used for experimental work in the production of wool and mutton.

The collection of specimens in the botanical department of the station and college museum includes about 8,000 herbarium specimens of plants, representing nearly the entire west-coast flora of the State. In the entomological department of the museum there are about 12,000 specimens of insects mounted and 216 in alcohol. There is also a small collection of photographs, 100 lantern slides, and 840 mineralogical specimens. The station library contains about 1,200 volumes and the college library about 5,000 volumes. The two libraries are not kept separate.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	594.36
Balance on hand July 1, 1898	1,237.31
Total	$16,831.67

LINES OF WORK.

The only inspection duties imposed upon the station are in connection with the State dairy and food commissioner, for whom the chemist makes food analyses. No revenue is derived from this work.

Oregon is a comparatively new State, and the station's work has thus far been to gather information as to existing natural conditions and agricultural adaptabilities. The most extensive systematic study of the natural resources and conditions of the State thus far made is on soils. Many typical soils have been collected and analyzed and data secured as to the characteristic action of each under cultivation. It is proposed to continue this work with a view to constructing ultimately a soil map of the State. Work has been begun looking toward a systematic study of the flora and forest conditions of the State. In eastern Oregon demonstration experiments are in progress looking to the introduction of methods of reclaiming the alkali soils. In the same region experiments are in progress which are designed to demonstrate the losses of soil moisture sustained in the system of bare summer fallowing commonly practiced, and to introduce more profitable cultural methods. Experiments are in progress to determine the plants best adapted to the region. It has already been shown that *Bromus inermis* and Bermuda grass are well adapted to this part of the State, and that sugar beets may be grown with profit. The station's work in experimental sugar-beet growing has led to the establishment of a beet-sugar factory in eastern Oregon.

In western Oregon many of the soils are deficient in lime carbonate and exhibit an acid reaction, and experiments are in progress to demonstrate methods of reclaiming such soils. In the same part of the State another class of poor soils are the "white lands," and it has been shown by the station that tile drainage must precede any successful attempt permanently to improve them. Experiments conducted for a number of years demonstrated that, contrary to the very prevalent popular opinion, maize can be profitably grown in this section of the State if it is utilized as silage, and that it may be advantageously substituted for the "bare fallow" commonly practiced. Experiments conducted on a commercial scale have shown that this section of the

State is well adapted for the production of flax fiber of superior quality as regards length, fineness, and strength. Cooperative experiments now in progress in southern Oregon indicate that sorghum may be profitably grown for sirup making in that section of the State.

Feeding experiments have formed a considerable part of the station's work, and have thus far been designed to determine the feeding values of various forage crops as grown under local conditions. Among these was a determination of the coefficient of digestibility of cheat hay as compared with clover. A series of experiments was carried on to determine the comparative feeding value of raw and cooked silage. Various experiments have been made to determine the cost of producing butter fat from the more common fodders grown locally, and to determine their comparative merits for this purpose. Feeding experiments with hogs have been carried on mainly to determine the cost of producing pork with different grains, especially wheat variously prepared.

Several plants reported to be poisonous to stock have been shown by feeding trials not to be so. Considerable time has been spent in investigating the physical and chemical characteristics of Oregon fruits, especially prunes and cherries.

The entomologist has made considerable studies on the life history of the codling moth. Demonstration experiments have shown that at least 80 per cent of apples may be saved by using arsenical spray for the pest. It was shown that carbon bisulphid has no effect on bread made from wheat which has been treated with that chemical. Feeding experiments and dietary studies have been carried on by the station.

DISSEMINATION OF INFORMATION.

The station has issued 58 bulletins and 11 annual reports, the latter being now merely administrative documents. A number of special bulletins and circulars of instruction and suggestion have been sent out, and press bulletins are issued regularly each month during the college year. The mailing list contains about 13,000 names and is kept on cards arranged alphabetically by post-offices. The correspondence amounts to about 3,250 letters a year. Station officers take part generally in farmers' institute work and horticultural, agricultural, and dairy conventions. Exhibits are commonly made at the State and industrial fairs.

GENERAL RESULTS OF WORK.

The Oregon Station has done much to promote the diversification of agriculture in the State. Continuous cropping with wheat, often for nearly thirty years, had caused a serious decline in the yield. The station has shown that this was due to depletion of the humus and consequent physical changes in the soil. It has also demonstrated that

this may be remedied by a rotation including leguminous forage plants and by the development of animal husbandry and dairying. It has aided in showing that beets for sugar and flax for fiber may be successfully grown in the State, and has promoted the profitable development of fruit growing.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station, *State College.*

Department of the Pennsylvania State College.

GOVERNING BOARD.

Board of Trustees—Advisory Committee: John A. Woodward (*Chairman*), *Howard;* Joel A. Herr, *Cedar Springs;* Amos H. Mylin, *Lancaster;* Samuel R. Downing, *Goshenville;* George W. Atherton, *State College;* H. P. Armsby (*Secretary*), *State College.*

STATION STAFF.

George W. Atherton, LL. D., *President of the College.*

H. P. Armsby, Ph. D., *Director.*
William Frear, Ph. D., *Vice-Director; Chemist.*
William A. Buckhout, M. S., *Botanist.*
George C. Butz, M. S., *Horticulturist.*
George C. Watson, M. S., *Agriculturist.*
Harry Hayward, B. S., *Expert in Dairy Husbandry.*
William C. Patterson, *Superintendent of Farm.*
Julia C. Gray, *Secretary.*
J. A. Fries, *Assistant Chemist.*
E. H. Hess, *Assistant to the Director.*
C. A. Brown, jr., M. A., *Assistant Chemist.*
C. W. Norris, *Assistant Chemist.*
James P. Pillsbury, *Assistant in Horticulture.*
M. S. McDowell, M. S., *Assistant Chemist.*
Charles P. Beistle, B. S., *Assistant Chemist.*
Mary Garner, *Stenographer.*
Harry O. Way, *Fellow in Agricultural Chemistry.*

HISTORY.

The Pennsylvania Station is located in the center of the State in one of the fertile valleys found in the district which forms a part of the Appalachian Mountain system and constitutes a broad belt running northeast and southwest through the central portion of the State. East of this is an undulating tract of lower land between the mountains and the Delaware River. The western half of the State is "a broad rolling plateau with occasional ranges of hills," considerably dissected by water courses. The soil of the valleys and plains is relatively fertile. The climate varies considerably in different parts of the State. The mean annual temperature ranges from 44° F. in the northwest to 52° F. in the southeast. The average annual rainfall is about 40 inches. The forests are extensive. Agriculture has been practiced in the eastern part of the State for more than two hundred years, and in parts of the western portion for about one hundred years. Considerable areas in the northern and northeastern portions have been cleared of timber within comparatively recent years. Besides vast manufacturing, mining, and commercial interests, Pennsylvania has very large agricultural industries. The principal crops are hay, maize, wheat, oats, potatoes, and

tobacco. Large numbers of milch cows, cattle, sheep, swine, and horses are maintained. With the growth of several great cities and numerous large towns within the State and not far outside its borders dairying, truck farming, and fruit growing have become great industries in certain sections of the State.

The college with which the station is connected is a well-equipped institution with 375 students, exclusive of 600 enrolled in correspondence courses in agriculture, and has developed along technical and scientific lines.

Experimental work in agriculture in Pennsylvania was first formally organized in charge of an experiment station in 1887. Agricultural investigations at the State college, however, antedated this organization by thirty years, experimental work in the interest of agriculture having been carried on since its foundation. The thirty years prior to the organization of the station may be conveniently divided into three periods in accordance with the character of the work done.

During the first period, from 1857 to 1867, experimental work was to a large extent horticultural, but included some observations on the cultivation, fertilization, and testing of varieties of agricultural plants and on various kinds of agricultural implements. Some meteorological observations were also made. Most of the experiments were simple, but some involved a considerable amount of research in the chemical laboratory. Among the instructors of this period, who were also engaged more or less in experimental inquiries, were Dr. Evan Pugh, F. C. S., whose researches at Rothamsted in the laboratory of Sir J. B. Lawes have given him a world-wide reputation, and Prof. G. C. Caldwell, Ph. D., now professor of agricultural and analytical chemistry at Cornell University.

The second period extends from 1867 to 1881. At the beginning of this period three experimental farms were purchased under the provisions of an act of the State legislature, one at the college and one each in the eastern and western parts of the State, respectively. On the central experimental farm, located at the college, a large number of field experiments were carried on, while a lesser number were also made on the outlying farms. These experiments were without laboratory checks. Owing to the limited funds available, the experiments upon the outlying farms in particular were quite unsatisfactory. Those upon the central farm, under the immediate supervision of the professor of agriculture, were more satisfactory, although lack of time and means to collate and study the results greatly diminished the value of the work. All field work was in charge of the professor of agriculture of the college, and under the immediate direction of the superintendents of the several farms. Among the persons in charge of the work during this period were Prof. John Hamilton, now secretary of agriculture of Pennsylvania, and William C. Patterson, superintendent of

the central farm, who has continued in that capacity to the present time.

The third period begins with the appointment, in 1881, of Prof. W. H. Jordan, now director of the New York State Station, to the chair of agriculture and agricultural chemistry. He was relieved of numerous duties that had devolved upon his predecessor, and was therefore enabled to devote more time to research. In consequence of this change a more careful checking of field experiments was rendered possible, laboratory research became an important element in the experimental work, and a new programme of field experiments was introduced upon the central experimental farm. During this period a number of experiments upon the production of feeding stuffs and the feeding of domestic animals were also made. In 1884 the professor of agriculture was appointed chemist of the State board of agriculture, and in that capacity made the analyses necessary in the fertilizer control maintained by that board. In 1885 Professor Jordan was succeeded by Prof. William Frear, who remained in charge of the work until 1887, when he became chemist of the experiment station. In 1882 the publication of bulletins was undertaken, and 15 were issued prior to the organization of the experiment station.

The Pennsylvania Agricultural Experiment Station was organized as a department of the Pennsylvania State College June 30, 1887, under the provisions of the act of Congress of March 2, 1887. In the fall of the same year an agreement was entered into with the State board of agriculture, by which the analyses of commercial fertilizers incident to the fertilizer control were to be made by the station, any surplus arising to be devoted to experimental work in the interests of agriculture. The legislature of 1887 made an appropriation of $3,000 a year for four years for the experiment station and an appropriation for the erection of a residence for the director. The former appropriation, together with that portion of the first year's appropriation from the national funds which could be used for building purposes, was employed in the construction of a commodious office and laboratory building for the purposes of the station. The same legislature also authorized the sale of the outlying experimental farms, while the central experiment farm at the college was set aside by the trustees for the use of the experiment station. With an appropriation of $7,000 in 1889 and the addition of some funds arising from the fertilizer analysis, the farm buildings were entirely remodeled and a small dairy house was erected. Subsequently a small brick boiler house was built to provide steam for heating and power for all the station buildings, and a small building for the accommodation of a respiration calorimeter for investigations on the nutrition of animals was erected in 1899, at a cost of about $4,000.

FIG. 1.—PENNSYLVANIA STATION—OFFICE AND LABORATORY BUILDING.

FIG. 2.—PENNSYLVANIA STATION—DIRECTOR'S OFFICE.

FIG. 1.—PENNSYLVANIA STATION—READING ROOM.

FIG. 2.—PENNSYLVANIA STATION—CHEMICAL LABORATORY.

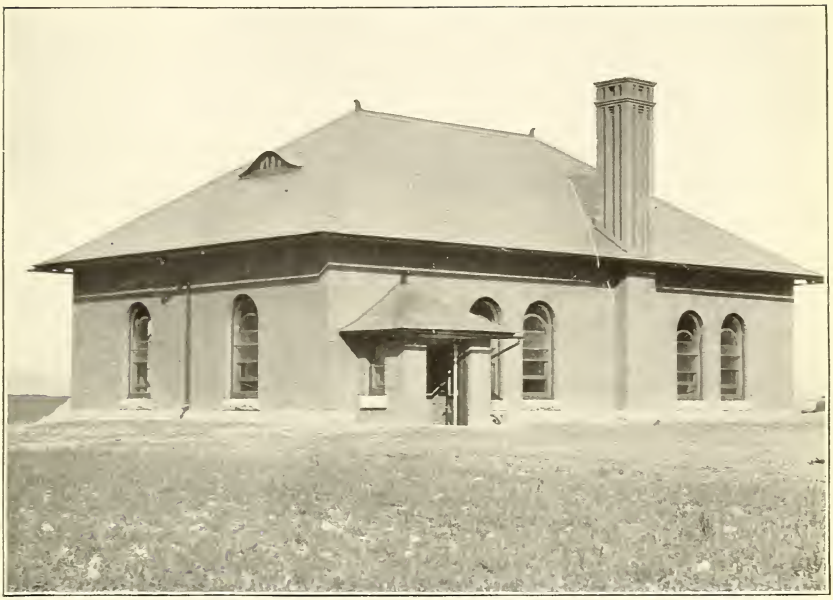

FIG. 1.—PENNSYLVANIA STATION—CALORIMETER BUILDING.

FIG. 2.—PENNSYLVANIA STATION—HORTICULTURAL BUILDING AND GROUNDS.

FIG. 1.—PENNSYLVANIA STATION—FIELD PLATS.

FIG. 2.—PENNSYLVANIA STATION—YOUNG STOCK.

ORGANIZATION.

The governing board of the station is the board of trustees of the college, which is represented in the interval between meetings by an executive committee consisting of five of its members. The governor, secretary of the Commonwealth, secretary of internal affairs, adjutant-general, superintendent of public instruction, and the State secretary of agriculture are ex officio members of the board of trustees. A standing committee of five, known as the advisory committee, consults with the director regarding the work of the station, and makes recommendations to the board, but has no executive powers. This committee meets four times a year. Its members receive no compensation other than necessary traveling expenses. The general policy of the board regarding the station is to give the director large liberty of choice regarding the work and methods, holding him responsible for results.

The staff consists of the president of the college, director, chemist (who is also vice-director), botanist, horticulturist, agriculturist, expert in dairy husbandry, farm superintendent, secretary, 5 assistant chemists, assistant horticulturist, assistant to the director, stenographer, and fellow in agricultural chemistry. Members are nominated by the director and appointed by the board of trustees. The appointments are not made for any definite term, and are practically regarded as permanent, except in the case of fellows, whose appointments are for one year. The director is the executive head of the station and responsible for its administration, choice of subjects and methods of experimentation, and time and manner of reporting results. He also takes part, to such an extent as is practicable, in actual experimental work. It is the policy of the station to secure the fullest possible cooperation between the different divisions in the prosecution of experimental work. In the planning of all important experiments the heads of the divisions involved are expected to consult together, and the final plan of the experiment provides in detail for the work to be done by each.

EQUIPMENT.

The station buildings comprise an office and laboratory building, botanical and horticultural building with greenhouse, dairy house with ice house attached, barns, boiler house for furnishing steam to the station buildings, building for the respiration calorimeter, residence for the director, and residences for the superintendent of the farm and the herdsman. The office and laboratory building (Pl. CXVIII, fig. 1) is a two-story structure, 42 by 69 feet, with a one-story addition, 25 by 45 feet, and contains the director's office (Pl. CXVIII, fig. 2), business office, library and reading room (Pl. CXIX, fig. 1), agriculturist's office, dairy husbandry office, chemist's office, chemical laboratories (one of which is shown in Pl. CXIX, fig. 2), photograph and dark room, and

two assistants' rooms. The barns comprise a main barn, 54 by 100 feet, with a wing especially constructed for experimental purposes; calf barn, horse barn, and 100-ton silo. (The calorimeter building is shown in Pl. CXX, fig. 1, and the horticultural buildings and grounds in Pl. CXX, fig. 2.)

The station has exclusive control of a farm of 110 acres entirely separate from the college farm. Eighteen acres are laid out in 4 series of 36 field plats (Pl. CXXI, fig. 1) of one-eighth acre each, devoted to field experiments with the three chief ingredients of commercial fertilizers (nitrogen, phosphoric acid, and potash), singly and combined, compared with stable manure, lime, and plaster, upon the ordinary four-year rotation of the region (maize, oats, wheat, and grass). Tests of different forms and amounts of nitrogen are also included. These experiments have been conducted on the same plats and upon a uniform plan for nineteen years. About 10 acres are devoted to variety testing and miscellaneous field trials and about 2 acres to horticultural work. The live stock owned by the station consists of 59 cattle, 8 horses, and 33 hogs. Dairy cows are the only animals that are often used for experimental purposes. The herd is being improved by breeding and selection. (Some of the young stock are shown in Pl. CXXI, fig. 2.)

A considerable proportion of the collections of specimens is the property of the college, but is available for use in connection with station work. Farm crops are represented by 128 samples of grains and grasses in the sheaf, and 170 samples of agricultural seeds, chiefly varieties of grains and legumes tested at the station. There is a seed collection of 2,000 samples, including 400 varieties of vegetable seeds, 200 specimens of fruit seeds and nuts, 200 species of tree seeds, 500 species of ornamental plants, and 600 samples of weeds and native plants. The herbarium contains 4,000 specimens. A large number of these are grasses and other plants of economic importance collected by the United States Department of Agriculture. There is also a complete collection (166 species) of the native grasses of the State mounted in wing frames. The forestry collection includes 600 sections of trees of the United States, 100 pieces of trunks of Pennsylvania trees showing natural and oiled surfaces of longitudinal and cross sections, and 200 sets of sections of Hough's American woods. The insect collection contains 2,000 species, chiefly those which are known to be beneficial or injurious to vegetation. In the orchards, vineyards, and berry plantations there are about 500 varieties of the large and small fruits, of which 200 are apples. Upon the grounds of the college there are 300 species of native and foreign trees and 200 species of shrubs, and in the gardens and greenhouses about 500 species and varieties of ornamental plants. In the chemical division is a collection of about 300 samples of various substances and a set of about 100 lantern slides representing the geology of soil formation.

The library contains about 500 volumes, among which are included sets of the more important technical agricultural journals of this and other countries. Station workers also have access to the college library of about 12,000 volumes. A respiration calorimeter for the accurate determination of the metabolism of matter and energy in the animal body is being constructed. The apparatus will be of the same general character as that devised by Professors Atwater and Rosa of Wesleyan University, Middletown, Conn. (partly in connection with the nutrition investigations of the Office of Experiment Stations), with such modifications as are necessary for experiments with domestic animals. This apparatus will be used in investigations into the principles of the nutrition of the domestic animals in cooperation with the Bureau of Animal Industry of the United States Department of Agriculture, under whose immediate supervision the work is carried on. In the course of feeding experiments with steers a special apparatus (described in Bulletin 42 of the station) was devised at the station for the collection of excreta in digestion experiments.

FINANCIAL SUPPORT.

The revenue of the station is derived from the national appropriation, fees for the analyses of commercial fertilizers for the State department of agriculture, and the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	11,631.00
Farm products	976.12
Total	27,607.12

LINES OF WORK.

The station makes analyses of commercial fertilizers, and also to a limited extent of human foods, for the State department of agriculture; but the station has no official control duties. The gross revenue of the station from this work has averaged for the past few years about $10,000 a year.

Under the category of studies of natural resources and conditions may be classed the tests carried on in cooperation with the United States Department of Agriculture to determine the adaptability of Pennsylvania to sugar-beet production. The horticulturist has made extended studies of the fruit-growing industry in the different sections of the State. A phosphate deposit in Juniata County has been explored, and incidental examinations have been made of peat deposits in the various parts of the State. Systematic meteorological observations have been made since 1878.

It is the established policy of the station to undertake but few lines of investigation and prosecute these until results of both scientific and practical value shall have been reached.

These investigations have been mainly in the interest of the dairy industry, in the belief that the attention of the farmers of the State should be directed more specifically to its advantages as compared with grain raising, which has been in the past the predominant form of agriculture in large sections of the State. Along lines of dairy farming the work has included a study of forage crops, their cultivation, yield, and the methods of preservation; the soiling question; and the economic feeding of dairy cows as to amount and quality of ration.

Among forage plants the chief subject of study has been maize, the work with which has included investigations on its composition, digestibility, and yield of stock food, and their variations as influenced by rate of seeding and time of harvest. The study of maize was also extended to include the silage made from it. This investigation included comparative determinations of composition and digestibility of the fresh material and of the same material air dried and ensiled, together with practical feeding tests of the relative influence of the two materials upon the production of milk and beef. Comparisons were also made of the feeding value of silage and roots. These experiments covered the two questions of the yield of the crop and its cost on the one hand and its relative feeding value on the other. Experiments have also been made for the purpose of determining the value to dairymen of the by-products of the cotton plant, and in particular of a mixture of cotton-seed meal and hulls. The merits of the soiling system for milch cows have been a subject of study, particularly in regard to yield, composition, and digestibility of various crops and of pasturage. In the course of this work it was demonstrated that simple drying neither decreases the digestibility nor the milk-producing power of grass.

An elaborate experiment has been conducted to test the effect upon milk production of substituting highly nitrogenous feeding stuffs for the more starchy feeds commonly used, or, in other words, to test the effect of narrowing the nutritive ratio of the food. In this connection observations were made upon the relative effect of two different nitrogenous feeding stuffs upon the quality of the butter produced. Both in this experiment and the one upon roots and silage observations were made upon the variation in the number and size of fat globules in the milk from day to day.

More recently the investigations have been directed to determining the relations which exist between the amount and composition of the food and the yield of milk and butter, particularly with reference to financial considerations. The station is carrying on a series of investigations to obtain certain fundamental data relative to the principles

of stock feeding. One of these was a technical investigation on the maintenance ration of mature steers, in which the results of Kellner and other European investigators were fully confirmed. Incidentally interesting data were secured in the course of the investigation relative to the variations in the digestibility of the same kind of feed by the same animal at different times. From a practical standpoint the investigations on the influence of quantity of food and of nutritive ratio on the yield, composition, and quality of the milk produced have yielded the important result that for each individual animal there is a certain optimum amount of food which will produce the most profitable result and that either a heavier or a lighter ration will result in relative financial loss.

Work in dairy technology has included numerous tests of creamery separators, and experiments in the manufacture of domestic cheese, and in the use of pure cultures and pasteurization in butter making. Among minor investigations carried on incidentally in connection with feeding experiments were studies of the viscosity of milk, of the fat globules of milk, and of the constitution of milk fat as affected by feed. This was the first American station to demonstrate the applicability of the tuberculin test to the stamping out of tuberculosis in cattle.

The work in horticulture has included studies in fruit growing in the different sections of the State, and numerous variety tests of fruits and vegetables, including tests of new varieties previous to their introduction. Cultural experiments have been made with cereals with respect to the influence of quantity of seed, preparation of seed bed, time, depth, and thickness of planting, manner of cultivation, etc., on the yield.

Cooperative experiments are being conducted with commercial fertilizers on tobacco to determine the most suitable sources and combinations of ingredients. These are the only cooperative experiments in which the station has engaged. They are carried on in two distinct localities of the State. The land necessary for the experiments is leased, and farmers or others in the locality who are interested in the experiment supervise the details under general directions from the station, receiving therefor compensation for the time actually employed. Detailed directions for the work are supplied by the station and a station officer makes somewhat frequent visits to the localities to aid in securing proper compliance with these directions and proper record of results. For four years past this work has been largely paid for by the State department of agriculture.

DISSEMINATION OF INFORMATION.

The station has issued 48 bulletins and 12 annual reports. Up to the present time the subject of each bulletin has been presented with some degree of fullness. It is proposed hereafter to make them simpler and more popular in character, and to distribute them very freely

throughout the State. The annual reports are intended to contain a full discussion of the work completed during the year. They include all matter published in bulletin form, together with additional material. The attempt hitherto has been to make them as popular in character as was consistent with a fairly full presentation of results. In the future it is proposed to make them somewhat more full and technical, relying largely upon the bulletins for the dissemination of the practically important results. Occasional short press bulletins are sent to leading agricultural papers as well as to a selected list of the rural papers of the State. Two bulletins of information have also been issued. The director, Dr. H. P. Amsby, is the author of a "Manual of Cattle Feeding," a treatise on the laws of animal nutrition and the chemistry of feeding stuffs in their application to the feeding of farm animals.

The mailing list, which contains about 25,000 names, is kept set up in linotype, corrections being made and a proof copy taken whenever a publication is to be distributed. With the exception of a few special lists, this printed mailing list is used. Publications are addressed with a Dick mailer. The correspondence amounts to about 4,000 letters a year. The growth of the correspondence courses in agriculture conducted by the college of agriculture has increased the demand for information on agricultural topics, but is at the same time serving as an important means of satisfying it. Station officers address about 200 farmers' institutes each year. The traveling expenses of the officers, together with the cost of securing substitutes when necessary to carry on their station and college work, is borne by the State department of agriculture, which has charge of the institute work. A limited number of other farmers' gatherings are ordinarily addressed, and officers of the station have been in demand as judges of live stock, dairy products, etc., at numerous fairs. One of the officers of the station is the secretary and executive officer of the State Dairy Union.

GENERAL RESULTS OF WORK.

The investigations of the Pennsylvania Station on animal nutrition, and especially those with reference to dairy cows, have been an important factor in the establishment of a rational basis for the feeding of farm animals in this country, and have had a widespread influence in improving farm practice in this regard. As part of this work, it has been shown that a dairy herd may be greatly improved by judicious breeding and selection at comparatively small expense, and that the improved cows respond correspondingly well to higher feeding, enabling the dairyman to convert relatively large quantities of food into dairy products at a profit. There is, however, a point of maximum profit, depending on the individuality of the cow. Dairy farming has also been greatly helped by the investigations of the station, which

have shown that careful selection of varieties, proper rate of seeding, and proper time of harvesting will materially increase the yield per acre of maize, considered as a forage crop.

The work of the station in connection with the control of commercial fertilizers has been of general importance in connection with the establishment of the methods of this control in the United States, as well as of much practical value to the farmers of the State, who annually purchase some $4,000,000 worth of fertilizers. Along with this the station has done much useful work regarding the more economical use of fertilizers. It has shown that commercial fertilizers may be used to great advantage in the production of tobacco, giving both a large yield and a wrapper leaf of high quality. Its investigations on tobacco curing have also been important as demonstrating that the process of curing by artificial heat is capable of yielding a high grade of product and is comparatively easy of application, while it practically prevents pole burn.

RHODE ISLAND.

Rhode Island Agricultural Experiment Station, *Kingston.*

Department of Rhode Island College of Agriculture and Mechanic Arts.

GOVERNING BOARD.

Board of Managers: Henry L. Greene (*President*), *River Point;* C. H. Coggeshall (*Vice-President*), *Bristol;* Melville Bull (*Treasurer*), *Newport;* Gardiner C. Sims (*Clerk*), *Providence;* Jesse V. B. Watson, *Wakefield.*

STATION STAFF.

John H. Washburn, PH. D., *President of the College.*

A. A. Brigham, PH. D., *Director; Agriculturist.*
Fred W. Card, M. S., *Horticulturist.*
H. J. Wheeler, PH. D., *Chemist.*
George W. Field, PH. D., *Biologist.*
Joseph A Tillinghast, *Assistant in Field Experiments.*
Burt L. Hartwell, B. S., *Assistant Chemist.*
George E. Adams, B. S., *Photographer and Assistant Horticulturist.*
H. W. Marshall, *Assistant Biologist.*
J. A. Warren, *Poultryman.*
Nathaniel Helme, *Meteorologist.*
Bertha E. Bentley, *Stenographer.*

HISTORY.

The Rhode Island Station is located in the southern part of the State, which is the smallest in the Union. The surface consists very largely of low hills. Along the ocean are extensive salt marshes. In Narragansett Bay are numerous islands. The soil is stony, and has been generally depleted by injudicious methods of farming for over two hundred years. Fertilizers are extensively used. The winters are long and the summers comparatively cool, a considerable portion of the State feeling the influence of the Gulf Stream, which materially moderates the climate. The annual rainfall is 53.6 inches. With the

development of very large manufacturing interests and the consequent growth of cities and towns within and near the borders of the State, market gardening and poultry raising have become important industries. The principal field crops are hay and potatoes. Considerable numbers of milch cows and horses are maintained.

The college with which the station is connected was established in 1888, and is being developed along technical and scientific lines.

On March 23, 1888, the State of Rhode Island established an agricultural school at Kingston, and accepted the provisions of the act of Congress making the agricultural experiment station a department of the agricultural school. Prof. Charles O. Flagg was appointed director. On March 19, 1892, the bill establishing the agricultural school was amended, and the institution was designated as the Rhode Island College of Agriculture and Mechanic Arts, whereupon the course of study was extended, and the institution placed upon a college basis.

In July, 1896, the scope of the station work was enlarged by the appointment of a biologist, who undertook at once a study of the conditions affecting the growth of oysters and other bivalves in the bays and brackish waters of the State. During the succeeding year a marine laboratory located adjacent to Point Judith Pond was erected as a further aid in the prosecution of this work, and the same year a vegetation house was built. November 1, 1897, Professor Flagg resigned, and his place was filled temporarily by the president of the college as acting director until the appointment of the present incumbent, in 1897.

In response to general public sentiment an arrangement was perfected between the State board of agriculture and the experiment station on April 8, 1891, by which the analyses of commercial fertilizers in connection with the State inspection should be made at the State experiment station. This arrangement was terminated on April 20, 1892, by the passage of an act which placed the responsibility for the execution of the fertilizer inspection in certain respects with the experiment station, while certain other points were left in the control of the State board of agriculture. On May 21, 1897, an act was passed conveying the entire control of the fertilizer inspection to the State board of agriculture, and the work of analyzing commercial fertilizers at the station was suspended. On March 1, 1898, an act was passed transferring the entire control of the fertilizer inspection from the State board of agriculture to the board of managers of the Rhode Island College of Agriculture and Mechanic Arts. This board delegated the work of analysis of commercial fertilizers to the experiment station. In 1899 the State legislature passed an act providing for an inspection of concentrated feeding stuffs by the station and making an annual appropriation of $1,300 for defraying the expenses of the same.

FIG. 1.—RHODE ISLAND STATION—MAIN BUILDING.

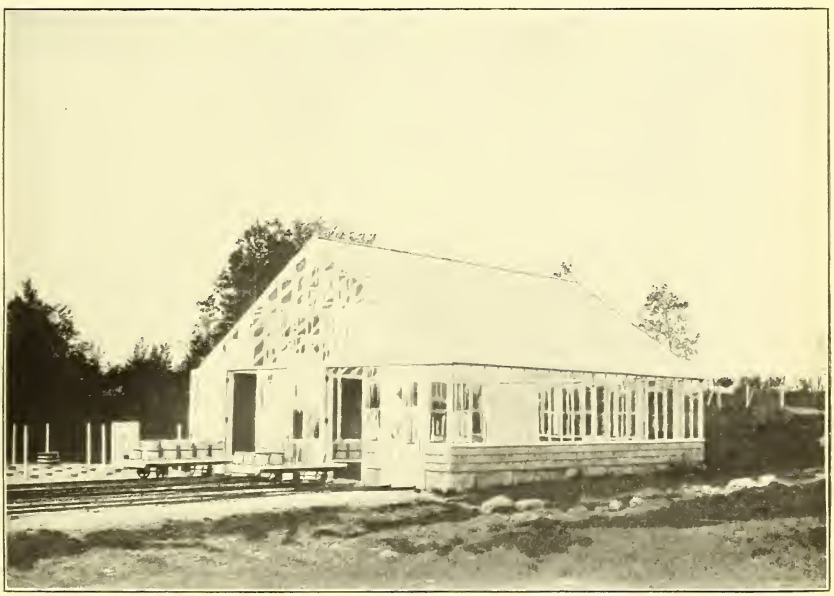

FIG. 2.—RHODE ISLAND STATION—VEGETATION HOUSE.

FIG. 1.—RHODE ISLAND STATION—BARN, USED BY COLLEGE AND STATION.

FIG. 2.—RHODE ISLAND STATION—EMBDEN GOSLINGS.

FIG. 1.—RHODE ISLAND STATION—EXPERIMENTS IN LIMING CLOVER.

FIG. 2.—RHODE ISLAND STATION—EXPERIMENTS IN LIMING BEETS.

ORGANIZATION.

The governing board of the station is the board of managers of the college, which consists of five members, appointed by the governor of the State. The term of office is five years, one member retiring annually. Meetings are held regularly once a month, and sometimes more frequently. Two members of the board are appointed a special committee on experiment station, whose duty it is to recommend to the board such changes, additions, etc., as may seem desirable. Members of the board receive no compensation, and in some cases members have presented no bills for traveling expenses incurred in the discharge of their duties. The officers of the board are president, vice-president, clerk, and treasurer.

The staff consists of the president of the college, director (who is also agriculturist), horticulturist, chemist, biologist, assistant in field experiments, assistant chemist, photographer and assistant horticulturist, assistant biologist, poultryman, meteorologist, and stenographer. Connection of members of the staff with the station may be severed upon a three months' notification on either side. The director has general oversight of the work of the station, designating the amount of money which shall be used in the different lines of investigation and outlining with the heads of divisions the general experimental work. The station council, consisting of the director, heads of divisions, and first assistants, meets monthly to discuss the work of the station, and holds a meeting once a year to consider lines of work proposed for the coming year, at which time the head of each division presents an outline of the work recommended.

EQUIPMENT.

The station buildings comprise a main building known as Taft Laboratory, barn, incubator house, vegetation house, and marine laboratory. The main building (Pl. CXXII, fig. 1) is a two-story stone structure 63 by 57 feet, which is used for laboratory purposes by the biological and chemical divisions. It also contains offices for all the officers of the station. The incubator house is fitted up as a tenement for an attendant, with conveniences for preparing food for the poultry under investigation. The vegetation house (Pl. CXXII, fig. 2) is constructed after the general plan of the well-known houses at Darmstadt and Bernburg in Germany. (The barn is shown in Pl. CXXIII, fig. 1.)

The college farm has an area of about 169 acres, of which about 28 are assigned to the station for experimental purposes. Twenty-four acres are devoted to field experiments or are being prepared for such experiments. With a few exceptions the experimental plats comprise two-fifteenths of an acre each, and are 30 by 193.6 feet. These plats are so arranged that 3 feet are discarded from each side and 6 feet from each end upon harvesting. By this arrangement the interior plat, the weights of which are recorded, contains one-tenth of

an acre. The entire area of a plat is always manured the same as the inner one-tenth acre. Two acres are devoted exclusively to experiments with bush fruits, under the direction of the horticulturist.

The station makes use, for the most part, of the college live stock, which consists of 11 head of cattle, 10 sheep, 60 swine, a lot of Belgian hares, and about 2,000 head of poultry of various kinds, including ducks, hens, and geese. (Pl. CXXIII, fig. 2 represents a flock of the station's Embden goslings.) Occasionally animals are purchased by the station for specific experiments. The station owns 3 horses.

The station has a collection of about 2,350 samples of weed seeds, fungi, and wild and economic plants; about 1,200 photographs, and 150 lantern slides. The station library contains 1,235 volumes, among which are sets of the principal foreign periodicals in German, French, English, and Italian, chiefly in the lines of bacteriology, mycology, agriculture, and agricultural and analytical chemistry. Station workers also have access to the college library, which, with the station library, comprises approximately 7,000 volumes.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund, fees for fertilizer analyses, and sales of farm produce. The State appropriations for inspection of fertilizers and concentrated feeding stuffs are not here included, as they were not available at the time this statement was made, July 1, 1899. During the last fiscal year the income of the station was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	30.00
Farm produce	752.55
Miscellaneous	53.69
Total	15,836.24

LINES OF WORK.

The station is charged by State law with the execution of the fertilizer inspection and with carrying out the provisions of the act providing for the inspection of concentrated commercial feeding stuffs. This work is supported by State appropriations, the total amount of which will approximate $4,000 annually.

The investigations of the Rhode Island Station have been mainly along lines of experiments in the treatment of acid soils with lime and problems growing out of it, poultry culture, aquiculture, and horticulture. Soon after the organization of the station, fertilizer tests revealed the presence of an injurious degree of acidity in upland and naturally well-drained soils, and cooperative experiments showed that this condition is generally prevalent throughout the State. Further

experiments demonstrated that lime is a cheap and effective remedy for this condition. These investigations have led to the use of lime by farmers in many parts of the State, with the result that large crops of clover, timothy, beets, etc., are now grown where in former years there was an almost entire failure of crops on the unlimed acid soil, regardless of the amounts of other manures employed. Clover grown on acid soil with and without lime is shown in Pl. CXXIV, fig. 1, and fig. 2 of the same plate shows beets similarly grown.

Growing out of these investigations were numerous others on the effect of lime on different fertilizers when applied to acid soils. Comparative tests of different forms of phosphoric acid and nitrogen on limed and unlimed soil have been carried on for some time, and experiments are now in progress to determine the effect of lime in rendering the insoluble phosphoric acid of the soil available. Tests have been made with different forms of nitrogen upon acid soils, limed and unlimed. Comparative experiments with nitrate of soda and sulphate of ammonia as sources of nitrogen upon limed and unlimed soils have demonstrated the superiority of the former on the acid soils of the State, particularly in the production of spinach, lettuce, asparagus, beets, and a number of other vegetables. Comparisons have been made of different forms of lime and of lime applied under different conditions. Experiments have been made in the introduction of lime into the subsoil.

Extended tests have been made of the effect of lime upon the growth of native and cultivated plants, the number of varieties studied being about 150. In experiments with potatoes it was found that while lime favors the development of the tuber, it also favors the development of the potato scab. Thereupon tests were made to determine the influence of alkali and acid media in general upon the development of this disease. Further investigations showed that it might be prevented by liming several years before the potatoes were planted. Still other investigations showed that the tendency to the development of the disease was reduced by the application of certain chemicals to the soil.

The deficiencies of the soils of the State have been studied in other respects, especially with reference to lack of phosphoric acid, potash, nitrogen, and magnesia. Experiments have been made in the substitution of soda for potash, with investigations to ascertain to what the occasional beneficial action of soda is due. Comparative trials have been made of methods of tillage and of different rotations of crops. An important agricultural industry in Rhode Island is the production of poultry, especially geese and turkeys, and this industry has therefore been the subject of important experiments. Much attention has been paid to breeding. The station has shown the desirability of introducing the blood of wild birds into domestic flocks and has aided

turkey raisers in securing birds containing the wild blood. Experiments in the crossbreeding of geese and other fowls have been carried on, which have demonstrated that cross-bred fowls are more desirable for market purposes than pure-bred fowls, and have shown what crosses are most profitable. Considerable attention has been paid to caponizing.

Studies have been made upon the infectious diseases of poultry, especially along lines of prevention and remedies. Roup bacteria and diseases of the chick have received especial attention. In cooperation with the United States Department of Agriculture the cause of the black head of turkeys has been worked out, a disease which has almost annihilated one of the important agricultural industries of the State. Considerable investigations have been made on the post-embryonic development of the chick.

The productive possibilities of both the inland and marine waters of the State are being investigated. The work has been carried on at the marine laboratory at Point Judith Pond and at the experiment station. The work is carried on at the pond under two heads: (1) The study of the oyster as it exists in the pond; (2) the study of the pond itself, comprising the nature and changes of the water under different meteorological conditions; the relations between the water of the pond and that entering from the adjacent watershed and the ocean; the course of the currents and their influence upon the bottom, and the reciprocal relations between the fauna and flora of the pond. This latter involves study of all the animals and plants found in the pond, and of the conditions under which each lives; the effects of increased or diminished salinity of the water, of the temperature, etc.; of the feeding and breeding habits of all the animals, including not only those of immediate economic importance (e. g., oyster, clam, white perch, herring, flatfish, crab, etc.), but also those which, though of no apparent immediate importance, are, as food, indispensable to the growth of the larger forms. One of the most important points thus far ascertained, from study of the conditions in the pond, is the conclusion that the oysters in certain positions are killed by the deposition of sediment. Specific recommendations for overcoming this difficulty have been made. At the station laboratory work has progressed on an extensive study of the oyster, including its life history, ecology, comparative anatomy and histology, methods of cultivation, etc. The cause of the disappearance of scallops and clams in certain of the waters of the State has also been determined and recommendations for definite legislation made.

In the horticultural division the culture of celery has received considerable attention. A study has been made of the soil conditions which affect the leaf spot of this plant, and experiments conducted by the station have proven that the disease may be controlled by thorough mulching of the ground during hot weather. Variety tests with

strawberries have been carried on, and improved varieties have been introduced in the State. Considerable experimental work has been done in the culture of lettuce, including forcing, and a systematic study has been made of the cultivated varieties. Various other fruits and vegetables have been similarly studied. The station has introduced and urged the practice of spraying in the State. It has examined numerous samples of garden seeds for purity and germinating power.

Cooperative experiments are conducted in various portions of the State. The object of these is to secure experimental data, and at the same time to serve an educational end. It is the purpose of the station, after having worked out a problem, to ascertain by cooperative experiments in how far the results are applicable to the various sections of the State. This has been done in connection with experiments in the use of lime with great success. The station usually furnishes manures and seeds, and has a representative present when the manures are applied and the seed planted. The care of the plats is left to the owner of the land. A representative of the station visits them at the time of harvest, assists in harvesting, and makes a record of the weights of produce. The produce becomes the property of the owner of the land. The number of such experiments conducted by this station in any one season seldom exceeds twelve.

DISSEMINATION OF INFORMATION.

The station has issued 54 bulletins, 3 circular bulletins, 11 annual reports, and 1 spraying calendar. The annual report contains a detailed account of the more important investigations carried on during the year. The biologist, Dr. G. W. Field, is the author of a work on "Zoology," and the horticulturist, Prof. F. W. Card, one on "Bush Fruits." The station has about 7,000 addresses on its mailing list. This is kept in printed form, and corrections are made from time to time until a new copy is printed. Publications are addressed with a Dick mailer. The correspondence amounts to about 2,500 letters a year. Station officers take part when requested in farmers' institutes and other work of a similar nature, but on account of the small size of the State the amount of work in this line is very limited. Exhibits, illustrative of practical features of certain experiments, are made so far as possible at the various agricultural fairs held within the State.

GENERAL RESULTS OF WORK.

The investigations of the Rhode Island Station on the use of lime as a soil amendment has been of genera importance. The great need of the soils of the State for lime has been demonstrated, both for the correction of acidity and for the liberation of phosphoric acid. By the

proper use of lime the production of clover, grasses, and vegetables in the State has been rendered much more successful than formerly. Much has also been done to show the farmers the great desirability of the discriminating use of fertilizers and to protect them against fraud in their purchase. The investigations on geese and turkeys have materially aided the successful raising of these fowls in the State. The promotion of the general practice of spraying orchard and small fruits and vegetables has proven of great practical value to the horticultural interests of the State.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station, *Clemson College.*

Department of Clemson Agricultural College.[1]

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STATION STAFF.

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J. S. Newman, *Vice-Director; Agriculturist.*
M. B. Hardin, *Chemist.*
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F. S. Shiver, PH. G., *Assistant Chemist.*
C. M. Connor, B. AGR., B. S., *Assistant Agriculturist and Dairyman.*
C. C. McDonnell, *Assistant Chemist.*
R. N. Brackett, PH. D., *Assistant Chemist.*
C. C. Newman, *Assistant Horticulturist.*
——— ———, *Entomologist.*
G. E. Nesom, B. S., D. V. M., *Veterinarian.*
J. S. Pickett, *Station Foreman.*
J. N. Hook, *Secretary.*

HISTORY.

The South Carolina Station is located in the northwest part of the State. The eastern half of the State is a lowland region, rising gradually from the Atlantic Ocean to the west; the western half is an upland region, much of which is hilly and sometimes even mountainous. There are many different kinds of soil in different regions. The summers are long but not extremely hot, and the winters are mild. The mean annual temperature is 63° F. and the annual rainfall about 52 inches. Agriculture has been practiced in the State for over two hundred years, and had its very rapid development between 1820 and 1860, when the growing of cotton and rice with slave labor was greatly extended. The principal crops are cotton, maize, rice, wheat, and sweet potatoes. Truck farming, fruit growing, and tobacco growing have become important industries in recent years. Numerous swine, milch cows, cattle, and mules are maintained. Commercial fertilizers are extensively used. The manufacturing interests of the State, especially the making of cotton goods, are being rapidly developed.

[1] Telegraph office, Clemson College, S. C.; express and freight address, *Calhoun.*

The college with which the station is connected was established in 1893, and is being developed along industrial and scientific lines.

Previous to the establishment of an experiment station in South Carolina, experimental work in agriculture had been carried on at the South Carolina College at Columbia since 1882. At that time about 20 acres of land belonging to the institution were set apart for the purposes of agricultural experimentation. Numerous field tests of varieties of cotton, maize, small grains, grasses, fertilizers, etc., were carried on under the direction of the professor of agriculture, R. H. Loughridge, Ph. D., now of the California Station. The results of this work were given to the public in two reports, the first covering the operations of the years 1883, 1884, and 1885, and the second those of 1886. In December, 1886, the State legislature passed an act providing for the establishment of two experiment stations, to be known as the South Carolina Experiment Stations, to be located one in the Piedmont region and the other in the lower tier of counties of the State. For their establishment $10,000 was appropriated. Their support was to be derived from a fertilizer tax. In July, 1887, the board of agriculture proceeded to organize the station in the Piedmont region at Spartanburg, where the people of the county had given 300 acres of land and $2,000 for the purpose. The farm in the lower tier of counties was located at Darlington, Darlington County, where the people of that county had given $5,000 in cash. In August of the same year 227 acres of land were purchased for the use of the farm. Prof. J. M. McBryde, the president of the South Carolina University, but now of the Virginia Polytechnic Institute, was elected director of both stations, and a superintendent was appointed for the Spartanburg farm. In September a superintendent was appointed for the Darlington farm, and contracts were awarded for the necessary buildings on each. Full possession of the Spartanburg farm was secured in December, 1887, and of the Darlington farm in January, 1888, and a series of field tests was begun the following spring.

In the meanwhile the South Carolina Agricultural Experiment Station had been organized in January, 1888, by the board of trustees of the University of South Carolina, in accordance with the act of Congress, as a department of the University of South Carolina, with the president of the university, Prof. J. M. McBryde, Ph. D., as director. At the same time the board of trustees submitted a proposition to the State board of agriculture looking to the consolidation of the university and State stations. This proposition was accepted by the board of agriculture in March. By this joint agreement of the two boards the three experimental farms were placed under the same direction and management, the ten members of the State board of agriculture being members ex officio of the board of trustees of the university, and five of them constituting the special committee of the two boards in charge of the station. A farm of 120 acres was secured near the

university at Columbia, and in May the organization was fully completed.

By the will of Hon. Thomas G. Clemson, who died April 6, 1888, the State came into possession of 814 acres of land and certain other property, both real and personal. On this land there was established, at the old homestead of John C. Calhoun, the Clemson Agricultural and Mechanical College of South Carolina. By act of legislature, in November, 1890, the real estate and other property of the experiment station in Columbia and of the experiment farms in Darlington and Spartanburg were sold, and the proceeds of these sales were devoted to the establishment of an agricultural experiment station at Clemson College. In 1890 Dr. H. A. Strode was elected president of the college and director of the experiment station. He was succeeded in both offices by Prof. E. B. Craighead in 1893, who was in turn succeeded in 1897 by the present incumbent.

ORGANIZATION.

The government of Clemson College is vested in a board of 13 trustees, 7 of whom are testamentary and 6 are elected by the State legislature. This board has control also of the experiment station. Immediate supervision of the station is delegated to an experiment station committee of 3 members of the board. This committee is required to meet at least twice every year, and at any other time the director may request. It inspects the station property and examines into the conduct of station affairs and reports upon the same to the board of trustees.

The staff consists of the president of the college (who is also director), vice-director and agriculturist, chemist, 4 assistant chemists, assistant agriculturist and dairyman, assistant horticulturist, botanist, entomologist, veterinarian, station foreman, and secretary. These officers are all appointed by the board of trustees. The director is responsible for the general conduct of the station.

EQUIPMENT.

The station buildings comprise an office building, two greenhouses, cannery, packing house, horticultural building, barn, and veterinary hospital. The horticultural building (Pl. CXXV, fig. 1) is a two-story wooden structure containing two offices for the horticulturist and two large rooms, one of which is used as a lecture hall and the other as a museum. The packing house is of wood, one story high, has two large rooms and a large brick cellar used for cold storage. The office building is a wooden structure containing the office of the agriculturist, library, and large lecture room. The veterinary hospital contains an

FIG. 1.—SOUTH CAROLINA STATION—HORTICULTURAL BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—SOUTH CAROLINA STATION—MAIN COLLEGE BUILDING, USED BY COLLEGE AND STATION.

FIG. 1.—SOUTH CAROLINA STATION—CHEMICAL LABORATORY, USED BY COLLEGE AND STATION.

FIG. 2.—SOUTH CAROLINA STATION—HORTICULTURAL GROUNDS.

office, drug room, dissecting room, stables, and kennel. The divisions of botany, live stock and dairying, and entomology are located in the main college building (Pl. CXXV, fig. 2). The dairy division occupies a commodious wooden building equipped with the best modern appliances for experiments in cheese making. The chemical laboratory (Pl. CXXVI, fig. 1) is a two-story brick building, 50 by 80 feet. On the first floor there are eight rooms. Five of these are appropriated for State analytical and experiment station work and one is an office. The basement is used for assaying and for storage. On the second floor there are five rooms—qualitative laboratory, lecture room, professor's laboratory, office, and balance room.

The station owns 70 acres of land which is entirely separate from the college farm. Of this 30 acres are devoted to field work in horticulture (Pl. CXXVI, fig. 2) and 40 to field experiments conducted by the agricultural division. Thirty acres are devoted to plat experiments. The area of the plats varies from one-fortieth to one-fourth acre each.

The horticultural ground comprises 16 acres of orchard, 4 acres of vineyard, 8 acres devoted to small fruits and vegetables, and 2 acres devoted to flowers and ornamental plants. The station owns 28 head of cattle of several breeds, and also has the use of the college herd of 80 head. When not used for experimental purposes the station herd is used and maintained by the college. The station has small collections of preserved fruits, seeds, and native plants. The chemical division has a collection of feeding stuffs, fertilizers, soils, etc., of which samples have been analyzed. The college cabinet of specimens used in the courses of industrial and agricultural chemistry is also available for station purposes. The combined herbariums of the college and station contain about 4,000 specimens, mainly from South Carolina. Dr. A. P. Anderson, formerly botanist, donated to the station a collection of 837 specimens collected in Minnesota and Europe. The division of entomology has a collection of about 2,500 specimens of insects and a small collection of specimens in other branches of natural history. The station library contains about 1,500 volumes. Station officers also have access to the college library.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	375.62
Miscellaneous	7.93
Balance on hand July 1, 1898	161.74
Total	15,545.29

LINES OF WORK.

The station has no control duties, but the chemist makes analyses of commercial fertilizers for the board of trustees of the college, which is charged by law with the inspection.

The problems set before the South Carolina Station do not differ greatly from those of other experiment stations in the cotton belt. These are problems of fertilization and culture of the staple crops, especially cotton and maize, treatment of worn soil, and diversification of crops. While the station was located at Columbia much of the work was necessarily of a preliminary character, such as field tests and soil and fodder analyses. Specifically the lines of work included field tests with the staple crops, observations upon miscellaneous industrial or forage crops, feeding tests, chemical tests of the cotton plant, botanical and entomological observations, soil studies, and meteorological observations. In the work on the culture of the staple crops, the exhausted condition of the soil made the problem of fertilizers of primary importance. With cotton, experiments were made to determine the amounts and proportions of nitrogen, phosphoric acid, and potash required, the specific effect of each of these fertilizing elements on the growth of the plant, and the value of composts as fertilizers. Comparisons were made of different methods of applying fertilizers, with tests to determine the best time to apply nitrate of soda. Various culture problems also received attention, such as methods of planting, topping, and rotations, and numerous variety tests were made. With maize the work has been of a similar nature. Observations have been made upon the effect of the different fertilizing elements singly and in various combinations. Comparisons have been made of different methods of applying fertilizers, and cultural experiments having reference to methods of planting, methods of cultivation, and rotations have been carried on. Variety and fertilizer tests with wheat and oats have been similarly conducted. A study has been made of tobacco from the commercial point of view, to determine the cost per acre of growing the crop. Various other industrial and forage crops have received attention, and of the latter numerous analyses have been made to determine their feeding value when grown under local conditions. Feeding and digestion tests have been made with various fodders and feeding stuffs. The feeding of live stock with cotton-seed meal, maize meal, cowpea meal, and soy-bean meal has received particular attention. Soil studies have been in the nature of chemical and mechanical analyses of a number of typical soils, together with general investigations on the capillarity of soils.

The efforts of the entomologist have been confined largely to observations on various injurious insects, including studies of life histories, and those of the botanist to fungus diseases. A detailed study has been

made on the chemistry of the cotton plant, which included analyses of the several parts and determinations of the proportion of each in a given plant.

After the station had been moved field tests continued to be a prominent feature of the work, but at the same time the scope of the investigations was broadened to include poultry culture, dairying, veterinary science, and horticulture.

In the fertilizer tests with field crops, special attention was given to the utilization of cotton seed and cotton-seed meal, with a view to determining their relative value for this purpose. Tests were made of different methods of improving worn-out soils by the use of fertilizers and rotation of crops, and to determine the adaptability of a number of pasture and hay grasses to local conditions, and their comparative merits. Observations were made on the growth of sugar beets in the State.

Recently much work has been done in the hybridizing of the sea-island and upland cottons. The attempt is being made to produce a staple that may take the place of Egyptian cotton in the manufacture of sewing thread.

A line of experiments was instituted in the interest of the horticultural industries of the State. These were principally in the nature of variety tests of vegetables and fruits, together with certain cultural experiments. Investigations were made on various plant diseases, especially rice blast and asparagus rust and methods of treatment. A special study was made of rice smut. Experiments in poultry culture have recently been begun. They are designed to include tests of breeds and crosses for egg production and for raising "broilers."

The work in dairying has been along the two general lines of tests of the different kinds of cream separators in common use in the South, and of experiments to determine the value of skim milk, alone or in combination with various feeding stuffs, for the production of pork. Studies are now being made of methods of butter making from separator cream, cream raised by gravity, and by churning the entire milk.

In the veterinary division, which has recently been established, some experimental work has been done in the treatment of "red water" among cattle. Tuberculin tests have been made upon a number of herds in different parts of the State.

Considerable studies have been made of the sweet potato with special reference to starch content, and this as affected by differences in variety, by different fertilizers, and by different methods of storage. A detailed chemical study has been made of sea-island cotton. Investigations have been made on the available phosphoric acid and water-soluble potash in cotton-seed meal; also on methods of preparing solutions of cotton-seed meal by precipitation of the phosphoric acid, and observations were made on the occurrence of metaphosphoric and

pyrophosphoric acid in it. A study was made of methods of determining the oxids of iron and aluminum in the presence of phosphoric acid, lime, and magnesia. Some time has been devoted to studies of methods of analysis for the Association of Official Agricultural Chemists.

DISSEMINATION OF INFORMATION.

As has already been stated, publication of results of experimental work prior to the establishment of the station was made in two reports. After the reorganization of the station in accordance with the national law, and while the station was located at Columbia, 8 bulletins and 3 annual reports were issued which were designated as "new series." With the removal of the station to the Clemson Agricultural College a third series of publications was begun. In this series 43 bulletins and 8 annual reports have been issued. The annual report is merely an administrative document. The mailing list contains 7,500 names. Station officers take part in farmers' institute work.

GENERAL RESULTS OF WORK.

The chief work of the South Carolina Station has been the promotion of more careful methods of culture, the discriminating use of fertilizers, the rotation of crops in which leguminous plants grown for forage and green manuring have a part, and the diversification of agriculture. The station has also aided in the introduction of improved methods of dairy farming and dairying, industries which are being rapidly revived in the State after a long period of comparative neglect.

SOUTH DAKOTA.

South Dakota Agricultural Experiment Station, *Brookings.*

Department of South Dakota Agricultural College.

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STATION STAFF.

Jno. W. Heston, M. A., Ph. D., LL. D., *President of the College.*

Jas. H. Shepard, B. S., *Director; Chemist.*
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A. M. Allen, *Secretary.*

HISTORY.

The South Dakota Station is located near the eastern boundary, on the gently undulating prairie which forms the eastern half of the State. This is divided from the western half by the Missouri River, which flows southeast across the State. West of the river the land rises rapidly and culminates in the Black Hills, the highest peak of which reaches an elevation of nearly 10,000 feet. The land in this region is more broken and relatively arid. The soils are generally fertile. The winters are sometimes severe and the summers comparatively cool. The mean annual temperature is 43° F. The annual rainfall in the eastern part is about 23 inches, but this declines considerably toward the west, where in many places irrigation is required for successful agriculture. At Deadwood, in the Black Hills, the annual precipitation is 28.5 inches. Agriculture has been practiced in the State about thirty years. The principal crops are wheat, hay, millet, oats, potatoes, maize, flax, and barley. Large numbers of cattle, milch cows, sheep, horses, and swine are produced. Dairying has become an important industry. South Dakota was admitted to the Union as a separate State in 1890.

The college with which the station is connected was established in 1881, and is being developed along industrial and scientific lines.

The South Dakota Agricultural Experiment Station was organized under the act of Congress as a department of the South Dakota Agricultural College in 1887, with Prof. L. McLouth, president of the college, as director. He was succeeded in 1890 by Prof. Luther Foster, now director of the Utah Station. In 1893 President McLouth again assumed the duties of the office, serving until the appointment of the present incumbent, in 1895. Professor Shepard had previously been connected with the station as chemist since 1888.

ORGANIZATION.

For several years the immediate management of the college and station was in the hands of a local board of trustees appointed by the State board of regents of education, which is charged with the supervision of all the State educational institutions. As the laws prescribing the duties of the two boards were somewhat indefinite, much friction arose between them, which materially hindered the progress of the college and station, and the legislature was therefore led to abolish the subordinate board and commit the entire management of the institution to the State board of regents of education. This board consists of five members, appointed by the governor for a term of six years, and confirmed by the senate. Immediate oversight of the college and station is delegated to one member, known as a regent's committeeman. The board meets two or three times a year and is paid by the State.

It is the policy of the board to confine the work of the station to lines that will be of immediate practical value.

The staff consists of the president of the college, director (who is also chemist), vice-director (who is also agriculturist), botanist, animal pathologist, horticulturist, assistant horticulturist, assistant in soils, assistant chemist, librarian, and secretary, appointed by the regents and holding office as long as service is satisfactory. The station council, consisting of the regent's committeeman, president of the college, director, heads of divisions, and secretary and accountant, decides on general lines of work. The director supervises all scientific experiments and the disbursements for the same.

EQUIPMENT.

The station buildings comprise a main building; greenhouse, with root cellar; seed house, with winter storage for crops, etc., and two barns. The main building (Pl. CXXVII, fig. 1) is a three-story brick structure, 36 by 66 feet, in which the laboratories are located. (The soil-physics laboratory is shown in Pl. CXXVII, fig. 2. A general view of the farm buildings is given in Pl. CXXVIII, fig. 1, and fig. 2 of the same plate shows the greenhouse.)

The station makes use of a part of the college land, but the station and college farms are administered separately. The horticultural division has about 60 acres of land, mostly in forestry and orchards, and about 15 acres platted. The division of agriculture has about the same amount of land with about 20 acres in plats. (Pl. CXXIX, fig. 1, gives a bird's-eye view of the experimental plats and forest plantation). The station owns no permanent live stock except two work horses. At present it owns a few sheep, which will be sold at the close of the experiment for which they were purchased. The college furnishes most of the live stock used for experimental purposes. It consists of 28 head of cattle, 157 sheep, 24 swine, and 9 work horses. (The dairy herd is shown in Pl. CXXIX, fig. 2.) There is no division of specimens and collections between college and station. The combined museums of the two institutions contain 10,000 specimens of plants and 20,000 specimens of insects. The library also is not divided. It contains upward of 5,000 volumes and ten times as many pamphlets.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, a State appropriation, and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
State appropriation	1,500.00
Farm products	394.11
Total	16,894.11

FIG. 1.—SOUTH DAKOTA STATION—MAIN BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—SOUTH DAKOTA STATION—SOIL PHYSICS LABORATORY.

FIG. 1.—SOUTH DAKOTA STATION—FARM BUILDINGS.

FIG. 2.—SOUTH DAKOTA STATION—HORTICULTURAL BUILDING.

FIG. 1.—SOUTH DAKOTA STATION—EXPERIMENTAL PLATS AND FOREST PLANTATION.

FIG. 2.—SOUTH DAKOTA STATION—DAIRY HERD.

LINES OF WORK.

The station has no control duties. The scientific investigations of the station have been mainly along lines of production of cereals, animal husbandry, and dairying. In the agricultural division tests have been carried on to determine the varieties of maize that can be most safely relied on to mature and give fair returns in an average season in South Dakota; the varieties of wheat, oats, and barley that have strongest straw, are freest from rust, and give the largest yield and best quality of grain; the grasses, clovers, or other forage plants best adapted for pasture and meadow and others that may supply coarse fodder in seasons of drought. Various cultural methods have been studied, including methods of preparing the seed bed for different crops, methods of seeding or planting, quantity of seed, and time of seeding. Experiments have been made with wheat and oats with reference to manuring, effects of broadcast and drill seeding, and surface packing. A special study has been made of the varieties of millet and their classification. Tests of different crop rotations have been made. Experiments have been made in renovating native pasture without plowing and reseeding. Studies of soil moisture have received some attention, and investigations have been made on the root development of various economic plants under different conditions. Meteorological observations have been made for a number of years. Experiments in controlling soil moisture are in progress.

Feeding experiments have been made to determine the quality and cost of production of pork from different rations, and to compare English rape with cultivated grasses for fattening and fall feeding. Experiments have also been carried on to ascertain the relative value of wheat, ground and unground, as compared with maize and peas in feeding for pork. Comparisons have been made of different breeds of sheep for different purposes, special attention being given to Shropshire and Merino sheep and their crosses and grades. Breeding experiments with sheep and with hogs have been carried on. Some feeding experiments with dairy cows have been conducted.

The veterinarian has investigated numerous outbreaks of disease in different parts of the State. Special attention has been given to the treatment of external parasitic diseases of sheep. Studies have been made of actinomycosis, with a view to ascertaining at what stage the disease is most amenable to the potassium iodid treatment. Investigations have been made on the so-called "bottom disease" among horses on the Missouri River and on the fringed liver worms of sheep.

The botanical division is making a survey of the flora of the State. The collection of native grasses is already nearly complete, and their feeding value has been determined by chemical analysis. A study has been made of the weeds of the State, particularly the Russian thistle.

In the study of weeds special attention was paid to the underground parts of each. The value of each species for forage or fertilizing purposes was determined. Studies were made on the vitality of the seeds and the agency of certain weeds, as squirrel-tail grass, in the distribution of rusts of grain. Considerable attention has been given to studying the distribution of the various weeds in the State and the effect of drought and irrigation on their development and dissemination. A partial survey has been made of the fungus flora of the State, and preliminary studies have been made on the rot of the tomato.

The work of the horticultural division has been to determine the adaptability of various plants to the climate of the State and their value. The division has made numerous experimental plantings of various forest trees and orchard and small fruits, and in connection with this work observations have been made on the use of wind-breaks. Many seedling plants, chiefly Russian, have been grown, and experiments have been made in top-grafting half hardy varieties of the apple on hardy stocks. The peach has been budded on the sand cherry and a good growth obtained. The improvement of native fruits by selection and hybridization has recently been begun. The horticulturist recently traveled through Russia and northern Asia as special agent of the United States Department of Agriculture, collecting new varieties of plants and seeds. As a result many new species have been added to the station collection.

In the entomological division studies have been made on the life histories of various injurious insects and their distribution. Various insecticides have been tested and the relative merits of various machines for applying them determined. A homemade sprinkler for applying Paris green, built on the principle of a street sprinkler, was devised at the station. Observations have been made on the parasites of the large willow sawfly and the food habits of the striped gopher, and the life history of the cottonwood leaf-miner has been worked out. Contributions have been made to our knowledge of the life history of a small moth causing gall-like swellings in the twigs of the box elder. The plum sawfly has been traced through nearly all the stages of its yearly cycle. Plant lice, belonging chiefly to the genus Pemphigus and found in large numbers on the leaves of root crops, have been studied. Investigations have been made on the life histories of the native worms. Uhler's green plant bug has been much studied and a means of repression recommended. Successful experiments were made in infecting it with the chinch-bug fungus. Experimental bee keeping has received attention with a view to determining whether it can be made profitable on the prairies.

The chemical division is making a survey of the soils of the State. Analyses have been made of the artesian and surface waters of the State and of many feeding stuffs.

The station has taken part in numerous cooperative experiments with farmers in testing the adaptability of sugar beets, forage crops, and cereals new to the State. Cooperative experiments are now being carried on in the James River Valley along lines of irrigation and tests of the adaptability of certain plants to that region. The station is also cooperating with the Division of Agrostology of the United States Department of Agriculture in experiments at Highmore, in the range region, with drought-resisting forage plants, on land donated by the citizens of the town.

DISSEMINATON OF INFORMATION.

Up to January 1, 1900, the station had issued 11 annual reports, 65 regular bulletins, and a few press bulletins. The annual report is now merely an administrative document. The station mailing list contains about 9,900 names. The director and chemist, Prof. Jas. H. Shepard, is author of "Elements of Chemistry," and "Briefer Course in Chemistry," and a chemical note-book. The station correspondence amounts to about 10,000 letters a year. Station workers take part in farmers' institutes generally. An exhibit is usually made at the State fair.

GENERAL RESULTS OF WORK.

The chief work of the South Dakota Station has been the promotion of animal industry and dairying. Experiments with forage crops and roots have shown the farmers how to lengthen the period of green feed for stock, thus largely removing the obstacles presented by the early drying up of the native pasture grasses. *Bromus inermis* has been shown to be adapted to the climate of the State, and it has been demonstrated that beets for sugar may be successfully grown. The station's work has been an important factor in the development of the creamery industry in the State, which has grown very rapidly in recent years. By showing the advantages of deeper tillage and other more careful cultural methods the station has taught the farmers how the yield per acre of their cereal crops may be increased. The station has been instrumental in promoting the practice of diversified agriculture throughout the State, to take the place of the one-crop system of growing wheat.

TENNESSEE.

Tennessee Agricultural Experiment Station, *Knoxville.*

Department of the University of Tennessee.

GOVERNING BOARD.

Board of Trustees—Experiment Station Committee: O. P. Temple (*Chairman*), *Knoxville;* James Maynard, *Knoxville;* James D. Porter, *Paris;* James Comfort, *Knoxville;* T. F. P. Allison, *Nashville.*

STATION STAFF.

Chas. W. Dabney, PH. D., LL. D., *President of the University.*
Andrew M. Soule, B. S. A., *Agriculturist.*
Charles A. Keffer, B. H., *Horticulturist and Forester.*
Charles A. Mooers, B. S., *Chemist.*
Samuel M. Bain, B. A., *Botanist.*
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George A. Flickinger, B. S., *Dairyman.*
J. B. Killebrew, PH. B., *Grass Expert.*
Ethel Reese, *Stenographer.*

HISTORY.

The Tennessee Station is located on the Tennessee River in the hill region which forms the eastern third of the State and embraces a portion of the Appalachian Mountains. The central part of the State is undulating and the western part is a plateau sloping down to the rich bottom lands on the Mississippi River. The forests are extensive, especially in the eastern and western parts. The soils are of many different kinds, including rich limestone and black loam soils. The climate ranges from that of the eastern mountains, which is comparatively cold, to that of the western bottom lands, which is relatively warm. The mean annual temperature for the State is 58° F. The annual rainfall is about 54 inches. Agriculture has been practiced in the State somewhat more than 150 years. The principal crops are maize, hay, wheat, tobacco, oats, potatoes, and cotton. Large numbers of swine, cattle, milch cows, sheep, horses, and mules are maintained.

The college with which the station is connected was established in 1794 and became the University of Tennessee in 1879. It has been materially strengthened in recent years, especially along technical and scientific lines.

The agricultural experiment station of the University of Tennessee grew out of its school of agriculture, horticulture, and botany. The experimental work of this school was inaugurated by Prof. J. M. McBryde, now director of the Virginia Station, who was at its head from June, 1879, to June, 1882. Three reports of 150 to 200 pages each, on experimental work, for the most part field and feeding experiments, were published during this period. The success of this work led to the establishment of the station as a department of the university by the board of trustees, June 8, 1882. Prof. J. M. McBryde resigned to take the presidency of the University of South Carolina, and Prof. John W. Glenn, who was elected professor of agriculture, horticulture, and botany in the university, became the first director of the station in June, 1882. He held the office until June, 1887. On July 24, 1887, the board of trustees elected Dr. Charles W. Dabney, jr., director of the North Carolina Station, director, with authority to propose a plan and nominate officers for the reorganization of the station which the

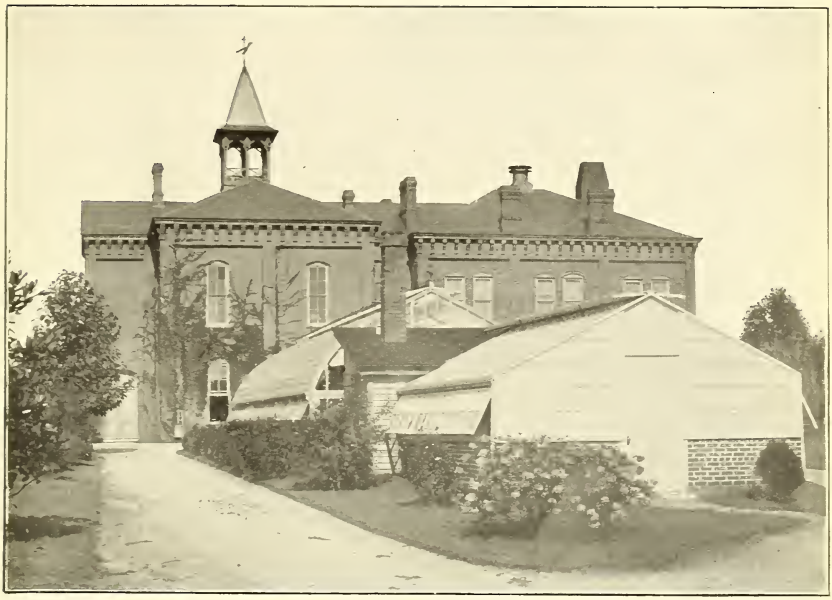

FIG. 1.—TENNESSEE STATION—MAIN BUILDING.

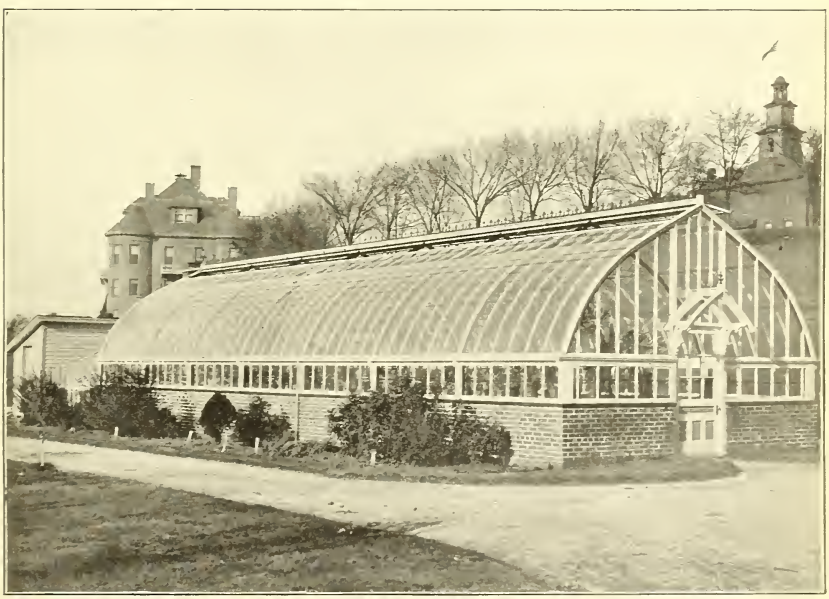

FIG. 2.—TENNESSEE STATION—GREENHOUSE.

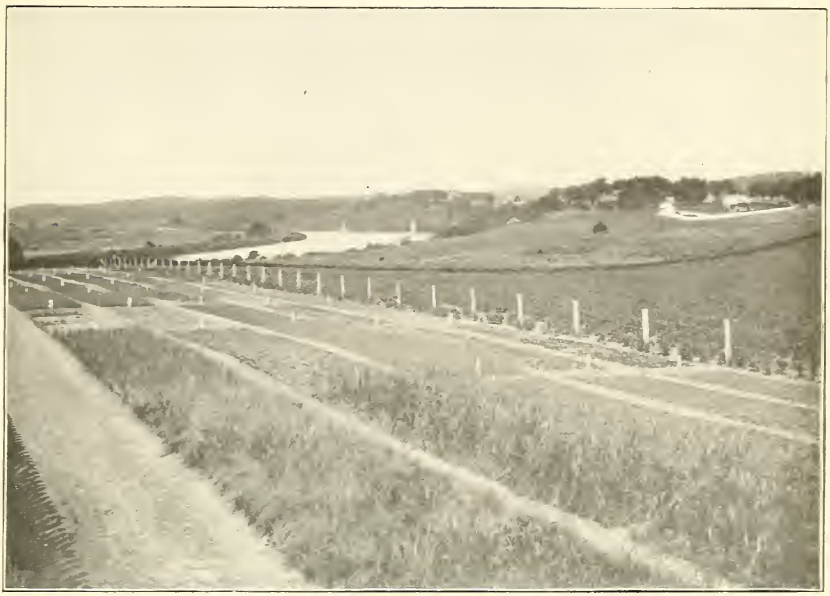

FIG. 1.—TENNESSEE STATION—GRASS GARDEN.

FIG. 2.—TENNESSEE STATION—ARUNDO DONAX.

FIG. 1.—TENNESSEE STATION—EXPERIMENTS WITH TOMATOES.

FIG. 2.—TENNESSEE STATION—LETTUCE UNDER GLASS.

State legislature had made the recipient of the funds appropriated by Congress by the act of March 2, 1887. Prof. Charles S. Plumb, now director of the Indiana Experiment Station, was appointed to take charge of the field and feeding experiments, and entered upon his duties on October 11, 1887. At the same time Prof. F. Lamson-Scribner, now agrostologist of the United States Department of Agriculture, was chosen botanist and horticulturist. Dr. Dabney served as director until 1890, when Professor Scribner was elected director, serving until 1892. The staff was reorganized in July, 1892, at which time Dr. Charles W. Dabney was made president, and Prof. Charles F. Vanderford secretary. On the death of Professor Vanderford in 1899 Prof. Andrew M. Soule was elected agriculturist and superintendent of the farm, while the direct management of the station reverted to President Dabney.

ORGANIZATION.

The station is governed by the board of trustees of the university, which consists of 30 members, elected by the board for life, and approved by the legislature. It meets twice a year and directs the workings of the university and station. Members are reimbursed for actual expenses incurred in attending meetings. There is a committee in immediate charge of the experiment station.

The staff consists of the president of the university, agriculturist, horticulturist and forester, botanist, chemist, farm manager, librarian and secretary, gardener, plat expert, dairyman, grass expert, and stenographer. Members of the staff are nominated by the president and elected by the board of trustees. The term of office is limited by merit. The president of the university, as executive officer of the experiment station, directs the work of all the divisions.

EQUIPMENT.

The station buildings comprise a main building, two barns, dairy, and greenhouse. The main building (Pl. CXXX, fig. 1), erected on the university grounds during the summer of 1888, is a two-story brick building, 92 by 55 feet, in which are the laboratories of soil physics, chemistry and botany, herbarium, museum, library, lecture rooms, offices, and photographic department. The barns have five distinct departments—the cow stable, the horse stable, the silos, the storage barn, and the tool and implement sheds. The silos, three in number, are built in accordance with plans given by the United States Department of Agriculture in Farmers' Bulletin No. 32.

The barns, residence of farm manager, greenhouse (Pl. CXXX, fig. 2), and other small buildings are located on a farm of 105 acres

belonging to the university, on which practically all of the experimental field work is done. Ten acres are devoted to a series of uniform test plats, of which there are 450, each one one-hundredth of an acre in area. On the farm about 70 acres are devoted to extended field tests and general farm work. A record is kept of every crop, including the fertilizing of the land, yield, value and cost, and the draft on the food supplies of the soil. About 10 acres are devoted to investigations in horticulture, embracing plantations of orchard fruits, small fruits, nuts, and vegetables. The land affords a variety of exposures; hence such parts are used for experimental work as are best adapted to the crops to be grown. The station owns 30 cows, 4 calves, 7 horses, 4 mules, and other stock purchased from time to time as required for experimental purposes.

The division of botany has 25,000 herbarium specimens, which include a complete set of Ellis and Everhart's "North American Fungi," and Seymour and Earle's "Economic Fungi," besides a large number of fungi collected in Tennessee. This division also has 500 lantern slides. The zoological division has 5,140 mounted insects, and 400 vials of alcoholic material. The station has a collection of 1,000 photographic negatives and about 200 soil samples. The station library contains 2,000 volumes. It is separate from the university library, which contains about 17,000 volumes and to which station workers have access.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of the farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	2,376.05
Total	17,376.05

LINES OF WORK.

The station has no inspection duties except that the entomologist is charged with the inspection of nurseries for scale insects. The work of primary importance at the Tennessee Station is an investigation of the agricultural resources of the State. Plans were early made for studying the climate and soils, the flora and fauna of Tennessee with especial reference to the development of the agricultural, horticultural, and animal industries. Results of only a portion of this work have as yet been published. Among the more important are reports on the soils and grasses of the State, seedling apples of local origin, and a study of the feeding stuffs of the State.

In 1891 the station commenced a systematic survey of the soils of the State. A preliminary soil map was prepared, and typical samples of

many of the virgin soils were collected and studied physically and chemically. Notes were made at each place upon the geology, flora and fauna, and agricultural methods and products. A relief map of the State has been made from the soil map, and is preserved in the station museum. A thorough study has been made of the grasses of the State. The results appeared in a bulletin which constitutes a complete handbook of the subject. All of the genera and species known to occur in the State are described and most of them figured, and under the specific descriptions economic notes are often added. All of the illustrations were drawn especially for the publication from specimens in the station herbarium. A number of the species figured are there illustrated for the first time. At the same time a grass garden (Pl. CXXXI, fig. 1) was planted. The Division of Agrostology of the United States Department of Agriculture afterwards cooperated with the station in the maintenance of this garden. One of the species of grass that has been much studied is figured herewith. (Pl. CXXXI, fig. 2.)

A systematic study has been made of a number of Tennessee seedling apples, which were reported to be valuable but were unknown outside of the immediate vicinity of their origin. A large number of specimens of fruit have been collected and compared, and the most promising described and figured, and thus brought before the public.

One of the important crops of the State is the peanut. The station has made a general investigation of the statistics and culture of this crop and the chemistry of the plant. An examination has been made of the quality of cotton-seed meal and cotton-seed cake produced in Tennessee oil mills. An examination was also made of the products of some of the grain mills. This work comprised a chemical and physical examination of the cotton-seed products and others of the more generally used feeding stuffs, and an investigation of a number of mixed feeds found on sale in the markets of the State. At the same time a comparison was made of the average composition of Southern feeding stuffs and American feeding stuffs in general.

A thorough study has been made of the cotton plant from the chemist's point of view. This study comprised analyses of the different parts of the plant, determinations of the relative amounts of each of these parts, calculations of the fertilizing constituents contained in the average crop, and analyses of cotton seed and its products.

Feeding experiments have been carried on to determine the average cost of milk produced by cows of different breeds under like conditions of management, to compare the milk yield of thorough-bred and of grade cows at a like ration per thousand pounds live weight, to compare the feeding value and effect of the first and second crops of clover hay upon fattening steers, and to compare the economy of feeding home-grown stock with purchased material of higher nutritive value.

Cultural and variety tests have been made with potatoes and cereals. The station has carried on cooperative experiments to determine the value of different varieties of sugar beets, fruits, and grain. The management of this work is under the control of the member or members of the station staff in charge of each investigation.

Important investigations have been made on the diseases of the potato and grape. A disease of the Irish potato due to nematodes was first described by the botanist, Prof. F. Lamson-Scribner. In 1886, before his connection with the Tennessee Station, Professor Scribner in cooperation with a French investigator, M. Viala, determined the nature of the black rot of the grape, and as chief of the then Section of Vegetable Pathology of the United States Department of Agriculture, prepared the first official circular recommending the use of Bordeaux mixture published in the United States. During the season of 1888 he continued a series of experiments on the treatment of the disease under the direction of the Department.

In the horticultural division fertilizer, cultural, and variety tests have been made with small fruits, tomatoes (Pl. CXXXII, fig. 1), and other vegetables, especial attention being paid to strawberries and grapes. A general study has been made of the American and Japanese persimmons and their culture. Experiments in forcing lettuce (Pl. CXXXII, fig. 2) have been carried on. The horticulturist has made a report on the wild onion, a weed which gives much trouble to dairymen in some parts of the State. Experiments have been made to determine the effect of various fungicides on peach foliage.

The entomologist has given attention especially to the study of the life history of the Heteroptera. A general study has been made of the insects attacking the apple in Tennessee. Studies have been made of the bollworm and the chinch bug and a report has been made on the distribution of the San José scale in the State.

DISSEMINATION OF INFORMATION.

The station has issued 46 bulletins, 11 annual reports, and a few special bulletins, posters, etc. Press bulletins are issued monthly in editions of 10,000 copies. These treat important subjects in a simple, practical manner, and are widely read. The annual report is merely an administrative document. Prof. F. Lamson-Scribner, formerly botanist, is the author of a work on the Diseases of the Grape, and has translated Haeckel's "The True Grasses." The mailing list contains about 10,000 names, which are kept on cards arranged according to counties and post-offices. The station holds farmers' institutes in different sections of the State. Generally, three members of the station staff give illustrated lectures at each institute. Exhibits illustrating the work of the experiment station are made in connection with the institutes.

GENERAL RESULTS OF WORK.

The Tennessee Station has performed an important work in its studies of the soils, grasses, and other natural conditions on which the agriculture of the State is based. It has shown the causes of the deterioration of soils and the methods by which they may be improved. It has promoted the diversification of agriculture by the introduction of grasses and forage plants, the extension of tobacco, potato, and peanut growing, the development of the growing of small fruits and grapes, and the advancement of farm dairying and general stock industries. Its chemical investigations of the cotton and peanut plants and their products have been of general importance and have aided the wider use of these products as feeding stuffs. It has greatly aided the horticultural interests of the State by showing how black rot of grapes and other diseases of fruits, as well as injurious insects, may be repressed by spraying with fungicides and insecticides. It established an effective fertilizer control, and has done much in this and other ways to teach the farmers the discriminating use of commercial fertilizers and farm manures.

TEXAS.

Texas Agricultural Experiment Station, *College Station.*

Department of the State Agricultural and Mechanical College of Texas.

GOVERNING BOARD.

Board of Directors: M. Sansom (*President*), *Alvarado;* F. A. Reichardt, *Houston;* F. P. Holland, *Dallas;* D. A. Paulus, *Hallettsville;* P. H. Tobin, *Denison;* A. P. Smyth, *Mart;* John W. Kokernot, ———; Jeff Johnson, *Austin.*

STATION STAFF.

L. L. Foster, *President of the College.*

J. H. Connell, M. S., *Director.*
H. H. Harrington, M. S., *Chemist.*
M. Francis, D. V. M., *Veterinarian.*
R. H. Price, B. S., *Horticulturist.*
P. H. Tilson, M. S., *Associate Chemist.*
W. C. Martin, B. S., *Asssistant Chemist.*
B. C. Pittuck, B. S. A., *Agriculturist.*
H. C. Kyle, B. S., *Foreman of Farm.*
K. R. Hooper, *Stenographer.*
L. Taylor, *Assistant Meteorologist.*
A. M. Ferguson, M. S., *Assistant Horticulturist.*
J. G. Harrison, *Bookkeeper.*
Geo. E. Adamson, *Stenographer and Clerk.*
S. A. McHenry, *Superintendent of State Station (Beeville).*

HISTORY.

The Texas Station is located in the east-central part of the State. The surface of the State has been fitly characterized as a series of benches, rising one after another from the Gulf of Mexico to the great northwestern plateau. These are for the most part prairie regions, though there are extensive forests, especially in the north, east, and

along the coast. The soils vary in the different regions, but are generally fertile. The climate has a considerable range in different parts of the State. The mean annual temperature ranges from about 55° F. in the north to 68° F. in the south. In the coast region the southeast breezes from the Gulf moderate the climate in summer, and cold, northern winds produce sudden changes in temperature throughout the State, and occasionally in winter bring it down very much below the ordinary level. The annual rainfall varies from about 50 inches in the east to 15 inches in the west. Over large areas in the northern portion of the State agriculture can only be made possible by irrigation. Texas has in recent years become the leading State in the production of cotton. Very large crops of maize and oats are also grown, and considerable quantities of wheat, sugar cane, hay, potatoes, fruits, and vegetables. Enormous numbers of cattle are produced on the ranges and farms, as well as great numbers of sheep, swine, horses, mules, and milch cows. Agriculture has been practiced in the State by white men for some two hundred years, and was rapidly extended with slave labor for fifteen years after the admission of Texas to the Union in 1845, and has had its greatest development during the past twenty-five years.

The college with which the station is connected was established in 1871, and has been developed along industrial and scientific lines.

The Texas Agricultural Experiment Station was organized June 25, 1888, as a department of the Texas Agricultural and Mechanical College, with Prof. F. A. Gulley as director. A part of the college farm was assigned to the station, which was also allowed the use of the necessary college buildings and equipment. Soon after the organization of the station, branch stations were established at Harlem, Fort Bend County, for sugar investigations; at Gatesville, Coryell County, for grass tests; at McGregor, McLennan County, for wheat and other tests; at Rusk, Cherokee County, Huntsville, Walker County, and Prairieview, Waller County, for horticultural tests. The land and nearly all of the labor at these branch stations were furnished to the station without charge. The branch stations were, however, discontinued after having been in operation two or three years, as they did not receive sufficient financial support to make them successful. These branch stations were followed in 1893 by three substations, organized in accordance with an act of the State legislature and supported partly by the State appropriation and partly from the national fund. Two of these stations were discontinued in 1895, and now the substation at Beeville is supported entirely by a State appropriation of $2,500 per year. This substation is located in the southern part of the State in the semiarid region and is devoted mainly to testing the adaptability of vegetables and field crops to local conditions, and various cultural experiments with and without irrigation are carried on. Development

FIG. 1.—TEXAS STATION—MAIN BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—TEXAS STATION—MAIN BARN.

of the irrigation water supply of that region is an important feature of the work undertaken. In 1899 the State legislature appropriated $31,000 for the erection of an agricultural and horticultural building at the central station, in which the general offices and laboratories will be located.

Professor Gulley was succeeded in the directorship in 1890 by Prof. G. W. Curtis, who served until 1893. The present incumbent has held the office since that time.

ORGANIZATION.

The station is governed by the board of directors of the college, consisting of eight members, appointed by the governor and holding office for six years. The board distributes the funds of the station among the different divisions at the beginning of each fiscal year. Meetings are held quarterly, if necessary, but usually less often. Members of the board receive no compensation from station funds.

The staff consists of the president of the college, director, chemist, veterinarian, horticulturist, associate chemist, assistant chemist, agriculturist, foreman of farm, stenographer, assistant meteorologist, assistant horticulturist, bookkeeper, stenographer and clerk, and superintendent of the substation at Beeville. Members of the station staff hold office during good behavior. All new lines of experimental work must be authorized by the director before being carried into execution.

EQUIPMENT.

The offices and laboratories of the station are located at present in the main building of the college (Pl. CXXXIII, fig. 1), which is a four-story building of brick, with mansard roof. On the second floor are, among other rooms, the office of the director and the chemical laboratory. On the first floor are a private chemical laboratory, the office of the division of horticulture, entomology, and botany, and the laboratory of the division of veterinary science. There is now in process of construction a building to be devoted exclusively to the agricultural and horticultural divisions. It is of brick, 77 by 160 feet, two stories, and will contain twenty-five rooms. In it will be located the offices of the director, the professors of agriculture and horticulture and their assistants, a clerk's room, recitation rooms for classes in agriculture and horticulture, rooms for butter making, cheese making, canning and preserving fruits and vegetables, museum, library, and photographic room. The college and station have recently built new barns (the main barn is shown in Pl. CXXXIII, fig. 2), silos, and feeding sheds.

The station occupies 45 acres of college land for experimental work

exclusively, of which 25 acres are devoted to field crops, 10 acres are in orchard, 3 acres in vineyard, and 7 acres in garden.

The station owns 60 head of milch cows and besides is allowed the use of the college herd of 300 animals for experimental purposes when needed. The college feeds the experiment-station stock and has the use of it when not needed for experimental purposes by the station. Individual animals for use in hog, sheep, and steer feeding experiments are purchased by the station as needed.

The station has a collection of 150 specimens of grapes preserved in their natural color, and about 200 photographs and lantern slides. The station library contains about 800 volumes. Station workers also have access to the college library.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, a State appropriation of $2,500 a year for the support of the Beeville substation, and the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
State appropriation for substation	2,500.00
Farm products and miscellaneous	1,007.34
Total	18,507.34

LINES OF WORK.

The station has no inspection duties. The investigations have been mainly along lines of cattle feeding, cotton culture, and horticultural investigations. Texas produces more cattle than any other State in the Union, and to this industry the best efforts of the station have been devoted. The investigations have included an economic study of all the food stuffs commonly used in the State, the experimental feeding of steers, milch cows, and hogs, studies of the effect of different food stuffs upon the quality of the product, and field experiments with forage crops. Investigations have been made on several diseases and parasites of the cattle of the State. Experiments in feeding milch cows were carried on to determine what forage stuffs are most suitable to be fed with the common grains of the State, and in feeding beef cattle to determine the feeding value of the important fodders and feeding stuffs. The object of the experiments in steer feeding was to determine what fodder may be most economically fed with cotton seed and cotton-seed products in the production of beef. In these experiments a test was made of the feeding value of cotton seed in different forms, and it was also compared with maize as a fattening food. Studies have been made on the effect of cotton seed and cotton-seed meal on butter with reference to content of volatile acids, grain,

texture, color, optimum temperature for churning, and quality of cream. Similarly, these feeding stuffs were studied in another experiment with reference to their effect on creaming of milk.

Studies have been made by the veterinarian on the screw worm, liver flukes, glanders, tuberculosis, actinomycosis, Texas fever, and cattle ticks. The two last named have been important subjects of investigation since the establishment of the station, and have for some time been carried on in cooperation with the Missouri Station.

Numerous varieties of maize have been tested and this work was accompanied by botanical studies of the different varieties, especially of their root systems, to determine, if possible, the reason for their differing adaptabilities. Studies were made of the influence of climate on composition of maize, and it was shown that southern-grown maize when carried north loses in protein and fat, and vice versa. Studies were made in methods of saving maize fodder. Considerable experimental work has been done with sorghum as a fodder plant, chemical analyses have been made of numerous feeding stuffs, and numerous forage plants have been tested with respect to their adaptation to different sections of the State.

While Texas produces more cotton than any other State in the Union, the station's investigations along this line have not been proportionate to the commercial importance of the crop, it being the policy of the station rather to develop diversified agriculture and to assist in building up the live-stock interests of the State than to develop further the cotton interests.

Experimental work in cotton culture has been along lines of variety testing and breeding. A study has been made of the cost per pound of growing cotton in different parts of the State with different fertilizers, based on the reports made by the growers themselves. Extended studies of the root rot of cotton, which also attacks alfalfa, have been carried on, and it has been shown that this disease is caused by a parasite.

Experimental work in horticulture has been along lines of determining the adaptability of varieties of fruits and vegetables to local conditions, their propagation, cultivation, fertilization, and management, and a systematic study of varieties of the sweet potato and peach. Considerable experimental work has been done on methods of keeping sweet potatoes, and studies have been made on the changes in sugar content while in storage. The horticulturist has developed and extended the Onderdonk classification of peaches, and is now chairman of the committee of the Association of Agricultural Colleges and Experiment Stations which is determining the range of adaptability of the different races of peaches in the United States. Considerable attention has been given to determining the adaptability and relative merits of different varieties of plums, Japanese persimmons, and grapes. Observations have been made on the black rot of the grape.

Some experimental work in irrigation has been done with a view to utilizing underground water for irrigation purposes, and various methods of raising it by windmills and gas engines have been tried. Investigations have been made on the composition of paints with a view to encouraging the consumption of cotton-seed oil in their manufacture. The chemical staff has made improvements in methods of soil analysis and methods of determining tannic acid in canaigre.

Numerous cooperative experiments have been carried on with farmers throughout the State to determine the adaptability of different varieties of maize, cotton, and forage crops in the different climates and on the different soils. The station requires the written statement of two business men acquainted with the farmer who volunteers to cooperate that he is, in their opinion, reliable and competent to undertake such work.

DISSEMINATION OF INFORMATION.

January 1, 1900, the station had issued 11 annual reports, 54 regular bulletins, and during the last three years a number of special bulletins known as "Press Notes." These "Press Notes" are sent out quarterly to each newspaper in the State, and are very generally used. The annual report contains, aside from the usual administrative features, a brief statement of all results of importance obtained during the year.

The station mailing list contains 11,200 names. Publications are addressed with a mailer. The expense of printing has compelled the station to establish three distinct mailing lists—one for those interested in field crops, one for those interested in horticulture, and one for those engaged in stock raising. As many persons are not interested in more than one of these series, a great saving is effected in the number of publications sent out. Prof. G. W. Curtis, while director, published a book entitled "Horses, Cattle, Sheep, and Swine;" the horticulturist, Prof. R. H. Price, has published a work on "Sweet Potato Culture for Profit;" and Prof. F. A. Gulley, while director at this station, wrote "Field and Forest Crops."

The station correspondence amounts to from 5,000 to 7,000 letters a year. The value of this correspondence is much increased by publishing the substance of important letters in the agricultural papers of the State. The station's work at farmers' institutes is somewhat limited, owing to the fact that there is no State system of institutes in Texas, but station officers attend as many as practicable. The station organized a "farmers' congress" in July, 1898, and entertains the members upon the station grounds for three days during the month of July of each year. This congress is composed of the State Horticultural Society, Texas Stock Raisers' Association, State Cotton Growers' Association, and the Texas Dairymen's Association. The station has made a few exhibits at the State fair.

GENERAL RESULTS OF WORK.

The Texas Station has promoted the diversification of agriculture and the development of animal industry in a number of ways. It has shown the adaptability of different forage plants to different regions of the State. By introducing new methods of culture it has materially aided the extension of sorghum and alfalfa as profitable crops. By demonstrating the usefulness of subsoiling and tile drainage in certain regions it has greatly benefited agriculture and horticulture there. It has shown how the soils in certain other regions may be rendered more productive by a judicious use of fertilizers. Its investigations on cotton-seed products have been an important factor in promoting the more general and beneficial utilization of these products as feeding stuffs in the State and elsewhere. Its studies of Texas fever, and especially the means for its prevention, have also been of much importance to the live-stock interests of the entire South and West. Very many farmers, fruit growers, and market gardeners have been aided in the selection of varieties of maize, cotton, forage crops, fruits, and vegetables by the published investigations of the station.

UTAH.

Agricultural Experiment Station, *Logan.*

Department of the Agricultural College of Utah.

GOVERNING BOARD.

Board of Trustees: W. S. McCornick (*President*), *Salt Lake City;* P. W. Manghan (*Secretary*), *Logan;* Allan M. Fleming (*Treasurer*), *Logan;* Mrs. Emily S. Richards, *Salt Lake City;* D. C. Adams, *Salt Lake City;* John A. McAlister, *Logan;* L. Hansen, *Wellsville;* Mrs. R. N. Bagley, *Ogden;* Joseph Morrell, *Logan.*

STATION STAFF.

Joseph M. Tanner, *President of the College.*

Luther Foster, M. S. A., *Director; Agriculturist.*

F. B. Linfield, B. S. A., *Expert in Dairy Husbandry.*

[1]J. A. Widtsoe, B. S., *Chemist.*

C. P. Close, M. S., *Horticulturist and Botanist.*

Geo. L. Swendsen, C. E., *Irrigation Engineer.*

James Dryden, *Meteorologist and Poultry Manager.*

Lewis A. Merrill, B. S., *Assistant Agriculturist.*

John Stewart, B. S., *Assistant Chemist.*

John A. Crockett, *Assistant Dairyman.*

Wm. Peterson, *Assistant Horticulturist.*

HISTORY.

The Utah Station is located in the northern part of the State, on the mesa overlooking the Logan River and the Cache Valley, which is one of the most thickly populated and fertile irrigated regions in the State.

[1] On leave.

On either side of the valley are high mountain ranges. Agriculture is successfully practiced in a number of similar valleys, but there are large mountain regions and great tracts of deserts with soils too alkaline to make their reclamation practicable, especially in the basin of Great Salt Lake. In the valleys the annual rainfall does not exceed 12 inches, being especially scanty from May to October. The climate is comparatively mild and equable. On the mountains and more elevated valleys there is much nutritious grass, affording pasturage for large numbers of cattle and sheep. The principal crops grown on the irrigated lands are alfalfa, wheat, oats, and potatoes. Vegetables and orchard fruits are also produced in great abundance. Irrigation has been practiced in Utah for fifty years, and an extensive system of reservoirs, canals, and ditches has been developed. Utah was organized as a Territory in 1850, and admitted to the Union in 1896. The college with which the station is connected was established in 1889, and is being developed mainly along industrial and scientific lines.

The Utah Agricultural Experiment Station was organized November 16, 1889, in accordance with the act of Congress, as a department of the Agricultural College of Utah, with the president of the college, Prof. J. W. Sanborn, as director. Professor Sanborn was succeeded as president of the college in 1894 by Prof. J. H. Paul, who became also director of the experiment station. Professor Paul resigned in 1896, when the offices of president and director were separated, and the present incumbent was elected director.

In 1896 an act was passed by the State legislature creating a system of farmers' institutes and imposing the duty of its organization on the college and station officers, but providing a fund only for the actual expenses incurred in carrying out the provisions of the law. In 1897 the office of State dairy inspector was created and the station dairyman was designated as that official. In March, 1899, the State legislature passed a bill establishing an experiment station at St. George, Washington County, to be supported entirely by State funds. The work is to be confined by law to experiments in horticulture under the control of the State board of horticulture.

ORGANIZATION.

The governing board of the station is the board of trustees of the agricultural college, which consists of 7 members appointed by the governor and confirmed by the senate. Formerly the term of office was two years, but by a recent act of the legislature has been extended to four years. The State law provides that the trustees shall have charge of the experiment station, purchase land, erect buildings, and appoint necessary officers and assistants to conduct the experiments. The by-laws of the trustees provide for five regular meetings each year, and the secretary is authorized to call a special meeting at any time upon the written request of the president of the board. Members

FIG. 1.—UTAH STATION—OFFICE BUILDING.

FIG. 2.—UTAH STATION—BARN.

FIG. 1.—UTAH STATION—CHEMICAL BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—UTAH STATION—CAROLINA POPLARS, PLANTED FOR FUEL.

receive actual expenses only. The board is represented in the intervals between meetings by an executive committee consisting of the president of the board and two members. The planning of the work is left largely with the director. Outlines of investigations are submitted for the approval of the board from time to time, especially in the case of proposed new experiments involving a considerable outlay of money. Members of the staff are allowed considerable latitude in selecting lines of work. The expenditure of all sums exceeding $5 in a single requisition must be authorized by the board of trustees or have the approval of the chairman of the executive committee. The State examiner is authorized to inspect station accounts from time to time.

The staff consists of the president of the college, director (who is also agriculturist), expert in dairy husbandry, chemist, horticulturist and botanist, irrigation engineer, meteorologist, poultry manager, assistant agriculturist, assistant dairyman, assistant horticulturist, and assistant chemist. Members of the staff are appointed by the board of trustees for a period of one year, but tenure of office is at the pleasure of the board. The director is the executive officer of the station and is responsible for its management. His duties are to see that all funds are expended strictly in the line of station investigations, all purchases being made on his requisition; to make equable allotment of funds to the different divisions; to inspect and approve plans of investigation submitted by heads of divisions; to arrange cooperative work between divisions of the station, between the station and the United States Department of Agriculture, and between the station and farmers; to supervise the printing of station publications and decide what matter shall be printed; to attend to all official correspondence, and to prepare the annual report.

EQUIPMENT.

The station buildings consist of an office building, barn, greenhouse, chemical laboratory, poultry building, and forcing house. The office building (Pl. CXXXIV, fig. 1) is a two-story brick structure, in which are the offices of the director, horticulturist, assistant agriculturist, and poultry manager, a mailing room, and photographic and library rooms. Surrounding the barn (Pl. CXXXIV, fig. 2) are a hog house, root cellar, wagon and implement sheds, and a silo, which is now used as a storehouse for feeding stuffs. Attached to the greenhouse is a potting shed, with a cellar for storage purposes. The chemical building (Pl. CXXXV, fig. 1) is occupied by the college and station jointly, a floor space 36 by 40 feet being devoted to a suite of rooms conveniently arranged for station work. The poultry house is a one-story frame building, and consists of a central portion 20 by 20 feet, with wings on either side 10 by 52 feet. The latter are divided into pens 5 by 7 feet, each of which connects with a yard outside 40 feet in length.

The station farm consists of 83 acres of land ditched for irrigation. Seventeen acres are devoted to the work of the horticultural division for experiments with garden vegetables, fruits, and forestry (Pl. CXXXV, fig. 2), and 22 acres are in permanent pasture of alfalfa or mixed grasses. Four acres are devoted to variety tests of clover, grasses, and alfalfa, 16 acres are used in a series of rotation experiments, and the rest of the land, 24 acres, is laid out in permanent plats 2 by 4 or 2 by 6 rods, which are devoted to irrigation tests, tests of varieties of wheat, oats, barley, maize, and grass, cultural methods, and other experiments of like character.

The station owns 36 head of cattle, 6 horses, 67 hogs, and 14 sheep. The main purpose for which the hogs are kept is to raise pigs that are satisfactory for use in feeding experiments. Incidentally, the station sells a number of pure-bred males. Special animals are sometimes purchased for feeding experiments, among which are all steers used in feeding or digestion tests.

The museums contain an herbarium of 2,700 specimens, 1,400 of which were collected in the State; a small collection of the insects of the State, 200 samples of varieties of grain in bottles and 75 in the straw; a small collection of cultivated grasses, lantern slides illustrating different breeds and types of live stock or the evolution of farm machinery, and photographs showing the results obtained in building up the dairy herd from native stock. A separate station library is not maintained. The combined library of the college and station contains 7,200 volumes.

The station is well equipped with apparatus necessary in its lines of work. The barn is provided with machinery for preparing foods for stock by the most modern methods, power for which is supplied by an electric motor. The assistant chemist, Mr. John Stewart, has devised an apparatus for generating a regular current of hydrogen for use in moisture determinations in food analyses.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	3,009.14
Total	18,009.14

LINES OF WORK.

The station has no inspection duties. The efforts of the Utah Station have been directed in large part to the solution of problems of animal production. As would be expected, this work is accompanied by

investigations in irrigation and reclamation of alkali soils, since Utah is in the arid region of the West. The production of cereals, industrial crops, and fruit is also receiving attention. The work in irrigation has included tests to determine the duty of water applied to different field, fruit, and garden crops, the best time to apply it, and the best methods of distribution. Tests have also been made to learn the effect of varying quantities of water on the yield, sugar content, and purity of sugar beets. A study has been made of methods of earthen dam construction for the storage of water, and a hydrographic survey has been made of a portion of the northern part of the State to ascertain water supply. Experiments have been made in the maintenance of permanent pasture under irrigation. Investigations have been made on the alkali soils and seepage waters of the State, with a view to reclaiming large tracts of barren land. The effect of alkali on the germination of seed of some of the most important agricultural plants has been studied.

The division of chemistry has undertaken to make a soil survey of the State, taking up the work by counties. The work for two important counties has already been finished, and samples of soils from another county have been secured.

Feeding experiments undertaken by the station are designed to furnish more exact information in regard to the forage crops and feeding stuffs used in the State and their utilization in feeding cattle, sheep, horses, and swine. One of the most important investigations that has been completed by the station is a comparison of the feeding value of dry maize fodder and silage. It was shown that the use of the silo is not necessary in the dry climate of Utah. As a result of the discovery of this fact, many farmers have been saved the expense of undertaking the costly silo system of storing bulky crops. Another investigation which has proved to be of much practical importance was a study carried on for five years to determine at what stage of its growth alfalfa may be cut most profitably, annual yield of hay per acre and composition and feeding value being considered. The feeding value of the first, second, and third crops was determined and the feeding value of the plant as compared with timothy hay, red clover, and shredded maize fodder. Other comparisons have also been made of various feeding stuffs, together with digestion experiments with shredded maize fodder, alfalfa, timothy, and wheat bran. Tests have been made of the influence of shelter on food consumption and of the value of silage and root crops as compared with dry food.

Experiments in the economic production of pork have been carried on to determine to what extent alfalfa and mixed pastures may be used for this purpose in the summer and to determine whether roots and alfalfa hay may be profitably used for the same purpose in winter. The growth of grass-fed pigs has been compared with that of pigs that

have received no grass. Experiments have been made to determine the value of exercise for pigs and the relative value of wheat, peas, maize, and barley in the production of pork. Experiments in feeding horses have included feeding trials with work horses to determine the value of alfalfa hay as compared with timothy hay and other fodders; tests of narrow and wide rations, and the relative value of maize and oats. The experiments with sheep have been made to determine the value of silage, roots, and grass as compared with dry feeding stuffs.

The dairy work is carried on for the purpose of showing how to build up a choice dairy herd from common stock, and the best methods of increasing the production of the herd. Experiments have been made to determine the most economical winter ration for milch cows and the conditions of greatest thoroughness in churning have been studied. Feeding experiments are being conducted with calves and pigs to determine the feeding value of the by-products of the dairy and the best methods of using them. Studies have been made on tuberculosis and demonstrative experiments conducted in the use of tuberculin.

Experiments in poultry culture have been made to determine the age at which hens are most profitable, the value of exercise for poultry and the most profitable ration. Some striking results were obtained in this work. Artificial incubation and caponizing have also been subjects of experiment. Comparisons have been made of the breeds of fowls.

Among the field experiments carried on at the station are included variety tests of cereals and forage plants, tests to determine the amount of seed wheat and oats that may be most profitably used per acre, a comparison of results of plowing at different seasons and to different depths, tests of different kinds of manure for oats, and of different methods of tillage for maize. Comparisons have been made of different rotations of crops and the effect of each on the fertility of the soil. An extensive study has been made of the chemical life history of alfalfa, and analyses have been made of potatoes grown in different seasons and under different conditions. The changes in sugar content and feeding value of the sugar beet during the period of ripening have been traced.

The object of the experimental work in the interests of the fruit industry is to determine the most economical methods of combating insect pests and fungus diseases, to introduce better varieties of fruit, and to improve methods of culture and of preparation of fruit for market. The horticultural division is carrying on experiments in forestry in cooperation with the Division of Forestry of the United States Department of Agriculture, the object of which is to determine the kinds of trees best adapted to local conditions, to illustrate

approved methods of planting and the use of forest plantations for wind-breaks, and to encourage the more general planting of forest trees.

In the earlier years of the station a number of experiments were made to determine the draft of plows under varying conditions and the effects of the distribution of the load and other conditions on the draft of wagons. Determinations were also made of the draft of sleds as compared with wagons, and of different tillage implements and mowing machines.

DISSEMINATION OF INFORMATION.

The station has issued 62 regular bulletins, 1 special bulletin, about 50 press bulletins, and 9 annual reports. The annual report contains the usual administrative features and reports of investigations that are too brief or not of sufficient importance to appear in bulletin form.

The mailing list contains 4,329 names. The State list is arranged alphabetically by post-offices, and the names under each post-office according to the first vowel of each surname. The list for other States is arranged alphabetically by States, and the names in each State by vowel sounds. The lists are all kept in books, separate books being kept for Utah, other States, experiment stations and Government officials, State and agricultural papers, and foreign countries. Envelopes are addressed with a pen or typewriter.

The correspondence amounts to about 7,000 letters a year. The agricultural college and experiment station have entire management of the system of farmers' institutes. The time devoted by heads of divisions to this work varies from 5 to 55 days annually, averaging about 25 days each, not including the time consumed in the preparation of addresses.

GENERAL RESULTS OF WORK.

The investigations of the Utah Station on alfalfa have done much to increase the importance of that crop in the irrigated regions of the West and to show how it may be managed to secure the best results. The successful establishment of beet-sugar factories in several localities in the State is largely due to the results of cooperative experiments in the culture of sugar beets conducted by the station with the farmers. The large dairy interests recently developed in the State resulted directly from the investigations and teaching of the experiment station. The Cheddar process of cheese making has been generally adopted by factories in the State in place of the dip curd or soft cheese method as the result of the station's work in this line. The methods of feeding skim milk and whey to calves and pigs for best

results, taught by the station investigations, are now in practice wherever dairies are in operation in the State.

As a result of variety tests, new kinds of grain, fruits, and vegetables of better quality have been introduced. Better methods of tillage have been generally adopted in the State as a result of the station's cultural experiments. Stockmen are introducing improved breeds and making more effort to improve the common range stock of the country than ever before.

The investigations on irrigation problems have already brought out a considerable amount of accurate data very much needed for the improvement of irrigation methods in Utah and elsewhere in the irrigated region.

The poultry experiments, by supplying much accurate data in regard to the profitableness of egg production, have done much to stimulate an interest in poultry keeping in this and in other States.

VERMONT.

Vermont Agricultural Experiment Station, *Burlington.*

Department of University of Vermont and State Agricultural College.

GOVERNING BOARD.

Board of Trustees—Board of Control: Matthew Henry Buckham (*President*), *Burlington;* E. J. Ormsbee, *Brandon;* G. S. Fassett, *Enosburg;* Cassius Peck, *Burlington.*

STATION STAFF.

Matthew Henry Buckham, D. D., *President of the University.*

J. L. Hills, B. S., *Director.*
G. H. Perkins, Ph. D., *Entomologist.*
L. R. Jones, Ph. B., *Botanist.*
F. A. Waugh, M. S., *Horticulturist.*
F. A. Rich, V. S., M. D., *Veterinarian.*
Cassius Peck, *Superintendent of Farm.*
C. H. Jones, B. S., *Chemist.*
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HISTORY.

The Vermont Station is located in the northwestern part of the State on the shore of Lake Champlain in the chief city of the State. Vermont is chiefly a mountain and hill region, with the valley of the Connecticut River on the east and that of Lake Champlain on the west. The soils adapted to cultivation are in restricted areas. The winters are long and severe and the summers brief and cool. The annual rainfall is about 30 inches. A large portion of the surface of the State is covered with forests. The principal crops are hay, oats, potatoes, and maize. Numerous milch cows, cattle, sheep, horses, and swine are maintained. Dairying is the most important agricultural industry. Apples are produced in some portions of the State in large quantities, and the making of sugar and sirup from the sap of maple trees is

more extensively practiced than in any other State. Stone quarrying is a relatively large interest. Agriculture has been practiced in the State in a regular way somewhat over one hundred years.

The university with which the station is connected was established in 1791, and in recent years has been greatly developed along technical and scientific lines.

The Vermont Agricultural Experiment Station was organized as a department of the University of Vermont and State Agricultural College in accordance with an act of the State legislature approved November 24, 1886, and $3,500 annually was appropriated for its support. One of the requirements of this law was that the station should analyze, without charge, materials of an agricultural nature for the citizens of Vermont. Work was begun March 1, 1887, with Prof. W. W. Cooke as director, and continued until the national fund became available in February, 1888. The station was reorganized in March, 1888, under the act of Congress, and the scope of its work much enlarged. In May, 1888, a farm was bought about 3 miles from the university, which, however, proved to be poorly adapted to the purposes of the station. It was sold and another purchased in 1891 contiguous to the university grounds. In 1893 Professor Cooke was succeeded by the present incumbent, who had previously served as chemist since the organization of the station.

The State appropriation to the station lapsed June 1, 1890, but the duties prescribed by the State law were continued and still remain a part of the law of the State. No further appropriation was made by the State to the station until the session of 1898 when the statutes were so amended as to appropriate not to exceed $1,000 annually to be applied to the printing of the station report, this being considered a fair offset to expenses necessarily incurred in complying with the above-mentioned provisions of the law. In 1898 a feeding stuffs inspection law was passed, placing the inspection of commercial feeding stuffs in the hands of the station. The enforcement of a law relating to the accuracy of glassware used in milk testing, and the ability of creamery operatives to conduct the Babcock test properly, vested by the terms of the law in the person of the superintendent of the dairy school, is likewise carried out at present under station auspices. The control of commercial fertilizers has been assigned to the station since its establishment.

ORGANIZATION.

The State law, under which the station was originally established, provides that "the trustees of the university shall appoint annually two of their number, who, with the president of the university as their chairman, shall act as a board of control." Both the number and the personnel of this board remained unchanged until 1890, when

its membership was increased by the board of trustees to 5. This number and personnel remained intact until late in 1897 when broken by death, since which time the board has consisted of 4 members, the president of the university, an ex-governor of the State, who has served since 1886, and 2 practical farmers, who have served continuously since 1890. One-half of the trustees of the university are a self-perpetuating body, while the other half are elected by the State legislature for terms of six years. The duties of the board of control comprise the general oversight of station affairs, the authorization of lines of work, the auditing of bills incurred, and, in general, the shaping of the policy of the station. The general policy of the board as regards work, officers, expenditures, etc., is, while exercising a general supervision, to leave both inception and details of scientific work to the staff and to leave it free to make minor expenditures. Proposed expenditures of medium amounts are usually referred to the director, and of large amounts to the board. The board holds monthly meetings. The compensation of its members is $3 a day and expenses.

The staff comprises the president of the university, director, entomologist, botanist, horticulturist, veterinarian, farm superintendent, chemist, assistant chemist, dairyman, stenographer, and treasurer. The officers of the station are appointed by the board of control, and their tenure of office is practically conditioned by good behavior and efficiency. It has been customary to engage each individual at first for a definite and relatively short time, a year or less. If his services and personality are satisfactory, a more permanent engagement ensues. Practically all the executive work other than treasurer's duties is vested in the director, with the exception of the general management of the station publications, which is at present in the hands of the horticulturist.

EQUIPMENT.

For its offices and laboratories the station makes use of a part of two university buildings, the station building and Williams Science Hall. The principal station building (Pl. CXXXVI, fig. 1) is a brick structure 70 by 45 feet, four stories, with a two-story addition. A part of the first and entire second floor are occupied by the station. Here are located the director's office, chemist's office, the chemical laboratory, horticulturist's office and laboratory, and mailing room. The botanical and entomological offices and laboratories are located in Williams Science Hall (Pl. CXXXVI, fig. 2), a fireproof structure of brick (with basement and attic, three stories), finished in 1896 at an expense approximating $150,000. A considerable sum of money was applied by its donor to its equipment for college purposes, and the divisions of the stations located in it, particularly that of botany, have indirectly profited thereby. The farm buildings (Pl. CXXXVII, fig. 1) comprise a barn 105 by 48 feet with two additions, creamery, green-

FIG. 1.—VERMONT STATION—MAIN BUILDING, USED BY UNIVERSITY AND STATION.

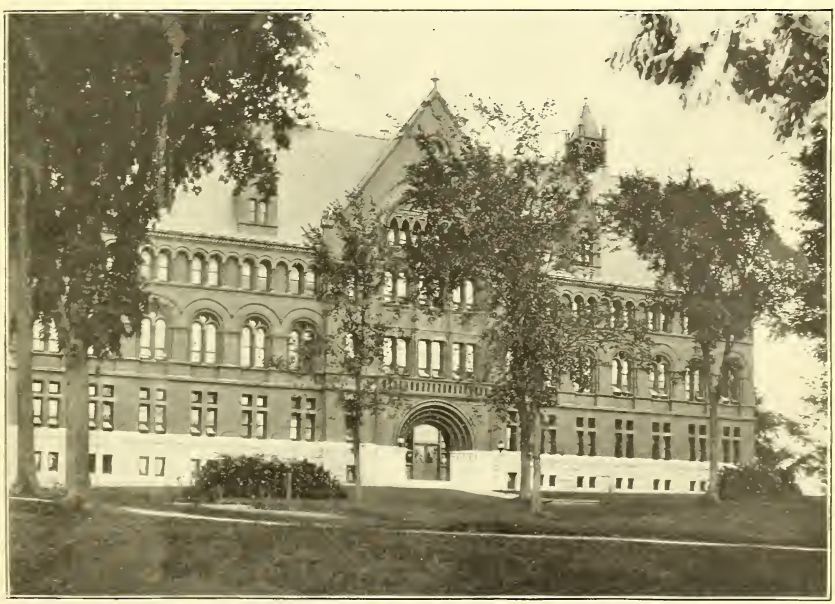

FIG. 2.—VERMONT STATION—WILLIAMS SCIENCE HALL, USED BY UNIVERSITY AND STATION.

FIG. 1.—VERMONT STATION—FARM BUILDINGS.

FIG. 2.—VERMONT STATION—GREENHOUSE.

FIG. 1.—VERMONT STATION—FIELD PLATS.

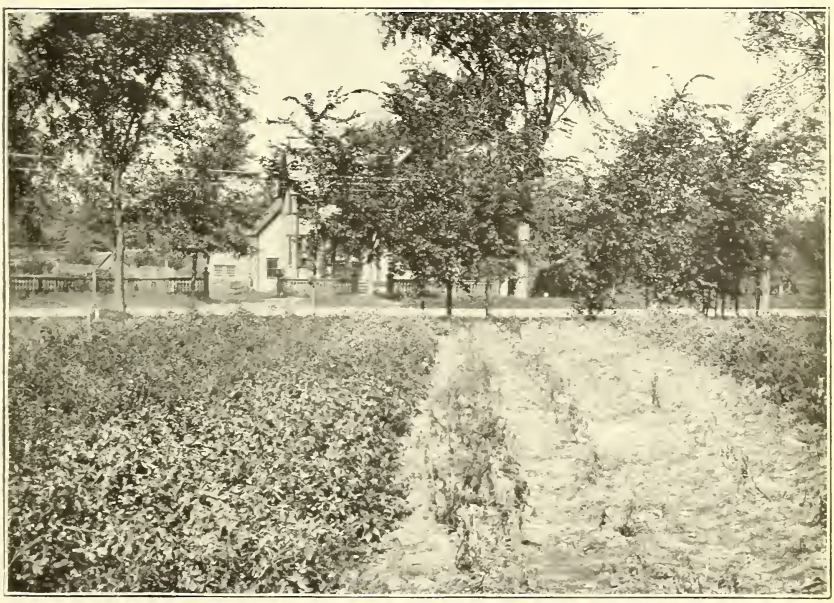

FIG. 2.—VERMONT STATION—SPRAYED AND UNSPRAYED POTATOES.

FIG. 1.—VERMONT STATION—SPRAYING APPLES.

FIG. 2.—VERMONT STATION—SPRAY CART.

house (Pl. CXXXVII, fig. 2), apiary, and the farm superintendent's dwelling house.

The entire college farm, containing about 125 acres, is under the control of the station. It is managed mostly as a dairy farm and its revenues are applied to the cost of management. The field plats are shown in Pl. CXXXVIII, fig. 1. The station live stock consists of 5 horses, 20 pigs, and 72 head of cattle, including 54 cows. All cows that are in good condition to be used in experimental feeding tests are thus used yearly from November to May. It is a general rule of the station to use large numbers of animals in each test and to conduct the same test during at least two years.

The station has a horticultural herbarium containing about 1,000 specimens and a mycological herbarium of about 10,000 specimens, among which are sets of the principal American exsiccati published during recent years, and a large number of specimens collected by the botanists in a survey of the State. The officers of the station have access to the collections of specimens in the university museum, among which is a comprehensive collection of the native plants of Vermont. The station has about 1,500 negatives, besides which the university has a large number of models, negatives, lantern slides, etc., which are made use of by the station when needed. The station library contains about 1,300 volumes. The university library, containing 50,000 volumes, is available for the use of the station staff, as is also a large city library. Both of these libraries contain a considerable amount of literature pertaining to horticulture and botany and other branches of natural history.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, sales of farm products, fees for fertilizer analyses, fees for feeding-stuffs inspection, and a State appropriation for printing not to exceed $1,000 annually. The State appropriation for printing will be available for the first time in 1900. The income during the last fiscal year was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	1,981.04
Fees for feeding-stuffs inspection	211.49
Farm products	5,589.85
Total	22,782.38

LINES OF WORK.

The inspection of commercial fertilizers and of certain feeding stuffs devolves upon the station. At present the inspection of creamery glassware and the examination and licensing of operators of the

Babcock test for dividend making are also carried on under station auspices. The expenses of the fertilizer and feeding-stuffs inspection are defrayed by the State, which licenses the commercial fertilizer companies and imposes a tonnage tax on certain feeding stuffs. The inspection of glassware is paid for by those owning the apparatus, and the fee for license to operate the Babcock test is charged to the licensee. Inspection work is managed, so far as possible, with a view to avoiding conflict with research work. During the months of March, April, and May the chemists are engaged almost exclusively upon the analysis of commercial fertilizers. The salaries and all the expenses of running the laboratory during this time are charged to fertilizer control funds. It is expected that the station will manage the feeding-stuffs control in a similar manner, giving to it a definite time in the course of the year. In this way the research work can be planned so as to avoid interruption.

The investigation work of the Vermont Station has been mainly along lines of dairy husbandry, plant diseases, pollination of plums, and studies on maple-sugar production. It is the established policy of the station to concentrate its efforts on a few important subjects of investigation and to strengthen the work along these lines.

The leading industry of Vermont is dairying, to which, from its organization, the station has given a large share of attention. The present equipment of the station is such that the experimental feeding of milch cows necessarily occupies the most important place in these investigations. During the first eight years of the station's existence its published work along this line had to do mainly with the determination of the food values of different rations, especially commercial feeding stuffs, various kinds of silage, and roots. At the same time, however, it was collecting data of value in improving methods of experimentation in feeding milch cows, and since 1896 this subject has been made of primary importance. The investigations along this line have included studies on the proper length of feeding period with reference to the effect of varying lengths upon quantity and quality of product; studies on the relative feeding values of rations of essentially equal balance, of medium and wide rations fed in medium quantities, and of medium and wide rations, the former fed in medium and the latter in small quantities, and studies on the experimental error in feeding tests. Studies have been made of the method of least squares as a means of determining the money values of commercial feeds. A long-continued series of investigations have been conducted on the variations in quantity and quality of milk as affected by period of lactation, environment, particularly weather, change from barn to pasture, different foods, and other circumstances, as abortion, breeding, and fatigue. Observations have been made on the effect of food on butter. In dairying, tests have been made of a large number of the cheaper antiseptics as milk preservatives.

Pig-feeding experiments were carried on for a number of years to ascertain the most economical way of using the skim milk from the dairy in the production of pork. These experiments included comparisons of the feeding values of sweet and sour skim milk, of different proportions of maize meal and skim milk, of various feeds and methods of treatment in flesh production, comparisons of breeds, comparison of the effects of concentrated and bulky food, skim milk and buttermilk, etc.

Tests have been made of the adaptability of various forage plants to local conditions, together with fodder analyses of these plants. Comparisons have been made of different methods of preserving maize and of different silage mixtures. The effect of fertilizers on the composition of maize and potatoes has been investigated.

The botanical division has made the study of plant diseases and their treatment its chief work. The most important investigations have been on the diseases of the potato. The term "potato blight," as used in Vermont, was shown to refer, contrary to previous opinion, to two distinct diseases, for which the botanist suggested the terms "late blight" and "early blight." A critical study of the latter disease showed that three well-known disorders were popularly designated by this term, namely, the typical early blight, which is a fungus disease, arsenical poisoning from Paris green, and tip burn caused by drought. Other investigations showed that the fungus which is the specific cause of early blight is not a Macrosporium, as previously believed, but an Alternaria. Studies were made on the relation of weather to the late blight. It was shown that the disease might be fully or in a great measure prevented by selection of seed tubers free from the late blight and rot. Observations have been made on the time and rate of growth of potato tubers and the effect of premature death of the potato tops upon yield. The relation of time of planting potatoes to the development of the diseases has been studied.

The subject of spraying has received much attention. Numerous field tests with Bordeaux mixture and other spraying mixtures on potatoes (Pl. CXXXVIII, fig. 2) have been made, and studies in methods of preparing Bordeaux mixture have been reported. Experimental spraying of apples (Pl. CXXXIX, fig. 1) and pears has been continued through a series of years. To facilitate the practical work of spraying, a convenient homemade spraying outfit (Pl. CXXXIX, fig. 2) was devised, consisting essentially of a barrel force pump carried on a two-wheeled cart.

Observations have been made on a number of other diseases, including the apple rust, a spot disease of the Baldwin apple, the brown rot of the plum, oat smut, lettuce mildew, lettuce rot, onion mildew, and carnation rust. Investigations on the apple scald are now in progress. A bacterial rot of carrot and other vegetables has received considerable attention.

Vermont produces more maple sugar than any other State in the Union. The methods of manufacture have been made the subject of important investigations by the station, and recently a study of sap flow in the maple has been taken up, both from the chemical and the physiological standpoints. The work thus far has borne upon the relation between temperature, sap pressure, and suction in the sugar maple, and the direction of the sap flow, and the relation of these to the composition of the sap. A general survey has been made of the weeds of the State, and a particular study made of the orange hawkweed. Studies on the impurities of Vermont clover seed have been reported.

The investigations of the horticulturist have been confined mostly to plums, especially their pollination. It was shown that for all practical purposes all classes and varieties of native and Japanese plums may be regarded as self-sterile; hence the necessity of cross pollination, for which natural adaptations were found to be quite various. The belief that the grouping of cultivated plums into species would indicate more or less exactly the lines of affinity in pollination led to an extensive study of relationships and a pomological classification. This led to a revision of the accepted classification in that the species *Prunus nigra* was merged in the species *P. americana*, forming the variety *P. americana nigra*. A group of cultivated plums, the Wayland group, was also recognized and described. In connection with the work in pollination, it was found that all the commonly cultivated Japanese and native varieties seem to be quite reliably interfertile, hence the practical problem is the selection of varieties that blossom at the same time. Extensive observations were made to determine the blossoming season of different varieties, and a chart was prepared that presented these observations graphically. It was shown that the sequence of blossoming periods is about the same in different years in the same locality and generally in widely separated localities. A monograph has been prepared on the hybrid plums thus far known, which is accompanied by a general discussion of hybridity in the group. Studies have been made on the hardiness of representative varieties in the principal groups of plums, and the approximate northern limit of their successful culture has been indicated. Considerable attention has been given to the study of hardy fruits, also to the practical features of apple growing. The horticulturist has published a revision of the genus Lilium, and is making investigations on the artificial use of enzyms in germination of seed.

The entomologist has studied a number of injurious insects, among which are the red spider, tent caterpillar, oyster-shell bark-louse, apple-tree borers, army worm, pea and bean weevils, and currant worms. The station is carrying on experiments in bee keeping along lines of feeding and management.

The present chemist has made considerable studies of the permanganate of potash method of determining the availability of nitrogen in fertilizers.

DISSEMINATION OF INFORMATION.

The station has issued 11 annual reports, 73 regular bulletins, and a number of press bulletins and posters. The annual report is composed entirely of new matter with the exception of a reprint of the abstracts of the bulletins issued during the year. It is the general policy of the station to publish its technical work in the reports, making its more popular presentations in bulletin form. Each bulletin is prefaced by a summary of the contents in black-faced type. Newspaper bulletins have been issued from time to time. Recently short, pithy newspaper articles, averaging about one-third of a column in length, have been prepared in newspaper style and issued biweekly. Posters have been issued quite commonly. Among such may be mentioned an illustrated poster describing potato spraying, an illustrated poster describing canker of apple trees, and a poster, illustrated in colors, showing the orange hawkweed or paint brush, with means of combating it. Whenever serious insect ravages of an uncommon nature have been threatened, posters have been placed in the different post-offices describing the insects and the way of preventing their work. The fertilizer analyses have been posted in the early spring for several years in the different post-offices of the State. The potato-spraying poster is believed to be the first use of the poster bulletin by an American experiment station.

The horticulturist, Prof. F. A. Waugh, is the author of a work on "Landscape Gardening" and jointly with V. A. Clark, of an annotated translation of the summary of Nägeli's "Abstammungslehre."

The mailing list is kept on index cards arranged by post-offices and contains about 8,500 names. The correspondence amounts to about 6,000 letters a year. Members of the staff are frequently called upon to address farmers' meetings, the number of addresses thus given by station officers during the past year being about 50. The director of the station has been, since its organization, an active member of the State board of agriculture, and since 1892 a member of the State board of cattle commissioners. The station occasionally makes an exhibit at the State fair or at local fairs.

GENERAL RESULTS OF WORK.

The work of the Vermont Station on problems relating to dairy farming and dairying has been an important factor in promoting the reorganization of these industries in the United States on the basis of modern business and scientific principles. The thorough investigation made by the station in cooperation with the State cattle commission of

the extent of tuberculosis in the State and the usefulness of tuberculin as a means of detecting the presence of the disease has been of much value. The studies of this station on potato diseases and the means for their repression have been of general importance. The station has also done much to make spraying with fungicides and insecticides a regular part of farm and orchard practice in the State.

The United States tariff law of 1890 allowed a bounty of 1¾ cents per pound upon such maple sugar as should test by the polariscope 80 per cent, and a 2-cent bounty on such as tested 90 per cent. At the time this law went into effect no one knew how to make maple sugar which would be reasonably certain to meet the requirements. An investigation of the matter by the station resulted in clearing up the problem, and in formulating rules whereby a sugar maker could determine for himself easily and without expensive apparatus the grade of sugar that he was making. As a result of the station's work many times the expected number of persons drew bounties, bringing many thousands of dollars into the hands of the farmers.

VIRGINIA.

Virginia Agricultural Experiment Station, *Blacksburg.*[1]

Department of Virginia Agricultural and Mechanical College and Polytechnic Institute.

GOVERNING BOARD.

Board of Visitors—Executive Committee: C. E. Vawter, *Crozet;* B. R. Selden, *Richmond;* I. W. Southall, *Richmond;* D. M. Cloyd, *Dublin;* J. T. Brown, *Brierfield;* J. F. Ryan, *Arcola;* J. S. Musgrave, *Pinopolis;* B. B. Brockenbrough, *Tappahannock;* W. R. Robertson, *Saltville.*

STATION STAFF.

J. M. McBryde, PH. D., LL. D., *President of the College and Director.*
W. B. Alwood, *Vice-Director; Horticulturist, Entomologist, and Mycologist.*
E. A. Smyth, jr., M. A., *Biologist.*
D. O. Nourse, B. S., *Agriculturist.*
R. J. Davidson, M. A., *Chemist.*
H. L. Price, B. S., *Assistant Horticulturist.*
E. P. Niles, D. V. M., *Veterinarian.*
Charles McCulloch, M. D., V. S., *Assistant Veterinarian.*
W. B. Ellett, M. S., *Assistant Chemist.*
C. I. Wade, *Treasurer.*

HISTORY.

The Virginia Station is located in the southwestern part of the State, in the Appalachian Mountain region, about 2,000 feet above sea level. This region extends in a northeasterly direction through the State, and from this the land descends in a series of great terraces to the tidewater region, which is bounded on the east by the Potomac River,

[1] Express and freight address, *Christiansburg Depot.*

Chesapeake Bay, and the Atlantic Ocean. The soil, climate, and crops vary in a general way with the elevation. The mean annual temperature ranges from 51° F. in the west to 56° F. in the east. The annual rainfall is about 43 inches. The forests are extensive. The principal crops are maize, hay, wheat, oats, tobacco, and potatoes. Apple growing is an important industry in some regions. Numerous swine, sheep, cattle, milch cows, and horses are maintained. Commercial fertilizers are extensively used. Agriculture has been extended from east to west throughout the State during a period of nearly three hundred years. It was especially developed in a large way with slave labor during fifty years preceding 1860. More recently western competition in grain growing and animal husbandry has necessitated more careful methods of farm management, the introduction of truck farming, and in general the further diversification of agriculture. The manufacturing and commercial interests are now being rapidly augmented.

The college with which the station is connected was established in 1872, and has been developed mainly along industrial and scientific lines.

The Virginia Agricultural Experiment Station was organized October 16, 1888, in accordance with the act of Congress, as a department of the Virginia Agricultural and Mechanical College, with Prof. W. B. Preston as director. He was succeeded in June, 1890, by Prof. William D. Saunders, who was in turn succeeded in June, 1891, by Dr. J. M. McBryde, who also became the president of the college at that time. Immediately upon the organization of the station an administration building was erected. In 1899 an industrial and manufacturing plant was erected for the manufacture of cider, jellies, and other by-products of fruit and for the canning and preservation by evaporation of all kinds of fruits and vegetables.

ORGANIZATION.

The governing board of the station is the board of visitors of the college, which consists of 9 members appointed for terms of four years by the governor and confirmed by the State senate. An executive committee of the board of visitors, known as the board of control, has immediate charge of station affairs. This committee meets quarterly. Members receive traveling expenses.

The staff consists of the president of the college (who is also director), vice director (who is also horticulturist, entomologist, and mycologist), biologist, agriculturist, chemist, veterinarian, assistant horticulturist, assistant veterinarian, assistant chemist, and treasurer, appointed by the board of visitors to serve during good behavior. The director is the executive officer of the station, has charge of all correspondence and general direction of work, suggests lines of investigation, edits publications, audits accounts, etc.

EQUIPMENT.

The station buildings comprise a horticultural building, industrial and manufacturing plant, forcing houses, tool house, storage barn, creamery, cattle barn, and veterinary building.

The administration building (Pl. CXL, fig. 1) is a stone structure, two stories in height, 100 by 40 feet. The treasurer's office is on the first floor, and the director's office, secretary's office, mailing room, and station library on the second floor. Academic building No. 1 is of brick, with a basement and two stories, 150 by 50 feet. The chemical laboratory (Pl. CXL, fig. 2) occupies a large room on the second floor, with office and balance room immediately adjoining. The biological rooms are in academic building No. 2, a building the exact counterpart of No. 1. The collections, etc., are in a large room on the first floor, the laboratory in the basement. The horticultural building (Pl. CXLI, fig. 1) is a two-story modern brick structure fitted with water, gas, and steam heat, and lighted by electricity. Among the rooms on the first floor are the offices of the chief of the division and his assistants and a laboratory. On the second floor is a laboratory for students.

The industrial and manufacturing plant (Pl. CXLI, fig. 2), which is used by college and station, is a two-story building with wing, planned especially for the manufacture of cider, vinegar, jellies, marmalade, and other by-products of fruits, and for the canning and preservation by evaporation of all kinds of fruits and vegetables. The building is fully equipped with steam, water, and motive power. The cider press has a capacity of 10,000 gallons a day, and the jelly machinery a capacity of a ton of jelly in ten hours. The method of evaporation, which employs steam heat, was devised at this station.

The forcing structures consist of four hotbeds, each 25 feet long, heated by hot water; one greenhouse, 13 by 50 feet, heated from the same boiler as the hotbeds; and a second greenhouse, 20 by 50 feet, heated by steam. The division of horticulture, entomology, and mycology occupies exclusively a small well-built barn and an underground cellar for the storage of roots and other horticultural products. A tool house is conveniently situated to the forcing structures. The dairy building (Pl. CXLII, fig. 1), a wooden structure, was erected in 1893. A new and commodious barn is now in course of erection. It consists of a main building, two stories high, the basement partly of stone and under a hillside, the rest of the structure of wood, 100 by 40 feet, with two wings, one 100 by 30 feet, the other 80 by 30 feet. There are stalls for 102 head of stock, 10 box stalls, milk room, and two large round silos, one connected with each wing by a short passage or way. The veterinary building (Pl. CXLII, fig. 2) is a two-story wooden structure heated by steam. The first floor is occupied with drug and instrument room, dissecting, photographic, and janitors'

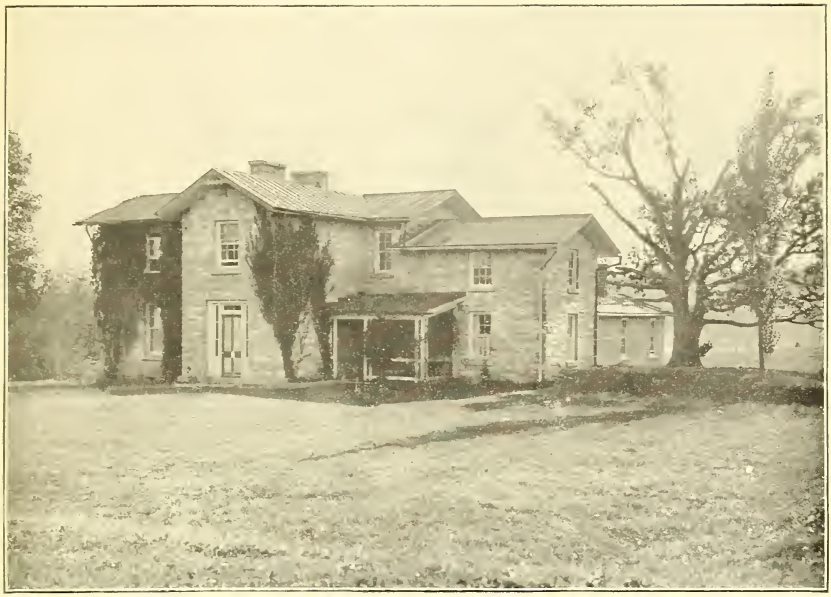

FIG. 1.—VIRGINIA STATION—ADMINISTRATION BUILDING.

FIG. 2.—VIRGINIA STATION—CHEMICAL LABORATORY.

FIG. 1.—VIRGINIA STATION—HORTICULTURAL BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—VIRGINIA STATION—INDUSTRIAL AND MANUFACTURING PLANT, USED BY COLLEGE AND STATION.

FIG. 1.—VIRGINIA STATION—DAIRY BUILDING, USED BY COLLEGE AND STATION.

FIG. 2.—VIRGINIA STATION—VETERINARY BUILDING. USED BY COLLEGE AND STATION.

rooms, three single and a large box stall for sick animals. The second story contains student and private bacteriological laboratories, lecture room and museum, and a large double office.

The station makes use of the college farm of about 400 acres, most of which is under cultivation. About 50 acres are devoted to field experiments, 30 acres are permanently assigned to the division of horticulture, entomology, and mycology, and the remainder is used for general farming purposes. The station live stock comprises 62 cattle representing several breeds, 15 sheep, 44 swine, and 9 horses and mules. The larger part of these animals are used for experimental purposes.

The collections of specimens in the division of horticulture, entomology, and mycology comprise about 1,500 species of insects and 1,000 species of fungi, representing principally the local flora and fauna of economic importance. A large number of photographs and drawings have accumulated, illustrating lines of work pursued in the division. The division of biology has a large number of specimens illustrating all of the principal zoological classes, among which may be mentioned a collection of the economic birds of Virginia. The collection is especially rich in native and exotic butterflies and moths, especially Papilioninæ and Sphyngidæ, some of the species being very rare and valuable. The division has also a collection of 2,000 or 3,000 species of plants, a considerable collection of seeds, and about 15,000 slides illustrating human and plant histology. The station library contains about 500 volumes and several thousand pamphlets. Officers also have access to the college library of about 3,000 volumes.

FINANCIAL SUPPORT.

The station income is derived mainly from the national fund and the sale of farm products. Not included in this statement are items of $1,000 a year appropriated by the State for inspection of nursery stock and $1,000 for control of infectious diseases of animals. For the last fiscal year the income was as follows:

United States appropriation	$15,000.00
Farm and garden products	4,007.18
Miscellaneous	146.41
Total	19,153.59

LINES OF WORK.

The division of horticulture, entomology, and mycology is charged with the execution of the orchard inspection laws of the State relating to the prevention of the spread of injurious insects. This work requires considerable attention from the head of the division and almost all the attention of an assistant. The assistant veterinarian is

also State veterinarian, and devotes the greater part of his time to the control of infectious diseases. This work is paid for by the State.

The scientific investigations in the division of horticulture, entomology, and mycology have in great part centered about the apple-growing interests, in which Virginia ranks only second to New York among the Atlantic coast States. Studies of soil and climatic conditions and observations upon the adaptation of varieties have been carried on for ten years. Investigations have been made on the life histories of a number of the more important parasitic fungi and insects injurious to orchards, among which may be mentioned the bitter rot of the apple, black rot of the apple, and the brown spot of apple leaves. Studies have been made on the black rot of the grape and on methods of treatment. The more important investigations in entomology have been on the life history of *Schizoneura lanigera*, which has been worked out, and on the tobacco worms (*Protoparce carolina* and *P. celeus*). Studies have also been made on the life histories of the weevils infesting the fruits of the chestnut and chinkapin and on a species of apple borer. The division has raised and is testing a large number of seedling apples, mostly from native stock. Observations have been made on the flowering season of fruit trees, especially as affected by meteorological conditions, with a view to bringing out race and variety characteristics. For a number of years the division carried on cooperative experiments with the United States Department of Agriculture to test the growth and hardiness of forest-tree seedlings grown from seeds collected over a wide range of territory. Much time and effort have been given to a study of the San José scale, especially with reference to the extent of its occurrence in the State and remedial measures. A large number of demonstration experiments have been carried on in the treatment of diseases and insect pests of orchards and vineyards. Meteorological observations have been made since the establishment of the station.

In the agricultural division feeding experiments have been conducted with steers and swine to make comparisons of the different fodders and feeding stuffs commonly used in the State. Field experiments with forage plants, wheat, oats, and tobacco have received considerable attention, especially with reference to methods of fertilization. For some time the station was much occupied with the study of tobacco. Numerous field tests were made of the leading varieties and of fertilizers for them, together with analyses of the varieties at different stages of growth, and of different grades of cured tobacco offered for sale in the State.

In the chemical division, besides the analyses of tobacco, investigations have been made, in cooperation with the division of horticulture, entomology, and mycology, on the effect of fertilizers on the starch content of the Irish potato. Studies have been made on the losses

sustained by maize fodder when left in the field. Investigations on the production of vinegar from cider are now in progress. Various deposits of marl occurring in the State have been examined and reported on. Considerable time has been devoted to studies of methods of analysis in cooperation with the Association of Official Chemists.

In the division of biology a study has been made of hawks and owls from the economic standpoint. For some time past, however, the main subject of investigation has been the life histories of the lesser known Lepidoptera of the State, and microscopic studies of certain points in wing structure, especially in the Hiramala group of Papilio. The veterinarian has studied Texas fever, blackleg, and various animal parasites, and has tested the effects of vaccines on quite an extensive scale.

DISSEMINATION OF INFORMATION.

The station has issued 8 annual reports, 94 regular bulletins, and a few special bulletins and circulars. The annual report is merely an administrative document. The mailing list contains about 13,000 names and is kept on cards in indexed boxes. It is revised annually by postal cards sent to each post-office in the State. The correspondence amounts to about 4,000 letters a year. A considerable feature of the botanist's work is the identification of plants for correspondents. Station officers take part generally in farmers' institutes and agricultural and horticultural meetings.

GENERAL RESULTS OF WORK.

The investigations of the Virginia Station on the black rot of the grape and methods of treatment soon after its organization was one of the most important factors in preventing the ruin of the wine industry and commercial grape growing. Methods of treatment for apple scab, introduced by the station, have greatly improved the quantity and quality of fruit produced. The spread of the San José scale has been checked, thus saving fruit-growers from serious loss. Improved methods of orchard and vineyard culture introduced by the station have resulted in some cases in an increase of at least 50 per cent in the crop. The station is now demonstrating by practical experiments the desirability of utilizing unmerchantable apples in the manufacture of cider and other by-products. The station has materially promoted the utilization of maize forage by shredding and the use of the maize husker. It has done much to teach the farmers of the State the discriminating use of fertilizers. The fertilizer tests made with wheat demonstrated that in some cases too much nitrogenous fertilizer was being used by farmers, and that in some cases, by change of formula, the yield could be increased more than threefold. Valuable work has also been done in the repression of contagious diseases of animals.

WASHINGTON.

Washington Agricultural Experiment Station, *Pullman.*

Department of Washington Agricultural College and School of Science.

GOVERNING BOARD.

Board of Regents: J. E. Edmiston, *Dayton;* R. C. McCroskey, *Garfield;* H. W. Canfield, *Colfax;* J. W. Stearns (*Treasurer*), *Tekoa;* J. B. Allen, *Seattle.*

STATION STAFF.

E. A. Bryan, M. A., *President of the College and Director.*

William J. Spillman, M. A., *Agriculturist.*
John A. Balmer, *Horticulturist.*
S. B. Nelson, D. V. M., *Veterinarian.*
C. V. Piper, B. S., *Botanist and Entomologist.*
Elton Fulmer, M. A., *Chemist.*
W. H. Heileman, B. S., *Assistant Chemist.*
R. W. Doane, B. A., *Entomologist.*
E. Elliott, M. S., *Assistant Agriculturist.*
Axel Kolling, B. S., *Assistant Veterinarian.*
R. K. Beattie, B. S., *Assistant Botanist.*

HISTORY.

The Washington Station is located in the southeastern part of the State, in the fertile Palouse Valley. The Cascade Mountains cross the State from north to south and divide it into two regions, which are quite diverse in soil and climate. In eastern Washington the soil is very largely of volcanic origin. The mean annual temperature is about 50° F., and the annual rainfall about 17 inches. There are large regions of plains covered by nature with nutritious grasses, and in many sections irrigation is essential to successful agriculture. The forests are comparatively restricted in area. In western Washington there are vast forests, the cultivated soil is largely alluvial, the mean annual temperature is about 50° F., and the average annual rainfall about 53 inches, though in the region immediately adjoining the Pacific Ocean it is much greater. The principal crops grown in the State are hay, wheat, oats, potatoes, and barley. Fruit growing has become an important industry. Numerous sheep, cattle, milch cows, horses, and swine are produced. Agriculture has been practiced in the State in a regular way about forty years. Lumbering is a very large interest and manufacturing is developing rapidly. Washington was made a separate Territory in 1853 and a State in 1889.

The college with which the station is connected was established in 1891 and opened for instruction in 1892, and is being developed largely along industrial and scientific lines.

The Washington Agricultural Experiment Station was organized May 1, 1891, under the act of Congress as a department of the Washington Agricultural College and School of Science, with Prof. George Lilley as president of the college and director of the station. The board of regents which had been appointed by the governor obtained

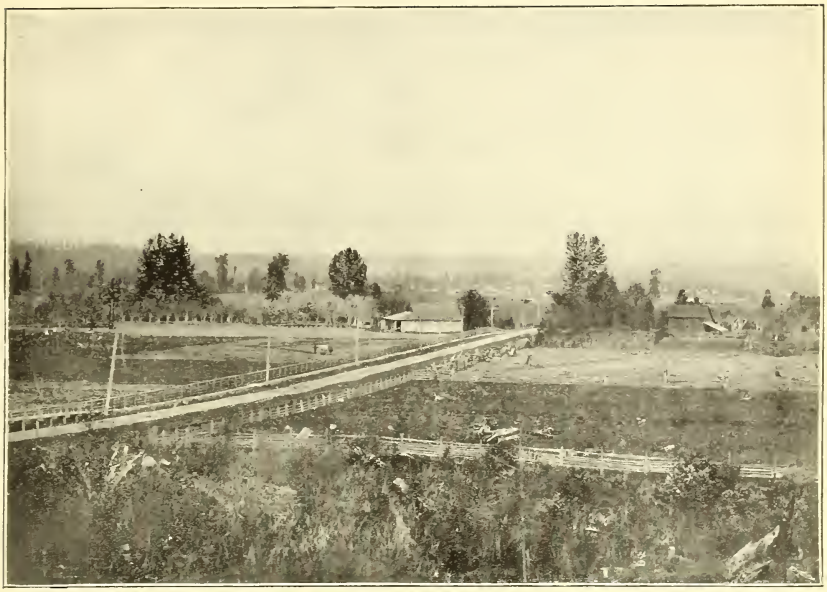

FIG. 1.—WASHINGTON STATION—PUYALLUP SUBSTATION.

FIG. 2.—WASHINGTON STATION—ADMINISTRATION BUILDING, USED BY COLLEGE AND STATION.

FIG. 1.—WASHINGTON STATION—COLLEGE HALL, USED BY COLLEGE AND STATION.

FIG. 2.—WASHINGTON STATION—FARM.

a farm for station purposes on May 22, 1891, but work was not actually begun until some months later. In 1892 Prof. John W. Heston became president of the college and director of the station. In March, 1893, the board of regents then existing was retired from office and other members appointed. This board reorganized the station and the college, placing the present incumbent at the head of both. In 1895 a substation was established at Puyallup, in the western part of the State, on 40 acres of bench land donated for the purpose, and 20 acres of bottom land purchased by the State. This station was discontinued in 1897 pending the appropriation by the State of funds for its support, but it was reopened in April, 1899, a State appropriation having been made for that purpose.

ORGANIZATION.

The board of control of the station is the board of regents of the college, which consists of 5 members appointed by the governor with the consent of the senate for terms of six years. The board elects a president and a treasurer from its own number, and the president of the college serves as secretary. Meetings are held bimonthly. Members receive traveling expenses paid from a State appropriation.

The staff consists of the president of the college (who is also director), agriculturist, assistant agriculturist, horticulturist, veterinarian, assistant veterinarian, botanist and entomologist, chemist, and assistant chemist, appointed by the board of control for an indefinite period. The duties of the director are administrative and include the determination of the lines of investigation to be pursued, the issuing of requisitions for purchases, and the general direction of the station. The staff, consisting of heads of divisions and assistants, meets from time to time as an advisory body for the discussion of lines and methods of station work.

The substation at Puyallup (Pl. CXLIII, fig. 1) is in charge of a resident superintendent, who is a member of the station staff. The lines of work are restricted to field tests of agricultural and horticultural crops and cultural methods best suited to the local conditions. The equipment comprises house, barn, tools, machinery, and horses.

EQUIPMENT.

The office and laboratory work of the station is carried on in a part of the college buildings. The main college building, known as the administration building (Pl. CXLIII, fig. 2), is a four-story structure of granite and brick, in which are located the offices of the director and the chemical and physical laboratories. The biological, veterinary, and agricultural laboratories are at present located partly in this building and partly in College Hall (Pl. CXLIV, fig. 1), a three-story frame building. The greenhouse covers 4,000 feet of ground space. The

farm buildings comprise a dwelling for the farm superintendent, barn, piggery, silo, cow barn, and creamery and cheese factory.

Science Hall is now nearly completed. It will cost, with its equipment, about $60,000. It is 70 feet long by 84 feet wide, three stories high, and is built of pressed brick with stone trimmings. It will accommodate the divisions of botany, zoology, bacteriology, agriculture, horticulture, veterinary science, and geology. The entire third story will be devoted to a series of connected museums, those of the several divisions being kept separate. Each division will have an office, a lecture room, and two or more laboratories. The divisions of botany and zoology will each have a large laboratory, 40 by 47 feet, with circular end, two lesser laboratories chiefly for station work, a storeroom, a lecture room, and an office. Connected with the veterinary division, but in a separate building, is a hospital and a dissecting room.

The station makes use of the college farm (Pl. CXLIV, fig. 2) of 198 acres. One hundred acres are devoted to experiments with field crops, 50 acres are assigned to the horticultural division, some land is laid out in permanent experimental plats of various sizes, and the rest is carried on as a general farm.

The station live stock comprises 8 head of cattle, 7 horses, 26 hogs, and some poultry. The station and college have a collection of 20,000 mounted specimens of plants and 30,000 specimens of insects. The station also has access to the college museums, which contain many hundred specimens of mammals, birds and fishes, grasses and forage plants, cereals, fibers, woods and other forestry specimens, besides a large mineral collection and 1,000 specimens illustrating the work of the divisions of veterinary science and animal husbandry. The station library contains about 300 volumes, exclusive of reports and bulletins of similar institutions. Station officers also have access to the college library of about 8,000 volumes.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund and the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
Farm products	1,472.68
Total	16,472.68

LINES OF WORK.

The station has no inspection duties. The investigations of the station have been mainly along the lines of field experiments, soil studies, entomology, and investigations looking to the extermination

of the ground squirrel. The division of chemistry has been occupied mostly with experiments in sugar-beet culture and soil analyses. The work on sugar beets included experiments in irrigation. In the soil studies numerous samples of soil have been analyzed and soil moisture tests are being made. The principal subject of investigation in this connection, however, is the relation between nitrogen and humus content of the soil. Fodder analyses have been made of wheat hay and native and cultivated grasses. The fertilizing value of certain forms of marine life, particularly starfish and seaweeds, has been studied.

In the agricultural division variety and cultural tests of various field crops have been made. The cultural tests have included depth of plowing, date of seeding, preparation of land, time of seeding, and amount of seed per acre. Experiments have been made in the seeding of pastures and the cultivation of native grasses. Various tests of feeding wheat and barley to swine have been carried on. Some work of a demonstration nature has been done with a view to the introduction of the dairy industry. Studies have been made on the effect of richness of cream on acid test, together with studies in the correction of the Babcock test for cream.

The subject of the culture of fiber flax has received considerable attention at the Puyallup substation with a view to determining the adaptability of the crop to the region west of the Cascade Mountains. Tests have been made at the Puyallup substation of different methods of clearing forest land of stumps.

In the division of horticulture numerous tests have been made of varieties of orchard and small fruits. Comparisons are being made of the relative value of trees grown east of the Cascade range as compared with those west of it for planting in the eastern part of the State. Some work of an experimental nature has been done in evaporating prunes. A report has been made on the damage done to varieties of fruit trees by a disastrous freeze in November, 1896. Studies have been made in tree pruning as adapted to local conditions. Comparisons have been made of different stocks for various fruits, and plantings of seedling apple, plum, peach, and cherry have been made with a view to producing the most vigorous stocks for experimental work. Comparisons have been made of the blooming periods of pears, apples, plums, and cherries. Tests are being made of the drought-resisting qualities of certain varieties of orchard fruits. Some work in plant breeding has been undertaken. Experimental forestry is receiving some attention. Some time has been given to a study of the weeds of the State, especially dodder and Russian thistle. Botanical and chemical studies are being made of the poisonous plants of the State.

The work in plant diseases has included studies of loose smut of oats, stinking smut of wheat, potato rot, potato scab, gummosis, apple

scab, twig blight of pear and apple, pear scab, leaf blight of pear, peach-leaf curl, peach mildew, black knot, and strawberry-leaf blight. Experiments have been made in the treatment of peach mildew and tomato blight, and laboratory studies have been made on the black-spot disease of the apple and crown galls of fruit trees.

Along entomological lines the work has included observations on the pea weevil, cottony maple scale, and diamond-back moth. Breeding-cage investigations, supplemented by field studies, have been carried on, and the life histories of 25 insects thus worked out and contributions made to our knowledge of 150 others. Thirty new species have been described. Studies have been made on several species of insects injurious to currants and gooseberries.

One of the most important lines of investigation at this station is that on methods of exterminating the ground squirrel, a very troublesome rodent in eastern Washington. The investigations are comprised in the three categories of life history studies, poison experiments, and bacteriological investigations. Under the head of life history studies, observations have been made on the food habits, the winter habits, and the reproductive habits of these animals. Attention has also been given to their natural enemies, including animal parasites. Tests have been made with carbon bisulphid as an exterminator. The principal feature of the investigations, however, is an effort to discover disease-producing bacteria by which to spread epidemics among the pests. Experiments under this head fall naturally into two divisions—those with known pathogenic bacteria and those with diseases to which spermophiles are subject. These investigations are still in progress.

DISSEMINATION OF INFORMATION.

The station has issued 39 bulletins and 7 annual reports. The annual report is merely an administrative document. The mailing list contains 2,700 names, and the correspondence amounts to 4,000 letters a year. Station officers take part to a considerable extent in farmers' institute work.

GENERAL RESULTS OF WORK.

The work of the Washington Station has been largely in the nature of an agricultural survey, and much useful information has been obtained regarding the soils, native plants, and the cultivated crops adapted to different regions. Animal husbandry, including dairy farming, has been promoted by the experiments with different forage plants, and the fruit-growing interests of the State have been much benefited by the work of the station. The capabilities of the State with reference to the growing of beets for sugar have been quite thoroughly determined, and as a result of these investigations a sugar-beet factory costing nearly a half million of dollars has been established in the State.

WEST VIRGINIA.

West Virginia Agricultural Experiment Station, *Morgantown.*

Department of West Virginia University.

GOVERNING BOARD.

Board of Regents: George C. Sturgiss (*President*), *Morgantown;* John J. Davis, *Clarksburg;* James F. Brown, *Charleston;* R. R. McMahon, *Harpers Ferry;* A. H. Kunst, M. D., *Weston;* W. E. Powell, *Parkersburg;* J. A. Campbell, *New Cumberland;* James L. Hamill, *Welch;* P. C. Eastham, *Point Pleasant.*

STATION STAFF.

J. H. Raymond, M. A., PH. D., *President of the University.*

J. H. Stewart, M. A., *Director; Agriculturist.*

A. D. Hopkins, PH. D., *Vice-Director; Entomologist.*

Bert H. Hite, M. S., *Chemist.*

L. C. Corbett, M. S., *Horticulturist.*

W. E. Rumsey, B. S. A., *Assistant Entomologist.*

C. D. Howard, B. S., *Assistant Chemist.*

——— ———, *Assistant Chemist and Meteorologist.*

Horace Atwood, M. S., *Assistant Agriculturist.*

Eugene C. Frame, *Stenographer and Clerk.*

M. A. Stewart, *Librarian.*

S. G. Chadwick, *Auditor.*

A. R. Whitehill, PH. D., *Treasurer.*

HISTORY.

The West Virginia Station is located in the northern part of the State on the Monongahela River. The surface of the State is for the most part hilly and mountainous. The forests are extensive and the cultivated areas relatively restricted. The soils are of various kinds and are generally fertile. The mean annual temperature is about 56° F. and the annual rainfall about 44 inches. The principal crops are maize, hay, wheat, rye, oats, tobacco, and potatoes. Numerous sheep, swine, cattle, milch cows, and horses are maintained. Fruit growing has been rapidly developed in recent years, especially in the northern part of the State. Coal mining, petroleum production, lumbering, and manufacturing are large interests, which are being rapidly developed. Agriculture has been practiced in the State for about one hundred years. West Virginia was a part of Virginia until 1863, when it became a separate State. The university with which the station is connected was established in 1867 and in recent years has been rapidly developed along technical and scientific lines.

The West Virginia Agricultural Experiment Station was established in 1887, in accordance with the act of Congress, as a department of the West Virginia University, with Prof. John A. Myers as director, who served until 1897, when he was succeeded by the present incumbent. In 1889 the State legislature enacted a law charging the director of the station with the supervision of the sale of commercial fertilizers within the State. The college farm, of which the station made use for several

years, was not well suited to experimental uses and has recently been exchanged for other property better suited to station purposes. This property is being equipped as rapidly as possible. Extensive additions have recently been made to the greenhouses.

ORGANIZATION.

The governing board of the station is the board of regents of the university, which consists of nine members appointed by the governor for terms of six years. Immediate supervision of station affairs is assigned to a committee of three called the station committee. An auditing committee of the board of regents is annually appointed to audit the expenditures of the station.

The staff consists of the president of the university, director (who is also agriculturist), vice-director (who is also entomologist), chemist, horticulturist, assistant entomologist, assistant chemist, assistant chemist and meteorologist, assistant agriculturist, stenographer and clerk, librarian, auditor, and treasurer. Tenure of office is conditioned on good behavior and satisfactory service. The director has supervisory control of all station work. He decides upon lines of investigation to be undertaken and has charge of all disbursements for the station.

EQUIPMENT.

The station buildings comprise a main building, farm dwelling, storage room, barn, and three greenhouses. The main building (Pl. CXLV, fig. 1) is a two-story brick structure 117 by 48 feet, with basement and attic. In it are located the offices of the director and members of his staff, station library, photographic rooms, botanical and entomological collections, chemical laboratories, a large lecture room, and mailing rooms. (The entomological laboratory is shown in Pl. CXLV, fig. 2.) The chemical division alone occupies about one-half of the building. Its rooms comprise a large laboratory devoted to the analyses of soils, fertilizers, and general analytical work; a laboratory devoted to the analyses of foods, feeding stuffs, etc.; one devoted to the preservation of perishable food stuffs; a small room for nitrogen determinations, a weighing room, a room for grinding and mixing feeding stuffs, etc.; a room for grinding and sampling fertilizers, with vault for preserving samples; two storerooms for chemical apparatus, two storerooms for chemicals, and an office and chemical laboratory. The farm dwelling is the residence of the assistant agriculturist and at least one permanent employee, and in it is located an office equipped for the convenience of station workers who may be conducting experiments at the farm. The greenhouses, which are located near the station building, comprise three houses covering about 4,200 feet of ground. The station farm, which was recently acquired, consists of 91 acres, located about 1 mile from the university. About 40 acres are

FIG. 1.—WEST VIRGINIA STATION—MAIN BUILDING.

FIG. 2.—WEST VIRGINIA STATION—ENTOMOLOGICAL LABORATORY.

FIG. 1.—WEST VIRGINIA STATION—MUSKMELONS UNDER GLASS.

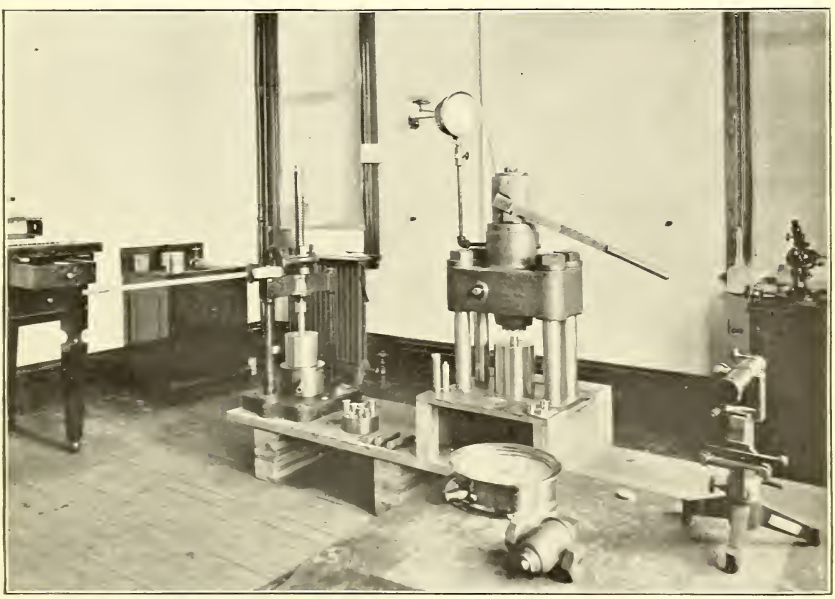

FIG. 2.—WEST VIRGINIA STATION—APPARATUS USED IN EXPERIMENTS IN PRESERVING MILK BY PRESSURE.

to be devoted to field experiments. The station owns 3 horses, 50 sheep, 250 head of poultry, and a few animals, principally sheep, purchased from time to time for the purposes of special experiments.

The entomological division has between 30,000 and 40,000 specimens of insects and biological material showing their work. These were mostly collected in the State by the entomologist since the division was organized in 1890. The station herbarium contains about 1,700 specimens, representing the flora of the State, collected by the botanist. There is a collection of 300 photographs illustrating the character of the land and the condition of agricultural industry in various parts of the State, and a number of lantern slides. The station library contains about 3,000 volumes. Station workers also have access to the university library of 13,000 volumes.

The station is well equipped with apparatus for its different lines of inquiry, which includes a number of pieces devised by station officers. The present director, Mr. J. H. Stewart, and chemist, Prof. B. H. Hite, have devised an apparatus for sampling soils. The chemist has devised an apparatus for drying feed stuffs, etc., an apparatus for ether extraction, an apparatus for grinding sugar beets, etc., a mill for grinding limestone and other minerals, a self-registering thermometer, a self-registering wind gauge that registers direction and velocity, an apparatus for drying gases, a gas absorption apparatus, an apparatus for determining the average molecular weights of fats, oils, etc., and an ebullioscope. The horticulturist, Prof. L. C. Corbett, has designed a special apparatus for studying the rate and periodicity of plant growth, and a transpiration apparatus which measures the actual quantity of moisture thrown off by the plants under various conditions, and records it on a revolving cylinder.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund, fees for fertilizer analyses, and the sale of farm products. During the last fiscal year it was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	6,877.61
Farm products	245.00
Miscellaneous	737.77
Balance on hand June 30, 1898	283.74
Total	23,144.12

LINES OF WORK.

The director of the experiment station is charged by law with the supervision of sales of commercial fertilizers within the State. The enforcement of this law entails upon the director, his office and chemical force, the expenditure of a large amount of labor and time. The

expenses of the control are defrayed by fees charged to the manufacturers and held by the treasurer of the university for the use of the station.

The investigations at the West Virginia Station have been mainly along lines of dairying, entomology, chemistry, horticulture, feeding experiments, and a soil survey. The work was first organized upon the theory that as the State is mountainous, it would be better adapted to live-stock raising than most other agricultural industries, and for this reason one of the first subjects to receive attention was dairying. The work was mainly along lines of dairy management. After three years this line of work was discontinued and a botanical survey of the State undertaken by the botanist, Dr. Millspaugh, now director of the botanical division of the Field Columbian Museum of Chicago, preparatory to the organization of horticultural work, for which the State is also well adapted. More recently an extended study has been made of the physical conditions of the State with reference to its adaptability to fruit growing, and the various fruit growing sections have been mapped.

In the horticultural division considerable demonstration work in methods of orchard pruning, grafting, cultivation, and spraying to show how old and unprofitable orchards may be improved has been carried on. Fertilizer tests are being made in the peach and apple belts of the State to determine the kind and quantity of fertilizer needed, and fertilizer tests with the apple have also been made to determine the influence of certain ingredients and their combinations on the development of root, top, and fruit. Studies of fruit in cold storage have been made to determine the amount of loss in weight, when it occurs, and means of prevention; also the cause of scald, its physiological effect on the tissue of the fruit, and the means of avoiding it. The experimental forcing of vegetables has received considerable attention. (Muskmelons thus grown are shown in Pl. CXLVI, fig. 1.) A study has been made of the alluvial deposits about the head waters of the rivers of the State to determine their adaptability to cranberry, celery, onion, and cabbage culture. A collection has been made of all varieties of strawberries known to the horticulturist for the purpose of making a systematic study of the group. Studies have been made in the cross pollination of strawberries to determine the immediate effect of pollination, if any, and incidentally to determine the best combination of pistillate and perfect flowered varieties for commercial purposes. The horticulturist has made a study of the effects of different climatic conditions on cuttings. It has been shown that rose plants propagated from flower stems blossom more freely than plants propagated from blind stems; and that the stimulating influence of the Welsbach gas light upon lettuce, radishes, tomatoes, spinach,

cabbage, and potatoes is equal to that of the arc or incandescent electric light.

On account of the importance of the forest interests of the State the special subject of investigation in the entomological division is insects injurious to forest trees or forest products. It has been shown that the death of large quantities of spruce and pine timber is due to the work of the pine-bark beetle. This insect has been much studied, and many previously unrecorded facts concerning its life history, habits, and natural enemies have been brought to light. Assisted mainly by contributions from owners of forest property in the State, the entomologist was enabled to make a trip to Germany in 1892 to study the European bark-beetle destroyer, and succeeded in introducing over 3,000 living specimens of it into this country. Numerous other insect enemies of forest trees have also been studied. A common defect in oak, tulip, and other kinds of wood, known as black-hole stains, was shown to be due to the work of a hitherto undescribed insect. Studies have been made upon the chestnut timber worm which causes pinholes in chestnut wood, and the entomologist has reared the adult form of the insect. The entomologist has also found the adult form of a destructive bark borer, and showed that the chestnut-timber worm gains access to the wood of living trees for the most part only through wounds made by fire or other agencies. He has discovered a number of parasites of wood-infesting insects, and has recorded the host plants of a number of species of insects injurious to forest trees. The cause of a common and serious injury to oak tan-bark has been ascertained, and numerous important facts concerning insects attacking seasoned lumber have been brought to light. The interrelations of forest fires, insects, and fungus diseases of trees to great destruction of timber, which had previously been overlooked, have been pointed out.

Various species destructive to stave timber, staves, and barrels have been identified and preventive measures suggested. Experiments have been carried on for several years to ascertain at what season of the year various species of trees must be felled to avoid serious injury to the felled timber and manufactured products from the attacks of insects. As a result of these experiments, the station is enabled to give very specific advice on this point. Studies of a technical nature have been mostly on the Scolytidæ, the bark and timber beetles. This family has been studied both from economic and systematic standpoints, a number of new species have been described, and important contributions have been made to our knowledge of their life histories and habits. Many new species have also been discovered which have not yet been described. A special feature of the work was a study of the sexual characters of these species, resulting in many cases in a revision of existing opinions. Monographs are in preparation on the insects known to infest

the pines of North America, insects infesting the yellow locust, and insects infesting the black spruce.

Closely allied to the insects infesting forest trees are the insects attacking fruit trees, and these have also received considerable attention. The entomologist has succeeded in raising parasites from the gouty gall beetle and a large number from the imported fruit-bark beetle. The life history of the plum-twig-gall mite has been partially worked out, and various facts bearing on the life histories and habits of other insect enemies of fruit trees have been brought to light. A parasite of the cabbage aphis which attacks radishes in the greenhouse has been described, and it has been shown that this parasite may be successfully employed under glass in combating that pest. A study has been made of the periodical cicada in West Virginia and the distribution of its different broods in the State has been mapped. Recently the San José scale has also received attention.

The life zones of the State are being investigated with a view to mapping the distribution of beneficial and destructive insects.

The director and chemist of the station, in connection with the director of the State geological and economic survey, are making a systematic examination and classification of the typical soils of the State. Pot experiments are being carried on to test the relative capacity of certain leguminous plants for fixing nitrogen and to determine, in connection therewith, the influence of the elements of plant food other than nitrogen in the fixation of that substance.

The chemist is studying the effect of pressure in the preservation of milk and other perishable food stuffs. (The apparatus used in these experiments is shown in Pl. CXLVI, fig. 2.) In the course of this work a method and apparatus for subjecting liquids to a wide range of pressure and temperature was devised. The method is also applicable to a study of chemical reactions under pressure. Incidentally a method with necessary auxiliary apparatus was devised for determining with accuracy the compressibility of liquids at different temperatures and pressures. The former chemist, Dr. R. J. J. de Roode, devised an abridged method of determining the phosphoric acid in fertilizers containing nitrogen that is now official.

Experiments with poultry are now in progress to determine the relations of heat and moisture to artificial incubation. Feeding experiments with poultry are also being carried on to determine the effect of carbonaceous and nitrogenous foods when thus used. At the same time the effect of such foods upon the fertility of eggs and their keeping qualities is being studied. Experiments are being made in preserving eggs. Feeding experiments with sheep are in progress. Experiments with swine have been made to determine the influence exerted by extirpation of the spleen upon fattening qualities, and to ascertain whether this extirpation affords any immunity from anthrax.

The entomologist has distinguished forty varieties of timothy differing greatly in adaptability and productiveness, and is now engaged in establishing these varieties.

DISSEMINATION OF INFORMATION.

The station has issued 61 bulletins, 15 emergency bulletins and posters, and 11 annual reports. The annual report is merely an administrative document. The mailing list contains about 6,000 names. The correspondence is extensive. The station has a representative at as many farmers' institutes and other farmers' meetings as possible.

GENERAL RESULTS OF WORK.

The West Virginia Station has done much to promote the horticultural interests of the State by the introduction of spraying with fungicides and insecticides, the suppression of the San José scale, and by investigations regarding the forcing of vegetables under glass. The work on forest insects has been of material benefit to the forest owners of the State, and in many respects is of general importance to the forestry interests of the country. Through the fertilizer inspection the station has materially protected the farmers against fraud and taught them the desirability of the discriminating purchase of fertilizers.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin, *Madison.*

Department of the University of Wisconsin.

GOVERNING BOARD.

Board of Regents: John Johnston (*President*), *Milwaukee;* E. F. Riley, (*Secretary*), *Madison;* State Superintendent of Instruction, *Madison;* President of University, *Madison;* Ogden H. Fethers, *Janesville;* Byron A. Buffington, *Eau Claire;* C. A. Galloway, *Fond du Lac;* William F. Vilas, *Madison;* B. J. Stevens, *Madison;* George H. Noyes, *Milwaukee;* Orlando E. Clark, *Appleton;* J. A. Van Cleve, *Marinette;* J. E. Morgan, *Spring Green;* J. H. Stout, *Menomonie;* John R. Riess, *Sheboygan.*

STATION STAFF.

Charles Kendall Adams, LL. D., *President of the University.*

W. A. Henry, B. Agr., *Director.*
F. H. King, *Physicist.*
A. R. Whitson, B. S., *Assistant Physicist.*[1]
E. S. Goff, *Horticulturist.*
Frederic Cranefield, *Assistant Horticulturist.*
E. H. Farrington, M. S., *Expert in Dairy Husbandry.*
U. S. Baer, *Assistant in Dairying.*
W. L. Carlyle, B. S. A., *Expert in Animal Husbandry.*
Arthur G. Hopkins, D. V. M., *Veterinarian.*
H. L. Russell, Ph., D., *Bacteriologist.*
Victor H. Bassett, *Assistant Bacteriologist.*
S. M. Babcock, Ph. D., *Chief Chemist.*
F. W. Woll, M. S., *Chemist.*
Alfred Vivian, *Assistant Chemist.*
R. A. Moore, *Assistant to Director.*
E. G. Hastings, *Assistant in Bacteriology.*
Leslie H. Adams, *Farm Superintendent.*
Ida Herfurth, *Clerk and Stenographer.*
E. M. Close, *Librarian.*

[1] After May, 1900.

HISTORY.

The Wisconsin Station is located at the capital, in the southern part of the State, between Lakes Monona and Mendota. The State lies between the Mississippi River and Lakes Michigan and Superior, and its surface is rolling and hilly, ranging in elevation from 600 to 1,800 feet. There are numerous small lakes within the State. Originally a large share of the State was covered with forests, and these are still quite extensive in the north. The soils are of different kinds, many of which are relatively fertile, but there are considerable tracts of poor sandy soil in the central and northern portions. The winters are long and severe and the summers brief and comparatively cool. The annual rainfall is about 30 inches. The principal crops are hay, oats, maize, barley, wheat, potatoes, rye, and tobacco. Large numbers of milch cows, cattle, sheep, swine, and horses are maintained. Dairying is a very extensive industry. Small fruits and vegetables are largely grown. Lumbering and manufacturing are large interests. Agriculture has been practiced in the State about seventy-five years. Wisconsin was admitted to the Union in 1848. The university, with which the station is connected, was established in 1850, and has grown to be a strong and well-equipped institution, especially along technical and scientific lines, with over 2,000 students, over 360 of whom are registered in the college of agriculture.

The work of the Wisconsin Experiment Station was preceded by experimental work, mostly with cereals, for a number of years at the college of agriculture of the University of Wisconsin, the results of which were published in the annual reports of the board of regents of the university. In 1881 the State legislature appropriated $4,000 to the university for "experiments in the manufacture of amber cane and the ensilage of fodders." A small sugar plant was erected and considerable quantities of sugar made from amber cane. A silo was built and filled and feeding experiments conducted. With an additional appropriation the experiments were continued the following year. The best known result of the experimental work of this period, however, was the introduction of the Manshury barley, a very hardy variety from Manchuria, Asia. The dissemination of this variety throughout the Northwest is considered to have been worth millions of dollars to the region. In some cases yields were twice as great as from the seed commonly sown by the farmer. In many cases farmers had lost all their grain crops excepting this, but through it many settlers were enabled to remain on their homesteads when otherwise they would have been compelled to relinquish them.

In 1883, Governor J. M. Rusk, more recently Secretary of the United States Department of Agriculture, in his annual message recommended the establishment of an experiment station at the university. The

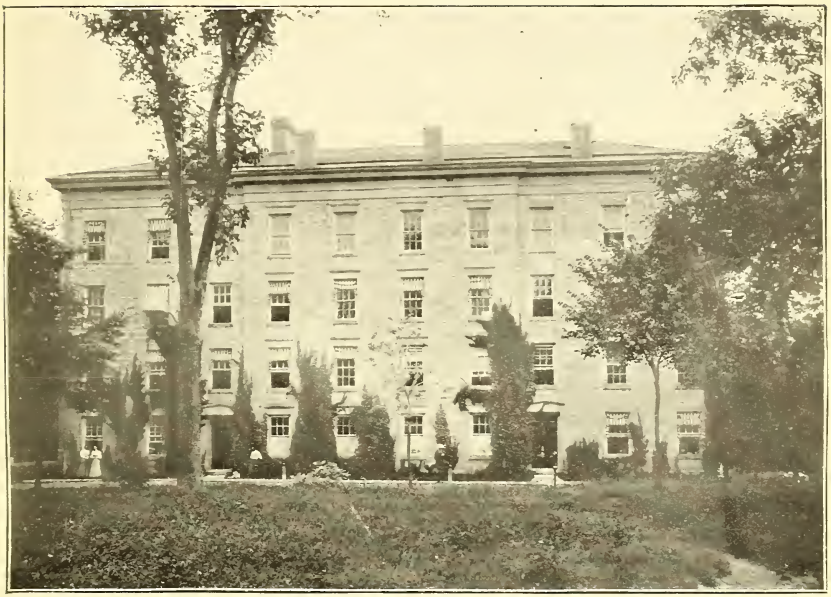

FIG. 1.—WISCONSIN STATION—AGRICULTURAL HALL, USED BY COLLEGE AND STATION.

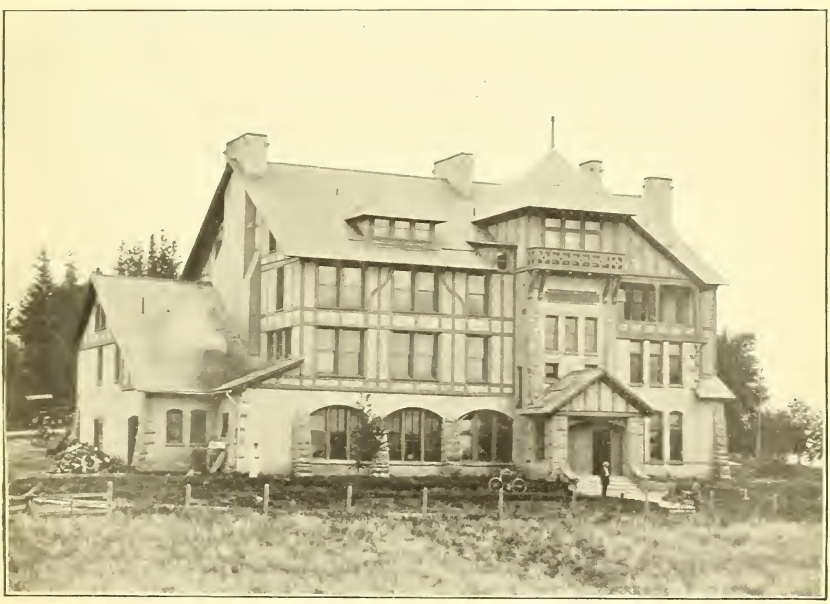

FIG. 2.—WISCONSIN STATION—DAIRY BUILDING, USED BY COLLEGE AND STATION.

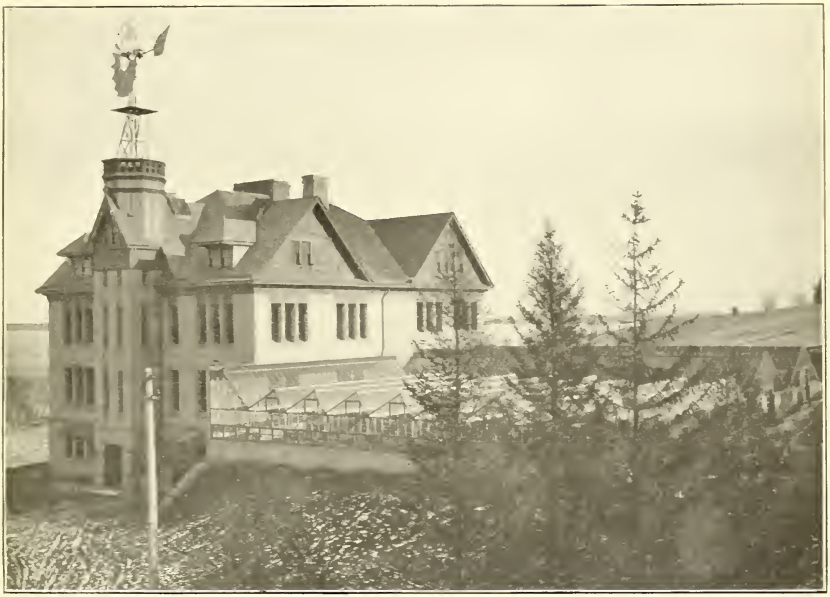

FIG. 1.—WISCONSIN STATION—HORTICULTURAL-PHYSICS BUILDING, USED BY COLLEGE AND STATION.

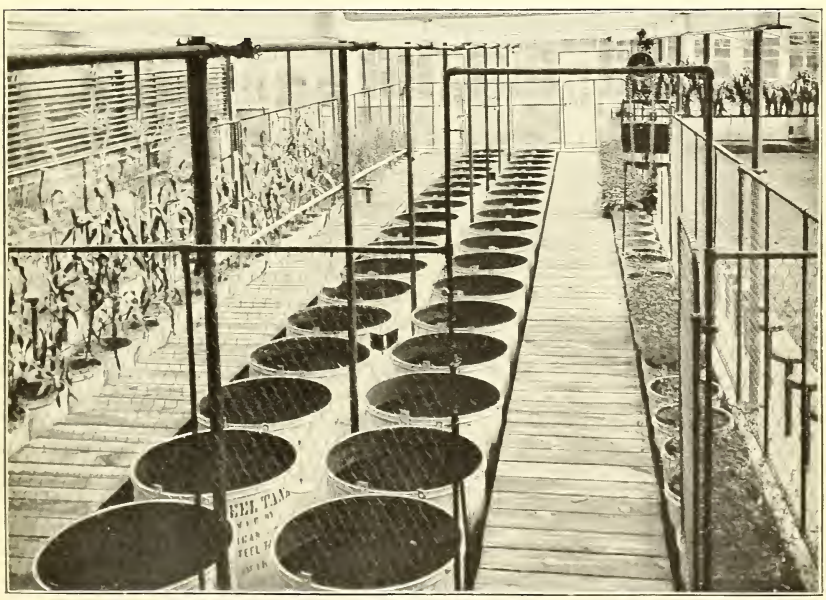

FIG. 2.—WISCONSIN STATION—PLANT HOUSE, WITH EXPERIMENTAL POTS.

FIG. 1.—WISCONSIN STATION—DAIRY BARN, USED BY COLLEGE AND STATION.

FIG. 2.—WISCONSIN STATION—FILLING ROUND SILO.

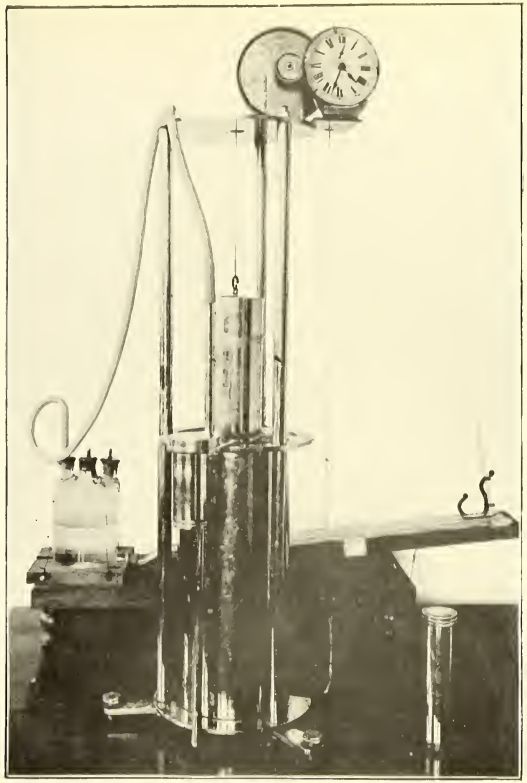

FIG. 1.—WISCONSIN STATION—ORIGINAL KING APPARATUS FOR DETERMINING THE EFFECTIVE SIZE OF SOIL GRAINS.

FIG. 2.—WISCONSIN STATION—ORIGINAL BABCOCK MILK TESTER.

Legislature acted upon the recommendation and increased the appropriation of that institution, directing that out of such increase an agricultural experiment station should be maintained, but named no definite sum for its support. About this time the legislature provided for the publication of the annual reports and bulletins of the station at State expense. On organization of the station, Prof. W. A. Henry was appointed agriculturist; Dr. H. P. Armsby, now director of the Pennsylvania Station, chemist; and Dr. William Trelease, now director of the Missouri Botanic Garden and professor of botany in the Washington University, botanist.

ORGANIZATION.

The station is governed by the board of regents of the university, consisting of the State superintendent of public instruction and the president of the university, ex officio, and one member from each Congressional district and two members from the State at large appointed by the governor and holding office for three years.

Immediate oversight of the agricultural college and the experiment station is delegated to a committee of the board of regents, comprising the president of the university, ex officio, and five members of the board.

The staff consists of the president of the university, director, physicist, horticulturist, bacteriologist, chief chemist, chemist, experts in dairy husbandry and animal husbandry, veterinarian, assistant physicist, assistant horticulturist, assistant in dairying, two assistant bacteriologists, assistant chemist, assistant to director, farm superintendent, clerk and stenographer, and librarian. Members of the staff are appointed by the board of regents for an indefinite period of time and are removable only for cause.

EQUIPMENT.

The buildings used by the agricultural college and the experiment station are Agricultural Hall, Hiram-Smith Hall, a horticulture-agricultural physics building, and farm buildings. Agricultural Hall (Pl. CXLVII, fig. 1) is a stone structure 42 by 120 feet, four stories in height. It contains the agricultural library, chemical and bacteriological laboratories, and the offices of the director and heads of divisions. Hiram-Smith Hall, the dairy building (Pl. CXLVII, fig. 2), is a brick and stone structure 75 by 54 feet, three stories in height. The horticultural-physics building (Pl. CXLVIII, fig. 1) is a brick and stone structure 76 by 60 feet, three stories in height, with three plant houses 75 feet in depth at the rear. (The interior of one of the plant houses is shown in Pl. CXLVIII, fig. 2.) At the farm is a dairy barn (Pl. CXLIX, fig. 1) 50 by 86 feet, with wings 70 by 110 feet, and

round silo attached; a horse and steer feeding barn 50 by 98 feet, four stories in height; also barns for sheep, swine, tools, etc. The value of all agricultural buildings is $190,000. (Pl. CXLIX, fig. 2, shows the method of filling the silo.)

The university farm proper covers 125 acres of available land adjoining the college campus and skirting Lake Mendota. Twelve acres are devoted to irrigation investigations, the equipment being an engine, 4-inch centrifugal pump, and about 2,000 feet of 6 and 4 inch wrought-iron pipe, with hydrants, etc. Ten acres are assigned to the horticulturist. Ten acres of marsh land on a level with Fourth Lake have been reclaimed by diking, draining, and lifting the water over the dike into the lake by a windmill. Other plats of land are devoted to raising forage crops, and there are pastures for animals used in experiments. Two miles distant is a second farm of 160 acres providing pasture and forage for the main farm.

The live stock of the agricultural college comprises 14 horses; 55 head of cattle, including 32 dairy cows; 80 pigs, and 150 sheep. Of these animals, the cows, pigs, and sheep, are used primarily for experimental purposes. In addition, there is a tuberculous colony of 7 cows on the second farm.

The agricultural library, comprising over 4,500 bound volumes on distinctly agricultural topics, is kept separate from that of the university proper, and is used jointly by the departments of instruction and investigation. It is quite complete in the current home and foreign agricultural, chemical, physical, and bacteriological journals, and contains over 700 bound volumes of studbooks, herdbooks, and flock books. The university library contains 53,000 volumes. The apparatus available for the station in the divisions of chemistry, agricultural physics, bacteriology, horticulture, and dairying inventories over $15,000. In the division of physics is the original King apparatus for determining the effective size of soil grains. (See p. 457 and Pl. CL, fig. 1.) In the dairy division can be seen the original Babcock milk tester (Pl. CL, fig. 2); also the apparatus used in operating the Wisconsin curd test.

FINANCIAL SUPPORT.

The financial support of the station is derived from the national fund, a State appropriation, and fees for the analyses of fertilizers. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
State appropriation	15,000.00
Fees for fertilizer analyses	125.00
Total	30,125.00

LINES OF WORK.

By act of the State legislature the inspection and regulation of the sale of commercial fertilizers rests with the station. During 1899 license fees were paid on only five brands. This is due in a great measure to the fact that the station is urging farmers to feed the by-products of the great mills of the Northwest to their live stock, and to use the manures resulting therefrom on their farms. In this way fertility worth millions of dollars is being annually imported from other States. The horticulturist has recently been charged by State law with the inspection of orchards for San José scale.

Wisconsin possesses superior natural advantages for grass and maize growing, but these products can not be shipped out of the State with profit; they must be fed upon the farm, and this fact makes it necessary that the live-stock industry should form the basis of agriculture and agricultural investigations in the State. To this industry, more especially to dairy farming, dairying, and sheep and swine feeding, the largest part of the station's energies has been given. The other lines of investigation have been soil physics and horticulture. It has been the policy of the station to concentrate its efforts as far as possible upon a few important problems of immediate usefulness to the State, and to continue their study until positive conclusions shall have been reached.

The most widely known result of the station's work is the origination of the Babcock test. This is a method for the rapid determination of the percentage of fat in milk. It was devised by the chief chemist, Dr. S. M. Babcock, and the first account of it appeared in July 1890. Since then the station has issued over 60,000 copies of bulletins and reports in which it is described. While a number of other tests had already been devised for the same purpose, this one excelled them all in simplicity, inexpensiveness, and rapidity of manipulation.

One of these earlier inventions was an ingenious method devised in 1888 by the former chemist, Mr. F. G. Short, later chemist to the Wisconsin Dairy and Food Commission, and known as "Short's test." It was so soon superseded by the Babcock test, however, that it never came into general use.

Studies in cheese making have engaged much of the station's attention in recent years, the object of which is to establish the industry on a scientific basis.

The Wisconsin cheese industry suffers $100,000 or $200,000 loss each summer through receiving tainted or defective milk at the cheese factories. An ordinary chemical analysis does not reveal the cause of the trouble. The station set to work to find out how to discover these defective milks, and as a result in 1896 the Wisconsin curd test was

devised. This test affords a means by which cheese makers are enabled quickly and accurately to detect bad milk and locate its source, so that such can be rejected. By this means floating curds and "huffy cheese" are guarded against, and factory losses, which have often run from $10 to $15 per day for weeks, are easily avoided. Wherever adopted, the curd test has almost entirely forestalled such losses.

Studies on the sources of the infection of milk by bacteria have determined the relation which gas-producing organisms exert in the manufacture of cheese. The use of a lactic ferment as a starter to overcome the effects of tainted milk was first worked out for cheese by the bacteriologist in 1896. In 1897 the bacteriologist and chief chemist announced the discovery of an unorganized ferment in milk which has a digestive action on proteid substances, and which is believed to be an important factor in the curing of cheese. This enzym was named "Galactase."

The conditions necessary for the thorough pasteurization of milk and cream for direct consumption were first worked out for the United States at this station by the development of suitable apparatus for the intermittent treatment of milk and cream. This permitted a satisfactory pasteurization from the hygienic standpoint, and set the standard for American conditions. The viscosity of cream is materially lessened when treated by heat during pasteurization, and a thin cream unsatisfactory to the user results. It was shown that this viscosity can be restored by the addition of a minute quantity of sucrate of lime, which, for this purpose, has been named "Viscogen."

In preparing a monograph on dairy salts, the station has opened up a new subject. Numerous samples of American and European dairy salts were analyzed chemically to determine their percentage of purity, and the different brands were examined physically as to other factors which influence their value for butter or cheese making, as the rate of solubility, specific gravity, form and crystallization, etc., and churning experiments were made to determine the effect of each on the butter and its weight.

Along lines of dairy farming the station has made studies of the necessary losses of dry matter in silage, rations used for dairy cows in this country, and the effects of hot and cold water for cows. For demonstration purposes the station has tested a number of dairy herds in its vicinity, pointing out the differences in productive capacity of individual animals on the same farm and of herds on neighboring farms. The station cooperates with the various pure-bred dairy stock associations in testing dairy cows.

Studies on the exclusive feeding of maize to pigs in comparison with rations rich in protein have shown that the bodies of the protein-fed pigs carried the larger ratio of lean to fat. It was also shown that the bones of the protein-fed pigs contained more ash and were stronger

than those of the maize-fed pigs. It was further shown that when growing pigs were kept on maize exclusively, an allowance of wood ash or bone meal additional increased the ash content of the bones and materially strengthened them. Among other studies along this line have been experiments on the feeding value of separator skim milk, the feeding value of whey, the relative value of cooked and uncooked feed for swine, and the relative value of ground and unground maize.

Wisconsin is by nature eminently adapted to sheep husbandry, but this industry does not flourish, chiefly because of the sharp competition of other sections. This competition does not affect the local market for mutton, however, and this fact taken with the proximity of city markets makes mutton production an industry of promise, and to its development the station has given much effort. Feeding experiments covering many phases of the subject have been carried on for the last ten years. A number of breeding experiments have also been conducted. The station has called the attention of the people of the State to the value and advantages of rape for sheep feeding and numerous feeding experiments with this plant have been reported. Rape is now grown on thousands of farms in the State, and its use is rapidly spreading.

The duties of the physicist are the investigation of problems of soils, drainage, irrigation, farm buildings, and farm machinery. Most of the work has been on soil moisture. A preliminary step of fundamental importance was the devising of an expeditious method for the mechanical analysis of soils. This method differs from previous ones in that, instead of merely separating a soil into "separates" it attempts to determine the effective surface of a unit volume of soil, both for the holding of soil moisture and for the solution of plant food. The method consists in measuring the flow of air through a sample of soil. Observations have been made on the rate of percolation of water through long columns of sand and on the percentage of water retained.

In addition to these investigations relating to the general principles of soil physics, the application of these and other principles has been studied in their relation to certain cultural practices, especially the influence of subsoiling on soil moisture and the influence of early spring tillage on soil moisture as compared with late spring tillage. Studies have been made of the destructive effects of wind on sandy soils, together with methods of prevention, and on the treatment of swampy and humus soil. A study was made of the natural distribution of the roots of certain plants in field soils. Up to the time this study was undertaken no successful attempts appear to have been made to photograph roots in position or to preserve them intact; but in 1892 the physicist devised a plan by which both of these results were in great measure accomplished.

Irrigation, under the conditions of a climate of ordinary humidity, has received considerable attention. Among the features of the work have been field experiments on the percolation of water as related to irrigation and comparative tests of surface and subirrigation for certain field crops. Closely related with this work is a series of demonstrations of the importance of the right amount and the right distribution of water in crop production. Determinations have been made of the amount of water required to produce a pound of dry matter in various crops and the amount of water absorbed by the plants.

An extended examination of silos constructed by farmers showed serious faults both as to expense and period of usefulness. The outcome of these studies was the round silo which has now become the leading form wherever economy of cost, permanence of structure, and minimum losses of silage are considered.

The work of the horticultural division has been along lines of combating insect and fungus enemies of plants, investigations with potatoes and tobacco, cultural experiments, and botanical studies of immediate application in horticulture. The horticulturist has been especially successful in devising special apparatus for various horticultural purposes. As an improvement upon methods of applying kerosene for insects, he arranged a pump to throw water and kerosene simultaneously from different receptacles, mixing them and breaking them up into a fine spray as discharged. To prevent the settling of spraying mixtures, such as Bordeaux mixtures and Paris green, pipes were arranged at the bottom of a spray barrel. Through these a small amount of the fluid is forced by the action of the pump, thus setting up a revolving movement at the bottom and preventing an accumulation of sediment. A practical means of combating the cabbage-root maggot by means of bits of cardboard was also devised, together with a convenient tool for cutting the cardboard. To prevent the failure of a tree to start growth promptly when transplanted, a scheme was devised for the application of artificial root pressure, which consisted in supporting a quantity of distilled water at a height equal to or slightly exceeding that of the tree and connecting this by means of a tube with one of the roots that has been cut off for the purpose. The constant pressure tends to force the water into the wood. A method of shading greenhouses from the inside with readily removable screens is another device originated by the horticulturist.

Among the botanical problems are studies of the roots of certain perennial plants, following the method originally devised by the physicist of this station. Observations were made on the resumption of root growth in spring in which some important points were brought out which have been little considered in culture. A careful study was made of the morphology of the strawberry plant, which resulted in

the discovery of the rational basis for certain points in its culture. A study was made of the question whether the ripening season of a pistillate strawberry is affected by the blossoming period of the pollenizing flower. Observations have been made on the degree of cold endurable by flower buds of the plum and cherry and on the fertility of native plums. The influence of varying amounts of water on the germination of beet seed has been studied, as also the conditions affecting the starch content of potatoes. Comparisons of the effect of warm and of cold water on plant growth led to the conclusion that well or spring water may be used with safety on the common greenhouse plants at any season of the year without being warmed.

Experiments in the curing and culture of tobacco were carried on during 1893 and 1894, with a special State appropriation. The investigations included studies of the changes occurring during the curing process, the amount of water evaporated during curing, conditions affecting the escape of water from cured tobacco, studies of the change in the color of tobacco leaves while curing, the degree of atmospheric moisture best suited to the curing of tobacco as determined by the psychrometer, and a study of pole burn and its prevention. These investigations led to well-defined results.

DISSEMINATION OF INFORMATION.

The station has issued 79 bulletins and 16 annual reports. By law 15,000 copies of the annual report, limited to 350 pages, are printed by the State, which also provides $500 for illustrating the reports and bulletins. The State further provides for the publication of the bulletins of the station, the size of the edition and number of pages not being limited. The mailing list contains 10,000 names. It is revised every two years. Several single-page poster bulletins printed on light manila pasteboard have also been issued, and mimeograph press bulletins of 500 each are sent out to the agricultural press of the State from time to time.

Aside from its regular publications, the station has made large and important contributions to agricultural literature. The director, Prof. W. A. Henry, is the author of "Feeds and Feeding." Part II, of the "Special Report on the Diseases of Cattle and Cattle Feeding" issued by the United States Department of Agriculture in 1892, and jointly with his assistants in the experiment station, of "Northern Wisconsin; a Handbook for the Home Seeker." The physicist, Prof. F. H. King, has written "The Soil," "Drainage and Irrigation," and "Agricultural Physics." The horticulturist, Prof. E. S. Goff, has issued "Principles of Plant Culture" and "Lessons in Pomology." The bacteriologist, Dr. H. L. Russell, has published "Dairy Bacteriology." The chemist, Prof. F. W. Woll, is the author of "A Handbook for Farmers and

Dairymen," "A Book on Silage," and has translated Grotenfelt's "Principles of Modern Dairy Practice." Jointly with Prof. E. H. Farrington, expert in dairy husbandry, he is also the author of "Testing Milk and Its Products." Prof. J. W. Decker, formerly in charge of dairying, while connected with this station, published "Cheddar Cheese Making."

The combined correspondence of the agricultural college and experiment station amounts to about 7,500 letters a year, exclusive of stencils, mimeograph sheets for press bulletins, general letters to correspondents, etc. A large part of this is station correspondence. Over 200 communications on agricultural subjects were sent to the press during the year. All of the station force assist at farmers' institutes and other agricultural and educational meetings from time to time. Some exhibits, principally of sheep, have been made at various fairs.

GENERAL RESULTS OF WORK.

By the invention of the Babcock test and other investigations in dairying and dairy farming, the Wisconsin Station has not only contributed very largely to the success of these industries in its own State, but has also done very much to establish them on a rational and scientific basis throughout the country, and thus make them more generally successful. Regarding the Babcock test as locally applied, it is believed that this test has been the means of saving not less than two-tenths of 1 per cent of fat, heretofore wasted, of all the milk delivered to Wisconsin creameries. This has been accomplished by driving out poor separators, and by enabling the creamery operator to secure the best possible results in the way of close skimming. It has also made it possible to prevent large losses which occurred in former times in imperfect churning. It is estimated that the saving by the Babcock test to Wisconsin alone is not less than $800,000 a year, or twice the annual current expenses of the State University, including its agricultural college and experiment station. The Babcock test is now used by dairymen everywhere in the United States and in many foreign countries. It is as generally used in New Zealand and Australia as in Wisconsin. The round silo devised at this station is widely regarded as an important adjunct to dairy farming. The investigations on pig feeding have also been of general importance, especially as showing that a better product can be obtained by combining more nitrogenous feed with maize. The growing of sheep for mutton in the State has been greatly promoted by the work of the station. The widespread use of rape as a forage plant for sheep has been largely due to the station's efforts. The introduction of Manshury barley has been of great practical value to the agriculture of the Northwest. The investigations of this station in agricultural physics have given valuable results and have led the way to the establishment of investigations and courses of instruction in the subject at a number of institutions in different parts of the country.

WYOMING.

Wyoming Agricultural Experiment Station, *Laramie.*

Department of the University of Wyoming.

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STATION STAFF.

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B. C. Buffum, M. S., *Vice-Director; Agriculturist and Horticulturist.*
Aven Nelson, M. S., *Botanist.*
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C. B. Ridgaway, M. A., *Physicist.*
Grace R. Hebard, M. A., Ph. D., *Secretary.*
W. H. Fairfield, M. S., *Superintendent.*

HISTORY.

The Wyoming Station is located in the southeastern part of the State at an elevation of over 7,000 feet. The elevation in different parts of the State ranges from about 3,500 to 14,000 feet. There are forests on the mountains and very extensive tracts of treeless grazing land covered with nutritious grasses. Great herds of cattle and numerous flocks of sheep are fed on the ranges. Irrigation is essential to successful agriculture, which has thus far been conducted only on restricted areas. The soils in the valleys are fertile when irrigated, unless too much alkali is present. The winters are long and severe and the summers brief and cool. The annual rainfall is about 10 inches. The principal crops are potatoes, alfalfa, and oats. Agriculture has been practiced in the State only about 30 years. Wyoming became a separate Territory in 1868 and was admitted to the Union in 1890. The university with which the station is connected was established in 1887, and is being developed largely along technical and scientific lines.

The Wyoming Agricultural Experiment Station was established March 27, 1891, in accordance with an act of the State legislature, as a department of the Agricultural College of the University of Wyoming. The first director was Dice McLaren, M. S., B. D., who served until April, 1892, since which time the president of the university has filled the office. When the station was organized five outlying experimental farms were established in various parts of the State and at various altitudes, as follows: At Lander, altitude 5,500 feet; at Saratoga, altitude 6,000 feet; at Sheridan, altitude 4,000 feet; at Sundance, altitude 4,500 feet; and at Wheatland, altitude 5,000 feet.

After five or six years of field experiments had been carried on to ascertain the capabilities of the land represented by these farms, their financial support was withdrawn, and they are now rented for a nominal amount on condition that reports of experiments are kept up.

ORGANIZATION.

The station is under the control of the board of trustees of the university, consisting of 9 members, appointed by the governor for terms of 6 years. Immediate charge of station affairs is delegated to an agricultural committee of 3 members of the board, to whom the plans and reports of work must be submitted for approval.

The staff consists of the president of the university (who is also director), vice-director (who is also agriculturist and horticulturist), botanist, chemist, geologist, physicist, secretary, and farm superintendent. These officers are appointed by the board of trustees for one year, subject to removal for cause. Routine executive duties are performed mostly by the vice-director. The station council, consisting of members of the staff, meets once a month, or oftener, to discuss plans and results of work.

EQUIPMENT.

The offices of the director, vice-director, and secretary, and the botanical, physical, and chemical laboratories are in the main building of the university (Pl. CLI, fig. 1), which is a stone structure 50 by 150 feet, and three stories high. On the university campus are a barn, granary, and greenhouse (Pl. CLI, fig. 2), and on the farm a dwelling house and barn. The station owns 120 acres of land (Pl. CLII, fig. 1) near Laramie, 80 acres of which were recently donated, with water rights, to be held by the station as long as it is used for experimental purposes. Twenty-eight acres are laid out in plats, and the rest of the farm is devoted mostly to experiments in irrigation. The only live stock owned by the station is four horses.

The station has a collection of about 5,000 named species of insects, and a herbarium containing over 16,000 specimens representing 8,000 species. Of these 1,600 were collected in Wyoming and include 150 species first described by the botanist. The agricultural museum contains four large cases of grains and collections of native grasses and seeds. The photographic department contains 600 negatives and numerous cuts. The station library contains 1,500 volumes. Station officers also have access to the general university library of 7,500 volumes. The station has full sets of meterological instruments, including quadruple registers, thermometers, and rain guages, at different parts of the State. An apparatus for measuring evaporation from soil has been devised by the physicist, Prof. C. B. Ridgaway.

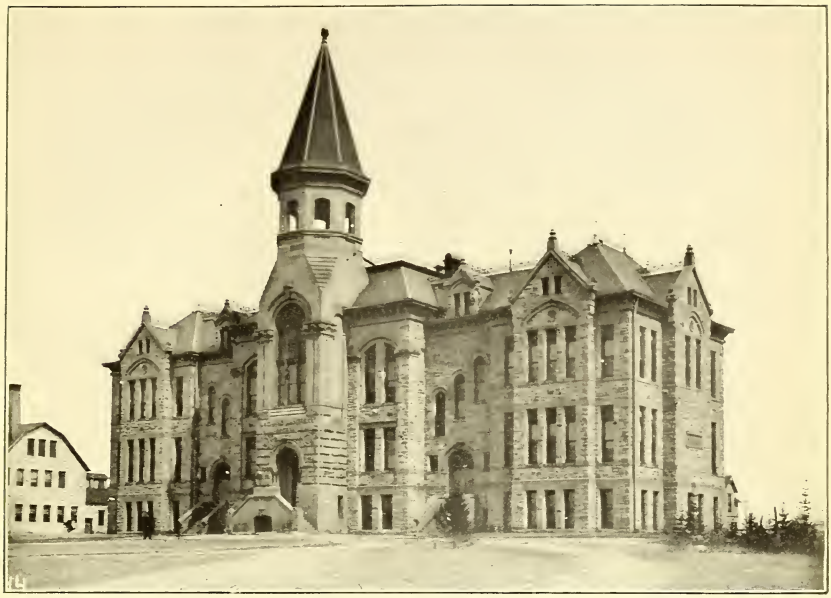

FIG. 1.—WYOMING STATION—MAIN BUILDING, USED BY UNIVERSITY AND STATION.

FIG. 2.—WYOMING STATION—GREENHOUSE.

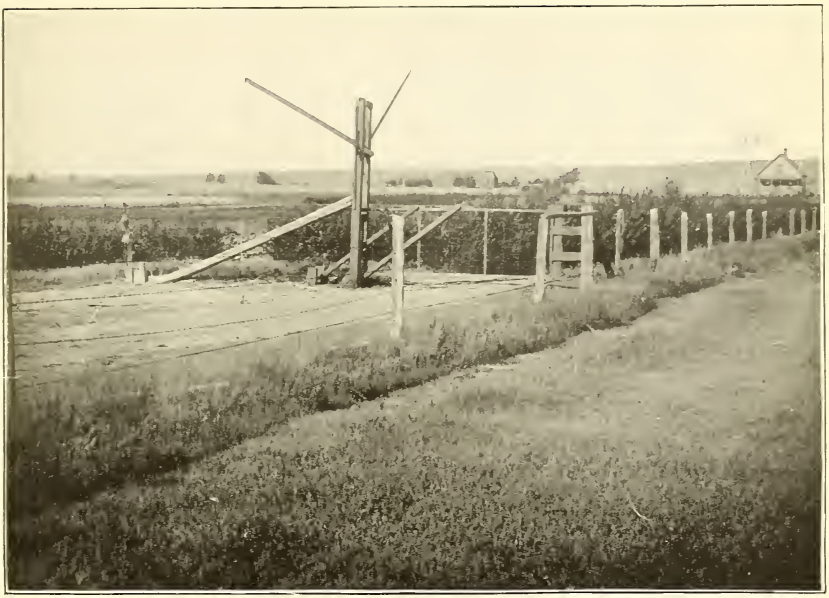

FIG. 1.—WYOMING STATION—FARM.

FIG. 2.—WYOMING STATION—EXPERIMENTS WITH SUGAR BEETS.

FIG. 1.—WYOMING STATION—EXPERIMENTAL OAT FIELD.

FIG. 2.—WYOMING STATION—SECOND CROP ALFALFA.

FINANCIAL SUPPORT.

The financial support of the station is derived mainly from the national fund and the sale of farm products. For the last fiscal year it was as follows:

United States appropriation	$15,000.00
Fees	70.90
Farm products	100.00
Miscellaneous	300.00
Total	15,470.90

LINES OF WORK.

The station has no inspection duties. At the organization of the station the State was for the most part unexplored from a scientific point of view, and hence a biological and geological survey was begun, which has been carried on by the geologist, botanist, and chemist for six years. Collections of birds, minerals, fossils, soils, water, petroleum, grasses and other plants, and insects have been made on an extensive scale, two or more parties being in the field nearly every summer. Only a small part of this work has been done with station funds, and but a small part published at station expense.

Since the State is largely unsettled and its agricultural resources but slightly developed, obviously the first work of the station was to see what crops could be grown under local conditions and what method of cultivation produced the best results. This was done by variety tests carried on at the substations and the station farm. The station first demonstrated that, contrary to the common belief, alfalfa can be successfully grown at high altitudes. This result was obtained by the use of the press drill. (Field experiments with sugar beets, oats, and alfalfa, conducted by the station, are shown in Pl. CLII, fig. 2, and Pl. CLIII, figs. 1 and 2, respectively.) The station has introduced *Bromus inermis* into the northeastern part of the State, where it is becoming the main hay crop. The station first demonstrated that numerous varieties of fruits can be grown at Wheatland, Sheridan, and Lander, and introduced the fruit-growing industry in those sections. Considerable demonstration work has been done in methods of irrigation.

The station is situated on a very arid plateau, with an altitude of 7,000 feet, and its work has been most naturally the study of the climatic and soil conditions of such regions. Most of the scientific investigations of the station have borne directly or indirectly on the subjects of irrigation and alkali. The physicist has kept records of the climate, has made mechanical analyses of the soils, and has studied evaporation and methods of checking it. The botanist has collected and studied the flora of the arid region to determine the cause of its resistance to alkali and excessive evaporation. The geologist has located the artesian basins of the State. The chemist has analyzed

the soils, alkali, and water, necessary preliminary work in a new State, and has studied, in collaboration with the agriculturist, the effect of alkali on the germination of seeds and growth of plants. The agriculturist has studied methods of irrigation and especially the duty of water as a basis for future legislation on water rights.

The botanist has conducted experiments on the influence of altitude on the loss of water by transpiration, by which it was shown that the winterkilling of trees in Wyoming is largely due to excessive evaporation. The same officer has made a general survey of the weeds of the State and a particular study of the squirrel-tail grass, one of the stock pests of Wyoming. Studies have been made of methods of exterminating the ground squirrel, which does much damage in the State. The chemist has made a study of the composition of numerous cereal foods. Experiments with sugar beets were carried on for a number of years in cooperation with farmers in different parts of the State. In this work, as well as in that on irrigation, the station has been associated with the United States Department of Agriculture.

DISSEMINATION OF INFORMATION.

The station has issued 41 regular bulletins, a few press bulletins and circulars of information, and 9 annual reports. From 1891 to 1898 the annual reports included only administrative details, all results of experiments being published in bulletins and bound with the annual report. A new policy was adopted in 1898–99, according to which all technical matter will be published in the form of papers appended to the annual report, and bulletins will be of a popular character only.

The geologist, botanist, agriculturist, and chemist have contributed many articles to scientific periodicals. The station mailing list contains 2,500 names. The correspondence amounts to about 1,500 letters a year. The farming population of the State is at present so small and scattered that no farmers' institute work has as yet been undertaken.

GENERAL RESULTS OF WORK.

The Wyoming Station has done considerable useful work in determining the agricultural capabilities of the State and showing how difficulties in the way of agriculture met by settlers in an arid region of high elevation may be overcome. It has shown that alfalfa, wheat, oats, and root crops may be successfully grown at relatively high altitudes by proper methods of culture and intelligent choice of varieties. By calling attention to the dangers attending improper irrigation and the means of preventing the rise of alkali by drainage the station has prevented much loss and promoted settlement. The introduction of *Bromus inermis* and of improved varieties of fruits has been of much value. In general the station has helped to demonstrate that mixed farming under irrigation may be profitably united with grazing, and has thus pointed out the direction in which the development of the agricultural interests of the State should proceed.

APPENDIX.

INSPECTION OF AGRICULTURAL MATERIALS IN THE UNITED STATES.

INSPECTION WORK OF THE STATIONS.

The inspection of materials useful in agriculture is one of the most important features of the work done by the experiment stations. The amount and variety of this work is increasing yearly. The first established and still the most extensive and important is the fertilizer inspection, but feeding-stuffs controls are being rapidly multiplied, and the list of inspected articles now includes, in addition to fertilizers and feeding stuffs, human foods (including dairy products), seeds, Paris green, dairy apparatus, nursery stock, and domestic animals.

The following is a summary of the inspection work directly or indirectly required by law of the experiment stations (or agricultural and mechanical colleges) in the different States:

ALABAMA.—The chemist of the station is required by law to make analyses of fertilizers, which are inspected by the State commissioner of agriculture.

COLORADO.—The station entomologist is ex-officio State entomologist, and determines the eligibility of the county horticultural inspectors.

CONNECTICUT.—The State Station at New Haven inspects fertilizers, foods, and feeding stuffs, under State laws. The horticulturist inspects nursery stock in orchards once annually, but this is not required by law.

ILLINOIS.—Analyses of fertilizers have been made for the State board of agriculture, which has charge of the fertilizer inspection.

INDIANA.—Fertilizer inspection is in charge of the State chemist, who is also the station chemist.

IOWA.—The station entomologist is also State entomologist, and inspects nursery stock.

KANSAS.—The inspection work of the station is of an indirect nature. The station veterinarian is State veterinarian, and the station entomologist gives certificates of inspection of nursery stock.

KENTUCKY.—Inspection of fertilizers and food materials by station officers, under State law.

LOUISIANA.—The station has charge of the chemical analyses under the fertilizer and Paris green law of the State, the work being done by the station under the direction of the bureau of agriculture and immigration.

MAINE.—The station inspects fertilizers, feeding stuffs, and dairy apparatus, and makes seed tests, under State laws.

MARYLAND.—Fertilizer and nursery inspection are placed by law in charge of officers of the Agricultural and Mechanical College, with which the station is connected.

MASSACHUSETTS.—The station, under State laws, inspects fertilizers and feeding stuffs. The station entomologist cooperates with the State board of agriculture in general against the gypsy moth, brown-tail moth, and San José scale.

MICHIGAN.—The station conducts the inspection of fertilizers under State law.

MINNESOTA.—The station veterinarian has charge of the veterinary work of the State board of health.

MISSOURI.—According to State law, the station has charge of the inspection of fertilizers.

MONTANA.—Nursery and orchard inspection is made by the station, under State law.

NEW HAMPSHIRE.—Analyses of fertilizers and butter for the State board of agriculture, which has charge of the inspection of these articles.

NEW JERSEY.—Fertilizer and nursery inspection is in charge of the station.

NEW YORK.—Fertilizers, concentrated feeding stuffs, and Paris green are inspected by the station at Geneva, under State law.

NORTH CAROLINA.—The station instituted work in fertilizer inspection, seed tests, nursery and orchard pests, food control, and cattle diseases, but these are now in charge of the State board of agriculture, the station cooperating to some extent in the work.

OREGON.—The chemical work of dairy and food inspection is done by the station, under State law.

PENNSYLVANIA.—The station chemist is chemist of the State board of agriculture, and analyzes commercial fertilizers and to a limited extent human foods for the board.

RHODE ISLAND.—The station conducts fertilizer and feeding-stuff inspection, under State law.

SOUTH CAROLINA.—Fertilizer inspection is placed by State law under the direction of the board of managers of the Agricultural and Mechanical College. The analytical work is done by the station chemist.

TEXAS.—Analyses of fertilizers and Paris green are made under State law by the professor of chemistry of the Agricultural and Mechanical College, who is also chemist of the station.

VERMONT.—The inspection of commercial fertilizers and feeding stuffs is intrusted to the director of the station by State law. The inspection of creamery glassware and the licensing of operatives of the Babcock test, vested by law in the person of the superintendent of the dairy school, is carried on at present under station auspices.

VIRGINIA.—Enforcement of quarantine regulations against cattle diseases and laws against San José scale and peach yellows is intrusted to the station, under State law.

WEST VIRGINIA.—Inspection of fertilizers is done by the station, under State law.

WISCONSIN.—Fertilizer and orchard inspection are conducted by the station, under State law.

INSPECTION LEGISLATION AS RELATED TO THE STATIONS.

Inspection of Fertilizers.

The trade value of the commercial fertilizers annually used in the United States probably exceeds $50,000,000. The industry has grown to these proportions within fifty years. It was but natural that a business growing so rapidly and offering such opportunities and temptations for fraud and imposition should have early become a field for extensive operations of unscrupulous and dishonest men. As the industry developed in one State after another there was an urgent demand for laws providing for the inspection of fertilizers, with a view to the prevention, or the detection and punishment, of fraud. Systematic inspection of fertilizers was first undertaken in Connecticut, under experiment-station auspices. Every State in which commercial fertilizers are used to any great extent, including all of the States east of the Mississippi River, and Arkansas, Louisiana, Missouri, and Texas west of that river—30 in all—has now provided for such inspection. The work in the majority of cases has been assigned to the agricultural experiment stations of the different States, and forms one of their most important and exacting duties. In some cases the stations

cooperate with the State boards of agriculture (the latter as a rule attending to administrative details), while in a few instances the inspection is entirely in the hands of the latter, or of a State chemist. With few exceptions, however, the analytical work is done in the laboratories of the experiment stations or agricultural colleges of the different States.

The various State fertilizer laws are quite similar in most of their general features. As a rule they require that there shall be affixed to each package of fertilizer placed on the market (and in most cases filed with the inspection official accompanied by a sealed sample of the fertilizer) a statement including, usually, the guaranteed composition of the fertilizer and the name and address of the manufacturer, and sometimes the net weight of the package, and other information. The inspection official designated by the law is authorized to issue licenses or certificates allowing the sale of fertilizers to the manufacturers or dealers complying with the requirements of the law; to collect (through the manufacturers and in the open market) and analyze samples of the fertilizers offered for sale; to publish the results of the analyses (with such comment and explanation as he may deem pertinent), and to prosecute violators of the law.

The laws differ mainly in the amount and manner of levying the tax, or license, or analysis fee; the form of statement of the guaranteed composition; the materials subject to inspection, and the penalty for violation. As regards the tax (or license or analysis fee), the laws are generally of two classes—those which require the payment of a fee for each brand sufficient to meet the expenses of inspection and those which provide for a tonnage tax yielding in many cases a large revenue, which in many instances is used for scientific investigations in agriculture or for the maintenance of the State boards of agriculture. The Connecticut law is fairly representative of the first class; the North Carolina law of the second. These laws are as follows:

CONNECTICUT FERTILIZER LAW.

"(1) Every person or company who shall sell, offer, or expose for sale, in this State, any commercial fertilizer or manure, except stable manure and the products of local manufacturers of less value than ten dollars a ton, shall affix conspicuously to every package thereof a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and the chemical composition of the fertilizer, expressed in the terms and manner approved and usually employed by the Connecticut Agricultural Experiment Station.

"If any such fertilizer be sold in bulk, such printed statement shall accompany every lot and parcel sold, offered, or exposed for sale.

"(2) Before any commercial fertilizer is sold, offered, or exposed for sale the manufacturer, importer, or person who causes it to be sold or offered for sale within this State shall file with the director of the Connecticut Agricultural Experiment Station two certified copies of the statement prescribed in section 1, and shall deposit with said director a sealed glass jar or bottle containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

"(3) The manufacturer, importer, agent, or seller of any commercial fertilizer shall pay on or before May 1, annually, to the director of the Connecticut Agricultural Experiment Station, an analysis fee of ten dollars for each of the fertilizing ingredients contained or claimed to exist in said fertilizer: *Provided*, That when the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee prescribed in this section.

"(4) Every person in this State who sells or acts as local agent for the sale of any commercial fertilizer of whatever kind or price shall annually, or at the time of

becoming such seller or agent, report to the director of the Connecticut Agricultural Experiment Station his name and brand of said fertilizer, with the name and address of the manufacturer, importer, or party from whom such fertilizer was obtained, and shall, on demand of the director of the Connecticut Agricultural Experiment Station, deliver to said director a sample suitable for analysis of any such fertilizer or manure then and there sold or offered for sale by said seller or agent.

"(5) No person or party shall sell, offer, or expose for sale, in this State, any pulverized leather, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer or manure, without explicit printed certificate of the fact, such certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany every parcel or lot of the same.

"(6) Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemicals, approved by the director of said experiment station, in such quantity as to arrest decomposition: *Provided, however,* That in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

"(7) Any person violating any provisions of the foregoing sections of this chapter shall be fined one hundred dollars for the first offense and two hundred dollars for each subsequent violation.

"(8) This chapter shall not affect parties manufacturing, importing, or purchasing fertilizer for their own private use, and not to sell in this State.

"(9) The director of the Connecticut Agricultural Experiment Station shall pay the analysis fees received by him into the treasury of the station, and shall cause one or more analyses of each fertilizer to be made and published annually. Said director is hereby authorized, in person or by deputy, to take samples for analysis from any lot or package of manure or fertilizer which may be in the possession of any dealer.

"(10) The director of the Connecticut Agricultural Experiment Station shall, from time to time, as bulletins of said station may be issued, mail or cause to be mailed two copies, at least, of such bulletins to each post-office in the State."

NORTH CAROLINA FERTILIZER LAW (DIGEST).

The State board of agriculture is charged with the supervision of the trade in commercial fertilizers and with the enforcement and supervision of all laws and regulations which are or may be enacted in the State controlling the sale of such fertilizers. No commercial fertilizers shall be sold or offered for sale unless a tonnage charge of 20 cents per ton has been paid. The board of agriculture is authorized to reduce this tax to 15 cents per ton "when in their judgment it becomes expedient." The board may exempt "certain natural materials as may be deemed expedient." Each barrel, package, or bag shall have attached a tag showing that the tax has been paid, which tag shall be issued by the commissioner of agriculture, according to regulations prescribed by the board of agriculture.

"The department of agriculture shall have power and authority at all times to have collected samples of any commercial fertilizer or fertilizing materials offered for sale in this State, and have the same analyzed, and such samples shall be taken from at least 10 per cent of the lot from which they may be selected. And whenever any commercial fertilizers or fertilizing material shall be analyzed, as required by law, and such analysis shall show the presence in such commercial fertilizer or fertilizing material of hair, hoof meal, horn, leather scraps, or other deleterious substances not available for plants, but which contains ingredients that go to make up the required or guaranteed analysis, publication shall be made in the monthly bulletin by the

department of agriculture, showing the result of such analysis and calling the attention of the public to the presence in such commercial fertilizer or fertilizing material of such deleterious substance, and such commercial fertilizer or fertilizing material shall be seized and condemned in the same manner as is provided by law for the seizure and condemnation in other cases. * * *

"Every bag, barrel, or other package of such fertilizers or fertilizing material, as above designated, offered for sale in this State, shall have thereon plainly printed a label or stamp, a copy of which shall be filed with the commissioner of agriculture, together with a true and faithful sample of the fertilizers or fertilizing material which it is proposed to sell, at or before the delivery to agent, dealers, or consumers in this State, and which shall be uniformly used and shall not be changed during the fiscal year for which tags are issued. The said commissioner shall keep an alphabetical list of names of brands or trade-marks, and shall prevent the duplication thereof; and the said label or stamp shall truly set forth the name, location, and trade-mark of the manufacturer, also the chemical composition of the contents of such package, and the real percentage of any of the following ingredients asserted to be present, to wit: Soluble and precipitated phosphoric acid, which shall not be less than 8 per cent; soluble potassa, which shall not be less than 1 per cent; ammonia, which shall not be less than 2 per cent, or its equivalent in nitrogen, together with the date of its analyzation, and that the requirements of the law have been complied with. * * *

"Cotton-seed meal is exempted from paying the tonnage charge; also land plaster, agricultural lime, oyster-shell lime, marl, and bulk materials for manufacturing purposes, upon which a tonnage charge is to be paid thereafter.

"It is a misdemeanor, punishable by a fine of $10 for each bag or package, for an agent or dealer to offer for sale any fertilizer or fertilizing materials not properly tagged, or a consumer to remove it, or a railroad agent to deliver it—one-half, less the cost, going to the party suing, and the remainder to the department; and if such fertilizer is condemned, the department makes analyses of the same and has printed labels placed on each package, giving the true chemical ingredients of the same, and fixes the commercial value at which it may be sold. Any fertilizer or fertilizing material that does not contain the ingredients as represented by the label is liable to seizure, and, after being established on trial, its value is recovered by the board of agriculture. * * * The department of agriculture can require agents of railroads and steamboat companies to furnish monthly statements of the quantity of fertilizers transported by them. The State chemist analyzes samples of fertilizers taken by the official inspectors."

Some of the main features of the fertilizer laws of other States are given in the following summary:

SUMMARIES OF FERTILIZER LAWS IN THE VARIOUS STATES.

ALABAMA.—The inspection official in this State is the commissioner of agriculture. The analytical work is done by the State chemist, who is the professor of chemistry of the Agricultural and Mechanical College, and also the chemist of the experiment station. Before fertilizers can be sold in the State a license must be secured from the commissioner and there must be filed with him a certified statement of the name and brand of the fertilizer, the name of the manufacturer, the place of manufacture, and the percentage of nitrogen, water-soluble phosphoric acid, citrate-soluble phosphoric acid, acid-soluble phosphoric acid, potash, and any other ingredients which the dealer may desire to guarantee. The license fee is $1 per year. Samples are collected by the commissioner and analyzed by the State chemist. On the basis of the analyses tags are prepared stating the composition and the estimated value of the fertilizer. These tags are supplied at a price of 5 cents for each package of 200 pounds or less and

must be attached to all packages of fertilizers offered for sale. The exemptions from the law are common lime, land plaster, cotton seed, cotton-seed meal, ashes, and common salt not in combination. The law contains provisions prohibiting the including of the inspection tax in the price of the fertilizer and the charging of "excessive or fictitious prices." Selling fertilizers without submitting to the commissioner the statement required by law is punishable by a fine of not more than $500; selling fertilizers which have not been properly tagged, by a fine of not less than $50; using tags more than once or counterfeiting the same, by a fine of $100; dealing in fertilizers without a license, by a fine of not less than $100; and "any person who commits a fraud in the manufacture, sale, or exchange of any fertilizer, or of the ingredients of a fertilizer, must, on conviction, be fined not less than $100 for each offense." For making a false certificate of analysis the chemist is subject to imprisonment for not less than two nor more than five years.

ARKANSAS.—The inspection official designated by the law is the professor of chemistry at the State University. Manufacturers or dealers are required to furnish this official with samples of fertilizers, accompanied by a statement of the name of the brand and the name and address of the manufacturer. The inspector is required to analyze these samples and furnish the manufacturer with a certificate, giving the percentage of ammonia, potash, soluble, reverted, and insoluble phosphoric acid, and "all other available fertilizing ingredients." Each package of fertilizer must bear a statement of the brand of fertilizer, the name of the manufacturer, and a guaranteed analysis which agrees substantially with that made by the official inspector. An analysis fee of $15 for each brand is charged. Purchasers may have analyses made free of charge under certain conditions. The penalty for each violation or evasion of the law is a fine of $100. Fertilizers selling for $10 or less per ton are exempt.

CONNECTICUT.—(See p. 467.)

DELAWARE.—The inspection is in charge of the State chemist, who is also the professor of chemistry in the Delaware College, at Newark. The agricultural experiment station has no direct connection with the work. Manufacturers are required to plainly mark each package of fertilizer offered for sale with a statement of the net weight, the name, brand, or trade-mark of the fertilizer, the name and address of the manufacturer, the place of manufacture, and the percentages of ammonia, of potash soluble in water, of available phosphoric acid, and of insoluble phosphoric acid. Barnyard manure, marl, lime, ashes, plaster, and chemicals used in compounding fertilizers are exempt. The State chemist must collect and analyze the fertilizers offered for sale in the State each year, and publish the results (with the estimated value) in two newspapers in each county during April and August. Any misstatement of composition by the manufacturer is punishable by a fine of $200 for the first offense and $300 for each subsequent offense, while a failure to send a copy of the certificate of analysis to the State chemist subjects the offender to a fine of $100 for the first offense and $150 for each subsequent one. Defrauded purchasers may recover damages to the extent of twice the price of the materials purchased. For reporting false analyses the State chemist is subject to a fine of not exceeding $500, and must stand committed until the fine is paid. For each brand an analysis fee of $30 is required. Purchasers may have analyses made free of charge under certain conditions.

FLORIDA.—The administrative officer is the commissioner of agriculture of the State. The analytical work is done by the State chemist. The experiment station has no connection with the inspection. The tag or label attached to each package of fertilizer must show the "number of net pounds of fertilizer in the package, the name, brand, and trade-mark under which the fertilizer is sold, the name and address of the manufacturer, and chemical analysis, stating the percentage of ammonia, of potash soluble in water, of available phosphoric acid and the source from which the same is derived, and insoluble phosphoric acid; also percentage of moisture contained

therein, and all other ingredients of which it is compounded." Samples for analysis are collected by the assistant to the chemist, who is designated inspector, and who is also required to see that fertilizers offered for sale are properly tagged. On receipt of the analysis made by the chemist the manufacturer must pay a fee of 25 cents per ton. Tags for labeling the packages of fertilizer are furnished by the commissioner on request of the manufacturer. The penalty for a false guaranty is $500 for the first offense and $1,000 for each subsequent offense; for failure to file with the commissioner a certificate giving agent and guaranteed analysis, $500. A defrauded purchaser may obtain damages to the extent of twice the value of the material purchased. For reporting a false analysis the chemist is liable to a fine not exceeding $1,000, and shall stand committed until the fine is paid. Purchasers may have analyses made on payment of a fee of $2.

Georgia.—The commissioner of agriculture of the State conducts the inspection, assisted by twelve inspectors. The State chemist makes the analyses. The experiment station has no connection with the work. All fertilizers must be labeled with a statement showing the net weight of the package, the name of the fertilizer, the name of the manufacturer, the place of manufacture, and the percentages of moisture at 212° F., insoluble phosphoric acid, available phosphoric acid, ammonia, actual and potential, and potash (K_2O). Tags for so labeling fertilizers must be obtained from the commissioner. The tax is 10 cents per ton. The law forbids the sale of the following: Any acid phosphate which contains less than 10 per cent of available phosphoric acid; any acid phosphate with potash which contains a sum total of less than 10 per cent of available phosphoric acid and potash when the percentages of the two are added together; any acid phosphate with ammonia which contains a sum total of less than 10 per cent of available phosphoric acid and ammonia when the percentages of the two are added together; any acid phosphate with ammonia and potash which contains a sum total of less than 10 per cent of available phosphoric acid, ammonia, and potash when the percentages of the three are added together; and all cotton-seed meal which is shown by official analysis to contain less than 7½ per cent of ammonia. No brands shall be sold as ammoniated superphosphates unless they contain 2 per cent or more of ammonia. "Nothing in this act shall be construed to restrict or avoid sales of acid phosphate, kainit, or other fertilizer material in bulk to each other by importers, manufacturers, or manipulators who mix fertilizer material for sale, or as preventing the free and unrestricted shipment of these articles in bulk to manufacturers or manipulators who mix fertilizer material for sale."

There is a special law providing for the inspection of cotton-seed meal. This exempts sea island cotton-seed meal from the 7.5 per cent ammonia requirement and authorizes the commissioner to fix a minimum for this product. It also allows any other cotton-seed meal which does not show 7.5 per cent of ammonia to be put on the market as second-class meal. The penalty for violating these laws is that of a misdemeanor. A third State law provides for depositing with a county officer sealed samples of fertilizers taken at the time of purchase to be analyzed by the State chemist after the crop grown with them has been harvested, if the results have not been satisfactory. "If this analysis shows that such fertilizer does not come up to the guaranteed analysis, then the sale shall be illegal, null, and void."

Illinois.—The inspection is conducted by the secretary of the State board of agriculture. The experiment station has been employed to make the analyses. The certificate placed on each package and filed with the inspection official (accompanied by a sample of the fertilizer) must state the net weight of the package, "the name or trade-mark under which the article is sold, the name of the manufacturer and place of manufacture, and the chemical analysis, stating the percentage of nitrogen or its equivalent in ammonia in an available form, of potash soluble in water, and of phosphoric acid in an available form, soluble or reverted, as well as the total phosphoric acid." The inspector may collect samples for analysis in the open market, and must have made and published at least one analysis of each fertilizer annually.

The license fee is $20. The law does not apply to fertilizers the price of which is $10 or less per ton. The penalty for violation is a fine of not less than $200 for the first offense and not less than $500 for every subsequent one, and the offender is liable for damages; but a deficiency of 1 per cent or less of the nitrogen, potash, or phosphoric acid claimed to be contained is not considered as evidence of fraudulent intent.

INDIANA.—The inspection is in charge of the State chemist, who is the professor of agricultural chemistry in Purdue University and chemist of the experiment station. Before fertilizers are sold in the State certified samples must be furnished the inspector. These are analyzed and labels to be attached to each package are printed by the inspector, stating the name of the manufacturer, the place of manufacture, "the ingredients contained in the preparation, showing particularly, in an available form, the percentage therein contained of nitrogen or its equivalent in ammonia, of potash soluble in water, of soluble and reverted phosphoric acid, and of insoluble phosphoric acid." An analysis fee of $2 is required, and labels are furnished by the inspector in lots of 500 or multiples thereof at $1 per hundred, provided the labels "may be printed without cost" to the inspector. The inspector may collect samples for analysis on the open market. The exemptions from the law are barnyard manure, marl, lime, wood ashes, and plaster. A violator of the law pays $50 for the first offense and $100 for each subsequent one.

KENTUCKY.—The director of the agricultural experiment station is the official in charge. Manufacturers or dealers are required to furnish the inspector certified samples accompanied by a statement of "the name and address of the manufacturer, the name of the fertilizer, the number of net pounds in each package, and the minimum percentages of the essential ingredients guaranteed in said fertilizer in such form and manner as may be prescribed by said director." The inspector prepares labels to be attached to each package of fertilizer, in accordance with this statement, and furnishes the same in numbers sufficient for not less than 20 tons of fertilizer at a price of 50 cents per ton. Additional tags may be secured in lots sufficient for 10 tons of fertilizer. The inspector may refuse to furnish labels for any material which he believes to be of no manurial value. The fees collected are to be used for the expenses of inspection and for experimental purposes. The inspector is authorized to collect samples for analysis in the market, and is required to make and publish annually at least one analysis (with estimated value and guaranteed composition) of each fertilizer sold or offered for sale. Purchasers may have analyses made free of charge under certain restrictions. "To facilitate the inspection of fertilizers the director is authorized to require all manufacturers making shipments into or within the State to notify him of the kinds, amounts, dates, destinations, and consignees of all such shipments." The penalty for violations of the law is a fine of not less than $100 nor more than $500. No exemptions from the law are specified.

LOUISIANA.—The official in charge of the inspection is the commissioner of agriculture and immigration. The analytical work is done and the results published by the experiment station, the director of the State stations being also State chemist. Before sales can be made samples must be furnished the inspector with a statement of the name and brand of the fertilizer, the net weight of the package, the name of the manufacturer and the place of manufacture, and the guaranteed amounts of nitrogen, soluble phosphoric acid, reverted phosphoric acid, insoluble phosphoric acid, and potash, and such other ingredients as the seller may desire to guarantee. On the basis of this statement and the results of the official analyses the commissioner prepares tags to be attached to each package of fertilizer and furnishes them to the manufacturers or dealers on the payment of fees of 25 cents per ton for the inspection and an equal amount for tags. The commissioner also gives a certificate authorizing the sale of fertilizers in the State. Notice of sales must be given to the commissioner or his deputies, who shall sample the goods, if practicable, before delivery. The commissioner is required to issue and distribute at the beginning of the season "circulars

setting forth the brands of fertilizers sold in this State, their analysis as claimed by their manufacturers or dealers, and their relative and, if known, their commercial value." The inspector is authorized to collect, analyze, and publish the results of analysis of samples of all fertilizers found on the market. Purchasers may require dealers to send samples to the inspector for examination. The penalty for selling without a certificate is a fine not exceeding $500; for not tagging fertilizers $250 and $5 for each package not tagged; counterfeiting tags $500, which "may be doubled or tripled at each second or third conviction, and so on, progressively;" for failure to attach the prescribed guaranty of composition $1 for each package. Fertilizers may be seized and sold for payment of fines. The price of fraudulent fertilizers can not be collected. Lime, land plaster, cotton-seed meal, ashes, and common salt are exempt. Funds accruing under this law are to be applied to the expenses of inspection and to tests of fertilizers under the auspices of the experiment stations in Louisiana.

Maine.—The inspection official is the director of the agricultural experiment station. Before fertilizers are offered for sale each package must bear, conspicuously printed, the following statements: The number of net pounds contained in each package; the name or trade-mark under which it is sold; the name of the manufacturer or shipper; the place of manufacture; the place of business of manufacturer or shipper; the percentage of nitrogen or its equivalent in ammonia; the percentage of potash soluble in water; the percentage of phosphoric acid in available form; and the percentage of total phosphoric acid. There shall be filed annually between November 15 and December 15, with the director of the station, a copy of the above statement with a certified sample of each fertilizer. The director shall analyze these samples, as well as others collected in the open market, and publish the results. The penalty for violation of the law is $100 for the first offense and $200 for each subsequent offense, the secretary of the State board of agriculture prosecuting offenders. Fertilizing materials selling for less than $10 per ton are exempted. For each brand of fertilizer sold or offered for sale in the State there shall be paid annually to the director of the station "an analysis fee as follows: Ten dollars for the phosphoric acid and five dollars each for the nitrogen and potash contained or said to be contained in the fertilizer."

Maryland.—The inspection official designated by the law is the professor in charge of the chemical department of the Agricultural College, who is ex officio State chemist. Before fertilizers can be sold a license fee of $15 for each brand must be paid, and each package must be plainly marked with a statement showing "the net pounds of fertilizer in the package or lot; the name, brand, or trade-mark under which the fertilizer is sold; the name and address of the importer, manufacturer, or manipulator; the place of manufacture or manipulation; and a chemical analysis stating the percentum of the minimum, and only the minimum, contained therein of nitrogen or its equivalent in available ammonia, of potash soluble in distilled water, and of available phosphoric acid." The penalty for violation of these provisions is $100 for the first offense and $200 for subsequent offenses. Notice of intended sales must be given before August 1 of each year under penalty of a fine of $25 for the first offense and $50 for each subsequent offense. The penalty for adulterating or changing the constituents of fertilizers as certified, or for using another manufacturer's trade-mark, is a fine of not more than $200, or imprisonment not exceeding six months, or both. Defrauded purchasers may recover the purchase money and the cost of suit. The inspector is authorized to collect and analyze samples of all fertilizers on sale and to publish the results with the estimated value per ton. Purchasers may have samples analyzed free. The law does not apply to fertilizers selling for $10 or less per ton, nor to materials sold in bulk for compounding fertilizers.

Massachusetts.—The director of the agricultural experiment station is charged with the inspection. In its more important features the law of this State is almost

identical with that of Connecticut (see p. 467). It provides that no one shall sell "any pulverized leather, hair, or wool waste, raw, steamed, roasted, or in any form, as a fertilizer or as an ingredient of any fertilizer without an explicit printed certificate of the fact." It differs from the Connecticut law in not containing any provision regarding fish guano and also in requiring an analysis fee of only $5 for each ingredient guaranteed. The penalty for violation of the law is $50 for the first offense and $100 for each subsequent offense.

MICHIGAN.—The inspection official is the secretary of the State board of agriculture. The analytical work is done and the results published by the agricultural experiment station. Each package must bear a plainly printed certificate stating the net weight, name, or trade-mark of brand, name of manufacturer, place of manufacture, and percentages of nitrogen in avaialble form, potash soluble in water, phosphoric acid in available form (soluble and reverted), and insoluble phosphoric acid. This certificate must also be filed with the secretary of the State board of agriculture, accompanied by a sealed certified sample of the fertilizer. The inspector is also authorized to collect samples for analysis in the open market. At least one analysis of each fertilizer must be made annually and the results published. A license fee of $20 is required for each brand. If any surplus money remains after paying the expenses of inspection it is to be placed to "the credit of the experimental fund" of the board. Violations of the law are punished by a fine of $100 for the first offense and not less than $300 for each subsequent offense. Fertilizers selling for less than $10 per ton are exempt.

MISSISSIPPI.—The inspection is in charge of the professor of chemistry of the Agricultural and Mechanical College, who is ex officio State chemist. Before selling fertilizers in the State the manufacturers or dealers must furnish the State chemist with samples, accompanied by guarantees of composition. The samples are analyzed and a certificate of analysis, showing "the percentage therein of nitrogen in an available form, of potash soluble in water, and of phosphoric acid in an available form, soluble or reverted, and of insoluble phosphoric acid," together with the manufacturer's certificate, giving the name or trade-mark of the brand, the name and address of the manufacturer, and the guaranteed composition, and stating that the fertilizers do not contain leather in any form, must be kept posted conspicuously in every place where the fertilizers are sold. Such certificates must also be attached to each package of fertilizer in form of tags, which are furnished by the State chemist. The State chemist is also authorized to collect samples for analysis in the open market and to analyze free of charge properly certified and prepared samples of fertilizers furnished him by farmers and other purchasers. Adulterated fertilizer, that which has not been analyzed and tagged, or which does not conform to the certificate, is to be forfeited to the county and contracts for it are void. Counterfeiting or using false tags is forgery. The seller of such fertilizers shall be liable to damages to the extent of four times the price of the material. For each analysis there is a fee of $15 and the charge for tags enough for 1 ton of fertilizer is 30 cents. The law does not apply to "animal excrement, cotton-seed and unmixed cotton-seed products, and castor pomace."

MISSOURI.—The official in charge is the director of the agricultural experiment station. On or before May 1, each year, dealers must send certified samples of the fertilizers which they intend to sell in the State to the official inspector. These are to be analyzed (the fee for each analysis is $10), and the results of analysis, together with the name of the manufacturer, the place of manufacture, and the brand of fertilizer, are to be printed in the form of labels to be attached to each package of fertilizer. These labels are furnished in lots of 500 or multiples thereof at $1 per hundred. The funds derived from fees and sale of labels are used for the expenses of the inspection and for experimental purposes. Samples of fertilizers for analysis may be collected in the market by the inspector or his deputy. Purchasers may

have analyses made free of charge. Violations or evasions of the law are punishable by a fine of $100 for the first offense and $200 for each subsequent offense. Fertilizers selling for less than $10 per ton are exempt.

NEW HAMPSHIRE.—The secretary of the State board of agriculture has charge of the inspection. Fertilizers must not be sold without a license from the State treasurer, for which $50 must be paid. Each package must bear a label giving name and address of manufacturer, number and date of license, name of fertilizer and date of its manufacture, the percentages of ammonia, nitrogen, soluble phosphoric acid, insoluble phosphoric acid, potash, and other constituent parts. Samples of fertilizer collected by the secretary of the State board of agriculture are submitted to the College of Agriculture and Mechanic Arts for analysis. The penalty for selling without a license is a fine of $500, one-half of which goes to the prosecutor. For failure to attach a label to each package or for a false statement on a label the fine is $20 for the first offense and $40 for each subsequent one, one-half to go to the prosecutor. "The money received for license fees is appropriated for the following purposes: A sufficient sum to pay the College of Agriculture and Mechanic Arts the actual expenses of making analyses of fertilizers and other substances submitted to the college by the board of agriculture for analysis, and the balance thereof to pay the expenses of farmers' meetings held in winter months under the authority of the board of agriculture."

NEW JERSEY.—The inspection is conducted by the chemist of the State board of agriculture, who is the director of the State Experiment Station. The analytical work is done in the laboratory of the experiment station and published in its bulletins and reports. The law requires that "every commercial fertilizer which shall be offered for sale in this State shall be accompanied by an analysis, stating the percentage therein of ammonia or its equivalent of nitrogen, of potash in any form or combination soluble in distilled water, and of phosphoric acid in any form or combination, the portion of phosphoric acid soluble in distilled water, that portion soluble in a neutral solution of citrate of ammonia at a temperature not exceeding one hundred degrees Fahrenheit, and that portion of phosphoric acid not soluble in either of the above-named fluids shall be determined separately, and the material from which the phosphoric acid is obtained shall also be stated. A legible statement of such analysis shall accompany all packages or lots of over one hundred pounds sold, offered, or exposed for sale." A fee of $15 is charged for each analysis requested by manufacturers. The payment of this fee is not compulsory. The penalty for violation of the law is $50 for the first offense and $100 for each subsequent offense. Fertilizers selling for one-half cent per pound or less and imported guanos are exempted.

NEW YORK.—The director of the agricultural experiment station at Geneva is charged with the inspection. The law applies to "any commercial fertilizer or any material to be used as a fertilizer, the selling price of which exceeds $15 per ton," and requires that there shall be printed on or affixed to each package of fertilizer, in a conspicuous place, a plainly printed statement certifying the net weight; the name, brand, or trade-mark; the name and address of the manufacturer; the chemical composition expressed as follows: Per cent of nitrogen; per cent of available phosphoric acid, or, in case of undissolved bone, total phosphoric acid; per cent of potash soluble in distilled water. Such a statement must also be filed with the official inspector. When fertilizers contain leather or similar inert products the fact must be explicitly and conspicuously stated on each package. It is to be regarded as a violation of law if the number of pounds in a package is less than that certified, if the name and address of the manufacturer or name of the brand of fertilizer is misstated, and if the fertilizer contains less nitrogen, phosphoric acid, and potash than is guaranteed, "when such deficiency is greater than one-third of 1 per centum of nitrogen, or one-half of 1 per centum of available phosphoric acid (or 1 per centum of total phosphoric

acid in the case of undissolved bone), or one-half of 1 per centum of potash soluble in distilled water." The penalty for violation of law is $100. A license fee of $20 for each brand is charged. This fee is to be paid and the statements of guaranteed analysis, etc., are to be filed in December preceding the year in which the goods are to be sold.

North Carolina.—(See p. 468.)

Ohio.—The inspection is conducted by the secretary of the State board of agriculture and all analyses are made under his direction by the State chemist. The experiment station of the State has no connection with the inspection. The seller of fertilizers must attach to each package and file with the inspection official (with a sealed certified sample of the fertilizer) a certificate stating net weight, name of brand, name of manufacturer and place of manufacture, and the percentages "of nitrogen, or its equivalent in ammonia, in an available form, of potash soluble in water, and of phosphoric acid, in an available form (soluble or reverted) as well as the total phosphoric acid." The inspector may collect samples in the open market and must make and publish annually at least one analysis of each fertilizer sold in the State. A license fee of $20 for each brand is charged. Any surplus money over and above the expenses of the inspection is placed to the credit of the agricultural fund of the board of agriculture. Violation of the law is punishable by a fine of $200 for the first offense and not less than $500 for each subsequent offense, the offender being also liable for damages, or by a fine not exceeding $200 or imprisonment for not more than 30 days, or by both fine and imprisonment. "A deficiency of 1 per cent of the nitrogen, potash, or phosphoric acid claimed to be contained shall not be considered as evidence of fraudulent intent."

Pennsylvania.—The official in charge of the inspection is the secretary of agriculture of the State. The analytical work is done by the chemist of the board, who is also the chemist of the experiment station. Each package of fertilizer sold in the State must "have plainly stamped thereon the name of the manufacturer, the place of manufacture, the net weight of its contents, and an analysis stating the percentage therein contained of nitrogen, or its equivalent in ammonia, in an available form, of potash soluble in water, of soluble and reverted phosphoric acid, and of insoluble phosphoric acid." The manufacturer or importer is required to report under oath at the end of each year the amounts of his sales, and must pay a fee of $10 for each article of fertilizer sold during the preceding year if the amount sold was less than 100 tons; if the amount was 100 tons and over, but less than 500 tons, the fee is $20; and if the amount was 500 tons or more it is $30; but if no sales were made in the preceding year the fee is $10. These fees are paid into the State treasury, which pays the expenses of inspection, allowing for each determination a sum not exceeding 75 per cent of the usual price paid for such services. The penalty for violation of law is a fine of not less than $25 nor more than $100 for the first offense, and not less than $200 for each subsequent offense, half of which goes to the informer. The law does not cover barnyard manure, marl, lime, and wood ashes, nor any commercial fertilizer which contains none of the constituents to be mentioned in the certificate of the chemical analysis.

Rhode Island.—The board of managers of the Rhode Island College of Agriculture and Mechanic Arts is charged with the inspection. The inspection work is done under the direction of the chemist of the experiment station. The certificate required to be placed on each package filed in the office of the inspection official (with a sample of the fertilizer) must state the net weight, name of brand, name of manufacturer, and place of manufacture, and in addition to the usual statements regarding brand, manufacture, etc., the percentage of nitrogen, of potash (K_2O) soluble in distilled water, and of soluble, reverted, and insoluble phosphoric acid (P_2O_5). The inspector is authorized to collect samples in the open market and to analyze the samples and report the results with the commercial value per ton and

other desirable information. For each ingredient of the fertilizer an analysis fee of $6 is charged. This is paid into the State treasury. The penalty for the first violation of the law is a fine of $50; each subsequent one, $100. The exemptions from the law are fertilizers worth less than $10 per ton, except that packages of such fertilizers must be accompanied by a label giving a correct general statement of composition. Pulverized leather in any form sold as a fertilizer must bear a printed certificate of the fact.

South Carolina.—The board of trustees of Clemson Agricultural and Mechanical College is charged with the inspection. The analytical work is in charge of the chemist of the experiment station. The label on each package must state the name, location, and trade-mark of the manufacturer, "and the real percentage of any of the following ingredients asserted to be present, to wit: Soluble and precipitated phosphoric acid, soluble potassa, ammonia or its equivalent in nitrogen, together with the date of its analysis;" and every package must also be branded "high grade," "low grade," or "standard." An inspection tax of 25 cents per ton is required, and all packages of fertilizers must bear the prescribed inspection tax tags or stamps. The law not only requires that the fertilizers shall be sampled and analyzed, but also that they shall otherwise be experimented with to determine their agricultural value. "The results of all analyses of samples officially drawn during the months of November, December, January, February, and March of fertilizers, commercial manures, and fertilizing materials shipped during the said months shall be printed and ready for distribution by April 20 following, and shall bear upon all fertilizers of similar brands shipped during the aforesaid months. The results of all analyses of samples officially drawn during the months of April, May, June, July, August, September, and October of all fertilizers, commercial manures, and fertilizing materials shipped during the said months shall be printed and ready for distribution by November 20 following, and shall bear upon all fertilizers of similar brands shipped during the corresponding months." Counterfeiting tax tags is punishable by a fine of $200 to $500 or imprisonment at hard labor for one to five years. Failure to pay the tax and tag the fertilizer and transporting untagged fertilizers are punishable by the forfeiture of a sum equal to the value of the fertilizer.

Tennessee.—The inspection official is the commissioner of agriculture of the State. Each package or parcel must bear the name of the manufacturer, the place of manufacture, and the guaranteed composition (the same to be filed with the commissioner), and the certificate of inspection of the commissioner. No fertilizer shall be sold unless it contains a given percentage of ammonia, potash, and available phosphoric acid to be prescribed by the commissioner. An inspection fee of 50 cents per ton is required. The fees, to the amount of $800, may be applied to paying the expenses of inspection. Any surplus remaining is to be used for the maintenance of the State bureau of agriculture. The commissioner collects samples in person or by deputies (bonded), and delivers them to a chemist for analysis. The results of analyses must be reported within fifteen days after the receipt of the sample. Manufacturers or dealers violating the law are fined $200 for each offense. Transportation companies handling untagged fertilizers are subject to a fine of $100 to $500. Homemade manures are exempt.

Texas.—The inspection is in charge of the professor of chemistry in the Agricultural and Mechanical College, who is also chemist of the experiment station. The law requires an annual analysis of each brand, for which a fee of $15 is charged. Certificate labels based on this analysis are furnished by the inspector in lots of 500 at a cost of one cent each and one must be placed on each package of fertilizer. Farmers and other consumers may have analyses made free.

Vermont.—The director of the Vermont Agricultural Experiment Station conducts the inspection, and the results are published in the reports and bulletins of the station. There must be affixed to each package and filed with the director of the

station (accompanied by a sample) a statement certifying "the number of net pounds of fertilizer in a package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water, and reverted, as well as the total phosphoric acid. In case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients it accompanies." An annual license must be secured from the State treasurer, for which $100 must be paid and a bond of $1,000 given. Each package must be marked "licensed," with the number and date of license. The law applies to all materials selling for $10 or more per ton, which are represented to contain two or more of the fertilizing ingredients—nitrogen, potash, and phosphoric acid; but does "not apply to the separate ingredients used to manufacture [fertilizers], or to bone meal, land plaster, lime, or any substance the product of nature which has not been compounded." Leather in any form must not be sold alone or in mixture as a fertilizer without a statement of the fact. The inspector is authorized to collect samples in the open market and to make and publish an annual analysis of each brand. The actual expenses of inspection are paid for out of the license fees collected. Violations of the law are punishable by a fine of $50 for the first offense and $100 for each subsequent offense.

Virginia.—The inspection is intrusted to the commissioner of agriculture of the State. The experiment station has no connection with the work. Before fertilizers are sold, the manufacturer must submit to the commissioner and put on each package a statement "setting forth, first, the names and brands under which his said fertilizers are to be sold, the number of pounds contained, or to be contained, in the package in which they are to be put upon the market for sale, and the name or names of the manufacturers and the place of manufacture; second, a statement setting forth the following per centum of the named ingredients which they are willing to guarantee said fertilizers to contain—first, ammonia; second, available phosphoric acid; third, potash soluble in water." In accordance with this statement, and on the payment of a fee of 15 cents per ton, the commissioner issues a certificate allowing sale, and furnishes such tags as he may prescribe to be attached to each package of fertilizer. These provisions are not to be construed as affecting "sales of acid phosphate, kainit, or other fertilizer material in bulk to each other by importers, manufacturers, or manipulators who mix fertilizer material for sale, or as preventing the free and unrestricted shipment of these articles in bulk to manufacturers or manipulators who mix fertilizers for sale." Lime, land plaster, ashes, common salt, and tobacco stems are also exempt. The penalty for selling without a license is a fine not exceeding $1,000; for not properly labeling packages, $50. Purchasers may require dealers to send samples to the inspector for examination, and the commissioner is authorized to collect and have analyzed samples of fertilizers on sale, and to publish the results of analysis. The funds accruing over and above the salary of the commissioner and the expenses of the inspection "shall be used by the board of agriculture for carrying on experiments on the nutrition and growth of plants with a view to ascertain what fertilizers are best suited to the various crops of the State, and whether other crops may not be advantageously grown on its soil, and reporting, publishing, and disseminating the result of such experiments."

West Virginia.—The inspection official is the director of the agricultural experiment station. The certificate attached to each package and filed with the director (with a sample of the fertilizer) must state "the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer, the place of manufacture, and a chemical analysis, stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form, soluble in dis-

tilled water, and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other cheaper materials said labels shall give a correct general statement of the composition." An analysis of each brand is made, for which a fee of $10 is required, and tags to be attached to each package are furnished at 50 cents per hundred. These tags state among other things the results of analyses and the computed value per ton. The inspector is authorized to collect samples for analysis in the open market. The funds accruing are used for paying the expenses of the inspection and of the experiment station. The making of a false certificate is perjury. The penalty for sale without analysis, as provided, is $50 to $500, and the penalty for removing, altering, or transferring the label, or selling without a label, is $10 to $50; for any other violation, $10 to $100.

Wisconsin.—The director of the agricultural experiment station has charge of the inspection. The certificate attached to each package and filed with the inspection official (with a sealed certified sample of the fertilizer) must state "the number of net pounds in the package sold or offered for sale, name or trade-mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business, and a statement of the following fertilizing constituents, namely, the percentage of nitrogen in an available form, the percentage of potash soluble in water, and the percentage of available phosphoric acid, soluble and reverted, as well as total phosphoric acid." All samples thus obtained shall be analyzed and the results published on or before April 1 next succeeding. The inspector is also authorized to collect samples for analysis in the market. An annual license fee of $25 for each brand is required. The fees are paid into the treasury of the station. The penalty for violating the law is $100 for the first offense and $200 for each subsequent offense.

Recently steps have been taken to secure greater uniformity in fertilizer legislation in the different States. Committees of the Association of American Agricultural Colleges and Experiment Stations and of the Association of Official Agricultural Chemists (see p. 87), after conference with representatives of fertilizer manufacturers in different parts of the United States, have agreed upon the following as the points which should be uniform in the laws of the several States:

(1) All substances containing nitrogen, potash, or phosphoric acid, sold, offered, or exposed for sale for manurial purposes, excepting the dung of domestic animals when sold as such, should be subjected to inspection.

(2) Each package of manurial substance as above defined, sold, offered, or exposed for sale should bear a printed, legible guaranty.

(3) The number of net pounds in each package should be stated.

(4) Each package should bear the brand, name, or trade-mark, and the name and address of the manufacturer.

(5) The quantities of manurial ingredients should be expressed in percentages.

(6) The guaranteed statements on the packages or forwarded to the inspectors need not be in the form of an affidavit.

(7) Sealed samples of fertilizers offered for sale need not be sent by the manufacturers to the inspectors.

(8) In lots of 5 tons or less, samples should be drawn from at least ten packages, or if less than ten packages are present, all should be sampled; in lots of over 5 tons not less than twenty packages, should be sampled.

(9) Duplicate samples should be drawn and sealed in the presence of the party or parties in interest or their representatives, one of the samples to be taken by the collector and the other left with the party whose goods were inspected, subject to the call of the manufacturer.

(10) Total nitrogen should be guaranteed in all cases, and nitrogen in the form of nitrates or of ammonium salts should be guaranteed separately, if the manufacturer desires credit therefor.

(11) Total phosphoric acid should be guaranteed in all cases, and soluble, reverted, and insoluble separately, if the manufacturer desires credit therefor.

(12) Potassium should be guaranteed as potash (potassium oxid) soluble in water.

(13) When chlorin is present in fertilizers, manufacturers shall guarantee the maximum percentage thereof.

(14) Only statements of the minimum amount of the substances present, except in the case of chlorin, should be made. For example, instead of guaranteeing from 2 to 4 per cent of potash, guarantees should read thus: Two per cent of potash.

(15) It should be specified that the methods of the Association of Official Agricultural Chemists should be used for official work.

(16) An imprisonment clause for violation of fertilizer laws should be omitted.

(17) Manufacturers should not be obliged to secure bondsmen.

(18) Commercial valuations should not be affixed to the published analyses of manurial substances.

(19) A definiton of the term "brand" should be inserted wherever a brand tax is assessed.

(20) The guaranty should state the ingredients guaranteed, in the following form and order:

——— per cent phosphoric acid soluble in water.
——— per cent phosphoric acid reverted.
——— per cent phosphoric acid insoluble.
——— per cent phosphoric acid total.
——— per cent nitrogen in nitrates.
——— per cent nitrogen as ammonia.
——— per cent nitrogen total.
——— per cent potash soluble in water.
——— per cent chlorin.

Ingredients not present should be omitted from the guaranty, and no other form of statement should be interpolated.

These recommendations have been approved by both of the associations above mentioned, and standing committees have been appointed whose duty it is to see that, as far as possible, the recommendations are embodied in legislation in the different States.

The perfecting of methods of examination of fertilizers naturally demands considerable attention from the experiment stations charged with fertilizer inspection. The results of this work appear annually in the Proceedings of the Association of Official Agricultural Chemists, published by the Division of Chemistry of the United States Department of Agriculture, and is embodied in the so-called official methods.

The systems of inspection of fertilizers in force in the United States have in general been very effective in repressing fraud and in disseminating correct ideas regarding the nature, value, and use of fertilizers. This class of work is among the most popular that the experiment stations undertake, and where properly managed it has been made of great value to their constituencies without serious detriment to the more strictly scientific work for which the stations are primarily established.

LIST OF OFFICIALS IN CHARGE OF FERTILIZER INSPECTION IN THE UNITED STATES.

ALABAMA.....Commissioner of Agriculture, Montgomery.
ARKANSAS.....Professor of Chemistry, Arkansas Industrial University, Fayetteville.
CONNECTICUT.....Director Agricultural Experiment Station, New Haven.
DELAWARE.....Professor of Chemistry, Delaware College, Newark.
FLORIDA.....Commissioner of Agriculture, Tallahassee.
GEORGIA.....Commissioner of Agriculture, Atlanta.
ILLINOIS.....Secretary State Board of Agriculture, Springfield.

INDIANA ..... Professor of Agricultural Chemistry, Purdue University, Lafayette.
KENTUCKY ..... Director Agricultural Experiment Station, Lexington.
LOUISIANA ..... Commissioner of Agriculture and Immigration, Baton Rouge.
MAINE ..... Director Agricultural Experiment Station, Orono.
MARYLAND ..... Professor of Chemistry, Maryland Agricultural College, College Park.
MASSACHUSETTS ..... Director Agricultural Experiment Station, Amherst.
MICHIGAN ..... Secretary State Board of Agriculture, Agricultural College.
MISSISSIPPI ..... Professor of Chemistry, Agricultural and Mechanical College, Agricultural College.
MISSOURI ..... Director Agricultural Experiment Station, Columbia.
NEW HAMPSHIRE ..... Secretary State Board of Agriculture, Concord.
NEW JERSEY ..... Director Agricultural Experiment Station, New Brunswick.
NEW YORK ..... Director Agricultural Experiment Station, Geneva.
NORTH CAROLINA ..... Commissioner of Agriculture, Raleigh.
OHIO ..... Secretary State Board of Agriculture, Columbus.
PENNSYLVANIA ..... Secretary of Agriculture, Harrisburg.
RHODE ISLAND ..... Chemist, Agricultural Experiment Station, Kingston.
SOUTH CAROLINA ..... Secretary Board of Fertilizer Control, Clemson College.
TENNESSEE ..... Commissioner of Agriculture, Nashville.
TEXAS ..... Professor of Chemistry, Agricultural and Mechanical College, College Station.
VERMONT ..... Director Agricultural Experiment Station, Burlington.
VIRGINIA ..... Commissioner of Agriculture, Richmond.
WEST VIRGINIA ..... Director Agricultural Experiment Station, Morgantown.
WISCONSIN ..... Director Agricultural Experiment Station, Madison.

INSPECTION OF FOODS AND FEEDING STUFFS.

While the feeding stuffs inspection is in every case in charge of the experiment stations, only a small part of the food inspection is assigned by law to the stations. This is frequently presided over by other State officials, so that the inspection work referred to below constitutes only a portion of that carried on throughout the country. The stations often have an indirect connection with the work, where they are not specifically charged with it by law; and in a number of cases where no State food laws exist as yet the stations maintain a voluntary control, which has a healthy influence and serves to arouse interest which sooner or later will lead to food legislation.

FEEDING STUFFS INSPECTION.

Although the experiment stations had from the first analyzed quite generally the feeding stuffs found on the markets, and called attention to the variation in their composition and the effect of this upon their real value, there was no inspection and control of concentrated feeding stuffs under law in the United States until 1897. The State of Connecticut in 1895 passed a food law providing for the inspection of foods used by man or domestic animals, but in the execution of this law only human food was included.

In 1897 the legislature of Massachusetts passed an act authorizing the experiment station to sample and analyze for protein and fat all concentrated commercial feeding stuffs offered for sale in the State and to publish the results, "with such additional information as circumstances advise," omitting the names of the jobbers or local dealers selling the feeding stuffs. The law directs that the samples shall be taken from packages representing not less than 5 per cent of the whole lot inspected, and each sample divided into two equal parts, properly labeled, one duplicate to be

retained by the party whose stock is sampled and the other used by the station for analysis. No provision is made by this law for a guaranty of the composition of feeding stuffs and no penalty for selling inferior goods. However, through the influence of the station a considerable number of large manufacturers and jobbers have been led to place guaranties upon their goods, and intelligent farmers have been aroused to the desirability of buying feeding stuffs only on guaranty.

The same year (1897) the State of Maine enacted a law for the inspection of feeding stuffs much more comprehensive in its character, and this law has served as the basis of laws since passed in the States of Connecticut, New York, Rhode Island, and Vermont.

The concentrated feeding stuffs coming within the scope of the Maine law include linseed meals, cotton-seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, maize and oat chops, ground beef or fish scraps, mixed feeds, and all other material of similar nature, not including hays and straws, the whole seeds or unmixed meals made directly from the entire grains of wheat, rye, barley, oats, maize, buckwheat, and broom corn, or wheat, rye, and buckwheat brans or middlings.

The concentrated feeding stuffs as defined are required to bear a label stating the number of net pounds in the package, the name or trade-mark of the material, name and address of the manufacturer or shipper, and the percentage of crude protein and of crude fat, as determined by the methods adopted at the time by the Association of Official Agricultural Chemists. Before offering a concentrated feeding stuff for sale in the State, the manufacturer or dealer must file with the director of the Maine Experiment Station a certified copy of the label to be used on each brand, accompanied, when requested, by a certified sample of the feeding stuff. This is not required of local dealers when the manufacturer or importer has complied with the law; otherwise the local dealers are liable. An inspection tax of 10 cents per ton is to be paid to the director of the Maine Station, who in return furnishes tags to be affixed to each package stating that the specified charges have been paid. The inspection taxes received by the director are paid over to the treasurer of the Maine Station, who is required to make an annual report of receipts and expenditures from this fund, and to turn over to the State treasury all receipts in excess of $3,000 per annum.

The inspection is conducted by the director of the station, who is authorized to take samples in person, or by deputy, not exceeding 2 pounds in weight, from any lot or package of concentrated commercial feeding stuffs which may be in the possession of any manufacturer, importer, or dealer in the State, the samples to be drawn in the presence of a representative of the dealer. The mixed sample is divided into two equal parts, properly labeled, and one part taken for the inspection, while the other is retained by the dealer. The results of the inspection are published in reports or bulletins from time to time.

Failure to comply with the provisions of the law is punishable by a fine of not more than $100 for the first offense and not more than $200 for each subsequent offense. The secretary of the State board of agriculture is made the prosecuting officer under the law, being notified of any violation of its provisions by the director of the experiment station. Upon learning of violations of the act the secretary is required to notify the manufacturer, importer, or dealer and give him not less than thirty days in which to comply with the requirements of the act. No prosecution relative to the quality of a concentrated feeding stuff is to be made if the same is found substantially equivalent to the guaranty. This law went into effect October 1, 1897.

The Vermont law, which is modeled on the Maine law, was passed in 1898 and went into effect July 1, 1899. It differs from the Maine law in some minor details. It charges the director of the Vermont Experiment Station with the carrying out of

the law and the inspection in practically the same manner as the Maine law. It provides that the percentage of crude fat need not be guaranteed when it is less than 3 per cent. To facilitate the inspection, the law requires that all manufacturers and importers of concentrated commercial feeding stuffs shall, upon request, furnish the director of the station with a complete list of the brands of feeding stuffs which they sell in the State and their agents.

The inspection tax received by the director is to be paid to the State treasurer, and from this the station is to be reimbursed for the expense of carrying out the inspection, in no case in excess of the amount of inspection tax received.

The penalty for noncompliance with the law is fixed at $50 for the first offense and not more than $100 for each subsequent offense. The director notifies the State treasurer of all violations of the act and the latter institutes the prosecution.

The laws of Connecticut and Rhode Island, both of which went into effect July 1, 1899, are almost exactly alike and are both quite similar to the Maine law. The Connecticut law includes in its scope brans and middlings, and is the only law which does not exempt these materials. Neither the Connecticut nor Rhode Island law imposes an inspection tax. The Connecticut law makes no provision of funds for its execution, but the Rhode Island law carries an appropriation of $1,300 per annum for that purpose. Both laws provide the same penalty as the Maine law, prosecution under the law being in the hands of the State dairy commissioner in case of the Connecticut law and the board of managers of the Rhode Island College of Agriculture and Mechanic Arts in the case of Rhode Island.

The New York law, which went into effect December 1, 1899, is likewise very similar to the Maine law in its general provisions, but differs in requiring a license fee of $25 annually by each manufacturer, importer, or dealer. These license fees are transmitted by the director of the station to the State treasurer, and are used in defraying the expense of the inspection and in enforcing the provisions of the law. The penalty for failure to comply with the provisions of the law is the same as in the case of the Maine law, and is enforced by the State commissioner of agriculture.

A clause relating to adulteration of meal or ground grain with milling or manufacturing offals is added, providing that such adulteration, unless plainly marked or indicated upon the package, shall be punishable by a fine of not less than $25 nor more than $100 for each offense.

The New Jersey Station has from time to time made quite comprehensive studies of different classes of concentrated feeding stuffs, showing the variation in percentage composition and in relative price.

For a time the Tennessee Station conducted a voluntary inspection of cotton-seed meals.

It will be seen that, except in Massachusetts and Maine, the feeding stuffs control has only recently gone into operation, so that little can be said of its effect.

The Massachusetts Station in 1898 collected and analyzed over 650 samples of concentrated feeding stuffs. While the law confers very small powers on the station, it has by its extensive inspection and the publication of results, and by timely circulars of warning, made the State an unprofitable field for the sale of adulterated, misbranded, or inferior feeding stuffs. The good moral effect of the law has been very apparent, and it has given much greater security in the purchase of commercial feeds.

In Maine, where the law is more stringent and far-reaching, its workings have been entirely satisfactory. Low-grade or adulterated cotton-seed meal, which was sold extensively in the State in 1897, has been driven out of the market. The station has insisted that the guaranty should not exceed the composition, and where violations of this have occurred manufacturers have promptly changed the labels to correct the error. The law has been found to "protect both the dealer and the consumer," and to "tend toward a more rational use of feeding stuffs, which will be alike beneficial to the feeder and the dealer."

INSPECTION OF FOODS.

The food law of Connecticut, mentioned above, has served as a model for the Kentucky law, which went into effect in 1898, and the North Carolina law, which went into effect August 1, 1899. Although the Connecticut law was never applied to concentrated feeding stuffs, the laws in all three States clearly bring these materials within their scope. The Connecticut law makes it unlawful for any person to manufacture or offer for sale any article of food which is adulterated or misbranded, and it defines at length what constitutes adulterating and misbranding. The Connecticut Experiment Station is charged with making analyses of food products suspected of being adulterated, samples being purchased for this purpose, and the station is authorized to adopt or fix standards of purity, quality, or strength. The penalty for adulteration is a fine not exceeding $500, or imprisonment for not more than one year. The act carries an appropriation to the station of $2,500 per annum to defray the expenses of the inspection.

The Kentucky law exempts spirituous, vinous, and malt liquors from the provisions of the law, and provides that "nothing in this act shall be construed to prohibit the manufacture or sale of oleomargarine, butterine, or kindred compounds in a separate and distinct form and in such manner as will advise the customer of its real character, free from coloration or ingredient that causes it to look like butter." The penalty for adulterating food products is the same as that fixed by the Connecticut law. The compensation which the station is to receive for the inspection is $5 and traveling expenses for each sample taken and analyzed, the expenses of the inspection in no year to exceed $2,500.

The enforcement of the North Carolina food law is at present in charge of the State board of agriculture, together with all other inspection work, but the station was instrumental in securing the passage of the law, and formerly carried on considerable work to determine the character and extent of adulteration in the State. In essential details the law is very similar to the Connecticut law, except that the penalty is not exceeding $200 for the first offense and $300 for each subsequent offense, or imprisonment not exceeding one year, or both. A penalty of not less than $10 nor more than $100, or imprisonment for not more than 100 days, or both, is provided for refusing to furnish samples or interfering with the food inspection.

The Idaho Station has in the past maintained a voluntary inspection of food materials to a limited extent, and the Wyoming Station has made a quite extended study of the prepared cereal and similar foods sold in the State.

The Montana Station makes examinations of food products and kerosene oil in conjunction with the State bureau of agriculture and labor, the incidental expense of this inspection being borne by the bureau.

The Missouri Station voluntarily assists the State board of agriculture in regulating the sale of artificial butters, its function being merely to furnish the scientific information on which the board bases its action.

Under the State law the New Hampshire Station cooperates with the board of agriculture in the inspection of dairy products, principally butters. The samples are collected by the board of agriculture and are sent to the station for analysis.

For a number of years the North Dakota Station has made something of a study of the food supply of the local markets.

The food law of Oregon is in charge of a State dairy and food commissioner, but the law makes it the duty of the chemist of the experiment station "to correctly analyze any and all substances the said commissioner may send him for the purpose of carrying out the provisions of this act." Under this arrangement the station chemist acts merely as analyst, with no authority to collect samples or prosecute.

The Pennsylvania Station does a limited amount of work for the State department of agriculture in the inspection of human foods and dairy products. The station has no direct legal relation to the work, but acts only as one of the analysts.

Inspection of Apparatus Used in Milk Testing.

The widespread adoption of the system of paying for milk and cream according to its fat content, as determined by the Babcock test, has led two States (Maine and Vermont) to pass laws providing for the inspection of the graduated apparatus used in this and similar tests. The laws are also intended to limit the official use of the Babcock test to persons who have shown themselves to be competent to operate it. The Maine law was passed in 1895 and the Vermont law in 1898. The laws of the two States are alike in all essential details except the penalty.

The Maine law provides that all bottles, pipettes, or other measuring glasses used at any creamery, butter factory, cheese factory, or condensed-milk factory in determining the value of milk or cream received from different persons, shall before use be tested by the experiment station for accuracy of measurement, and shall be ineffaceably marked to show that they have been tested. The experiment station is to receive for this service the actual cost incurred, the same to be paid by the persons or corporations for whom the apparatus is tested. The penalty for using untested apparatus is a fine not exceeding $50 for the first offense, nor $100 for each subsequent offense. All persons who manipulate the Babcock test or any other test for the purpose of measuring the butter fat in milk or cream, for a basis of apportioning the values, are required to secure certificates from the superintendent of the dairy school of the State (director of the experiment station) stating that they are competent and well qualified to perform the test. The rules and regulations governing the granting of these certificates are to be fixed by the superintendent of the dairy school, and the fee for issuing a certificate is not to exceed $1, to be paid by the applicant. The penalty for violating this section is a fine not exceeding $10. The law further forbids the use of sulphuric acid of less than 1.82 specific gravity for official purposes. The fine for having a weaker acid in possession where such tests are made is not exceeding $25 for the first offense nor $50 for the second offense. It is made the duty of every milk inspector, sheriff, deputy sheriff, and constable to institute complaint against any person or persons violating the provisions of the law, and, on conviction, one-half of the fine is to go to the complainant and the balance to the State.

The Vermont law omits the clause in regard to the employment of sulphuric acid of 1.82 specific gravity. The penalty for violating either of the other clauses is not exceeding $25 for the first offense nor $50 for each subsequent offense. In all other respects the law is like the Maine law.

The annual report of the Maine Station for 1898 states that "a very small percentage of the goods inspected the past year was inaccurately graduated. All bottles and pipettes examined by the station and found correct have the letters M. E. S. etched upon them."

The Vermont Station reports (February 1, 1899) having tested over 5,000 pieces of glassware for use in the Babcock test, part of which was old and part new apparatus. "One out of every 28 pieces of old apparatus and 1 out of every 55 pieces of new apparatus proved to be wrong. Several bad bottles and two very bad lots of bottles have been found. Correct apparatus is stamped indelibly Vt. Ex. Sta.; incorrect apparatus is indelibly stamped BAD. There have been 115 applications for licenses (to operate the Babcock test), 45 of which have been granted and 3 refused, while in 67 cases examinations are still incomplete."

Inspection of Nursery Stock.

Inspection of nursery stock and orchards for injurious insects and fungus diseases is made by the stations in the following States: Official—Colorado, Iowa, Kansas, Massachusetts, Montana, New Jersey, Ohio, Virginia, and Wisconsin; voluntary—Connecticut (State Station), Florida, Minnesota, Missouri, Nevada, South Carolina, and Tennessee.

In the following States this work is done under other auspices: Delaware, Indiana, Maryland, and North Carolina.

Laws against injurious insects and fungus diseases usually involve the establishment of a State board of horticulture or State board of agriculture, of which the State entomologist or station entomologist and State botanist or station botanist are ex officio members. Such State board, with the advice of the official entomologist and botanist, ordinarily appoints inspectors for the different districts. The laws usually specify certain insects and fungus diseases which are declared dangerous and which are to be quarantined when discovered by inspectors. These laws, like the laws against contagious diseases of animals, usually require the notification from railroad and transportation companies and also from nursery companies and shippers of intended shipments of nursery stock and other plants into the State. Punishment is provided for failure to notify of such intended shipments. The law empowers the official entomologist or botanist to order quarantine upon stock infested with dangerous fungus diseases and insect pests or to order the destruction of such stock at his discretion. The official entomologist or botanist is usually empowered to inspect nurseries within the State and to grant certificates of apparent freedom from disease where such is found to be the case. In some States the official inspectors and State officers are required to inspect the orchards of the State once annually, and where dangerous insect pests or fungus diseases are discovered, to order the treatment or destruction of such trees or plants by the owner.

In the laws against fungus diseases the following are specified as dangerous diseases: Peach yellows, black knot, and a cranberry disease. For the most part the diseases are not specified, but the law is a general one.

In the laws against injurious insects, specification is often made of such insects as are considered most injurious, and among the more important ones should be mentioned scale insects, codling moth, woolly aphis, and pear-leaf blister mite.

Inspection of Animal Diseases.

Laws for the control of contagious diseases of animals are in force in 37 States and Territories. The stations in the following States are directly or indirectly connected with this work: Kansas (the station veterinarian being also State veterinarian); official—Minnesota, Virginia, and Vermont (the station veterinarian being also State veterinarian, and in the latter capacity performing inspection duty in the control of animal diseases); voluntary—Missouri.

In laws for controlling contagious diseases of animals certain diseases are usually specified as being the only ones considered by the law. The most important diseases thus specified include the following: Glanders, Texas fever, sheep scab, tuberculosis in cattle, hog cholera, and swine plague. These laws usually provide for the establishment of a live-stock commission or State sanitary board, of which the State veterinarian or station veterinarian is an ex officio member. This board or commission has power to appoint and pass on the eligibility of persons as inspectors of various districts in the State. There are often county commissions which cooperate with the State commission in the detection of outbreaks of contagious diseases and in the enforcement of regulations against them. The law ordinarily empowers the State board or State veterinarian to establish quarantines as soon as an outbreak of any contagious disease is made known, and to punish any infringement upon such quarantine regulations. The law also stipulates under what circumstances these animals shall be destroyed and how the carcasses shall be disposed of. In some cases indemnity is allowed the owner for slaughtered animals; in other cases not. These laws usually require a notification from railroad companies of shipments of stock into the State or through the State from another State, in order that such stock may be inspected by the local inspector.

Miscellaneous Inspection Work.

Weeds.—Weed laws are in force in 25 States. In many cases the stations are directly or indirectly concerned in the enforcement of these laws. The general advisory officer is, as a rule, the State botanist or station botanist. The destruction of weeds along public highways is usually made the duty of road supervisors and similar officers. Weeds along railroad tracks are, according to law, to be destroyed by the railroad companies. Whenever dangerous weeds are found upon any person's property, the owner of the property may, by law, be ordered to destroy these weeds at his own expense. The laws against weeds in the various States usually specify by the common or scientific name those weeds which are considered dangerous and are to be eradicated. The most important weeds so specified are bull thistle, burdock, Canada thistle, wild mustard, cocklebur, couch grass, curled dock, milkweed, white daisy, pennycress, toad flax, Russian thistle, sow thistle, sweet clover, wild carrot, wild oats, wild parsnip, and yellow daisy.

Water.—Voluntary examination of water for drinking and irrigation purposes is an important feature of the work of a number of the stations, notably those of California, Delaware, Idaho, Massachusetts, Nevada, New Hampshire, North Dakota, Oklahoma, Rhode Island, South Carolina, South Dakota, Vermont, and Wyoming.

Seeds.—The inspection of seeds is required of the Maine Station by law. Voluntary examinations of seeds are made by a number of other stations.

Paris green.—The experiment stations in Louisiana, New York, and Texas are required by law to inspect this material.

FEDERAL LEGISLATION AND RULINGS AFFECTING AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

FEDERAL LEGISLATION.

Act of 1862 Donating Lands for Agricultural Colleges.

AN ACT donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there be granted to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State a quantity equal to thirty thousand acres for each Senator and Representative in Congress to which the States are respectively entitled by the apportionment under the census of eighteen hundred and sixty: *Provided*, That no mineral lands shall be selected or purchased under the provisions of this act.

Sec. 2. That the land aforesaid, after being surveyed, shall be apportioned to the several States in sections or subdivisions of sections, not less than one quarter of a section; and whenever there are public lands in a State subject to sale at private entry at one dollar and twenty-five cents per acre, the quantity to which said State shall be entitled shall be selected from such lands within the limits of such State, and the Secretary of the Interior is hereby directed to issue to each of the States in which there is not the quantity of public lands subject to sale at private entry at one dollar and twenty-five cents per acre, to which said State may be entitled under the provisions of this act, land scrip to the amount in acres for the deficiency of its distributive share; said scrip to be sold by said States and the proceeds thereof applied to the uses and purposes prescribed in this act and for no other use or purpose whatsoever: *Provided*, That in no case shall any State to which land scrip may thus be issued be allowed to locate the same within the limits of any other State, or of any Territory of the United States, but their assignees may thus locate said land scrip upon any of the unappropriated lands of the United States subject to sale at private

entry at one dollar and twenty-five cents, or less, per acre: *And provided further*, That not more than one million acres shall be located by such assignees in any one of the States: *And provided further*, That no such location shall be made before one year from the passage of this act.

SEC. 3. That all the expenses of management, superintendence, and taxes from date of selection of said lands, previous to their sales, and all expenses incurred in the management and disbursement of the moneys which may be received therefrom, shall be paid by the States to which they may belong, out of the treasury of said States, so that the entire proceeds of the sale of said lands shall be applied without any diminution whatever to the purposes hereinafter mentioned.

SEC. 4. That all moneys derived from the sale of the lands aforesaid by the States to which the lands are apportioned, and from the sales of land scrip hereinbefore provided for, shall be invested in stocks of the United States, or of the States, or some other safe stocks, yielding not less than five per centum upon the par value of said stocks; and that the moneys so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except so far as may be provided in section fifth of this act), and the interest of which shall be inviolably appropriated, by each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.

SEC. 5. That the grant of land and land scrip hereby authorized shall be made on the following conditions, to which, as well as to the provisions hereinbefore contained, the previous assent of the several States shall be signified by legislative acts:

First. If any portion of the fund invested, as provided by the foregoing section, or any portion of the interest thereon, shall, by any action or contingency, be diminished or lost, it shall be replaced by the State to which it belongs, so that the capital of the fund shall remain forever undiminished; and the annual interest shall be regularly applied without diminution to the purposes mentioned in the fourth section of this act, except that a sum, not exceeding 10 per centum upon the amount received by any State under the provisions of this act, may be expended for the purchase of lands for sites or experimental farms, whenever authorized by the respective legislatures of said States.

Second. No portion of said fund, nor the interest thereon, shall be applied, directly or indirectly, under any pretense whatever, to the purchase, erection, preservation, or repair of any building or buildings.

Third. Any State which may take and claim the benefit of the provisions of this act shall provide, within five years, at least not less than one college, as described in the fourth section of this act, or the grant to such State shall cease; and said State shall be bound to pay the United States the amount received of any lands previously sold, and that the title to purchasers under the State shall be valid.

Fourth. An annual report shall be made regarding the progress of each college, recording any improvements and experiments made, with their costs and results, and such other matters, including State industrial and economical statistics, as may be supposed useful, one copy of which shall be transmitted by mail free, by each, to all the other colleges which may be endowed under the provisions of this act, and also one copy to the Secretary of the Interior.

Fifth. When lands shall be selected from those which have been raised to double the minimum price, in consequence of railroad grants, they shall be computed to the States at the maximum price and the number of acres proportionately diminished.

Sixth. No State while in a condition of rebellion or insurrection against the Government of the United States shall be entitled to the benefit of this act.

Seventh. No State shall be entitled to the benefits of this act unless it shall express its acceptance thereof by its legislature within two years from the date of its approval by the President.

SEC. 6. That land scrip issued under the provisions of this act shall not be subject to location until after the first day of January, one thousand eight hundred and sixty-three.

SEC. 7. That the land officers shall receive the same fees for locating land scrip issued under the provisions of this act as is now allowed for the location of military bounty land warrants under existing laws: *Provided*, Their maximum compensation shall not thereby be increased.

SEC. 8. That the governors of the several States to which scrip shall be issued under this act shall be required to report annually to Congress all sales made of such scrip until the whole shall be disposed of, the amount received for the same, and what appropriation has been made of the proceeds.

Approved, July 2, 1862.

ACT OF 1887, ESTABLISHING AGRICULTURAL EXPERIMENT STATIONS.

AN ACT to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July second, eighteen hundred and sixty-two, and the acts supplementary thereto.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under direction of the college or colleges or agricultural department of colleges in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July second, eighteen hundred and sixty-two, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station:" *Prorided*, That in any State or Territory in which two such colleges have been or may be so established the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate from time to time such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purpose of this act. It shall be the duty of

each of said stations annually, on or before the first day of February, to make to the governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same and as far as the means of the station will permit. Such bulletins or reports and the annual reports of said stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster-General may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the Treasury proceeding from the sales of public lands, to be paid in equal quarterly payments, on the first day of January, April, July, and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, eighteen hundred and eighty-seven: *Provided, however,* That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be so expended.

SEC. 6. That whenever it shall appear to the Secretary of the Treasury from the annual statement of receipts and expenditures of any of said stations that a portion of the preceding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act and having also agricultural experiment stations established by law separate from said colleges, such State shall be authorized to apply such benefits to experiments at stations so established by such States; and in case any State shall have established under the provisions of said act of July second, aforesaid, an agricultural department or experimental station in connection with any university, college, or institution not distinctively an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the legislature of such State may apply in whole or in part the appropriation by this act made to such separate agricultural college or school, and no legislature shall by contract, express or implied, disable itself from so doing.

SEC. 9. That the grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purposes of said grants: *Provided,* That payment of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act shall be made upon the assent of the governor thereof duly certified to the Secretary of the Treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the Treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend, or repeal any or all the provisions of this act.

Approved, March 2, 1887.

ACT OF 1890, FOR THE FURTHER ENDOWMENT OF AGRICULTURAL COLLEGES.

AN ACT to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts established under the provisions of an act of Congress approved July second, eighteen hundred and sixty-two.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be, and hereby is, annually appropriated, out of any money in the Treasury not otherwise appropriated, arising from the sales of public lands, to be paid as hereinafter provided to each State and Territory for the more complete endowment and maintenance of colleges for the benefit of agriculture and the mechanic arts now established, or which may be hereafter established, in accordance with an act of Congress approved July second, eighteen hundred and sixty-two, the sum of fifteen thousand dollars for the year ending June thirtieth, eighteen hundred and ninety, and an annual increase of the amount of such appropriation thereafter for ten years by an additional sum of one thousand dollars over the preceding year, and the annual amount to be paid thereafter to each State and Territory shall be twenty-five thousand dollars, to be applied only to instruction in agriculture, the mechanic arts, the English language, and the various branches of mathematical, physical, natural, and economic science, with special reference to their applications in the industries of life, and to the facilities for such instruction: *Provided,* That no money shall be paid out under this act to any State or Territory for the support and maintenance of a college where a distinction of race or color is made in the admission of students, but the establishment and maintenance of such college separately for white and colored students shall be held to be a compliance with the provisions of this act if the funds received in such State or Territory be equitably divided as hereinafter set forth: *Provided,* That in any State in which there has been one college established in pursuance of the act of July second, eighteen hundred and sixty-two, and also in which an educational institution of like character has been established or may be hereafter established, and is now aided by such State from its own revenue, for the education of colored students in agriculture and the mechanic arts, however named or styled, or whether or not it has received money heretofore under the act to which this act is an amendment, the legislature of such State may propose and report to the Secretary of the Interior a just and equitable division of the fund to be received under this act between one college for white students and one institution for colored students, established as aforesaid, which shall be divided into two parts and paid accordingly, and thereupon such institution for colored students shall be entitled to the benefits of this act and subject to its provisions, as much as it would have been if it had been included under the act of eighteen hundred and sixty-two; and the fulfillment of the foregoing provisions shall be taken as a compliance with the provisions in reference to separate colleges for white and colored students.

SEC. 2. That the sums hereby appropriated to the States and Territories for the further endowment and support of colleges shall be annually paid on or before the thirty-first day of July of each year, by the Secretary of the Treasury, upon the warrant of the Secretary of the Interior, out of the Treasury of the United States, to the State or Territorial treasurer, or to such officer as shall be designated by the laws of such State or Territory to receive the same, who shall, upon the order of the trustees of the college, or the institution for colored students, immediately pay over said sums to the treasurers of the respective colleges or other institutions entitled

to receive the same, and such treasurers shall be required to report to the Secretary of Agriculture and to the Secretary of the Interior, on or before the first day of September of each year, a detailed statement of the amount so received and of its disbursement. The grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purpose of said grants: *Provided,* That payments of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of legislature meeting next after the passage of this act shall be made upon the assent of the governor thereof, duly certified by the Secretary of the Treasury.

SEC. 3. That if any portion of the moneys received by the designated officer of the State or Territory for the further and more complete endowment, support, and maintenance of colleges, or of institutions for colored students, as provided in this act, shall, by any action or contingency, be diminished or lost, or be misapplied, it shall be replaced by the State or Territory to which it belongs, and until so replaced no subsequent appropriation shall be apportioned or paid to such State or Territory; and no portion of said moneys shall be applied, directly or indirectly, under any pretense whatever, to the purchase, erection, preservation, or repair of any building or buildings. An annual report by the president of each of said colleges shall be made to the Secretary of Agriculture, as well as to the Secretary of the Interior, regarding the condition and progress of each college, including statistical information in relation to its receipts and expenditures, its library, the number of its students and professors, and also as to any improvements and experiments made under the direction of any experiment stations attached to said colleges, with their costs and results, and such other industrial and economical statistics as may be regarded as useful, one copy of which shall be transmitted by mail free to all other colleges further endowed under this act.

SEC. 4. That on or before the first day of July in each year, after the passage of this act, the Secretary of the Interior shall ascertain and certify to the Secretary of the Treasury as to each State and Territory whether it is entitled to receive its share of the annual appropriation for colleges, or of institutions for colored students, under this act, and the amount which thereupon each is entitled, respectively, to receive. If the Secretary of the Interior shall withhold a certificate from any State or Territory of its appropriation the facts and reasons therefor shall be reported to the President, and the amount involved shall be kept separate in the Treasury until the close of the next Congress, in order that the State or Territory may, if it should so desire, appeal to Congress from the determination of the Secretary of the Interior. If the next Congress shall not direct such sum to be paid it shall be covered into the Treasury. And the Secretary of the Interior is hereby charged with the proper administration of this law.

SEC. 5. That the Secretary of the Interior shall annually report to Congress the disbursements which have been made in all the States and Territories, and also whether the appropriation of any State or Territory has been withheld, and if so, the reasons therefor.

SEC. 6. Congress may at any time amend, suspend, or repeal any or all of the provisions of this act.

Approved, August 30, 1890.

EXTRACTS FROM AN ACT MAKING APPROPRIATIONS FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE FOR THE FISCAL YEAR ENDING JUNE THIRTIETH, NINETEEN HUNDRED.

AGRICULTURAL EXPERIMENT STATIONS, OFFICE OF EXPERIMENT STATIONS.

To carry into effect the provisions of an act approved March second, eighteen hundred and eighty-seven, entitled "An act to establish agricultural experiment stations in connection with the colleges established in the several States under the

provisions of an act approved July second, eighteen hundred and sixty-two, and of the acts supplementary thereto," and to enforce the execution thereof, seven hundred and sixty-five thousand dollars, thirty-three thousand dollars of which sum shall be payable upon the order of the Secretary of Agriculture, to enable him to carry out the provisions of section three of said act of March second, eighteen hundred and eighty-seven, and twelve thousand dollars of which sum may be expended by the Secretary of Agriculture to investigate and report to Congress upon the agricultural resources and capabilities of Alaska; and to establish and maintain agricultural experiment stations in said Territory, including the erection of buildings and all other expenses essential to the maintenance of such stations, of which sum seven thousand dollars shall be immediately available; and the Secretary of Agriculture shall prescribe the form of the annual financial statement required by section three of said act of March second, eighteen hundred and eighty-seven; shall ascertain whether the expenditures under the appropriation hereby made are in accordance with the provisions of the said act, and shall make report thereon to Congress; and the Secretary of Agriculture is hereby authorized to employ such assistants, clerks, and other persons as he may deem necessary, and to incur such other expenses for office fixtures and supplies, stationery, traveling, freight, and express charges, illustration of the Experiment Station Record, bulletins, and reports, as he may find essential in carrying out the objects of the above acts, and the sums apportioned to the several States shall be paid quarterly in advance. And the Secretary of Agriculture is hereby authorized to furnish to such institutions or individuals as may care to buy them copies of the card index of agricultural literature prepared by the Office of Experiment Stations, and charge for the same a price covering the additional expense involved in the preparation of these copies, and he is hereby authorized to apply the moneys received toward the expense of the preparation of the index.

IRRIGATION INVESTIGATIONS.

To enable the Secretary of Agriculture to investigate and report upon the laws and institutions relating to irrigation and upon the use of irrigation waters, with special suggestions of better methods for the utilization of irrigation waters in agriculture than those in common use, and for the preparation, printing, and illustration of reports and bulletins on irrigation; and the agricultural experiment stations are hereby authorized and directed to cooperate with the Secretary of Agriculture in carrying out said investigations in such manner and to such extent as may be warranted by a due regard to the varying conditions and needs of the respective States and Territories and as may be mutually agreed upon; and ten thousand dollars of the amount hereby appropriated shall be immediately available; thirty-five thousand dollars.

NUTRITION INVESTIGATIONS.

To enable the Secretary of Agriculture to investigate and report upon the nutritive value of the various articles and commodities used for human food, with special suggestions of full, wholesome, and edible rations less wasteful and more economical than those in common use, fifteen thousand dollars; and the agricultural experiment stations are hereby authorized to cooperate with the Secretary of Agriculture in carrying out said investigations in such manner and to such extent as may be warranted by a due regard to the varying conditions and needs of the respective States and Territories, and as may be mutually agreed upon; and the Secretary of Agriculture is hereby authorized to require said stations to report to him the results of any such investigations which they may carry out, whether in cooperation with said Secretary of Agriculture or otherwise.

PUBLIC-ROAD INQUIRIES.

To enable the Secretary of Agriculture to make inquiries in regard to the system of road management throughout the United States; to make investigations in regard to the best methods of road making and the best kind of road-making materials in the several States; for labor, traveling, and other necessary expenses, and for preparing and publishing bulletins and reports on this subject for distribution, and to enable him to assist the agricultural colleges and experiment stations in disseminating information on this subject, eight thousand dollars, of which sum one thousand dollars shall be immediately available.

GRASS AND FORAGE-PLANT INVESTIGATIONS, DIVISION OF AGROSTOLOGY.

For employment of local and special agents and assistants; collection of seeds, roots, and specimens for experimental cultivation and distribution; materials, tools, apparatus, supplies, and labor required in conducting experiments; freight and express charges and traveling expenses; the preparation of drawings and illustrations for special reports, and the preparation of illustrated circulars of information, bulletins, and monographic works on the forage plants and grasses of North America, and the agricultural experiment stations are hereby authorized and directed to cooperate with the Secretary of Agriculture in establishing and maintaining experimental grass stations, not necessarily on the grounds of the home station, and in making field and laboratory investigations relating to the natural history, geographical distribution, and uses of the various grasses and forage plants and their adaptability to the special soils and climates wherever, in the opinion of the Secretary of Agriculture, such experimental work is necessary or advisable, twelve thousand dollars.

DIVISION OF SEEDS, PURCHASE AND DISTRIBUTION OF VALUABLE SEEDS.

For the purchase, propagation, and distribution of valuable seeds, bulbs, trees, shrubs, vines, cuttings, and plants, and expense of labor, transportation, paper, twine, gum, printing, postal cards, and all necessary material and repairs for putting up and distributing the same, and to be distributed in localities adapted to their culture, one hundred and thirty thousand dollars. * * * *Provided further*, That twenty thousand dollars of the sum thus appropriated, or so much thereof as the Secretary of Agriculture shall direct, may be used to collect, purchase, test, propagate, and distribute rare and valuable seeds, bulbs, trees, shrubs, vines, cuttings, and plants from foreign countries for experiments with reference to their introduction into this country; and the seeds, bulbs, trees, shrubs, vines, cuttings, and plants thus collected, purchased, tested, and propagated shall not be included in general distribution, but shall be used for experimental tests, to be carried on with the cooperation of the agricultural experiment stations.

REGULATIONS OF THE POST-OFFICE DEPARTMENT FOR THE FREE TRANSMISSION IN THE MAILS OF THE BULLETINS AND REPORTS OF AGRICULTURAL EXPERIMENT STATIONS UNDER THE ACT OF CONGRESS OF MARCH 2, 1887.

Section 372 of the Postal Laws and Regulations of the United States reads as follows: Regulations for free transmission of bulletins and reports [under the act of Congress of March 2, 1887] are prescribed as follows:

(1) Any claimant of the privilege must apply for authority to exercise it to the Postmaster-General, stating the date of the establishment of such station, its proper name or designation, its official organization, and the names of its officers; the name of the university, college, school, or institution to which it is attached, if any, the

legislation of the State or Territory providing for its establishment, and any other granting it the benefits of the provision made by Congress as aforesaid (accompanied by a copy of the act or acts), and whether any other such station in the same State or Territory is considered, or claims to be, also entitled to the privilege; and also the place of its location and the name of the post-office where the bulletins and reports will be mailed. The application must be signed by the officer in charge of the station.

(2) If such application be allowed after examination by the Department, the postmaster at the proper office will be instructed to admit such bulletins and reports to the mails in compliance with these regulations, and the officer in charge of the station will be notified thereof.

(3) Only such bulletins or reports as shall have been issued after the station became entitled to the benefits of the act can be transmitted free, and such bulletins or reports may be inclosed in envelopes or wrappers, sealed or unsealed. On the exterior of every envelope, wrapper, or package must be written or printed the name of the station and place of its location, the designation of the inclosed bulletin or report, and the word "free" over the signature or facsimile thereof of the officer in charge of the station, to be affixed by himself or someone duly deputed by him for that purpose. There may also be written or printed upon the envelope or wrapper a request that the postmaster at the office of delivery will notify the mailing station of the change of address of the addressee, or other reason for inability to deliver the same, and upon a bulk package a request to the postmaster to open and distribute the "franked" matter therein in accordance with the address thereon.

Bulletins published by the United States Department of Agriculture and analogous to those of the station, and entitled to be mailed free under the penalty envelope of that Department, may also be adopted and mailed by the several stations, with their own publications, under the same regulations, and any bulletins or reports mailable free by any agricultural experiment station under these regulations may be so mailed by any other station having free mailing authority.

If such station's annual reports be printed by State authority, and consist in part of matter relating to the land-grant college to which such station is attached, then said report may be mailed free entire by the director of the station; provided, in his judgment, the whole consists of useful information of an agricultural character.

(4) The bulletins may be mailed to the stations, newspapers, or persons to whom they are by the foregoing act authorized to be sent, and the annual reports to any address within the United States, Canada, Mexico, or Hawaiian Kingdom (Sandwich Islands), but not to other foreign countries, free of postage.

An order of the Postmaster-General dated January 3, 1899, provides "That any article entitled to transmission free of postage in the domestic mails of the United States, either in a 'penalty' envelope or under a duly authorized 'frank,' shall be entitled likewise to transmission by mail free of postage between places in Hawaii, Cuba, Puerto Rico, and the Philippine Islands; from the United States to those islands, and from those islands to the United States."

Among other rulings on matters of detail the following are the most important:

"In sending out bulletins from an agricultural experiment station it is permissible to inclose postal cards to enable correspondents of the station to acknowledge the receipt of its publications and to request their continuous transmission.

"Copies of the reports or bulletins of the agricultural experiment stations, which are purchased, paid or subscribed for, or otherwise disposed of for gain, when sent in the mails, are not entitled to free carriage under the 'frank' of the director of the station."

Station bulletins and reports consisting of typewritten matter duplicated on a mimeograph or other duplicating machine "retain their character as free matter when properly franked by the director of the station."

Reports of State boards of agriculture or other State boards, commissioners, or officers, even though they contain station bulletins and reports, can not be sent free through the mails under the frank of the director of the station.

The catalogue of the college of which the station is a department can not be sent free through the mails under the frank of the director of the station, whether said catalogue is published separately or is bound together with a station publication.

RULINGS OF THE DEPARTMENT OF AGRICULTURE ON THE WORK AND EXPENDITURES OF AGRICULTURAL EXPERIMENT STATIONS.

In connection with examinations of the work and expenditures of the agricultural experiment stations established in accordance with the act of Congress of March 2, 1887, under authority given to the Secretary of Agriculture by Congress, questions have arisen which have seemed to make it advisable to formulate the views of this Department on certain matters affecting the management of the stations under that act. The statements given below have therefore been prepared to cover the points which seem to require special attention:

Expenditures for Permanent Substations.

This Department holds that the expenditure of funds appropriated in accordance with the provisions of the act of Congress of March 2, 1887, for the maintenance of permanent substations is contrary to the spirit and intent of said act. The act provides for an experiment station in each State and Territory, which, except in cases specified in the act, is to be a department of the college established under the act of Congress of July 2, 1862. The objects of the stations, as defined in the first-mentioned act, are evidently of such a character as to necessitate the services of scientific and expert workers. Most of the lines of investigation named in the act are general, rather than local, and involve scientific equipment and work. It is obviously the intent that the stations established under this act shall carry on important investigations which shall be of general benefit to the agriculture of the several States and Territories. The sum of $15,000, which is annually appropriated by Congress under this act for each station, is only sufficient to carry out a limited number of investigations of the kinds contemplated by the act.

As the work of the stations in the different States has developed it has been found necessary to limit rather than expand the lines of work of the individual stations. Thorough work in a few lines has been found much more effective and productive of more useful results than small investigations in numerous lines. When we consider the nature of the investigations, the amount of money provided for the work of each station, and the fact that the act expressly provides for only a single station in connection with each college, it becomes very clear that expenditures such as are necessary to effectively maintain permanent substations ought not to be made from the funds granted by Congress to the States and Territories for experiment stations. The maintenance of permanent substations as a rule involves the erection of buildings and the making of other permanent improvements. The sums of money which can be expended for permanent improvements under the act of Congress aforesaid are so small that it is clear they were not intended to meet the needs of more than one station in each State and Territory.

When the legislature of a State or Territory has given its assent to the provisions of the act of Congress of March 2, 1887, and has designated the institution which shall receive the benefits of said act, it would seem to have exhausted its powers in the matter. The responsibility for the maintenance of an experiment station under said act devolves upon the governing board of the institution thus designated. If the legislature of the State or Territory sees fit to provide funds for the equipment

and maintenance of other experiment stations and to put them under the control of the same governing board, well and good, but this does not in any way diminish the responsibility of the board to administer the funds granted by Congress in accordance with the provisions of said act.

The wisdom of Congress in limiting the number of stations to be established in each State and Territory under the aforesaid act has been clearly shown by the experience of the few States and Territories which have attempted the maintenance of substations with the funds granted under said act. The expense of maintaining substations has, as a rule, materially weakened the central station, and the investigations carried on at the substations have been superficial and temporary. It is granted that in many States and Territories more than one agricultural experiment station might do useful work, and in some States more than one station has already been successfully maintained; but in all these cases the State has given funds from its own treasury to supplement those given by Congress. It is also granted that experiment stations established under said act of Congress and having no other funds than those provided by that act will often need to carry on investigations in different localities in their respective States and Territories; but it is held that this should be done in such a way as will secure the thorough supervision of such investigations by the expert officers of the station, and that arrangements for such experimental inquiries should not be of so permanent a character as to prevent the station from shifting its work from place to place as circumstances may require, nor involve the expenditure of funds in such amounts and in such ways as will weaken the work of the station as a whole.

As far as practicable, the cooperation of individuals and communities benefited by these special investigations should be sought, and if necessary the aid of the States invoked, to carry on enterprises too great to be successfully conducted within the limits of the appropriation granted by Congress under the act aforesaid.

Purchase or Rental of Lands for Agricultural Experiment Stations.

This Department holds that the purchase or rental of land by the experiment stations from the funds appropriated in accordance with the provisions of the act of Congress of March 2, 1887, is contrary to the spirit and intent of said act. The act provides for "paying the necessary expenses of conducting investigations and experiments and printing and distributing the results. * * * *Provided, however,* That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such stations; and thereafter an amount not exceeding 5 per centum of such annual appropriation may be so expended." The only reference to land for the station in the act is in section 8, where State legislatures are authorized to apply appropriations made under said act to separate agricultural colleges or schools established by the State "which shall have connected therewith an experimental farm or station." The strict limitation of the amount provided for buildings and the absence of any provision for the purchase or rental of lands, when taken in connection with the statement in the eighth section which treats the farm as in a sense a necessary adjunct of the educational institution to which the whole or a part of the funds appropriated in accordance with said act might in certain cases be devoted, point to the conclusion that it was expected that the institution of which the station is a department would supply the land needed for experimental purposes, and that charges for the purchase or rental of land would not be made against the funds provided by Congress for the experiment station. This conclusion is reenforced by considerations of a wise and economic policy in the management of agricultural experiment stations, especially as relating to cases in which it might be desirable for the station to have land for

experimental purposes in different localities. The investigations carried on by the stations in such cases being for the direct benefit of agriculture in the localities where the work is done, it seems only reasonable that persons or communities whose interests will be advanced by the station work should contribute the use of the small tracts of land which will be required for experimental purposes. Experience shows that in most cases the stations have had no difficulty in securing such land as they needed, without expense, and it is believed that this may be done in every case without injuriously affecting the interests of the stations.

Expenditures by Agricultural Experiment Stations for Carrying on Farm Operations.

This Department holds that expenses incurred in conducting the operations of farms, whether the farms are connected with institutions established under the act of Congress of July 2, 1862, or not, are not a proper charge against the funds appropriated by Congress for agricultural experiment stations in accordance with the act of Congress of March 2, 1887, unless such operations definitely constitute a part of agricultural investigations or experiments planned and conducted in accordance with the terms of the act aforesaid under rules and regulations prescribed by the governing board of the station. The performance of ordinary farm operations by an experiment station does not constitute experimental work. Operations of this character by an experiment station should be confined to such as are a necessary part of experimental inquiries. Carrying on a farm for profit or as a model farm, or to secure funds which may be afterwards devoted to the erection of buildings for experiment station purposes, to the further development of experimental investigations, or to any other purpose, however laudable and desirable, is not contemplated by the law as a part of the functions of an agricultural experiment station established under the act of Congress of March 2, 1887. Section 5 of that act plainly limits the expenditures of funds appropriated in accordance with said act to "the necessary expenses of conducting investigations and experiments and printing and distributing the results."

Funds Arising from the Sale of Farm Products or Other Property of an Agricultural Experiment Station.

This Department holds that moneys received from the sales of farm products or other property in the possession of an agricultural experiment station as the result of expenditures of funds received by the station in accordance with the act of Congress of March 2, 1887, rightfully belong to the experiment station as a department of the college or other institution with which it is connected, and may be expended in accordance with the laws or regulations governing the financial transactions of the governing board of the station, provided, however, that all expenses attending such sales, including those attending the delivery of the property into the possession of the purchaser, should be deducted from the gross receipts from the sales and should not be made a charge against the funds appropriated by Congress.

Limit of Expenditures of Agricultural Experiment Stations during One Fiscal Year.

This Department holds that expenses incurred by an agricultural experiment station in any one fiscal year to be paid from the funds provided under the act of Congress of March 2, 1887, should not exceed the amount appropriated to the station by Congress for that year, and especially that all personal services should be paid for out of the appropriation of the year in which they were performed, and that claims for compensation for such services can not properly be paid out of the appro-

priations for succeeding years. The several appropriations for experiment stations under the aforesaid act are for one year only, and officers of experiment stations have no authority to contract for expenditures beyond the year for which Congress has made appropriations.

This is plainly implied in the act aforesaid, inasmuch as section 6 provides that unexpended balances shall revert to the Treasury of the United States, "in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support." The annual financial report rendered in the form prescribed by this Department should in every case include only the receipts and expenditures of the fiscal year for which the report is made.

Expenditures by Agricultural Experiment Stations for a Water System, to be Charged under "Building and Repairs."

This Department holds that expenditures by agricultural experiment stations from the funds appropriated in accordance with the act of Congress of March 2, 1887, for the construction of wells, cisterns, ponds, or other reservoirs for the storage of water, and for piping and other materials for a system of storing and distributing water, are properly charged, under abstract 18 in the schedule for financial reports prescribed by this Department, as being for improvements on lands which have hitherto been held to come under the head of "building and repairs." The fact that a water system may be a necessary adjunct of certain experimental inquiries does not affect the case, inasmuch as the limitations on expenditures for improvements contained in section 5 of the act of Congress of March 2, 1887, expressly stipulate that these improvements shall be such as are necessary for carrying on the work of the station.

Expenditures by Agricultural Experiment Stations for Membership in Agricultural and Other Organizations.

This Department holds that membership fees in associations and other organizations are not a proper charge against the funds appropriated by Congress in accordance with the act of March 2, 1887, except in the case of the Association of American Agricultural Colleges and Experiment Stations, which is held to be an essential part of the system of experiment stations established under said act.

The Borrowing of Money to Pay the Expenses of Agricultural Experiment Stations.

This Department holds that experiment station officers have no authority to borrow money to be repaid out of appropriations made under the act of Congress of March 2, 1887, and that charges for interest can not properly be made against funds appropriated under that act.

A. C. True, *Director.*

Approved.

J. Sterling Morton, *Secretary.*

Washington, D. C., *March 10, 1896.*

The Use of Experiment Station Funds for College Purposes.

This Department holds that no portion of the funds appropriated by Congress in accordance with the act of March 2, 1887, can legally be used, either directly or indirectly, for paying the salaries or wages of professors, teachers, or other persons whose duties are confined to teaching, administration, or other work in connection with the courses of instruction given in the colleges with which the stations are connected or

any other educational institution; nor should any other expenses connected with the work or facilities for instruction in school or college courses be paid from said fund. In case the same persons are employed in both the experiment station and the other departments of the college with which the station is connected a fair and equitable division of salaries or wages should be made, and in case of any other expenditures for the joint benefit of the experiment station and the other departments of the college the aforesaid funds should be charged with only a fair share of such expenditures.

Respectfully,

A. C. TRUE, *Director.*

Approved.

JAMES WILSON, *Secretary.*

WASHINGTON, D. C., *October 25, 1897.*

STATISTICS OF THE AGRICULTURAL EXPERIMENT STATIONS.

General statistics of the agricultural experiment stations in the United States, 1899.

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.	Number on staff.	Number of teachers on staff.	Publications during fiscal year 1898–99.		Number of addresses on mailing list.	Principal lines of work.
							Number.	Pages.		
Alabama (College).	Auburn	P. H. Mell	Feb., 1883	Feb. 24, 1888	13	8	11	330	7,910	Botany; soils; analyses of fertilizers and food materials; field and pot experiments; horticulture; diseases of plants, feeding experiments; diseases of animals.
Alabama (Canebrake).	Uniontown	H. Benton	Jan. 1, 1886	Apr. 1, 1888	4	.....	1	16	2,100	Soil improvement; field experiments; horticulture; floriculture; diseases of plants; diseases of animals.
Arizona	Tucson	R. H. Forbes	.....	1889	9	3	2	75	3,250	Chemistry; field experiments; meteorology; diseases of plants; horticulture (including date palm orchard).
Arkansas	Fayetteville	R. L. Bennett	.....	1887	8	4	5	74	7,000	Chemistry of foods; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals.
California	Berkeley	E. W. Hilgard	1875	Mar., 1888	30	11	6	160	6,000	Physics; chemistry and geographical distribution of soils; fertilizers; field crops; horticulture; botany; meteorology; technology of wine and olive oil, including zymology; chemistry of foods and feeding stuffs; entomology; drainage and irrigation; reclamation of alkali lands; plant introduction.
Colorado	Fort Collins	L. G. Carpenter	1879	Feb., 1888	17	8	7	544	5,200	Chemistry; botany; meteorology; field experiments; horticulture; entomology; irrigation.
Connecticut (State).	New Haven	S. W. Johnson	Oct. 1, 1875	May 18, 1887	15	.....	2	21	9,500	Analyses and inspection of fertilizers, foods, and feeding stuffs; chemistry; diseases of plants; horticulture; field experiments; entomology.
Connecticut (Storrs).	Storrs	W. O. Atwater	.....	.....do	7	1	4	315	7,000	Food and nutrition of man and animals; bacteriology of dairy products; field experiments; dairying.
Delaware	Newark	A. T. Neale	.....	Feb. 21, 1888	8	7	5	372	6,700	Chemistry; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; entomology; dairying.
Florida	Lake City	W. F. Yocum	.....	1888	9	5	5	235	4,000	Chemistry; field experiments; horticulture; entomology.

General statistics of the agricultural experiment stations in the United States, 1899—Continued.

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.	Number on staff.	Number of teachers on staff.	Publications during fiscal year 1898-99.		Number of addresses on mailing list.	Principal lines of work.
							Number.	Pages.		
Georgia	Experiment	R. J. Redding	Feb. 18, 1888	July 1, 1889	8	1	5	157	14,170	Field experiments; horticulture; entomology; mycology; pig feeding; dairying.
Idaho	Moscow	J. P. Blanton		Feb. 26, 1892	11	10	10	279	2,200	Physics; chemistry; botany; field experiments; horticulture; entomology; feeding experiments.
Illinois	Urbana	E. Davenport		Mar. 21, 1888	12	7	5	148	17,000	Chemistry, bacteriology, field experiments; horticulture; forestry; diseases of plants; feeding experiments; entomology; dairying.
Indiana	Lafayette	C. S. Plumb	1885	Jan., 1888	11	9	8	163	16,512	Chemistry, pot and field experiments; horticulture; feeding experiments; diseases of plants and animals.
Iowa	Ames	C. F. Curtiss		Feb. 17, 1888	23	13	5	172	18,000	Chemistry; bacteriology; field experiments; horticulture; diseases of plants; feeding experiments; entomology; dairying.
Kansas	Manhattan	J. T. Willard		Feb. 8, 1888	14	14	10	256	14,000	Soils; horticulture. seed breeding; field experiments; feeding and digestion experiments; diseases of animals, entomology.
Kentucky	Lexington	M. A. Scovell	Sept., 1885	Apr., 1888	10	1	7	153	6,600	Chemistry; soils; fertilizer analyses; field experiments; horticulture; diseases of plants; entomology; dairying.
Louisiana (Sugar)	New Orleans	Wm. C. Stubbs	do							Chemistry; bacteriology; soils and soil physics; field experiments; horticulture; sugar making; drainage; irrigation.
Louisiana (State)	Baton Rouge	do	Apr., 1886		23	6	4	187	7,000	Chemistry; geology; botany; bacteriology; soils; field experiments; horticulture; feeding experiments; entomology.
Louisiana (North)	Calhoun	do	May, 1887							Chemistry; soils; fertilizers; field experiments; horticulture; stock raising; dairying.
Maine	Orono	C. D. Woods	Mar., 1885	Oct. 1, 1887	13	6	9	338	9,000	Chemistry; botany; analyses and inspection of fertilizers and concentrated commercial feeding stuffs; horticulture; diseases of plants; seed tests; food and nutrition of man and animals; poultry raising; diseases of animals; entomology; dairying.
Maryland	College Park	H. J. Patterson	1888	Apr., 1888	16	7	7	221	8,000	Chemistry; soils; field experiments; horticulture; diseases of plants; feeding experiments; entomology.

Massachusetts	Amherst	H. H. Goodell	*a* 1882	Mar. 2, 1888	22	9	21	432	16,000	Chemistry; meteorology; analyses and inspection of fertilizers and concentrated commercial feeding stuffs; field experiments; horticulture; diseases of plants; digestion and feeding experiments; diseases of animals; entomology.
Michigan	Agricultural College.	C. D. Smith		Feb. 26, 1888	16	9	22	796	20,000	Botany and bacteriology; field experiments; horticulture; forestry; diseases of plants; feeding experiments; diseases of animals; entomology; dairying.
Minnesota	St. Anthony Park, St. Paul.	W. M. Liggett	Mar. 7, 1885	1888	14	7	6	1,192	9,000	Chemistry; field experiments; horticulture; forestry; diseases of plants; food and nutrition of man; plant and animal breeding; feeding experiments; diseases of animals; entomology; dairying.
Mississippi	Agricultural College.	W. L. Hutchinson		Jan. 27, 1888	12	4	6	78	14,000	Chemistry; soils; field experiments; horticulture; feeding experiments; dairying.
Missouri	Columbia	H. J. Waters		Jan., 1888	13	5	4	260	11,000	Chemistry; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; entomology; drainage.
Montana	Bozeman	S. M. Emery		July 1, 1893	7	6	3	94	4,270	Field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; irrigation.
Nebraska	Lincoln	T. L. Lyon	Dec. 16, 1884	June 13, 1887	19	10	7	213	7,000	Chemistry; botany; meteorology; field experiments; horticulture; forestry; feeding and breeding experiments; diseases of animals; entomology; irrigation.
Nevada	Reno	J. E. Stubbs			8	4	4	229	2,000	Chemistry; botany; soils; field experiments; horticulture; forestry; entomology; irrigation.
New Hampshire	Durham	C. S. Murkland	1886	Aug. 4, 1887	14	8	12	244	9,700	Chemistry; soil physics; field experiments; horticulture; diseases of plants; feeding experiments; entomology; dairying; road experiments.
New Jersey (State)	New Brunswick	E. B. Voorhees	Mar. 10, 1880		8	1	4	323	9,000	Chemistry; biology; botany; analyses of fertilizers and foods; pot and field experiments; horticulture; diseases of plants; food and nutrition of man; diseases of animals; entomology; dairy husbandry; bacteria of milk; irrigation.
New Jersey (College).	do	do		Apr. 26, 1888	8	4	5	341		
New Mexico	Mesilla Park	F. W. Sanders		Dec. 14, 1889	14	8	3	115	2,000	Chemistry; botany; field experiments; horticulture; diseases of plants; entomology; irrigation.
New York (State)	Geneva	W. H. Jordan	Mar., 1882		24		27	1,111	32,000	Chemistry; bacteriology; meteorology; analysis and control of fertilizers; field experiments; horticulture; diseases of plants; feeding experiments; poultry experiments; dairying.

a In 1882 the State organized a station here and maintained it until June 18, 1895, when it became a part of the Hatch Station, at the same place.

General statistics of the agricultural experiment stations in the United States, 1899—Continued.

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.	Number on staff.	Number of teachers on staff.	Publications during fiscal year 1898–99.		Number of addresses on mailing list.	Principal lines of work.
							Number.	Pages.		
New York (Cornell)	Ithaca	I. P. Roberts	1879	Apr., 1888	21	8	24	1,304	18,000	Chemistry of soils, feeding stuffs, and dairy products; soils; fertilizers; field experiments; horticulture: diseases of plants; feeding sheep and swine; diseases of animals; poultry experiments; entomology; dairying.
North Carolina	Raleigh	G. T. Winston	Mar. 12, 1877	Mar. 7, 1887	12	8	47	831	19,009	Chemistry; field experiments; horticulture; analyses of feeding stuffs; digestion experiments; poultry experiments.
North Dakota	Agricultural College.	J. H. Worst		Mar., 1890	12	6	9	231	5,000	Field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; dairying.
Ohio	Wooster	C. E. Thorne	Apr. 25, 1882	Apr. 2, 1888	13	.....	13	400	32,000	Soils; field experiments; horticulture; diseases of plants; breeding and feeding experiments; entomology.
Oklahoma	Stillwater	John T. Fields		Dec. 25, 1890	10	5	9	196	13,120	Botany; field experiments; horticulture; diseases of plants; digestion and feeding experiments; diseases of animals; entomology.
Oregon	Corvallis	T. M. Gatch		July, 1888	12	12	4	48	13,000	Chemistry; soils; field crops; horticulture; diseases of plants; digestion and feeding experiments; entomology; dairying.
Pennsylvania	State College	H. P. Armsby		June 30, 1887	18	7	4	393	25,000	Chemistry; meteorology; fertilizer analyses; field experiments; feeding experiments; dairying.
Rhode Island	Kingston	A. A. Brigham		July 30, 1888	12	4	10	337	7,000	Chemistry; meteorology; soils; field and pot experiments; horticulture; diseases of plants; poultry experiments; oyster culture.
South Carolina	Clemson College	H. S. Hartzog		Jan., 1888	13	8	13	195	7,500	Soils; analyses and control of fertilizers; field experiments; horticulture; plant breeding; diseases of plants; veterinary science; feeding experiments; entomology; dairying.
South Dakota	Brookings	J. H. Shepard		Mar. 13, 1887	11	6	4	230	9,000	Bacteriology; chemistry of soils and soil physics; field experiments; forestry; diseases of plants; feeding experiments; entomology; irrigation.

Tennessee	Knoxville	C. W. Dabney, jr	June 8, 1882	Aug. 4, 1887	12	3	4	192	10,000	Chemistry; botany; fertilizers, field experiments; horticulture; animal production; entomology; dairying.
Texas	College Station	J. H. Connell			15	7	5	289	11,200	Chemistry; soils; fertilizers; field experiments; horticulture; feeding dairy cows; sheep husbandry; diseases of animals; irrigation.
Utah	Logan	L. Foster		1890	11	8	6	319	4,329	Chemistry of soils and feeding stuffs; alkali soil investigations; meteorology; field experiments; horticulture; forestry; diseases of plants; cattle and sheep breeding; feeding experiments; dairying; poultry experiments.
Vermont	Burlington	J. L. Hills	Nov. 24, 1886	Feb. 28, 1888	12	5	7	406	8,500	Chemistry; analyses and control of fertilizers and feeding stuffs; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; dairying.
Virginia	Blacksburg	J. M. McBryde	1888	1891	10	6	16	185	13,000	Chemistry; fertilizers; diseases of plants; feeding experiments; diseases of animals; entomology.
Washington	Pullman	E. A. Bryan		1891	11	9	4	82	2,700	Chemistry; soils; bacteriology; field experiments; horticulture; diseases of plants; feeding experiments; entomology.
West Virginia	Morgantown	J. H. Stewart		June 11, 1888	12	4	11	584	6,000	Chemistry; analyses and control of fertilizers; field experiments; horticulture; feeding experiments; poultry experiments; entomology.
Wisconsin	Madison	W. A. Henry	1883	1887	20	.....	8	543	10,000	Chemistry; soils; field experiments; horticulture; feeding experiments; diseases of animals; dairying; drainage and irrigation.
Wyoming	Laramie	E. E. Smiley	1887	Mar. 1, 1891	8	6	5	515	2,500	Geology; botany; meteorology; waters; soils; fertilizers; field experiments; food analyses; feeding experiments; entomology.
Total					678	308	445	16,924	523,970	

Revenue and additions to equipment of the agricultural experiment stations in 1899.

Station.	Hatch fund.	State.	Individuals and communities.	Fees.	Farm products.	Miscellaneous.	Total.	Additions to equipment in 1899.						
								Buildings.	Library.	Apparatus.	Farm implements.	Live stock.	Miscellaneous.	Total.
Alabama (College)	$15,000.00	[1]$9,673.15	.....	.....	$720.65	.....	$25,393.80	$668.00	$572.12	$200.17	$46.93	$6.00	$135.36	$1,628.58
Alabama (Canebrake)	.....	2,500.00	.....	.....	350.00	.....	2,850.00	.....	20.00	60.00	10.00	45.00	.....	135.00
Arizona	15,000.00	[2]311.93	.....	$71.67	121.10	.....	15,504.70	600.00	70.00	475.00	500.00	50.00	30.00	1,725.00
Arkansas	15,000.00	.....	.....	.....	.....	.....	15,000.00	116.99	271.06	199.49	98.84	.....	.....	686.38
California	15,000.00	14,114.00	.....	.....	137.43	.....	29,251.43	511.47	109.00	1,006.13	156.25	.....	447.27	2,230.12
Colorado	15,000.00	.....	.....	.....	2,049.77	[2]$763.66	17,813.43	151.97	.....	196.97	30.25	.....	.....	379.19
Connecticut (State)	7,500.00	12,500.00	.....	6,721.00	.....	[3]168.95	26,889.95	.....	596.17	1,111.00	184.95	.....	.....	1,892.12
Connecticut (Storrs)	7,500.00	1,800.00	.....	.....	43.17	1,131.15	10,474.32	187.37	.....	686.50	.....	26.04	600.00	1,499.91
Delaware	15,000.00	.....	.....	.....	.....	20.02	15,020.02	79.22	727.82	173.85	43.55	.....	.....	1,024.44
Florida	15,000.00	.....	.....	.....	155.90	.....	15,155.90	400.80	142.00	338.52	50.00	.....	1,036.97	1,968.29
Georgia	15,000.00	650.00	.....	.....	1,907.18	[1]2,859.48	20,416.66	.....	300.00	300.00	50.00	500.00	50.00	1,200.00
Idaho	15,000.00	390.49	.....	.....	115.26	.....	15,505.75	1,500.00	.....	100.00	164.00	.....	.....	1,764.00
Illinois	15,000.00	.....	.....	195.00	3,148.95	396.53	[1]18,740.48	.....	142.90	354.50	238.19	.....	13.01	748.60
Indiana	15,000.00	.....	.....	.....	[1]2,561.33	.....	17,561.33	595.57	.....	.....	443.85	363.00	.....	1,402.42
Iowa	15,000.00	1,500.00	.....	39.00	1,905.06	412.13	18,856.19	.....	4.77	231.34	219.38	777.95	.....	1,233.44
Kansas	15,000.00	.....	.....	.....	.....	713.43	15,713.43	147.78	203.99	665.30	.....	.....	344.66	1,361.73
Kentucky	15,000.00	1,990.77	.....	[1]16,665.69	[1]2,516.74	[2]141.13	36,314.33	798.45	330.67	234.24	166.60	810.25	11,169.92	13,510.13
Louisiana	15,000.00	18,000.00	.....	5,202.31	664.44	9,779.51	48,646.26	715.03	141.52	119.84	110.47	1,011.62	1,711.97	3,810.45
Maine	15,000.00	.....	.....	4,359.49	1,582.28	1,198.54	22,140.31	1,000.00	279.83	.....	539.54	.....	.....	1,819.37
Maryland	15,000.00	.....	.....	.....	1,856.07	[2]522.89	17,378.96	1,807.48	595.59	573.27	832.05	.....	.....	3,808.39
Massachusetts	15,000.00	11,200.00	.....	3,585.00	1,641.78	1,906.71	33,333.49	2,000.00	445.00	310.00	50.00	180.00	700.00	3,685.00
Michigan	15,000.00	12,350.47	.....	1,460.00	865.40	[1]1,738.19	31,414.06	.....	244.81	264.50	35.74	310.17	87.25	942.47
Minnesota	15,000.00	12,623.13	.....	.....	5,976.50	.....	33,599.63	707.47	44.00	359.57	301.54	2,021.90	.....	3,434.48
Mississippi	15,000.00	.....	.....	.....	956.29	[2]52.93	16,009.22	800.00	.....	125.00	200.00	600.00	.....	1,725.00
Missouri	15,000.00	.....	.....	636.95	1,943.80	[1]1,158.16	18,738.91	500.00	250.00	396.06	115.00	973.00	.....	2,234.06
Montana	15,000.00	787.50	.....	.....	1,242.61	.....	17,030.11	673.79	108.19	292.56	151.70	224.50	.....	1,450.74
Nebraska	15,000.00	.....	.....	.....	1,791.55	[2]127.60	16,919.15	.....	302.54	588.34	107.65	97.45	490.57	1,586.55
Nevada	15,000.00	.....	$12,000.00	.....	578.51	.....	27,578.51	162.13	47.61	280.35	209.81	142.10	81.93	923.93
New Hampshire	15,000.00	.....	.....	[1]996.80	.....	.....	15,996.80	.....	299.71	344.19	3.78	.....	366.44	1,014.12
New Jersey (State)	.....	15,000.00	.....	.....	.....	.....	15,000.00	.....	106.34	646.44	.....	.....	823.71	1,576.49
New Jersey (College)	15,000.00	.....	.....	.....	.....	.....	15,000.00	673.07	651.44	746.34	.....	210.00	38.20	2,319.05
New Mexico	15,000.00	.....	.....	.....	249.95	15.00	15,264.95	121.42	126.42	265.09	167.83	260.50	161.70	1,102.96
New York (State)	1,500.00	68,000.00	.....	.....	2,105.20	.....	71,605.20	.....	676.54	1,050.00	.....	439.00	.....	2,165.54
New York (Cornell)	13,500.00	18,000.00	.....	.....	627.32	.....	32,127.32	147.00	77.00	119.00	17.00	7.50	4.00	371.50
North Carolina	15,000.00	.....	.....	14,166.66	874.76	303.94	30,345.36	119.96	146.31	133.87	.....	192.63	342.85	935.62
North Dakota	15,000.00	.....	.....	.....	2,463.77	319.14	17,782.91	740.91	28.50	50.50	406.35	800.00	.....	2,026.26
Ohio	15,000.00	18,549.31	.....	267.81	[1]5,298.24	.....	39,115.36	.....	476.06	138.73	990.32	564.12	1,864.64	4,033.87
Oklahoma	15,000.00	.....	.....	.....	[1]2,322.57	.....	17,322.57	600.00	2.00	219.83	190.65	.....	145.00	1,157.48
Oregon	15,000.00	.....	.....	.....	594.36	.....	15,594.36	25.28	296.83	114.26	550.00	135.00	.....	1,121.37
Pennsylvania	15,000.00	.....	.....	11,631.00	1,285.31	.....	27,916.31	.....	150.20	180.69	24.00	290.00	24.75	669.64
Rhode Island	15,000.00	505.46	.....	30.00	752.55	[1]53.69	16,341.70	830.28	425.61	157.15	52.96	148.35	149.18	1,733.53
South Carolina	15,000.00	.....	.....	.....	375.62	[1]169.67	15,545.29	750.00	219.38	528.72	676.64	84.96	15.73	2,275.43
South Dakota	15,000.00	1,500.00	.....	.....	394.11	.....	16,894.11	139.78	35.61	23.86	21.70	250.00	523.80	994.75

Tennessee	15,000.00				2,375.17		17,375.17	4,028.31	285.74	221.60	293.70	358.00	184.90	5,372.25
Texas	15,000.00	2,500.00				[3]1,007.34	18,507.34	650.61	220.34	39.99	53.50	285.88	55.05	1,305.37
Utah	15,000.00				3,009.14		18,009.14	326.64	30.73	115.24	215.25	1,545.70	47.89	2,281.45
Vermont	15,000.00			2,192.53	5,589.85		22,782.38	40.15	26.07	129.69	36.19			232.10
Virginia	15,000.00		100.00		4,007.18	46.41	19,153.59	250.00		76.31	132.50	407.83	250.00	1,116.64
Washington	15,000.00	853.99			[4]1,810.73		17,664.72	171.10	73.15	408.61	230.34	489.00	125.18	1,497.38
West Virginia	15,000.00			6,877.61	245.00	[1]1,021.51	23,144.12	47.71	181.68	439.46	199.65	130.50		999.00
Wisconsin	15,000.00	15,000.00		125.00			30,125.00	2,385.00	231.00	330.00	761.00	1,558.00		5,265.00
Wyoming	15,000.00			70.90	100.00	300.00	15,470.90	1,047.90	79.90	795.00	705.23		500.00	3,128.03
Total	720,000.00	240,300.20	12,100.00	75,294.42	69,312.60	26,327.71	1,143,334.95	27,218.64	10,796.15	16,917.07	10,784.88	16,265.95	22,521.93	104,504.62

[1] Including balance. [2] Balance. [3] Including farm products. [4] Including fees.

LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS AND THE SEVERAL STATIONS.

Publications of the Office of Experiment Stations, 1888–1899.

EXPERIMENT STATION RECORD.

Title.	Editor.
Experiment Station Record, Vol. I (1889–90), Nos. 1–6	W. O. Atwater.
Experiment Station Record, Vol. II (1890–91), Nos. 1–12	Do.
Experiment Station Record, Vol. III (1891–92), Nos. 1–12 and index	A. W. Harris.
Experiment Station Record, Vol. IV (1892–93), Nos. 1–12	A. C. True.
Experiment Station Record, Vol. V (1893–94), Nos. 1–12	Do.
Experiment Station Record, Vol. VI (1894–95), Nos. 1–12	Do.
Experiment Station Record, Vol. VII (1895–96), Nos. 1–12	Do.
Experrment Station Record, Vol. VIII (1896–97), Nos. 1–12	Do.
Experiment Station Record, Vol. IX (1897–98), Nos. 1–12	Do.
Experiment Station Record, Vol. X (1898–99), Nos. 1–12	Do.
Experiment Station Record, Vol. XI (1899–1900), Nos. 1–6	E. W. Allen.

ANNUAL REPORTS.

Title.	Author.
Reports of the Director of the Office of Experiment Stations for 1888–1890	W. O. Atwater.
Reports of the Director of the Office of Experiment Stations for 1891 and 1892	A. W. Harris.
Reports of the Director of the Office of Experiment Stations for 1893–1899	A. C. True.

ARTICLES IN THE YEARBOOK OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

Education and Research in Agriculture in the United States. (Yearbook 1894, pp. 81–116.)	A. C. True.
Food and Diet; Human Foods. (Yearbook 1894, pp. 357–388, 547–558)	W. O. Atwater.
The Feeding Value of Corn Stover. (Yearbook 1896, pp. 353–360)	J. B. Lindsey.
Origin, Value, and Reclamation of Alkali Lands. (Yearbook 1895, pp. 103–122)	E. W. Hilgard.
The Improvement of our Native Fruits. (Yearbook 1896, pp. 297–304)	L. H. Bailey.
Agricultural Education and Research in Belgium. (Yearbook 1896, pp. 361–370)	A. C. True.
Office of Experiment Stations. (Yearbook 1897, pp. 135–143)	Do.
Popular Education for the Farmer in the United States. (Yearbook 1897, pp. 279–290.)	Do.
The Needs and Requirements of a Control of Feeding Stuffs. (Yearbook 1897, pp. 421–428.)	E. W. Allen.
The Agricultural Outlook on the Coast of Alaska. (Yearbook 1897, pp. 553–576)	W. H. Evans.
Foods for Man. (Yearbook 1897, pp. 676–682.)	
Some Types of American Agricultural Colleges. (Yearbook 1898, pp. 63–80)	A. C. True.
Some Results of Dietary Studies in the United States. (Yearbook 1898, pp. 439–452.)	A. P. Bryant.
Agricultural Experiments in Alaska. (Yearbook 1898, pp. 515–524)	C. C. Georgeson.

BULLETINS.

Number.	Title.	Author.
Bulletin 1	Organization of the Agricultural Experiment Stations in the United States, February, 1889.	
Bulletin 2	Digest of the Annual Reports of the Agricultural Experiment Stations in the United States for 1888. (Parts I and II.)	
Bulletin 3	Report of a Meeting of Horticulturists of the Agricultural Experiment Stations at Columbus, Ohio, June 13–14, 1889.	A. W. Harris.
Bulletin 4	List of Horticulturists of the Agricultural Experiment Stations in the United States, with an Outline of the Work in Horticulture at the Several Stations.	W. B. Alwood.
Bulletin 5	Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, March, 1890.	
Bulletin 6	Lists of the Botanists of the Agricultural Experiment Stations in the United States, with an Outline of the Work in Botany at the Several Stations.	
Bulletin 7	Proceedings of the Fifth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., August 12–18, 1891.	A. W. Harris and H. E. Alvord.

Publications of the Office of Experiment Stations, 1888–1899—Continued.

BULLETINS—Continued.

Number.	Title.	Author.
Bulletin 8	Six Lectures on the Investigations at Rothamsted Experimental Station, Delivered under the Provisions of the Lawes Agricultural Trust, before the Association of American Agricultural Colleges and Experiment Stations at Washington, D. C., August 12–18, 1891.	R. Warington.
Bulletin 9	The Fermentations of Milk	H. W. Conn.
Bulletin 10	Meteorological Work for Agricultural Institutions	M. W. Harrington.
Bulletin 11	A Compilation of Analyses of American Feeding Stuffs	E. H. Jenkins and A. L. Winton.
Bulletin 12	Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, June, 1892.	
Bulletin 13	Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, April, 1893.	
Bulletin 14	Proceedings of a Convention of the National League for Good Roads, held at Washington, D. C., January 17–18, 1893, and Hearing by the Committee on Agriculture in the House of Representatives January 19, 1893.	
Bulletin 15	Handbook of Experiment Station Work. A Popular Digest of the Publications of the Agricultural Experiment Stations in the United States.	
Bulletin 16	Proceedings of the Sixth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at New Orleans, La., November 15–19, 1892.	A. W. Harris and H. E. Alvord.
Bulletin 17	Suggestions for the Establishment of Food Laboratories in Connection with the Agricultural Experiment Stations of the United States.	E. Atkinson.
Bulletin 18	A Contribution to the Investigation of the Assimilation of Free Atmospheric Nitrogen by White and Black Mustard.	J. P. Lotsy.
Bulletin 19	Organization Lists of the Agricultural Experiment Stations and Agricultural Schools and Colleges in the United States, January, 1894.	
Bulletin 20	Proceedings of the Seventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, at Chicago, October 17–19, 1893.	A. C. True and H. E. Alvord.
Bulletin 21	Methods and Results of Investigations on the Chemistry and Economy of Food.	W. O. Atwater.
Bulletin 22	Agricultural Investigations at Rothamsted, England, During a Period of Fifty Years. Six Lectures Delivered under the Provisions of the Lawes Agricultural Trust.	Sir J. H. Gilbert.
Bulletin 23	Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1895.	
Bulletin 24	Proceedings of the Eighth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 13–15, 1894.	A. C. True and H. H. Goodell.
Bulletin 25	Dairy Bacteriology	H. W. Conn.
Bulletin 26	Agricultural Experiment Stations: Their Objects and Work.	A. C. True.
Bulletin 27	Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1896.	
Bulletin 28	The Chemical Composition of American Food Materials	W. O. Atwater and C. D. Woods.
Bulletin 28 (rev.)	The Chemical Composition of American Food Materials	W. O. Atwater and A. P. Bryant.
Bulletin 29	Dietary Studies at the University of Tennessee in 1895	C. E. Wait.
	Comments	W. O. Atwater and C. D. Woods.
Bulletin 30	Proceedings of the Ninth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Denver, Colo., July 16–18, 1895.	A. C. True and H. H. Goodell.
Bulletin 31	Dietary Studies at the University of Missouri in 1895, and Data Relating to Bread and Meat Consumption in Missouri.	H. B. Gibson, S. Calvert, and D. W. May.
	Comments	W. O. Atwater and C. D. Woods.
Bulletin 32	Dietary Studies at Purdue University, Lafayette, Ind., in 1895.	W. E. Stone.
	Comments	W. O. Atwater and C. D. Woods.
Bulletin 33	The Cotton Plant: Its History, Botany, Chemistry, Culture, Enemies, and Uses.	A. C. True, et al.
Bulletin 34	The Carbohydrates of Wheat, Maize, Flour, and Bread, and the Action of Enzymic Ferments upon Starches of Different Origin.	W. E. Stone.
Bulletin 35	Food and Nutrition Investigations in New Jersey in 1895 and 1896.	E. B. Voorhees.

Publications of the Office of Experiment Stations, 1888–1899—Continued.

BULLETINS—Continued.

Number.	Title.	Author.
Bulletin 36	Notes on Irrigation in Connecticut and New Jersey	C. S. Phelps and E. B. Voorhees.
Bulletin 37	Dietary Studies at the Maine State College in 1895	W H. Jordan.
Bulletin 38	Dietary Studies with Reference to the Food of the Negro in Alabama in 1895 and 1896. Conducted with the Cooperation of the Tuskegee Normal and Industrial Institute and the Agricultural and Mechanical College of Alabama.	W. O. Atwater and C. D. Woods.
Bulletin 39	Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, February, 1897.	
Bulletin 40	Dietary Studies in New Mexico in 1895	A. Goss.
Bulletin 41	Proceedings of the Tenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 10–12, 1896.	A. C. True and H. H. Goodell.
Bulletin 42	Cotton Culture in Egypt	G. P. Foaden.
Bulletin 43	Losses in Boiling Vegetables and the Composition and Digestibility of Potatoes and Eggs.	H. Snyder, A. J. Frisby, and A. P. Bryant
Bulletin 44	Report of Preliminary Investigations on the Metabolism of Nitrogen and Carbon in the Human Organism, with a Respiration Calorimeter of Special Construction.	W. O. Atwater, C. D. Woods, and F. G. Benedict.
Bulletin 45	A Digest of Metabolism Experiments in Which the Balance of Income and Outgo was Determined.	W. O. Atwater and C. F. Langworthy.
Bulletin 46	Dietary Studies in New York City in 1895 and 1896	W. O. Atwater and C. D. Woods.
Bulletin 47	Organization Lists of the Agricultural Experiment Stations and Institutions with Courses in Agriculture in the United States, January, 1898.	
Bulletin 48	A Report to Congress on Agriculture in Alaska, Including Reports by W. H. Evans, B. Killin, and S. Jackson.	A. C. True.
Bulletin 49	Proceedings of the Eleventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Minneapolis, Minn., July 13–15, 1897.	A. C. True and H. H. Goodell.
Bulletin 50	A Report on the Work and Expenditures of the Agricultural Experiment Stations for the Year ended June 30, 1897.	A. C. True.
Bulletin 51	Statistics of the Land-Grant Colleges and Agricultural Experiment Stations in the United States for the Year ended June 30, 1897.	
Bulletin 52	Nutrition Investigations in Pittsburg, Pa., 1894–1896	Isabel Bevier.
Bulletin 53	Nutrition Investigations at the University of Tennessee in 1896 and 1897.	C. E. Wait.
Bulletin 54	Nutrition Investigations in New Mexico in 1897	A. Goss.
Bulletin 55	Dietary Studies in Chicago in 1895 and 1896, Conducted with the Cooperation of Jane Addams and Caroline L. Hunt, of Hull House.	W. O. Atwater and A. P. Bryant.
Bulletin 56	History and Present Status of Instruction in Cooking in the Public Schools of New York City.	Mrs. L. E. Hogan.
	Introduction	A. C. True.
Bulletin 57	Varieties of Corn	E. L. Sturtevant.
Bulletin 58	Water Rights on the Missouri River and Its Tributaries	E. Mead.
	Water Laws of Colorado	J. E. Field.
	Water Laws of Nebraska	J. M. Wilson.
Bulletin 59	Organization List of the Agricultural Colleges and Experiment Stations in the United States, with a List of Agricultural Experiment Stations in Foreign Countries, January, 1899.	
Bulletin 60	Abstract of Laws for Acquiring Titles to Water from the Missouri River and Its Tributaries, with the Legal Forms in use.	E. Mead.
Bulletin 61	A Report on the Work and Expenditures of the Agricultural Experiment Stations for the Year ended June 30, 1898.	A. C. True.
Bulletin 62	A Second Report to Congress on Agriculture in Alaska, including Reports by C. C. Georgeson and W. H. Evans.	Do.
Bulletin 63	Description of a New Respiration Calorimeter and Experiments on the Conservation of Energy in the Human Body.	W. O. Atwater and E. B. Rosa.
Bulletin 64	Statistics of the Land-Grant Colleges and Agricultural Experiment Stations in the United States for the Year ending June 30, 1898.	
Bulletin 65	Proceedings of the Twelfth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 15–17, 1898.	A. C. True, W. H. Beal, and H. H. Goodell.
Bulletin 66	The Physiological Effects of Creatin and Creatinin and Their Value as Nutrients.	J. W. Mallet.
Bulletin 67	Studies on Bread and Bread Making	H. Snyder and L. A. Voorhees.

Publications of the Office of Experiment Stations, 1888–1899—Continued.

BULLETINS—Continued.

Number.	Title.	Author.
Bulletin 68	A Description of Some Chinese Vegetable Food Materials and Their Nutritive and Economic Value.	W. C. Blasdale.
Bulletin 69	Experiments on the Metabolism of Matter and Energy in the Human Body.	W. O. Atwater, F. G. Benedict, A. W. Smith, and A. P. Bryant.
Bulletin 70	Water-Right Problems of Bear River	C. T. Johnston and J. A. Breckons.
Bulletin 71	Dietary Studies of Negroes in Eastern Virginia in 1897 and 1898.	H. B. Frissell and Isabel Bevier.
Bulletin 72	Farmers' Reading Courses	L. H. Bailey.
Bulletin 73	Irrigation in the Rocky Mountain States	J. C. Ulrich.

MISCELLANEOUS BULLETINS. *a*

Bulletin 1	Proceedings of the Second Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Knoxville, Tenn., January 1–3, 1889.	A. W. Harris and H. E. Alvord.
Bulletin 2	Proceedings of the Third Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 12–15, 1889.	Do.
Bulletin 3	Proceedings of the Fourth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Champaign, Ill., November 11–13, 1890.	Do.

FARMERS' BULLETINS. *b*

Bulletin 1	The What and Why of Agricultural Experiment Stations	W. O. Atwater.
Bulletin 2	The Work of the Agricultural Experiment Stations	Do.
Bulletin 9	Milk Fermentations and Their Relations to Dairying	A. W. Harris.
Bulletin 11	The Rape Plant: Its History, Culture, and Uses	T. Shaw.
Bulletin 14	Fertilizers for Cotton	J. M. McBryde.
Bulletin 16	Leguminous Plants for Green Manuring and for Feeding	E. W. Allen.
Bulletin 18	Forage Plants for the South	S. M. Tracy.
Bulletin 21	Barnyard Manure	W. H. Beal.
Bulletin 22	The Feeding of Farm Animals	E. W. Allen.
Bulletin 23	Foods: Nutritive Value and Cost	W. O. Atwater.
Bulletin 25	Peanuts: Culture and Uses	R. B. Handy.
Bulletin 26	Sweet Potatoes: Culture and Uses	J. F. Duggar.
Bulletin 29	Souring of Milk and Other Changes in Milk Products	
Bulletin 32	Silos and Silage	C. S. Plumb.
Bulletin 34	Meats: Composition and Cooking	C. D. Woods.
Bulletin 35	Potato Culture	J. F. Duggar.
Bulletin 36	Cotton Seed and Its Products	
Bulletin 37	Kafir Corn: Characteristics, Culture, and Uses	C. C. Georgeson.
Bulletin 39	Onion Culture	R. L. Watts.
Bulletin 41	Fowls: Care and Feeding	G. C. Watson.
Bulletin 44	Commercial Fertilizers: Composition and Use	E. B. Voorhees.
Bulletin 46	Irrigation in Humid Climates	F. H. King.
Bulletin 48	The Manuring of Cotton	
Bulletin 49	Sheep Feeding	J. A. Craig.
Bulletin 56	Experiment Station Work—I	
Bulletin 65	Experiment Station Work—II	
Bulletin 69	Experiment Station Work—III	
Bulletin 73	Experiment Station Work—IV	
Bulletin 74	Milk as Food	
Bulletin 76	Tomato Growing	E. B. Voorhees.
Bulletin 77	The Liming of Soils	H. J. Wheeler.
Bulletin 78	Experiment Station Work—V	
Bulletin 79	Experiment Station Work—VI	
Bulletin 81	Corn Culture in the South	S. M. Tracy.
Bulletin 84	Experiment Station Work—VII	
Bulletin 85	Fish as Food	C. F. Langworthy.
Bulletin 87	Experiment Station Work—VIII	
Bulletin 92	Experiment Station Work—IX	
Bulletin 93	Sugar as Food	Mary H. Abel.
Bulletin 97	Experiment Station Work—X	
Bulletin 103	Experiment Station Work—XI	
Bulletin 105	Experiment Station Work—XII	
Bulletin 107	Experiment Station Work—XIII	

a Series discontinued.

b These are published as part of a general series issued by the United States Department of Agriculture.

Publications of the Office of Experiment Stations, 1888–1899—Continued.

CIRCULARS.

[In this series 43 publications have been issued, of which Nos. 2–6, 9, 10, 12–17, 21, 24, and 26 are letters of inquiry or information, or address lists.]

Number.	Title.	Author.
Circular 1	List of Agricultural Experiment Stations in the United States, February 1, 1889.	
Circular 7	Cooperative Field Experiments with Fertilizers	
Circular 8	Explanations and Directions for Soil Tests with Fertilizers.	
Circular 11	Rules for Naming Vegetables. Report of Committee of Experiment Station Horticulturists.	
Circular 18	List of Originators of Fruits and Vegetables in the United States.	
Circular 19	Experiments with Fertilizers on Fruits and Vegetables, to Study the Feeding Capacities of the Plants and the Variations due to the Action of Fertilizers.	W. O. Atwater.
Circular 20	Organization List of the Agricultural Experiment Stations in the United States, 1891.	
Circular 22	Subject Index of the Literature of Agricultural Experiment Stations and Kindred Institutions.	A. W. Harris.
Circular 23 (rev.)	Key to Subject Index of Literature of Agricultural Experiment Stations and Kindred Institutions.	
Circular 25	Cañaigre (*Rumex hymenosepalus*)	
Circular 27	Statistics of Agricultural Colleges and Experiment Stations, 1894.	
Circular 28	Broom Corn (*Andropogon sorghum vulgaris*)	
Circular 29	Work and Expenditures of Agricultural Experiment Stations.	A. C. True.
Circular 30	Permanent Elements in Experiment Station Work	Do.
Circular 31	Some Books on Agriculture and Agricultural Science, Published in 1893–1896.	Do.
Circular 32	Report of Committee on Methods of Teaching Agriculture.	
Circular 33	Civil Service in the Department of Agriculture	C. W. Dabney, jr.
Circular 34	Rules and Apparatus for Seed Testing	
Circular 35	Statistics of Land-Grant Colleges and Agricultural Experiment Stations, 1896.	A. C. True.
Circular 36	Constitution of the Association of American Agricultural Colleges and Experiment Stations.	
Circular 37	Second Report of Committee on Methods of Teaching Agriculture.	
Circular 38	Some Books on Agriculture and Sciences Related to Agriculture, Published 1896–1898.	
Circular 39	Third Report of Committee on Methods of Teaching Agriculture.	
Circular 40	Land-Grant and Other Colleges and the National Defense	C. W. Dabney, jr.
Circular 41	Fourth Report of Committee on Methods of Teaching Agriculture.	
Circular 42	A German Common School with a Garden	C. B. Smith.
Circular 43	Food—Nutrients—Food Economy	

CHARTS.

One set of four food and diet charts	W. O. Atwater.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899. [a]

[Titles which have been changed from their original form are inclosed in brackets.]

ALABAMA COLLEGE STATION.

Publication.	Title.	Author.
1883.		
Bulletin 1	Address of Commissioner of Agriculture and of J. S. Newman, Director, to the Farmers of Alabama.	
1884.		
Bulletin 2	Economy in Fertilization	J. S. Newman and W. C. Stubbs.
Bulletin 3	Catalogue of Fruits	J. S. Newman.
	Experiments with Corn and Ensilage	W. C. Stubbs.
Bulletin 4	Experiments in Cotton	Do.

[a] So far as received at this Office up to January 1, 1900.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ALABAMA COLLEGE STATION—Continued.

Publication.	Title.	Author.
1884.		
Bulletin 5	Phosphates of Alabama	E. A. Smith and W. C. Stubbs.
Bulletin 6	Rules, Regulations, and Suggestions to Farmers for Purchase and Sale of Fertilizers.	W. C. Stubbs.
1885.		
Bulletin 7	Experiments with Corn, Peas, etc	J. S. Newman.
Bulletin 8	The Bollworm and the Cotton Worm	
Bulletin 9	Commercial Fertilizers	W. C. Stubbs.
Bulletin 10	Nitrogenous Manures	Do.
SECOND SERIES.		
Bulletin 1	The Grape	J. E. Saunders.
Bulletin 2	Fertilization	E. C. Betts.
Bulletin 3	Fertilizers	N. T. Lupton.
Bulletin 4	Gardening	
1886.		
Bulletin 5	Experiments for Clubs	J. S. Newman.
Bulletin 6	Experiments in Cotton Culture	Do.
Bulletin 7	Improvement of Soils	N. T. Lupton.
Bulletin 8	Analysis of Fertilizers	
Bulletin 9 *a*	Analysis of Fertilizers	Do.
1887.		
Bulletin 1	Experiments with Oats	J. S. Newman.
Bulletin 2	[Experiments with Field and Garden Crops]	Do.
Bulletin 3	Experiments with Corn, 1886	Do.
Bulletin 4	Experiments with Cotton, 1886	Do.
Bulletin 5	Experiments with Sweet Potatoes and Sugar Cane, 1886	Do.
Bulletin 6	Experiments with Oats	Do.
Bulletin 7	Experiments with Corn	Do.
Bulletin 8	Analyses of Fertilizers	R. F. Kolb.
1888.		
Bulletin 1	Experiments with Corn	J. S. Newman.
Bulletin 2	Experiments with Small Fruits and Vegetables	Do.
Bulletin 3	Experiments with Cotton	Do.
Bulletin 4	[Experiments with Fertilizers on Cotton]	Do.
Bulletin 5	Effects of Fertilizers on Sweet Potatoes	Do.
NEW SERIES.		
Bulletin 1	[Report of Lines of Work Pursued]	
Bulletin 2	[Report of Lines of Work Pursued]	
Annual Report	Annual Report, 1888	
1889.		
Bulletin 3	[Experiments with Field Crops and Grapes]	J. S. Newman.
	[Analyses of Fertilizers, Soils, etc.]	N. T. Lupton.
	[Woods of Alabama]	P. H. Mell.
	[Meteorology]	P. H. Mell and T. D. Sanford.
Bulletin 4	[Experiments in Horticulture]	J. S. Newman.
Bulletin 5	Experiments with Cotton; Pig Feeding; Cattle Feeding; Analyses of Fertilizers, Soils, and Feeding Stuffs; Meteorology.	Do.
Bulletin 6	Grasses and Their Cultivation	P. H. Mell.
Bulletin 7	Experiments with Vegetables; Methods of Setting Milk	
Bulletin 8	Commercial Fertilizers	N. T. Lupton.
Bulletin 9	Nematode Root Galls. (Science contributions, Vol. I, No. 1.)	G. F. Atkinson.
Annual Report	Annual Report, 1889	
1890.		
Bulletin 10	Grape Culture	J. S. Newman.
Bulletin 11	Notes on Peaches and Plums in the Experiment Station Orchard.	Do.
Bulletin 12	Cooperative Soil Tests	Do.
Bulletin 13	Microscopic Study of Certain Varieties of Cotton	P. H. Mell.
Bulletin 14	Pea Vines as a Fertilizer	N. T. Lupton.
Bulletin 15	Kerosene Emulsion: How to Make and Apply It	G. F. Atkinson.
Bulletin 16	Experiments with Fertilizers on Corn, Cotton, Rye, and Chufas.	J. S. Newman.

a Files and records prior to 1887 were destroyed by fire.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ALABAMA COLLEGE STATION—Continued.

Publication.	Title.	Author.
1890.		
Bulletin 17	Dry Application of Paris Green and London Purple for the Cotton Worm.	G. F. Atkinson.
	Report of the Alabama Weather Service	P. H. Mell.
Bulletin 18	Climatology of Alabama	Do.
Bulletin 19	Roads, and Road Making	J. H. Lane.
	Report of Weather Service	P. H. Mell.
Bulletin 20	Small Fruits, Melons, and Vegetables	J. S. Newman and J. Clayton.
	Report of Weather Service	P. H. Mell.
Bulletin 21	A New Root-Rot Disease of Cotton	G. F. Atkinson.
	Report of Weather Service	P. H. Mell.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 22	Experiments with Cotton	J. S. Newman and J. Clayton.
	Report of Weather Service	P. H. Mell.
Bulletin 23	Cooperative Soil Tests with Fertilizers	J. S. Newman.
	Report of Weather Service	P. H. Mell.
Bulletin 24	Dairying and Breeding	I. Ross.
	Report of Weather Service	P. H. Mell.
Bulletin 25	Effects on Butter of Feeding Cotton Seed and Cotton-Seed Meal.	N. T. Lupton.
Bulletin 26	Commercial Fertilizers	Do.
Bulletin 27	Black Rust of Cotton	G. F. Atkinson.
Bulletin 28	Watermelons and Cantaloupes	J. S. Newman and J. Clayton.
Bulletin 29	Grapes, Raspberries, and Strawberries	Do.
Bulletin 30	Apples, Pears, Peaches, and Plums	J. S. Newman.
Bulletin 31	Irish and Sweet Potatoes	J. S. Newman and J. Clayton.
Bulletin 32	Corn, Wheat, and Oats	Do.
Bulletin 33	Cotton	Do.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 34	Cooperative Soil Test Experiments, 1891	
Bulletin 35	Glanders	C. A. Cary.
Bulletin 36	Some Leaf Blights of Cotton	G. F. Atkinson.
Bulletin 37	Tobacco	A. J. Bondurant.
Bulletin 38	Fertilizers	N. T. Lupton.
Bulletin 39	Wheat	A. J. Bondurant and J. Clayton.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 40	Cotton Experiments	Do.
Bulletin 41	Some Diseases of Cotton	G. F. Atkinson.
Bulletin 42	Cooperative Soil Test Experiments, 1892	A. J. Bondurant and J Clayton.
Bulletin 43	Eye Diseases of Domestic Animals	C. A. Cary.
Bulletin 44	Tobacco Plant	A. J. Bondurant.
Bulletin 45	Injurious and Beneficial Insects	J. M. Stedman.
Bulletin 46	Rye v. Ensilage	A. J. Bondurant and A. F. Cory.
Bulletin 47	Fruits	A. J. Bondurant and J. Clayton.
Bulletin 48	The Effect of Organic Matter on Phosphates; Commercial Fertilizers.	N. T. Lupton.
Bulletin 49	Varieties of Wheats and Grasses	A. J. Bondurant and J. Clayton.
Bulletin 50	Fruit-Tree Blight in General	J. M. Stedman.
Bulletin 51	Vegetables	A. J. Bondurant and J. Clayton.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 52	Corn and Cotton	A. J. Bondurant.
Bulletin 53	A New Milk or Water Sterilizer	C. A. Cary.
Bulletin 54	Tobacco	A. J. Bondurant.
Bulletin 55	A New Disease of Cotton—Cotton Boll Rot	J. M. Stedman.
Bulletin 56	Experiments in Crossing for the Purpose of Improving the Cotton Fiber.	P. H. Mell.
Bulletin 57	Fertilizers Required by Cotton as Determined by the Analysis of the Plant.	J. T. Anderson.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ALABAMA COLLEGE STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 58	Paris Green—Composition and Adulterations	B. B. Ross.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 59	Cooperative Soil Tests of Corn	A. J. Bondurant.
Bulletin 60	Experiments on Foreign Seeds	P. H. Mell.
Bulletin 61	Insects Injurious to Stored Grain	J. M. Stedman.
Bulletin 62	Corn and Cotton	A. J. Bondurant.
Bulletin 63	Fertilizers: Commercial and Domestic	B. B. Ross.
Bulletin 64	Tobacco	A. J. Bondurant.
Bulletin 65	Cooperative Seed Tests	Do.
Bulletin 66	Cane Sirup	B. B. Ross.
Bulletin 67	Bovine Tuberculosis	C. A. Cary.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 68	Pig-Feeding Experiments	Do.
Bulletin 69	Treatment of some Fungus Diseases	L. M. Underwood and F. S. Earle.
Bulletin 70	The Flora of Alabama (Part V)	P. H. Mell.
Bulletin 71	Experiments with Foreign Cotton	Do.
Bulletin 72	A Study of Skin Tumors of Horses and Mules in Alabama	S. L. Coleman.
Index Vol. II	Index to Bulletins 1–21, new series	
Index Vol. III	Index to Bulletins 22–58	
Bulletin 73	Edible Fungi: A Wasted Food Product	L. M. Underwood.
Bulletin 74	Flour Considered from the Standpoint of Nutrition	Do.
Bulletin 75	Experiments with Corn	J. F. Duggar.
Index Vol. IV	Index to Bulletins 59–75	
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 76	Experiments with Cotton	Do.
Bulletin 77	I. The San José Scale: A Warning to the Fruit Growers of Alabama. II. Some Other Insect Pests.	C. F. Baker.
Bulletin 78	Cooperative Fertilizer Experiments with Cotton in 1896	J. F. Duggar.
Bulletin 79	Some Horticultural Suggestions	F. S. Earle.
Bulletin 80	A Preliminary List of Alabama Fungi	L. M. Underwood and F. S. Earle.
Bulletin 81	Meat Inspection	C. A. Cary.
Bulletin 82	Corn, Cowpeas, and Wheat Bran for Fattening Pigs	J. F. Duggar.
Bulletin 83	Hybrids from American and Foreign Cotton	P. H. Mell.
Bulletin 84	Turnips	F. S. Earle.
Bulletin 85	Japanese Plums	Do.
Bulletin 86	I. More About the San José Scale. II. A Sweet-Potato Pest. III. Regarding Carbon Bisulphid. IV. Insecticides and Pumps in General.	C. F. Baker.
Bulletin 87	Soil Inoculation for Leguminous Plants	J. F. Duggar.
Bulletin 88	Experiments with Corn	Do.
Index Vol. V	Index to Bulletins 76–88	
Annual Report	Tenth Annual Report, 1897	
1898.		
Circular	Information Concerning Bulletins and Reports	Do.
Bulletin 89	Experiments with Cotton	Do.
Bulletin 90	I. The Peach-Tree Borer. II. The Fruit-Bark Beetle	C. F. Baker.
Bulletin 91	Cooperative Fertilizer Experiments with Cotton in 1897	J. F. Duggar.
Bulletin 92	Experiments with Lime on Acid Soils	F. S. Earle and A. W. Orr.
Bulletin 93	Peanuts, Cowpeas, and Sweet Potatoes as Food for Pigs	J. F. Duggar.
Bulletin 94	Strawberries	F. S. Earle.
Bulletin 95	Experiments with Oats	J. F. Duggar.
Bulletin 96	Experiments with Crimson Clover and Hairy Vetch	Do.
Bulletin 97	Dairy and Milk Inspection	C. A. Cary.
Bulletin 98	Orchard Notes	F. S. Earle.
Bulletin 99	Cotton Rust	Do.
Bulletin 100	Lawns, Pastures, and Hay	P. H. Mell.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Index Vol. VI	Index to Bulletins 89–100	
Bulletin 101	Experiments with Cotton, 1898	J. F. Duggar.
Bulletin 102	Cooperative Fertilizer Experiments with Cotton	Do.
Bulletin 103	Experiments in Sirup Making	B. B. Ross.
Bulletin 104	Velvet Beans	J. F. Duggar.
Bulletin 105	Winter Pasturage, Hay, and Fertility Afforded by Hairy Vetch.	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ALABAMA CANEBRAKE STATION.

Publication.	Title.	Author.
1888.		
Bulletin 1	[Experiments with Field and Garden Crops]	W. H. Newman.
Bulletin 2	[Experiments with Vegetables and Fruit Trees]	Do.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 3	Experiments with Cotton; Forage Crops and Drainage	Do.
Bulletin 4	Experiments with Cotton; Meteorology	Do.
Bulletin 5	Experiments with Oats, Wheat; Meteorological Report	Do.
Bulletin 6	Vegetables; Grapes; Meteorology	Do.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 7	[Field Experiments with Cotton, Peas, Melilotus, and Corn]	Do.
Bulletin 8	Cattle Feeding; Pig Feeding	Do.
Bulletin 9	Crops for Ensilage; Forage Plants and Grasses	Do.
Bulletin 10	Meteorology and Soil Temperatures	Do.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 11	Experiments with Cotton	Do.
Bulletin 12	Grapes, Strawberries, and Raspberries	
Bulletin 13	Experiments with Corn	Do.
1892.		
Bulletin 14	Cotton	Do.
Bulletin 15	Cattle Feeding	Do.
1893.		
Bulletin 16	Potatoes—Amounts of Seed	B. M. Duggar.
Bulletin 17	Grapes and Some New Fruits	Do.
1895.		
Bulletin 18	Cotton, Corn, Wheat, Forage Crops, and Fruit	H. Benton.
	Diseases of Animals Treated	J. F. Connor.
1897.		
Annual Report	Twelfth Annual Report, 1897	
1898.		
Annual Report	Thirteenth Annual Report, 1898	

ALASKA STATIONS.

See Bulletins 48 and 62 of the Office of Experiment Stations, p. 510.

ARIZONA STATION.

1890.		
Bulletin 1	Organization of Station	F. A. Gulley.
Annual Report	First Annual Report, 1890	
1891.		
Bulletin 2	Notes on Some of the Range Grasses of Arizona; Overstocking the Range.	J. W. Toumey.
Bulletin 3	Irrigation in Arizona	V. E. Stolbrand.
Bulletin 4	Waters and Water Analysis	C. B. Collingwood.
Annual Report	Second Annual Report, 1891	
1892.		
Bulletin 5	Cañaigre	F. A. Gulley.
Bulletin 6	Soils and Waters	C. B. Collingwood.
Annual Report	Third Annual Report, 1892	
1893.		
Bulletin 7	Cañaigre	C. B. Collingwood, J. W. Toumey and F. A. Gulley.
Bulletin 8	Cattle Feeding	F. A. Gulley and M. Moss.
Bulletin 9	Insects and Insecticides	J. W. Toumey.
Bulletin 10	Experimental Work at Willcox	F. A. Gulley.
Bulletin 11	Pumping Water for Irrigation	F. A. Gulley and C. B. Collingwood.
Annual Report	Financial Report, 1893	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ARIZONA STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 12	Preliminary Report of Observations on the "Crown Knot".	J. W. Toumey.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 13	The Mesquite Tree: Its Products and Uses	R. H. Forbes.
Bulletin 14	Notes on Scale Insects in Arizona	J. W. Toumey.
Bulletin 15	List of Varieties of Fruits	W. S. Devol.
Bulletin 16	Notes on Apricots at Phenix Station	Do.
Bulletin 17	Agricultural Convention, Part I	Do.
Bulletin 18	Agricultural Convention, Part II	Do.
1896.		
Bulletin 19	Sixth Annual Report, 1895	Do.
Bulletin 20	Arizona Weather	E. M. Boggs.
Bulletin 21	Cañaigre	R. H. Forbes.
1897.		
Bulletin 22	Something About Weeds	J. W. Toumey.
Bulletin 23	Sugar Beets	W. S. Devol.
Bulletin 24	Seventh Annual Report, 1896	Do.
Bulletin 25	Eighth Annual Report, 1897	Do.
Bulletin 26	Sugar Beet Experiments	R. H. Forbes.
Bulletin 27	Arizona Weather and Climate	E. M. Boggs and N. H. Barnes.
1898.		
Bulletin 28	Salt River Valley Soils	R. H. Forbes.
Bulletin 29	The Date Palm	J. W. Toumey.
Annual Report	Ninth Annual Report, 1898	
1899.		
Bulletin 30	Sugar Beet Experiments during 1898	A. J. McClatchie and R. H. Forbes.
Annual Report	Tenth Annual Report, 1899	

ARKANSAS STATION.

1888.		
Bulletin 1	Cultivation of Cotton and Corn	A. E. Menke.
Bulletin 2	Diseases of Animals	
Bulletin 3	[Remedies for Peach Borer and Codling Moth]	S. H. Crossman.
Bulletin 4	Commercial Fertilizers	
Bulletin 5	Dehorning	R. R. Dinwiddie, S. S. Twombly, and C. P. Collingwood.
Bulletin 6	[Experiments with Wheat]	
Bulletin 7	Tests of Varieties of Grapes and Strawberries	
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 8	Spaying of Cattle	
Bulletin 9	Cotton-seed Hulls for Fattening	
Bulletin 10	[I. Insects and Insecticides]	
	[II. Chemical Fertilizers]	C. W. Woodworth.
Bulletin 11	[Strawberries and Cereals]	
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 12	Influence of Spaying on Milk Production. Milk Analysis.	
Bulletin 13	Entomology	Do.
	[Test of Varieties of Strawberries]	J. McNeill.
Bulletin 14	The Effects of the Arsenites Upon the Plants	C. W. Woodworth.
Bulletin 15	[New Insecticides for the Cotton Worm]	G. C. Davis.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 16	Nature and Treatment of a Prevalent Skin Disease of Young Cattle—Ringworm.	
Bulletin 17	Tests of Varieties of Grapes, Strawberries, Raspberries, and Plums.	J. F. McKay.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 18	Some Cotton Experiments at Newport	R. L. Bennett.
Bulletin 19	Manures and Some Principles in Farm Manuring	G. L. Teller.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ARKANSAS STATION—Continued.

Publication.	Title.	Author.
1892.		
Bulletin 20	Animal Parasitism. Some Texas Fever Experiments	R. R. Dinwiddie.
Bulletin 21	Grapes: Some Insect and Fungus Diseases and Their Remedies. Spraying Apparatus. Apples and Grapes in Arkansas.	J. T. Stinson.
Bulletin 22	Sorghum and Sugar-cane Culture. Sirup and Sugar Making on Small Farms. Some Field Experiments with Cantaloupes and Corn.	C. L. Newman.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 23	Cotton Experiments at Newport, 1892	R. L. Bennett and G. B. Irby.
Bulletin 24	Fodder	G. L. Teller.
Bulletin 25	Unsound Corn and Forage as a Cause of Disease in Live Stock. Colics in Horses and Mules. Some Further Experiments with Cattle. Texas Fever.	R. R. Dinwiddie.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 26	Spraying Apple Trees. Spraying for Apple Scab and Bitter Rot. Prevalence in the State of Apple Scab and Bitter Rot. Varieties of Apples in the State Reported as Surest Bearers. Some Apples Adapted to all Sections of the State. Arkansas Seedling Apples.	J. T. Stinson.
Bulletin 27	Late Crops for Overflow Lands. Corn: Varieties for all Sections of the State. Corn Culture. Rotation of Crops. Cotton: Egyptian Varieties. Cotton Culture. Stack Frame for Curing and Storing Cowpea Hay. Cowpea Hay. Forage Plants. Oats for Hay.	R. L. Bennett and G. B. Irby.
Bulletin 28	Rye for Green Winter Feeding. Fertilizer Experiments with Rye. Onions from Seed. Salsify, or Oyster Plant. Fall-raised Irish Potatoes. Preparation of Soil for Cotton. Bermuda Grass. Pocket Gopher. Moles.	C. L. Newman.
Bulletin 29	Wheat Experiments on Sandy Loam Soil at Newport Substation. Some Grass Experiments on Clay Loam Soil at Fayetteville.	R. L. Bennett and G. B. Irby.
Bulletin 30	Feeding Standards. Some Arkansas Stock Foods. Compounding Rations.	G. L. Teller.
Bulletin 31	Fattening Mature Steers on Cotton Seed and Cowpea Hay. Cowpeas. Sweet Potatoes. Peanuts. Cotton Varieties. Minor Miscellaneous Subjects.	R. L. Bennett and G. B. Irby.
Bulletin 32	Protection of Soil from Surface Washing. Hillside Ditches. Terraces. Drainage of Wet Lands. Indications of the Need of Drainage. Open Ditches. Underdrains.	C. L. Newman.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 33	Insects Injurious to Fruits and Vegetables and Remedies for Destroying Them.	J. T. Stinson.
Bulletin 34	Vegetables: Varieties, Culture, and Fertilization. Sundry Experiments.	C. L. Newman.
Bulletin 35	Verminous Bronchitis. Parturient Apoplexy of Cows. Hog Cholera and Other Swine Diseases. Tuberculosis of Cattle. Glanders in Horses and Mules.	R. R. Dinwiddie.
Bulletin 36	Grasses and Clovers	R. L. Bennett.
Bulletin 37	Sirups and Molasses	G. L. Teller and J. F Moore.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 38	Irish Potatoes	C. L. Newman.
Bulletin 39	Spraying Fruits: Strawberries, Grapes	J. T. Stinson.
Bulletin 40	On the Toxic Properties of Molds	R. R. Dinwiddie.
	Field Investigations of Various Stock Diseases	H. V. Goode.
Bulletin 41	Pork Production on Crops Gathered by Hogs. A Succession of Crops for Hogs.	R. L. Bennett.
Bulletin 42	Concerning Wheat and its Mill Products	G. L. Teller.
Bulletin 43	Report of the Horticulturist, 1896	J. T. Stinson.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 44	Vegetable Gardening	C. L. Newman.
Bulletin 45	Milk: Its Decomposition and Preservation	R. R. Dinwiddie.
Bulletin 46	Experiments with Manures and Rotation for Improving Worn Cotton Soils. Experiments on Beef and Pork Production in Connection Therewith.	R. L. Bennett.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ARKANSAS STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 47	Concerning Fertilizers and Manures. After-effect of Manures.	G. L. Teller.
Bulletin 48	Strawberries	J. T. Stinson.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 49	Preliminary Report on Arkansas Seedling Apples	Do.
Bulletin 50	Some Irish Potato Experiments	C. L. Newman.
Bulletin 51	Methods of Combating Communicable Diseases of Farm Animals.	R. R. Dinwiddie.
Bulletin 52	Feeding Value to Steers of Cotton Seed, Ground Cotton Seed, Cotton Meal, and Hulls. Effect of Temperature.	R. L. Bennett.
Bulletin 53	A Report of Progress of Investigations in the Chemistry of Wheat.	G. L. Teller.
Bulletin 54	Fattening Value of Certain Foods Gathered by Pigs	R. L. Bennett.
Bulletin 55	Orchard Cultivation	J. T. Stinson.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 56	Tomatoes, Cabbage, and Onions	C. L. Newman.
Bulletin 57	The Relative Virulence for the Domestic Animals of Human and Bovine Tubercle: I. Bibliographical Review. II. Experimental Researches.	R. R. Dinwiddie.
Bulletin 58	An Experiment in Grazing a Corn and Cowpea Field with Steers. Experiments with Peanuts, Legume Manuring, Cotton Meal, Whole and Crushed Cotton Seed Manuring, and Varieties of Cotton.	R. L. Bennett.

CALIFORNIA STATION. *a*

1875.		
Bulletin 8	Announcement of Lectures and Sketch of Outdoor Work *b*	
Bulletin 17	Thesis on Utility and Methods of Soil Analysis	L. S. Burchard.
1876.		
Bulletin 23	Lectures on the Phylloxera, or Grapevine Louse	E. W. Hilgard.
1877.		
Bulletin 26	Concerning Industrial Survey. Transmission of Soil Specimens, etc.	Do.
	Biennial Report, 1876 and 1877	
1878.		
Bulletin 32	On the Destruction of the Ground Squirrel by the Use of Bisulphid of Carbon.	
1879.		
Biennial Report	Biennial Report, 1878 and 1879	
1880.		
	Phylloxera, or the Grapevine Louse (revised reprint)	Do.
Annual Report	Annual Report, 1880	
1881.		
Annual Report	Annual Report, 1881	
1882.		
Biennial Report	Biennial Report, 1881–82	
Annual Report	Annual Report, 1882	
1884.		
Bulletin 1	Examination of the Water of the San Fernando Tunnel	Do.
Bulletin 2	Plant Distribution	
Bulletin 3	Remedies for Phylloxera; Failure of Cuttings	
Bulletin 4	Analysis of Tanning Materials	Do.
Bulletin 5	[Distribution of Plants]	Do.
Bulletin 6	Comparative Examination of Claret Grapes from Fresno and Livermore Valley.	Do.
Bulletin 7	Examination of Irrigation Waters	Do.

a The publications in this list from 1875 to 1882, inclusive, were issued as part of a general series of publications of the University of California.

b Summary of cultural station work prior to 1875.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

CALIFORNIA STATION—Continued.

Publication.	Title.	Author.
1884.		
Bulletin 8	[Examinations of Fertilizing Materials and Soils]	E. W. Hilgard.
Bulletin 9	Examination of Zinfandel Wines	Do.
Bulletin 10	Examination of Soils	Do.
Bulletin 11	On the Physical and Agricultural Features of California	Do.
Bulletin 12	Examination of Zinfandel Wines	Do.
Bulletin 13	Examinations of Red or Claret Wines	Do.
Bulletin 14	Examinations of Artesian Waters from the San Joaquin Valley.	Do.
Bulletin 15	Examinations of Soils from Southern California	Do.
Bulletin 16	Entomology in the College of Agriculture	C. H. Dwinelle.
Bulletin 17	The Muscat Grape on the Southern Mesas	E. W. Hilgard.
Bulletin 18	Mr. J. A. Bauer's Phylloxera Remedy	Do.
Bulletin 19	Observations on the Phylloxera made during 1884	F. W. Morse.
Bulletin 20	Examination of Stream and Well Waters	E. W. Hilgard.
Bulletin 21	Examination of Red Wines from Sonoma and Napa Counties.	
Bulletin 22	University Seed Distribution	C. H. Dwinelle.
Bulletin 23	Vintage Work in the Viticultural Laboratory, 1884	E. W. Hilgard.
Bulletin 24	Examinations of Grape-Growing Soils	Do.
Bulletin 25	Examinations of Alameda County Vineyard Soils	
Bulletin 26	Examinations of Miscellaneous Vegetable Substances	Do.
Bulletin 27	Examinations of Soils from the Northern Coast Range Region.	Do.
Bulletin 28	Examinations of Tule, Marsh, and Alkali Soils	Do.
Bulletin 29	Distribution of Plants and Scions	Do.
Bulletin 30	Examinations of Various Upland Soils	
Biennial Report	Biennial Report, 1883 and 1884	
1885.		
Bulletin 31	Examination of Trosseau and Burger Wines	Do.
Bulletin 32	Examinations of Well and Spring Waters	Do.
Bulletin 33	Examinations of Soils and Waters	Do.
Bulletin 34	Experiments on the Growth of Cuttings from Wild American Vines.	Do.
Bulletin 35	Investigations of Wines from Rare Grape Varieties	Do.
Bulletin 36	Examinations of Soils and Subsoils	Do.
Bulletin 37	Investigations of Wines from Rare Grape Varieties—Cinsaut, Petit Bouschet, Merlot, Verdot.	Do.
Bulletin 38	Investigations of Wines from Rare Grape Varieties—Beclan, Cabernet Franc, Cabernet Sauvignon.	Do.
Bulletin 39	Analysis of Oranges and Lemons from the Riverside Citrus Fair, March, 1885.	Do.
Bulletin 40	Investigations of Wines from Rare Grape Varieties—Clairetts Blanche, Rousanne, Marsanne.	Do.
Bulletin 41	Olive Culture	W. G. Klee.
Bulletin 42	Vintage Work in the Viticultural Laboratory, 1885	E. W. Hilgard.
Bulletin 43	Analysis of Santa Clara Valley Red Wines	Do.
Bulletin 44	The "Bed-Rock Lands" of Sacramento County	Do.
Bulletin 45	Grafting the California Wild Vine	Do.
Bulletin 46	Grafting and Fruiting of Resistant Vines	G. Husmann.
Bulletin 47	Seed Distribution	E. W. Hilgard.
Bulletin 48	Investigations upon the Mercurial Phylloxera Remedy	Do.
Bulletin 49	Examinations of Soils from the Bay Region	Do.
Bulletin 50	Distribution of Plants and Scions	Do.
Viticultural Report.	Report of Viticultural Work, 1883–84 and 1884–85	Do
Annual Report	Annual Report, 1885	
1886.		
Bulletin 51	The Wines of 1885	Do.
Bulletin 52	Alkaline Washes for Fruit Trees	Do.
Bulletin 53	Irrigation, Drainage, and Alkali	Do.
Bulletin 54	Condensed Grape Must and its Uses	Do.
Bulletin 55	The Woolly Aphis and Its Repression	W. G. Klee.
Bulletin 56	Whale-Oil Soap Insecticide Washes; The Sulphuring of Vines.	E. W. Hilgard.
Bulletin 57	Vintage Work and Instruction in the Viticultural Laboratory, 1886.	Do.
Bulletin 58	The Hessian Fly and Resistant Grains	E. J. Wickson.
Bulletin 59	[The Experimental Vineyard at Cupertino]	E. W. Hilgard.
Bulletin 60	Colorimetric Measurement of Wines	Do.
Bulletin 61	Distribution of Seeds and Plants	Do.
Bulletin 62	Distribution of Cuttings and Scions	Do.
Biennial Report.	Biennial Report, College of Agriculture, 1885–86	
Appendix VII	Alkali Lands, Irrigation and Drainage in Their Mutual Relations.	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

CALIFORNIA STATION—Continued.

Publication.	Title.	Author.
1886.		
Viticultural Report.	Report of Viticultural Work During 1885–86	E. W. Hilgard.
Annual Report	Annual Report, 1886	Do.
1887.		
Bulletin 63	Experiments on Methods of Fermentation	Do.
Bulletin 64	Planting and Grafting Resistant Vines	Do.
Bulletin 65	Shall California Make Sophisticated Wines?	Do.
Bulletin 66	The Principles and Practice of Pasteurizing	Do.
Bulletin 67	Misconception of the University Viticultural Work	Do.
Bulletin 68	University Distribution of Seeds, Plants, etc.; Influence of the Mode of Fermentation on the Color of Wines.	Do.
Bulletin 69	Wine Colors and Color Wines	Do.
Bulletin 70	Abnormal Deposits on Vine Leaves; Mysterious Death of Vines; Remedy for the Anthracnose of Vines.	Do.
Bulletin 71	The Use of Gases against Scale Insects	F. W. Morse.
Bulletin 72	Sugar Beets at Fresno; The Hessian Fly and Resistant Grains.	E. J. Wickson.
Bulletin 73	The Use of Hydrocyanic Acid against Scale Insects	F. W. Morse.
Bulletin 74	Vintage Work and Instruction in the Viticultural Laboratory, 1887; The Choice of Resistant Stocks.	E. W. Hilgard.
Bulletin 75	Spray and Band Treatments for the Codling Moth; Difficult Fermentations.	Do.
Bulletin 76	Distribution of Seeds and Plants	Do.
Bulletin 77	The Extraction of Color and Tannin during Red-Wine Fermentation.	Do.
Annual Report	Annual Report, 1887	
1888.		
Bulletin 78	Report on the Establishment of Outlying Stations	E. W. Hilgard.
Bulletin 79	Experiments on the Cause and Avoidance of Injury to Foliage in the Hydrocyanic-Gas Treatment of Trees.	F. W. Morse.
Bulletin 80	Progress of the Experiment Station Work	E. W. Hilgard.
Bulletin 81	Distribution of Seeds and Plants	E. J. Wickson.
Annual Report	Annual Report, 1888	
Advance sheets Annual Report, 1888.	Methods of Fermentation and Related Subjects, 1886–87	E. W. Hilgard.
Advance sheets Annual Reports 1888 and 1889.	Waters, Water Supply, and Related Subjects, 1886–1889	Do.
Biennial Report.	Biennial Report, 1887–88	
1889.		
	Circular Concerning Analyses of Waters	Do.
Bulletin 82	The Lakes of San Joaquin Valley	Do.
Bulletin 83	The Rise of Alkali in the San Joaquin Valley	Do.
Bulletin 84	Distribution of Seeds and Plants	E. J. Wickson.
Annual Report	Annual Report, 1889	
Biennial Report.	Biennial Report, 1888–89	
1890.		
Bulletin 85	Observations on Olive Varieties	W. G. Klee.
Bulletin 86	Preservative Fluids for Fresh Fruits; The Sulphuring of Dried Fruits.	E. W. Hilgard.
Bulletin 87	The Conservation of Wines	Do.
Bulletin 88	The Use of Fertilizers in California	Do.
Bulletin 89	Distribution of Seeds and Plants	E. J. Wickson.
Biennial Report	Biennial Report, 1889–90	
Annual Report	Annual Report, 1890	
1891.		
Bulletin 90	Fiber Plants for California	E. W. Hilgard.
	Flax for Seed and Fiber	E. J. Wickson.
Bulletin 91	Port and Sherry Grapes in California; Importation of Italian Grapes; Importation of Olives.	E. W. Hilgard.
Bulletin 92	Notes on California Olives, their Adaptations and Oils	L. Paparelli.
Bulletin 93	Investigation on California Oranges and Lemons	G. E. Colby and H. L. Dyer.
Bulletin 94	Composition of the Ramie Plant	M. E. Jaffa.
	Fertilizing Value of Greasewood	E. W. Hilgard.
Bulletin 95	Distribution of Seeds and Plants	E. J. Wickson.
1892.		
Bulletin 96	Sulphuring in Fruit Drying	E. W. Hilgard.
	Fig Trees at the Experiment Stations; Notes on Persian Palms.	C. H. Shinn.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

CALIFORNIA STATION—Continued.

Publication.	Title.	Author.
1892.		
Bulletin 97	Investigation of California Prunes, Apricots, and Peaches	G. E. Colby.
Bulletin 98	Distribution of Seeds and Plants	E. J. Wickson.
Bulletin 99	Root Knots on Fruit Trees and Vines; A New Nozzle Tester	C. W. Woodworth.
Viticultural Report.	Report of Viticultural Work During the Seasons of 1887–1889.	E. W. Hilgard and L. Paparelli.
Annual Report	Report for 1891–92	
Appendix to 1890 Report.	Alkali Lands, Irrigation and Drainage in their Mutual Relations.	E. W. Hilgard.
1893.		
Bulletin 100	Investigation of Cattle Foods of California	M. E. Jaffa.
Bulletin 101	Further Examination of California Prunes, Apricots, Plums, and Nectarines.	G. E. Colby.
Bulletin 102	Analysis of Figs and Fig Soils	M. E. Jaffa and G. E. Colby.
Bulletin 103	Distribution of Seeds and Plants	E. J. Wickson.
1894.		
Bulletin 104	Investigations of California Olives and Olive Oils	A. P. Hayne.
Bulletin 105	The Cañaigre, or Tanners' Dock	E. W. Hilgard.
	Australian Saltbush for Alkali Soils	M. E. Jaffa.
Bulletin 106	Distribution of Seeds, Plants, and Scions	E. J. Wickson.
Annual Report	Annual Report for 1892–93 and part of 1894	
1895.		
Bulletin 107	The Russian Thistle in California	C. H. Shinn.
Bulletin 108	The Distribution of the Salts of Alkali Soils	E. W. Hilgard and R. H. Loughridge.
Bulletin 109	Distribution of Seeds and Plants	E. J. Wickson.
Annual Report	Annual Report, 1894–95	
Appendix to Annual Report.	Olives	A. P. Hayne and G. E. Colby.
1896.		
Bulletin 110	The Study of Human Foods and Practical Dietetics	M. E. Jaffa.
Bulletin 111	The Work of the College of Agriculture and Experiment Stations.	E. W. Hilgard.
Bulletin 112	Distribution of Seeds and Plants	E. J. Wickson.
Bulletin 113	California Walnuts, Almonds, and Chestnuts; their Composition and Draft upon the Soil	G. E. Colby.
	The Bleaching of Nuts by Dipping	E. W. Hilgard.
Bulletin 114	The Causes of "Frogging" and "Bloating" of Prunes	F. T. Bioletti.
Bulletin 115	Remedies for Insects and Fungi	C. W. Woodworth.
Viticultural Report.	Report of the Viticultural Work, 1887-1893	
1897.		
Appendix to Viticultural Report, 1896.	Resistant Vines: Their Selection, Adaptation, and Grafting.	A. P. Hayne.
Bulletin 116	The California Vine Hopper	C. W. Woodworth.
Bulletin 117	The Control of the Temperature in Wine Fermentation	A. P. Hayne.
Bulletin 118	Distribution of Seeds and Plants	E. J. Wickson.
Bulletin 119	Vine Pruning	F. T. Bioletti.
1898.		
Biennial Report.	Partial Report of Work, 1895–1897	
Bulletin 120	The Olive Knot	Do.
Bulletin 121	The Conservation of Soil Moisture and Economy in the Use of Irrigation Water.	E. W. Hilgard and R. H. Loughridge.
Seed Bulletin	Distribution of Seeds and Plants	E. J. Wickson.
1899.		
Bulletin 122	Orchard Fumigation	C. W. Woodworth.
Bulletin 123	Olives	F. T. Bioletti and G. E. Colby.
Bulletin 124	Lupins for Green Manuring	J. B. Davy.
Bulletin 125	Australian Saltbushes; Characteristics, Propagation, and Field Experiments.	C. H. Shinn.
	Australian Saltbushes; Composition and Food Value	M. E. Jaffa.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

COLORADO STATION.

Publication.	Title.	Author.
1887.		
Bulletin 1	Reports of Experiments in Irrigation and Meteorology	E. Mead.
Bulletin 2	Grains, Grasses, and Vegetables	A. E. Blount.
Bulletin 3	Distribution of College Seeds and Plants; Duties of Secretary of State Board of Agriculture.	F. J. Jannis.
1888.		
Bulletin 4	Experiments with Potatoes and Tobacco	J. Cassidy.
Bulletin 5	Experiments in the Apiary	C. M. Brose.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 6	Insects and Insecticides	J. Cassidy.
Bulletin 7	Potatoes and Sugar Beets	J. Cassidy and D. O'Brine.
Bulletin 8	Alfalfa: Its Growth, Composition, and Digestibility	D. O'Brine and J. Cassidy.
Bulletin 9	Soils and Alkali	D. O'Brine.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 10	Tobacco	D. O'Brine and J. Cassidy.
Bulletin 11	Sugar Beets	C. L. Ingersoll and D. O'Brine.
Bulletin 12	Some Colorado Grasses and their Chemical Analysis	J. Cassidy and D. O'Brine.
Bulletin 13	The Measurement and Division of Water	L. G. Carpenter.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 14	Progress Bulletin on Sugar Beets	D. O'Brine.
Bulletin 15	Codling Moth and Grapevine Leaf Hopper	C. P. Gillette.
Bulletin 16	The Artesian Wells of Colorado and Their Relation to Irrigation.	L. G. Carpenter.
Bulletin 17	A Preliminary Report on the Fruit Interests of the State	C. S. Crandall.
Bulletin 18	Index to Bulletins Nos. 1–17	W. J. Quick.
Annual Report	Fourth Annual Report, 1891	
1892.		
Spec. Bulletin A	Subjects Investigated by the Experiment Station	Do.
Bulletin 19	Observations upon Injurious Insects	C. P. Gillette.
Bulletin 20	The Best Milk Tester for the Practical Use of the Farmer and Dairyman; The Influence of Food upon the Pure Fat Present in Milk.	W. J. Quick.
Bulletin 21	Sugar Beets; Irish Potatoes; Fruit Raising	F. L. Watrous.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 22	Preliminary Report on the Duty of Water	L. G. Carpenter.
Bulletin 23	Colorado Weeds	C. S. Crandall.
Bulletin 24	A Few Common Insect Pests	C. P. Gillette.
Bulletin 25	Progress Bulletin on the Loco and Larkspur	D. O'Brine.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 26	Farm Notes for 1893	W. W. Cooke and F. L. Watrous.
	Garden Notes for 1893	M. J. Huffington and C. S. Crandall.
	Seeding, Tillage, and Irrigation	F. Huntley.
Bulletin 27	The Measurement and Division of Water (Revised Edition of Bulletin 13).	L. G. Carpenter.
Bulletin 28	The Russian Thistle	C. S. Crandall.
Bulletin 29	Strawberries and Grapes; Notes on Varieties	M. J. Huffington.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 30	Farm Notes for 1894	W. W. Cooke and F. L. Watrous.
	Notes on Tomatoes	M. J. Huffington.
Bulletin 31	A Preliminary List of the Hemiptera of Colorado	C. P. Gillette and C. F. Baker.
Bulletin 32	Sheep Feeding in Colorado	W. W. Cooke.
Annual Report	Eighth Annual Report, 1895	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

COLORADO STATION—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 33	Seepage or Return Waters from Irrigation	L. G. Carpenter.
Bulletin 34	Cattle Feeding in Colorado	W. W. Cooke.
Bulletin 35	Alfalfa	W. P. Headden.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 36	Sugar Beets	W. W. Cooke and W. P. Headden.
Bulletin 37	The Birds of Colorado	W. W. Cooke.
Bulletin 38	Sheep Scab; A Few Insect Enemies of the Orchard	C. P. Gillette.
Bulletin 39	A Study of Alfalfa and Some Other Hays	W. P. Headden.
Bulletin 40	Barley	W. W. Cooke.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 41	Blight and Other Plant Diseases	C. S. Crandall.
Bulletin 42	Sugar Beets in Colorado in 1897	W. W. Cooke and W. P. Headden.
Bulletin 43	I. Colorado Lepidoptera. II. A New Species of Deltocephalus and Athysanus from Colorado. III. A List of Original Types, etc., in Collection.	C. P. Gillette.
Bulletin 44	Further Notes on the Birds of Colorado	W. W. Cooke.
Bulletin 45	The Loss of Water from Reservoirs by Seepage and Evaporation.	L. G. Carpenter.
Bulletin 46	A Soil Study, I. The Crop Grown: Sugar Beets	W. P. Headden.
Bulletin 47	Colorado's Worst Insect Pests and Their Remedies	C. P. Gillette.
Bulletin 48	Losses from Canals from Filtration or Seepage	L. G. Carpenter.
Bulletin 49	Meteorology of 1897, with Illustrations	L. G. Carpenter and R. E. Trimble.
Bulletin 50	Notes on Plum Culture	C. S. Crandall.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 51	Sugar Beets in Colorado in 1898	W. W. Cooke.
Bulletin 52	Pasturing Sheep on Alfalfa; Raising Early Lambs	Do.

CONNECTICUT STATE STATION.

1876.		
Prelim. Report *a*	Preliminary Work; Fertilizers, etc	
Annual Report *a*	First Annual Report (a supplementary report on experiments at Middletown was published in the Report of the Connecticut Board of Agriculture for 1878).	
1877.		
Annual Report	Annual Report, 1877	
1877–78.		
Bulletins 1–8	Fertilizer Analyses	
Bulletin 9	Fertilizers and "Egg Food"	
Annual Report	Annual Report, 1878	
1878–79.		
Bulletins 10–22	Fertilizer Analyses	
Bulletin 23	Analyses of Hay	S. W. Johnson.
Bulletins 24–33	Fertilizer Analyses	Do.
Bulletin 34	Analyses of Hay	Do.
Bulletin 35	Analyses of Maize Kernels	Do.
Annual Report	Annual Report, 1879	
1880.		
Bulletin 36	Shell Marl, Oyster Shell Lime, Marine Mud, and Seaweed	
Bulletin 37	Fresh Water Sediments; Peat or Swamp Muck	Do.
Bulletins 38–48	Fertilizer Analyses	Do.
Bulletin 49	Analyses of Swamp Muck	Do.
Bulletin 50	Fertilizer Analyses	Do.
Annual Report	Annual Report, 1880	
1881.		
Bulletin 51	Refuse Lime; Sorghum Seed; Brewers' Grains	
Bulletin 52	Cost of Active Ingredients of Fertilizers	Do.

a During 1875 and 1876 the station was at Middletown.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

CONNECTICUT STATE STATION—Continued.

Publication.	Title.	Author.
1881.		
Bulletin 53	Shell Marl; Apple Pomace	S. W. Johnson.
Bulletin 54	Fertilizer Analyses	Do.
Bulletin 55	Analyses of Night Soil and Ensilage	Do.
Bulletins 56–67	Fertilizer Analyses	Do.
Annual Report	Annual Report, 1881	
1882.		
Bulletins 68–72	Fertilizer Analyses	Do.
1883.		
Bulletins 73–76	Fertilizer Analyses	Do.
Annual Report	Annual Report, 1883	
1884.		
Bulletin 77	Analyses and Valuation of Fertilizers; Composition of Peach Wood, Healthy and Diseased.	Do.
1884–85.		
Bulletins 78–85	Fertilizer Analyses	
Annual Reports	Annual Reports, 1884 and 1885	
1886.		
Bulletins 86–87	Analyses of Fertilizers; Analyses of Feeding Stuffs	
Bulletin 88	Analyses of Commercial Fertilizers	
Bulletin 89	Analyses of Superphosphates and Special Manures	
Annual Report	Annual Report, 1886	
1887.		
Bulletin 90	Valuation of Fertilizers	Do.
Bulletin 91	Analyses of Fertilizers	Do.
Bulletin 92	Observance of the Fertilizer Law	
Bulletin 93	Classification of Plants and Grasses	
Annual Report	Annual Report, 1887	
1888.		
Bulletin 94	The Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals for 1888.	
Bulletin 95	Analyses of Fertilizers	
Annual Report	Annual Report, 1888	
1889.		
Bulletin 96	On the Valuation of Feeding Stuffs	
Bulletin 97	Fungus Diseases of Plants; Analyses of Fertilizers	
Bulletin 98	Analyses of Home-mixed Fertilizers	
Bulletin 99	Analyses of Fertilizers	
Bulletin 100	Analyses and Valuations of Fertilizers	
Annual Report	Annual Report, 1889	
1890.		
Bulletin 101	Fertilizer Analyses	
Bulletin 102	Fungicides	R. Thaxter.
Bulletin 103	Fertilizers	
Bulletin 104	Fertilizer Analyses	
Bulletin 105	Potato Scab	Do.
	The Proteids or Albuminoids of the Oat Kernel	T. B. Osborne.
Annual Report	Annual Report, 1890	
1891.		
Bulletin 106	The Babcock Method of Determining Fat in Milk and Cream; Butter Analyses; Fertilizers.	
Bulletin 107	The Connecticut Species of Gymnosporangium	R. Thaxter.
Bulletin 108	Examination of the Seed of Orchard Grass; Ash Analysis of White Globe Onions; Determination of Fat in Cream by the Babcock Method.	
Bulletin 109	Fertilizers	
Bulletin 110	Canada Ashes	S. W. Johnson.
Annual Report	Annual Report, 1891	
1892.		
Bulletin 111	Common Fungus Diseases and their Treatment	W. C. Sturgis.
Bulletin 112	On the Gunning-Kjeldahl Method and a Modification Applicable in the Presence of Nitrates.	A. L. Winton.
Bulletins 113–114	Fertilizers	
Annual Report	Annual Report, 1892	
1893.		
Bulletin 115	Common Fungus Diseases and their Treatment	W. C. Sturgis.
Bulletin 116	Fertilizers; Act Concerning Connecticut Fertilizers	
Annual Report	Seventeenth Annual Report, 1893	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

CONNECTICUT STATE STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 117	The Babcock Method of Determining Fat in Milk and Milk Products.	
Bulletin 118	A Provisional Bibliography of the More Important Works Published by the U. S. Department of Agriculture and the Agricultural Experiment Stations of the United States from 1886 to 1893, inclusive, on Fungus and Bacterial Diseases of Economic Plants.	W. C. Sturgis.
Bulletin 119	The Babcock Test as a Basis for Payment in Cream-gathering Creameries.	A. L. Winton and A. W. Ogden.
Annual Report	Eighteenth Annual Report, 1894	
1895.		
Bulletin 120	Analyses of Fertilizers; Trade Values of Fertilizer Ingredients for 1895; Poultry Foods.	E. H. Jenkins.
Bulletin 121	The Elm-Leaf Beetle; The San José Scale	W. C. Sturgis and W. E. Britton.
Annual Report	Nineteenth Annual Report, 1895	
1896.		
Bulletin 122	Cost of Nitrogen, Phosphoric Acid, and Potash in Connecticut for Spring Months of 1896.	E. H. Jenkins.
Bulletin 123	Examination of Food Products Sold in Connecticut	
Annual Report	Twentieth Annual Report, 1896	
1897.		
Bulletin 124	The Cost of Plant Food in Connecticut, Spring Months of 1897.	
Annual Report	Twenty-first Annual Report, 1897 (Parts I, II, III)	
1898.		
Bulletin 125	Preparation and Application of Fungicides	W. C. Sturgis.
Bulletin 126	Insecticides; Their Preparation and Use	W. E. Britton.
Bulletin 127	The Cost of Plant Food in Connecticut, Spring Months of 1898.	
Annual Report	Twenty-second Annual Report, 1898	
1899.		
Bulletin 128	Commercial Feeding Stuffs in the Connecticut Market	
Bulletin 129	Inspection and Care of Nursery Stock	Do.

CONNECTICUT STORRS STATION.

1888.		
Bulletin 1	Field Experiments; Organization	W. O. Atwater.
Bulletin 2	Experiments on the Effects of Tillage on Soil Moisture; Grass and Forage Garden.	Do.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 3	Roots of Plants as Manure	C. S. Phelps and C. D. Woods.
Bulletin 4	Meteorological Observations	E. A. Bailey.
	Bacteria in Milk and its Products	H. W. Conn.
Bulletin 5	Atmospheric Nitrogen as Plant Food	C. D. Woods.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 6	Grass and Forage Garden; Grasses and Legumes	C. D. Woods and C. S. Phelps.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 7	Chemistry and Economy of Food	W. O. Atwater and C. D. Woods.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 8	Summary of the Annual Report for 1891	
Bulletin 9	Soiling and Soiling Crops; Feeding Experiments with Soiling Crops.	C. S. Phelps.
Annual Report	Fifth Annual Report, 1892	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

CONNECTICUT STORRS STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 10	Results of Experiments with Fertilizers on Different Classes of Soils.	C. S. Phelps.
Bulletin 11	Summary of Annual Report for 1892	
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 12	The Ripening of Cream by Artificial Bacteria Cultures	H. W. Conn.
Bulletin 13	Rations Fed to Milch Cows in Connecticut	C. D. Woods and C. S. Phelps.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 14	The Elm-Leaf Beetle	
Bulletin 15	Food Investigations and Publications	W. O. Atwater and C. D. Woods.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 16	Experiments in Cream Ripening; Flavor, Aroma, Acid	H. W. Conn.
Bulletin 17	Hay Substitutes	C. S. Phelps.
Annual Report	Ninth Annual Report, 1896 (Parts I, II, III)	
1897.		
Bulletin 18	Nitrogenous Feeding Stuffs	Do.
Annual Report	Tenth Annual Report, 1897 (Parts I and II)	
1898.		
Annual Report	Eleventh Annual Report, 1898 (Parts I and II)	
1899.		
Bulletin 19	The Present Condition of Bovine Tuberculosis in Europe	H. W. Conn.

DELAWARE STATION.

1888.		
Bulletin 1	Objects and Organization of Station	A. N. Raub.
Bulletin 2	Horticulture and Entomology	M. H. Beckwith.
Bulletin 3	[Botany and Plant Pathology]	F. D. Chester.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 4	Injurious Insects: Their Identification and Extermination	M. H. Beckwith.
Bulletin 5	Inspection of Seed and of Stock Feed in Delaware	F. D. Chester and A. T. Neale.
Bulletin 6	A Summary of the Station Experiments on the Black Rot of Grapes.	A. T. Neale and F. D. Chester.
Bulletin 7	Stock Feeding	C. L. Penny and A. T. Neale.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 8	Experiments to Test the Possibility of Developing a Domestic Sugar Industry; Spraying with Sulphid of Potassium for Pear Scab; London Purple for the Codling Moth.	M. H. Beckwith.
Spec. Bulletin A	Fungicides	F. D. Chester.
Bulletin 9	Creamery Studies of Methods and Machinery	A. T. Neale and C. L. Penny.
Bulletin 10	Diseases of the Vine Controlled by Several Different Salts of Copper.	A. T. Neale and F. D. Chester.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 11	Soil and Crop Tests	A. T. Neale.
Bulletin 12	Injurious Insects and Insecticides: Spraying Machinery	Do.
Bulletin 13	Leaf Blight of the Pear and Quince	F. D. Chester.
Bulletin 14	Field Tests upon Indian Corn	A. T. Neale and M. H. Beckwith.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 15	Diseases of Crops and their Treatment	F. D. Chester.
Bulletin 16	Scarlet Clover	A. T. Neale.
Bulletin 17	Hand-Power Cream Separators	C. L. Penny.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

DELAWARE STATION—Continued.

Publication.	Title.	Author.
1892.		
Bulletin 18	Strawberries: Test of Varieties; A Strawberry Weevil	M. H. Beckwith.
Bulletin 19	Can Peach Rot be Controlled by Spraying?	F. D. Chester.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 20	Anthrax: Precautions Necessary to Prevent its Spread	A. T. Neale.
Bulletin 21	Insects Injurious to Stored Grain	M. H. Beckwith.
Bulletin 22	The Preparation of Ammoniacal Solution of Copper Carbonate.	C. L. Penny.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 23	Texas Fever	A. T. Neale.
Bulletin 24	Strawberries: Test of Varieties	M. H. Beckwith.
1895.		
Spec. Bulletin B.	Spray Calendar	
Bulletin 25	The San José Scale Insect in Delaware	Do.
Bulletin 26	Abstract from Annual Report, 1894	
Bulletin 27	Tests of Sorghum Varieties	C. L. Penny.
Bulletin 28	Strawberries: Test of Varieties; Varieties Grown in Delaware; Injury from Leaf Blight and Strawberry Weevil.	M. H. Beckwith.
Bulletin 29	Experiments in the Treatment of Peach Rot and of Apple Scab.	F. D. Chester.
Annual Report	Seventh Annual Report, 1894–95	
1896.		
Bulletin 30	The San José Scale Insect; Present Status of the San José Scale in Delaware; Status of the Insect in the United States.	M. H. Beckwith.
Bulletin 31	Milk Sampling	C. L. Penny.
Bulletin 32	Combating Anthrax in Delaware	A. T. Neale.
Bulletin 33	The Increase of the San José Scale in Delaware During 1896.	G. H. Powell.
Annual Report	Eighth Annual Report, 1896	
1897.		
Bulletin 34	The Treatment of Plant Diseases in 1896	F. D. Chester.
Bulletin 35	The Cherry in Delaware	G. H. Powell.
Bulletin 36	Potash: Its Commercial Relations; Its Agricultural Relations; Chemical Method for its Accurate Estimation in Soil.	C. L. Penny.
Annual Report	Ninth Annual Report, 1897	
1898.		
Bulletin 37	Anthrax: A Study of National and of State Legislation on this Subject.	A. T. Neale.
Bulletin 38	Some Principles in Delaware Apple Culture	G. H. Powell.
Bulletin 39	Sorghum: Its Development as a Commercial Source of Sugar.	C. L. Penny.
Bulletin 40	Soil Bacteria in their Relation to Agriculture, Part I	F. D. Chester.
Bulletin 41	Pea Canning in Delaware	
Bulletin 42	The European and Japanese Chestnuts in the Eastern United States.	G. H. Powell.
Annual Report	Tenth Annual Report, 1898	
1899.		
Bulletin 43	Veterinary Studies; State and Municipal Milk Legislation; Hay Farming.	A. T. Neale.
Bulletin 44	Sorghum in 1898	C. L. Penny.
Bulletin 45	The Pruning of Young Fruit Trees	G. H. Powell.

FLORIDA STATION.

1888.		
Bulletin 1	Grasses, Vegetables, Cereals, and Flowers	J. N. Whitner and J. Kost.
Bulletin 2	Reports of Departments of Station	
Bulletin 3	Experiments with Fertilizers	J. Kost
1889.		
Bulletin 4	Peach Growing in Florida	J. C. Neal.
	Annual Report, 1889	J. P. DePass.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

FLORIDA STATION—Continued.

Publication.	Title.	Author.
1889.		
Bulletin 5	Analyses of Fertilizers	J. M. Pickell and J. J. Earle.
Bulletin 6	General Report of Chemist	Do.
Bulletin 7	[Experiments with Corn and Cucumbers; Analyses of Muck.]	J. M. Pickell.
	General Characteristics of Muck	J. J. Earle.
	Muck Composting	J. C. Neal.
1890.		
Bulletin 8	Field Experiments with Cotton; Weeds of Florida	Do.
	Annual Report, 1889	
Bulletin 9	Entomological Notes	Do.
Bulletin 10	Report of Director	
	Phosphates	J. M. Pickell.
Bulletin 11	[Corn Experiments; Potato Experiments]	J. P. DePass.
	[Analyses of some Florida Weeds and Grasses]	J. M. Pickell.
1891.		
Bulletin 12	Tobacco	H. J. Fenton.
	Cotton, Rice, and Sorghum; Ashes as a Fertilizer; Miscellaneous Analyses.	J. P. DePass.
Bulletin 13	Experiments with Potatoes and Rye	Do.
	Composition and Value of Certain Materials for Fertilizing Purposes.	J. M. Pickell and J. J. Earle.
Bulletin 14	Annual Report; Horticulture, Cereals, Stock, etc	
Bulletin 15	Tobacco and its Cultivation	J. P. DePass.
1892.		
Bulletin 16	Corn, Hay, Weevil, Rice, Cane, Texas Blue Grass, and Cotton	Do.
Bulletin 17	Analysis of the Orange	J. M. Pickell and J. J. Earle.
	The Horn Fly	P. H. Rolfs.
	Questions Concerning Stock Diseases	
Bulletin 18	Grasses; Forage Plants; Tomato Blight	Do.
Bulletin 19	Tobacco	J. P. DePass.
Annual Report	Annual Report, 1892	
1893.		
Bulletin 20	Soils and Fertilizers	A. A. Persons.
Bulletin 21	The Tomato and Some of Its Diseases	P. H. Rolfs.
Bulletin 22	Fertilizers: How to Make and How to Use Them	A. A. Persons.
Bulletin 23	Insecticides and Fungicides	P. H. Rolfs.
1894.		
Bulletin 24	Annual Report, 1893	
Bulletin 25	Leeches or Leeching	A. W. Bitting.
Bulletin 26	Big Head	Do.
Bulletin 27	Notes on Experiments with the Pineapple	L. C. Washburn.
Bulletin 28	Liver Fluke; Southern Cattle Fever	A. W. Bitting.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 29	The San José Scale	P. H. Rolfs.
Bulletin 30	The Culture of Tobacco	F. B. Moodie.
Bulletin 31	Some Market Vegetables for Florida	P. H. Rolfs.
Annual Report	Annual Report, 1895	
1896.		
Bulletin 32	Cotton: Its Cultivation and Fertilization	A. A. Persons.
Bulletin 33	Present Condition and Treatment of Orange Groves	M. S. Moreman.
Bulletin 34	Insect Enemies of Truck and Garden Crops	A. L. Quaintance.
Bulletin 35	Cassava, the Velvet Bean, Prickly Comfrey, Taro, Chinese Yam, Cañaigre, Alfalfa, Flat Pea, and Sachaline.	O. Clute.
Bulletin 36	Insects Injurious to Stored Grain and Cereal Products	A. L. Quaintance.
Bulletin 37	The Pineapple at Myers	O. Clute and W. A. Marsh.
Annual Report	Annual Report, 1896	
1897.		
Bulletin 38	Tobacco in Florida	F. B. Moodie.
Bulletin 39	Strawberry Culture for the Market and the Home	S. Powers.
Bulletin 40	The Fall Army Worm; Southern Grass Worm	A. L. Quaintance.
Bulletin 41	A Fungus Disease of the San José Scale	P. H. Rolfs.
Bulletin 42	Some Strawberry Insects	A. L. Quaintance.
Bulletin 43	A Chemical Study of Some Typical Soils of the Florida Peninsula.	A. A. Persons.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

FLORIDA STATION—Continued.

Publication.	Title.	Author.
1898.		
Bulletin 44	Cane; Sirup; Sugar	H. E. Stockbridge.
Bulletin 45	Three Injurious Insects; Bean-Leaf Roller; Corn Delphax; Canna-Leaf Rollei.	A. L. Quaintance.
Bulletin 46	The Strawberry Thrips and the Onion Thrips	Do.
Bulletin 47	Diseases of the Tomato	P. H. Rolfs.
Bulletin 48	A Preliminary Report upon the Insect Enemies of Tobacco in Florida.	A. L. Quaintance.
Annual Report	Annual Report, 1898	
1899.		
Bulletin 49	Cassava as a Money Crop	H. E. Stockbridge.
Bulletin 50	Pineapple Fertilizers	P. H. Rolfs.

GEORGIA STATION.

1888.		
Bulletin 1	[Outline of Work, and History at Athens]	J. W. Spencer.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 2	Ash Analyses of Native Woods	H. C. White.
	Origin of Soils Geologically Considered	J. W. Spencer.
	The Imported Cabbage Butterfly	J. P. Campbell.
	Experiments with Phosphates and Kainit on Cotton; Preservation of the Sweet Potato in Winter.	W. L. Jones.
Bulletin 3	Notes on Various Insects and Remedies	J. P. Campbell.
	Ash Analyses of Native Woods	H. C. White.
	Cowpeas as a Fertilizing Crop; Preservation of the Sweet Potato in Winter.	W. L. Jones.
Bulletin 4	Analyses of Cattle Food	
Bulletin 5	[Reorganization of Station at Experiment]	
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 6	Notes on Some Injurious Insects	J. P. Campbell.
	"Southern Drift" and its Agricultural Relations	J. W. Spencer.
Bulletin 7	Analyses of Feeding Stuffs	H. C. White.
	Notes on a Destructive Insect	J. P. Campbell.
Bulletin 8	Irish Potato Culture	G. Speth.
Bulletin 9	Potash and Paying Crops	
Bulletin 10	Corn: Culture, Fertilizer, and Variety Tests	R. J. Redding.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 11	[Field and Garden Crops: Fertilizer, Variety, and Culture Tests.]	R. J. Redding and G. Speth.
Bulletin 12	Field Experiments with Forage Plants and Analyses of the Products.	G. Speth.
Bulletin 12½	Circular to the Farmers of Georgia from the Board of Directors.	R. J. Redding.
Bulletin 13	Analyses of Feeding Stuffs	H. C. White.
	Forage Plants	G. Speth.
Bulletin 14	Variety and Fertilizer Experiments with Oats; Variety Tests with Wheat.	R. J. Redding
	Variety Tests and Fertilizer Experiments with Vegetables.	G. Speth.
Bulletin 15	Fertilizer, Culture, and Variety Experiments on Corn	R. J. Redding.
	Culture of Small Fruits	G. Speth.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 16	Cotton: Fertilizer, Culture, and Variety Tests	R. J. Redding.
Spec. Bulletin 16½	Announcement Regarding Station Publications	
Bulletin 17	Irish Potatoes; Sweet Potatoes; Tomatoes; Forage Plants	G. Speth.
Spec. Bulletin 17½	The Air and the Soil in their Relations to Agriculture	H. C. White.
Bulletin 18	Cheese and Butter Dairying	R. J. Redding.
Bulletin 19	Culture of Tobacco	Do.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 20	Fertilizer, Culture, and Variety Experiments; Corn and Cotton.	Do.
Bulletin 21	Practical Dairying; Dehorning Cattle; Feed Formulas; Experiments.	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

GEORGIA STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 22	Manures and Fertilizers	H. C. White.
Bulletin 23	Fertilizer, Culture, and Variety Experiments on Corn	R. J. Redding.
	Fertilizer and Variety Tests on Field Peas	H. N. Starnes.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 24	Variety, Fertilizer, and Culture Experiments on Cotton	R. J. Redding.
	Cotton Crosses and Hybrids	H. N. Starnes.
Bulletin 25	Sweet Potatoes	Do.
Bulletin 26	Cowpeas: Fertilizer and Variety Tests	Do.
Bulletin 27	Fertilizer, Culture, and Variety Experiments on Corn; Fertilizer and Variety Tests on Cotton; Green Manuring with Cowpeas.	R. J. Redding.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 28	Grape Culture	H. N. Starnes.
Bulletin 29	Irish Potatoes	Do.
Bulletin 30	Corn Culture; Oat Culture	R. J. Redding.
Bulletin 31	Cotton Culture	Do.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 32	Strawberries	H. N. Starnes.
Bulletin 33	The Cultivated Blackberries and Dewberries	Do.
Bulletin 34	Corn Culture	R. J. Redding.
Bulletin 35	Cotton Culture	Do.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 36	The San José and Other Scales in Georgia	H. N. Starnes.
Bulletin 37	Corn Culture	R. J. Redding.
Bulletin 38	Watermelons	H. N. Starnes.
Bulletin 39	Cotton Culture: Fertilizer Formulas	R. J. Redding.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 40	Stringfellow Root Pruning Theory	H. N. Starnes.
Bulletin 41	Corn Culture: Fertilizer, Variety, and Culture Tests	R. J. Redding.
Bulletin 42	Some Peach Notes	H. N. Starnes.
Bulletin 43	Cotton: Fertilizer, Culture, and Variety Experiments	R. J. Redding.
Bulletin 44	Wheat and Oats, Rye and Barley	Do.
Bulletin 45	Some Important Insect Enemies of Cucurbits	A. L. Quaintance.
Annual Report	Eleventh Annual Report, 1898	

IDAHO STATION.

1892.		
Bulletin 1	Organization and Progress of Work of the Experiment Stations.	R. Milliken.
Bulletin 2	Announcement and Proposed Work of the Stations	Do.
1893.		
Bulletin 3	The Application of Chemistry to the Agricultural Development of Idaho.	C. W. McCurdy.
Bulletin 4	Methods of Preventing Smut in Wheat and Oats; Carbon Bisulphid as a Squirrel Exterminator: A New Squirrel Exterminator.	C. P. Fox.
Bulletin 5	The Relation of Meteorology to the Agricultural Interests of Idaho.	J. E. Bonebright.
1894.		
Bulletin 6	First Annual Report, 1893	
Bulletin 7	Insecticides and Spraying	J. M. Aldrich.
Bulletin 8	Water and Water Analyses	C. W. McCurdy.
Bulletin 9	Idaho Soils: Their Origin and Composition. Miscellaneous Analyses.	Do.
Annual Report	Annual Report, 1894	
1895.		
Annual Report	Annual Report, 1895	
1896.		
Annual Report	Annual Report, 1896	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

IDAHO STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 10	Idaho Agriculture, Descriptive and Experimental	C. P. Fox.
1898.		
Bulletin 11	Smuts and Rusts of Grains in Idaho, and the Most Approved Methods of Dealing with Them.	L. F. Henderson.
Bulletin 12	Sugar Beets in Idaho	C. W. McCurdy.
Bulletin 13	Meteorology	J. E. Bonebright.
Bulletin 14	Twelve of Idaho's Worst Weeds	L. F. Henderson.
Bulletin 15	I. Report for Fiscal Year ending June 30, 1898, with Financial Reports for 1897–98. II. Miscellaneous Information.	
1899.		
Bulletin 16	The San José Scale in Idaho	J. M. Aldrich.
Bulletin 17	Construction and Management of Hotbeds	F. A. Huntley.
Bulletin 18	Sugar Beet Investigation in 1898	C. W. McCurdy, and T. Smith.
Bulletin 19	Miscellaneous Analyses: Strawberries, Peas, Wines, Foods, Poisons, Fertilizers, Potable Water.	Do.

ILLINOIS STATION.

1885.		
Bulletin 1*a*	Economical Rearing and Feeding of Cattle	T. F. Hunt.
1886.		
Bulletin 2*a*	Report of the Horticultural Department	
1887.		
Bulletin 3*a*	On the Moisture of the Soil and its Relations to Tile Drainage and Cultivation.	
Bulletin 4*a*	Experiments in Feeding Pigs, Winter of 1886–87	Do.
1888.		
Bulletin 1	General Outline of Work	S. H. Peabody.
Bulletin 2	Ensilage	T. F. Hunt.
Bulletin 3	Field Experiments in Oats	G. E. Morrow and T. F. Hunt.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 4	Field Experiments with Corn	Do.
	Experiments with Sweet Corn	T. J. Burrill and G. W. McCluer.
Bulletin 5	Grasses and Clovers	T. F. Hunt.
Bulletin 6	A Bacterial Disease of Corn	T. J. Burrill.
Bulletin 7	The Biology of Ensilage	Do.
	Field Experiments with Oats, 1889	T. F. Hunt.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 8	Field Experiments with Corn	T. J. Burrill and G. W. McCluer.
Bulletin 9	Milk and Butter Tests	A. G. Manns.
	The Comparative Value of Corn Fodder and Ensilage in Feeding Yearling Heifers.	T. F. Hunt.
	Analyses of Corn Fodder and Ensilage made in Connection with the Foregoing Experiments.	E. H. Farrington.
	Value of Pasturage and Grain Ration with Pasturage for Young Cattle.	G. E. Morrow.
	List of Experiments in Progress	
Bulletin 10	Investigation of Milk Tests	E. H. Farrington.
Bulletin 11	Experiments with Wheat	T. F. Hunt.
Bulletin 12	Field Experiments with Oats	G. E. Morrow and T. F. Hunt.
	Milk and Butter Tests	G. E. Morrow.
	Cream Raising by Dilution	G. E. Morrow and E. H. Farrington.
	The Hessian Fly	S. A. Forbes.
	Canada Thistles	T. J. Burrill.
Annual Report	Third Annual Report, 1890	

a Issued as bulletins of the University of Illinois.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ILLINOIS STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 13	Field Experiments with Corn	G. E. Morrow and T. F. Hunt.
Bulletin 14	Milk Tests; Chemical Analyses of "Germ Meal" and Oat-Dust Feed.	E. H. Farrington.
Bulletin 15	Fruit Bark Beetle	S. A. Forbes.
	Experiments with Grass Seeds	G. E. Morrow and T. F. Hunt.
	Use of Fungicides upon the Apple, Potato, and Grape	T. J. Burrill and G. W. McCluer.
Bulletin 16	Experiments in Pig Feeding	G. E. Morrow.
	Composite Milk Samples Tested for Butter Fats	E. H. Farrington.
Bulletin 17	Experiments with Wheat, 1890–91	G. E. Morrow.
	Daily Variations in Milk and Butter Production of Cows	E. H. Farrington.
Bulletin 18	Dairying Experiments	Do.
Annual Report	Annual Report, 1891	
1892.		
Bulletin 19	Experiments with Oats	G. E. Morrow and F. D. Gardner.
	The Chinch Bug in Illinois	S. A. Forbes.
Bulletin 20	Field Experiments with Corn	G. E. Morrow and F. D. Gardner.
Bulletin 21	Horticulture, a General Report	T. J. Burrill and G. W. McCluer et al.
Bulletin 22	Experiments with Wheat, 1891–92	G. E. Morrow and F. D. Gardner.
Bulletin 23	Experiments with Oats	Do.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 24	Variations in Milk	E. H. Farrington.
Bulletin 25	Field Experiments with Corn	G. E. Morrow and F. D. Gardner.
Bulletin 26	The Forest Tree Plantation	T. J. Burrill and G. W. McCluer.
Bulletin 27	Some New Points in the Manipulation of the Babcock Milk Test.	E. H. Farrington.
Bulletin 28	Grapes: Test of Varieties; A Grape Disease; Method of Training.	G. W. McCluer.
Bulletin 29	Orange Rust in Raspberries and Blackberries	G. P. Clinton.
	A New Factor in Scientific Agriculture	A. Schneider.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 30	Blackberries and Raspberries: Variety Tests and Management.	G. W. McCluer.
Bulletin 31	Corn and Oats Experiments, 1893	G. E. Morrow, F. D. Gardner, and E. H. Farrington.
Bulletin 32	An Acid Test of Cream	E. H. Farrington.
Bulletin 33	The Chinch Bug in Illinois, 1894	S. A. Forbes.
	Alkaline Tablets for Testing the Acidity of Cream	E. H. Farrington.
	Certified Tests of Dairy Cows	G. E. Morrow.
Bulletin 34	Experiments with Wheat, 1893–94; Experiments with Oats, 1894.	G. E. Morrow and F. D. Gardner.
Bulletin 35	The Russian Thistle in Illinois	G. E. Morrow.
Bulletin 36	Stock Feeding in Illinois	Do.
	Index to Bulletins 17–36	
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 37	Corn Experiments, 1894	F. D. Gardner.
Bulletin 38	Experiments with the Muscardine Disease of the Chinch Bug, and with the Trap and Barrier Method for the Destruction of that Insect.	S. A. Forbes.
Bulletin 39	The Russian Thistle and Some Plants that are Mistaken for It.	G. P. Clinton.
Bulletin 40	Potatoes: Experiments of 1892–1894, with a Statement of Some Results Obtained at Other Stations.	G. W. McCluer.
	Fungus Diseases of the Potato: An Experiment to Prevent Scab and Leaf Blight of the Potato.	G. P. Clinton.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 41	Experiments with Wheat, 1888–1895: Experiments with Oats, 1888–1895.	E. Davenport and W. J. Fraser.
Bulletin 42	Corn Experiments, 1895	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

ILLINOIS STATION—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 43	Composition and Digestibility of Corn Silage, Cowpea Silage, Soja-Bean Silage, and Corn Fodder.	C. G. Hopkins.
Bulletin 44	Insects Injurious to the Seed and Root of Indian Corn	S. A. Forbes.
Bulletin 45	Varieties of Apples	T. J. Burrill and G. W. McCluer.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 46	Experiments with Corn	W. J. Fraser.
	Attempts to Grow Crimson Clover. On the Improvement of Retentive Clays; Drainage of the so-called "Hard Pan" Lands of Southern Illinois. On the Importance of the Physiological Requirements of the Animal Body. Results of an Attempt to Grow Cattle Without Coarse Feed.	E. Davenport.
Bulletin 47	Broom-Corn Smut	G. P. Clinton.
Bulletin 48	The San José Scale in Illinois	S. A. Forbes.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 49	The Sugar Beet in Illinois	P. G. Holden and C. G. Hopkins.
Bulletin 50	The Cost of Production of Corn and Oats in Illinois in 1896.	N. A. Weston.
Bulletin 51	Variations in Milk and Milk Production	E. Davenport and W. J. Fraser.
Bulletin 52	Orchard Cultivation	T. J. Burrill and J. C. Blair.
Bulletin 53	The Chemistry of the Corn Kernel	C. G. Hopkins.
Circular 13	A Study of the Milk Supply of Chicago	J. Addams and H. S. Grindley.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 54	Spraying Apple Trees, with Special Reference to Apple Scab Fungus.	J. C. Blair.
Bulletin 55	Improvement in the Chemical Composition of the Corn Kernel.	C. G. Hopkins.
Bulletin 56	Recent Work on the San José Scale in Illinois	S. A. Forbes.

INDIANA STATION. *a*

1875–1883.		
Annual Reports.	Annual Reports, 1875–1883	
1884.		
Bulletin 1	Report on Hessian Fly	F. M. Webster.
Bulletin 2	Report on Experiments with Various Commercial Fertilizers on Corn and Potatoes.	W. C. Latta.
Annual Report	Annual Report, 1884	
1885.		
Bulletin 3	Report on Insects Affecting Growing Wheat	F. M. Webster.
Bulletin 4	Experiments with Wheat	W. C. Latta.
Bulletin 5	Experiments with Small Fruits	J. Troop.
Annual Report	Annual Report, 1885	
1886.		
Bulletin 6	Experiments with Oats and Corn	W. C. Latta.
Bulletin 7	do	Do.
	Notes on Commercial Fertilizers and Agricultural Chemistry.	R. B. Warder.
Bulletin 8	Experiments with Wheat	W. C. Latta.
Bulletin 9	The American Meromyza	F. M. Webster.
Bulletin 10	Report on Horticultural Experiment Stations	J. Troop.
Annual Report	Annual Report, 1886	
1887.		
Bulletin 11	Commercial Fertilizers	R. B. Warder.
Bulletin 12	Experiments with Wheat	W. C. Latta.
Annual Report	Annual Report, 1887	

a The publications for the years 1875 to 1887, inclusive, were issued by the School of Agriculture of Purdue University.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

INDIANA STATION—Continued.

Publication.	Title.	Author.
1888.		
Bulletin 13	Report of New Organization	J. H. Smart.
Bulletin 14	Experiments with Oats and Corn	W. C. Latta.
Bulletin 15	Report Concerning the Potato Tuber	J. C. Arthur.
Bulletin 16	Experiments with Wheat: Crop Rotations	W. C. Latta.
Bulletin 17	Parturient Apoplexy	T. D. Hinebauch.
Annual Report	First Annual Report (of Station), 1888	
1889.		
Bulletin 18	Experiments with Vegetables	J. Troop.
Bulletin 19	Spotting of Peaches and Cucumbers	J. C. Arthur.
Bulletin 20	Experiments in Cross-Fertilization and the Culture of Tropical Ferns.	P. Van Landeghem.
Bulletin 21	Rational Feeding	C. A. Wulff.
Bulletin 22	Commercial Fertilizers	H. A. Huston.
Bulletin 23	Experiments with Corn	W. C. Latta.
Bulletin 24	Experiments on Milk Production	C. A. Wulff.
Bulletin 25	Entomological Experiments	F. M. Webster.
Bulletin 26	Wheat Rust	H. L. Bolley.
Bulletin 27	Field Experiments with Wheat	W. C. Latta.
Bulletin 28	Smut of Wheat and Oats	J. C. Arthur.
Bulletin 29	Grasses of Indiana	J. Troop.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 30	Influenza	T. D. Hinebauch.
Bulletin 31	Small Fruits and Vegetables	J. Troop.
Bulletin 32	Treatment of Smut in Wheat	J. C. Arthor.
	Field Experiments with Wheat	W. C. Latta.
	Two Expensive Fertilizers	C. S. Plumb.
Bulletin 33	Small Fruits	J. Troop.
	Entomological Notes	F. M. Webster.
	Absorptive Power of Soils	H. A. Huston and A. Goss.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 34	Sugar Beets	H. A. Huston.
	Field Experiments with Fertilizers on Barley and Oats	W. C. Latta.
	Tests of Vegetables	J. Troop.
Bulletin 35	Loose Smut of Oats	J. C. Arthur.
Bulletin 36	Field Experiments with Wheat; Testing Grain	W. C. Latta.
	Wheat Scab	J. C. Arthur.
	Forms of Nitrogen for Wheat	H. A. Huston.
Bulletin 37	Steer Feeding	C. S. Plumb.
	Indiana Feeding Stuffs	H. A. Huston.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 38	Small Fruits; Treatment of Powdery Mildew and Black Rot; Vegetables.	J. Troop.
Bulletin 39	Field Experiments with Corn	W. C. Latta.
	Sugar Beets	H. A. Huston.
	Diseases of the Sugar-Beet Root	J. C. Arthur.
Bulletin 40	The Silo and Silage in Indiana	C. S. Plumb.
	Field Experiments with Wheat	W. C. Latta.
Bulletin 41	Forms of Nitrogen for Wheat	H. A. Huston.
Bulletin 42	The Potato—The Relation of Number of Eyes on the Seed Tuber to the Product.	J. C. Arthur.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 43	Field Experiments with Corn	W. C. Latta.
	The Sugar Beet in Indiana	H. A. Huston.
Bulletin 44	Dairy Experiments	C. S. Plumb.
Bulletin 45	Field Experiments with Wheat	W. C. Latta.
	Forms of Nitrogen for Wheat	H. A. Huston.
Bulletin 46	A Modification of Grandeau's Method for the Determination of Humus; Determination of Crude Fiber.	H. A. Huston and W. F. McBride.
Bulletin 47	Does it Pay to Shelter Milch Cows in Winter? Upon Skim Milk as a Food for Calves.	C. S. Plumb.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 48	Experiments with Small Fruits	J. Troop.
Bulletin 49	Sugar Beets	H. A. Huston.
Bulletin 50	Field Experiments with Corn and Oats	W. C. Latta.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

INDIANA STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 51	Field Experiments with Wheat	W. C. Latta and G. R. Ives.
	Forms of Nitrogen for Wheat	H. A. Huston.
Bulletin 52	Wild, or Prickly, Lettuce	J. C. Arthur.
Bulletin 53	Influence of Climate on Onions from Seed; Potato Scab; Russian Apples in Indiana; Protecting Fruit from Birds; The Fruit-Bark Beetle	J. Troop.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 54	New Chemical Apparatus	H. A. Huston.
Bulletin 55	Experiments with Small Fruits	J. Troop.
	Experiments with Corn and Oats	W. C. Latta and G. R. Ives.
	Sugar Beets	H. A. Huston.
Bulletin 56	Field Experiments with Wheat	W. C. Latta and S. P. Carithers.
	Potato Scab and its Prevention	J. C. Arthur.
Bulletin 57	The Improvement of Unproductive Black Soils	H. A. Huston.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 58	Hog Cholera and Swine Plague in Indiana	A. W. Bitting.
Bulletin 59	Bacteriosis of Carnations	J. C. Arthur and H. L. Bolley.
Bulletin 60	The American Persimmon	J. Troop and O. M. Hadley.
Bulletin 61	Field Experiments with Wheat	W. C. Latta and W. B. Anderson.
Bulletin 62	The Udder of the Cow	C. S. Plumb.
Bulletin 63	Bovine Tuberculosis in Indiana	A. W. Bitting.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 64	Field Experiments with Corn, Oats, and Forage Plants	W. C. Latta and W. B. Anderson.
Bulletin 65	Formalin for Prevention of Potato Scab	J. C. Arthur.
Bulletin 66	Indoor Lettuce Culture	W. S. Stuart.
Bulletin 67	Wheat and Corn as Food for Pigs	C. S. Plumb and W. B. Anderson.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 68	The Sugar Beet in Indiana	H. A. Huston and J. M. Barrett.
Bulletin 69	Insecticides, Fungicides, and Spraying	J. Troop.
Bulletin 70	The Relation of Water Supply to Animal Diseases	A. W. Bitting.
Bulletin 71	I. Corn Meal and Shorts as Food for Pigs	C. S. Plumb and W. B. Anderson.
	II. Skim Milk as Food for Young Growing Chickens	W. B. Anderson.
Bulletin 72	Field Experiments with Wheat	W. C. Latta and W. B. Anderson.
Bulletin 73	Tests of Strawberries, Raspberries, Blackberries, and Grapes	J. Troop.
Bulletin 74	A Native White Bedding Plant: The Starry Grasswort	J. C. Arthur.
Annual Report	Eleventh Report, 1898	
1899.		
Bulletin 75	The Sugar Beet in Indiana in 1898	H. A. Huston and A. H. Bryan.
Bulletin 76	Skim Milk as a Food for Young Growing Chickens	W. B. Anderson.
Bulletin 77	Field Experiments with Corn	W. C. Latta and W. B. Anderson.
Bulletin 78	The San José and Other Scale Insects, and the Indiana Nursery Inspection Law	J. Troop.
Bulletin 79	Roots as Food for Pigs	C. S. Plumb and H. E. Van Norman.
Circular 1	List of Bulletins and Reports, 1884–1898	C. S. Plumb.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

IOWA STATION.

Publication.	Title.	Author.
1888.		
Bulletin 1	Organization and Plans	R. P. Speer.
	Notes on Crossing	A. A. Crozier.
Bulletin 2	Corn Tassels, Silks, and Blades	R. P. Speer.
	Fodder Analysis	G. E. Patrick.
	Grasses and Other Forage Plants	A. A. Crozier.
	A Few Important Chinch-Bug Remedies. Arsenic Experiments.	C. P. Gillette.
	Promising New Cherries	J. L. Budd.
Bulletin 3	Characteristics of Hardy and Tender Fruit Trees	R. P. Speer.
	Chinch-Bug Diseases	C. P. Gillette.
	Some Injurious Fungi. Work in Crossing	A. A. Crozier.
	Promising New Pears	J. L. Budd.
	Promising Grasses of the Northwestern Territories	J. Craig.
	Analysis of Apples	G. E. Patrick.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 4	Wild Plums	R. P. Speer.
	A Chemical Study of Apple Twigs	G. E. Patrick.
	An Investigation of Apple Twigs	B. D. Halsted.
	Propagation of Trees and Shrubs from Cuttings	J. Craig.
	Some Suggestions Concerning the Corn-Root Worm	H. Osborn.
Bulletin 5	Sorghum	G. E. Patrick.
	Important Injurious Insects	C. P. Gillette.
Bulletin 6	Experiment Station Wheat and Oats in 1889	R. P. Speer.
	Feeding Experiments: Comparison of Fodders and Rations in Fattening Steers.	G. E. Patrick and L. P. Smith.
	Food Habits of the Striped Prairie Squirrel	C. P. Gillette.
Bulletin 7	Experiments with Corn. The Millets. Sugar Experiments.	R. P. Speer.
	Codling Moth Experiments. New Cynipidæ. The Hog Louse.	C. P. Gillette.
	The College Vineyard	J. L. Budd.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 8	Iowa Station Milk Test. Sweet-Cream Butter. Sugar Beets. Sorghum.	G. E. Patrick.
Bulletin 9	Comparative Value of Fodder Plants and Other Feeding Stuffs.	R. P. Speer.
	The Iowa Station Milk Test—a Correction. The Relative Value Plan at Creameries.	G. E. Patrick.
	The Plum Curculio and the Plum Gouger	C. P. Gillette.
Bulletin 10	Our Rusted and Blighted Wheat, Oats, and Barley in 1890. Corn Fodder.	R. P. Speer.
	Experiments with Arsenites	C. P. Gillette.
	Stocks for the Cherry, Plum, Prune, and Apricot	J. L. Budd.
	A Chemical Study of Blue Grass	C. M. Wade.
Bulletin 11	Experiments in Making and Storing Hay	R. P. Speer.
	Cultivated and Wild Varieties of the Grasses in Iowa	R. P. Speer, C. M. Wade, and G. E. Patrick.
	Creamery and Dairy Notes	G. E. Patrick.
	The Potato-Stalk Weevil, Apple Curculio, and a New Currant Borer. Kerosene Emulsion as a Sheep Dip and as a Destroyer of Parasites on Domestic Animals.	C. P. Gillette.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 12	Experiments with Potatoes in 1889–90. A Feeding Experiment.	R. P. Speer.
	Sugar Beets	G. E. Patrick and E. N. Eaton.
	Sorghum	G. E. Patrick.
	Injurious Insects and Insecticides	C. P. Gillette.
	Index to Volume I, Bulletins 1–12	
Bulletin 13	Experiment in Feeding for Milk	J. Wilson, G. E. Patrick, C. F. Curtiss, E. N. Eaton, and D. A. Kent.
	Treatment of Fungus Diseases	L. H. Pammel.
	Preliminary Report on the Examination of Some Seeds	P. H. Rolfs.
	Notes on Methods of Cross Pollination	F. A. Sirrine.
	Some Insects Destructive to Grass	H. Osborn.
	Blossoms of the Orchard Fruits	J. L. Budd.
	Some Observations on Contaminated Water Supply for Stock.	M. Stalker.

Publications of the Agricultural Experiment Stations of the United State-, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

IOWA STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 14	Effect of Feed upon the Quality of Milk. Calf Feeding Experiment.	J. Wilson, C. F. Curtiss, D. A. Kent, and G. E. Patrick.
	A Feeding Experiment for Milk	J. Wilson, C. F. Curtiss, D. A. Kent, G. E. Patrick, and E. N. Eaton.
	Hog Experiment No. 1	J. Wilson, C. F. Curtiss, and D. A. Kent.
	Reports of Entomological Work	H. Osborn and H. A. Gossard.
	Breeding of the Orchard and Garden Fruits	
	An Aphthous Affection among Dairy Cows of the State	M. Stalker.
Bulletin 15	Sugar Beet Growing. Soiling Experiments	J. Wilson, C. F. Curtiss, D. A. Kent, and G. E. Patrick.
	Sugar Beets in Iowa, 1891	G. E. Patrick, E. N. Eaton, and D. B. Bisbee.
	Fungus Diseases of Sugar Beet	L. H. Pammel.
	Reports on Injurious Insects	H. Osborn and H. A. Gossard.
	Time of Sowing Grass Seed. Winter Wheat. Best Varieties of Oats.	J. Wilson, C. F. Curtiss, and D. A. Kent.
	Fertilizers	J. Wilson.
1892.		
Bulletin 16	Flaxseed Meal and Oil Meal	J. Wilson, C. F. Curtiss, and D. A. Kent.
	Crop Report of the Farm Department	D. A. Kent.
	Varieties of Potatoes. Corn Growing	C. F. Curtiss.
	Experiments with Fungicides	L. H. Pammel.
	Lice Affecting Domestic Animals	H. Osborn.
	Sugar Beets	G. E. Patrick.
	What to Plant on the Home Grounds	J. L. Budd.
	Hints for Beginners in Dairying	F. A. Leighton.
Bulletin 17	Feeding Beets and Potatoes for Butter	J. Wilson, F. A. Leighton, and D. B. Bisbee.
	Feeding Lambs	C. F. Curtiss.
	Winter Feeding of Hogs	
	Feeding Milk	J. Wilson and G. E. Patrick.
	Sugar Beets in Iowa, 1891	G. E. Patrick, E. N. Eaton, and D. B. Bisbee.
	Treatment of Some Fungus Diseases	L. H. Pammel.
	Effects of Spraying on Plants and Fruit, and Notes on Insects	H. Osborn.
	Ergotism	M. Stalker.
Bulletin 18	Experiments with Sheep. Feeding Colts	J. Wilson and C. F Curtiss.
	Sweet v. Sour Cream Butter	G. E. Patrick, F. A. Leighton, and D. B. Bisbee.
	Some Diseases of Plants Common to Iowa Cereals	L. H. Pammel.
	Reports on Injurious Insects	H. Osborn and H. A. Gossard.
	The Apple Trees and Apple Crop on the College Farm	J. L. Budd.
	A Farm Creaming Experiment	F. A. Leighton and H. C. Wallace.
	Experimental Creamery	D. A. Kent.
Bulletin 19	Experiments with New Orchard Fruits, Trees, and Shrubs	J. L. Budd.
	Report of Experiments and Studies in Entomology	H. Osborn, H. A. Gossard, and F. A. Sirrine.
	The Crossing of Cucurbits	L. H. Pammel.
	Root Crops. Depth of Covering Grass Seed. Winter Wheats.	J. Wilson and C. F. Curtiss.
	Corn Growing. Calf Feeding	C. F. Curtiss.
	Hog Feeding	D. A. Kent and O. C. Van Houten.
	Soiling Crops	J. Wilson, C. F. Curtiss, and W. H. Heileman.
	Hints to Cheese Makers	G. L. McKay.
	An Automatic Acid Measure	G. E. Patrick.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

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IOWA STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 20	Steer Feeding	J. Wilson and C. F. Curtiss.
	Sugar Beets in Iowa, 1892	G. E. Patrick, W. H. Heileman, and E. N. Eaton.
	Machinery and Methods of Spraying	H. Osborn and L. H. Pammel.
	Grass Leaf Hoppers	H. Osborn.
	Treatment of Spot Diseases of the Cherry and Currant, and Potato Blight.	L. H. Pammel.
	Prevention of Corn and Oat Smut	L. H. Pammel and F. C. Stewart.
	Experiments with Mullein	W. B. Niles.
	Rainfall Record	E. N. Eaton and E. S. King.
Bulletin 21	Investigations in Cheese Making	H. C. Wallace.
	Feeding Colts. Shrinkage of Wool	C. F. Curtiss.
	Time to Cut Corn	D. A. Kent, G. E. Patrick, E. N. Eaton, and W. H. Heileman.
	Sweet v. Ripened Cream Butter	G. E. Patrick, F. A. Leighton, and W. H. Heileman.
	An Aromatic Bacillus of Cheese. Some Bacteriological Work in the Dairy	L. H. Pammel.
	The Impurities of Clover Seed	F. C. Stewart.
Bulletin 22	A Study in Churning	H. C. Wallace.
	Composite Samples at Creameries; Chromate Preservatives. Rennet Extracts of Commerce.	G. E. Patrick.
	The Use of the Sand Cherry for Stocks. Rose Hybrids	J. L. Budd and N. E. Hansen.
Bulletin 23	Soiling	J. Wilson.
	A Study of Ripening Corn	C. F. Curtiss and G. E. Patrick.
	Notes on Injurious Insects	H. Osborn and F. A. Sirrine.
	Results of Crossing Cucurbits. Notes on a Few Common Fungus Diseases.	L. H. Pammel.
	Sugar Beets in Iowa, 1893	G. E. Patrick and O. H. Pagelsen.
	Rainfall Record	W. H. Heileman.
1894.		
Bulletin 24	Steer and Heifer Beef	J. Wilson and C. F. Curtiss.
	Changes During Cheese Ripening	G. E. Patrick.
	Spraying to Prevent Oat and Wheat Rust. Experiment in Treating Spot Diseases of Currants.	L. H. Pammel.
	Experiments in Treating Oats with Different Chemicals and Hot Water.	F. C. Stewart and L. H. Pammel.
	Corn Insects: Their Injuries and How to Treat Them	H. Osborn.
	Index to Volume II, Bulletins 13–24	
Bulletin 25	Feeding Winter Dairy Cows	J. Wilson.
	Calf Feeding	C. F. Curtiss.
	Specific Gravity and Weight of Wheat Seeds	L. H. Pammel and F. C. Stewart.
	Report on Separators	H. C. Wallace.
	Gravity Creaming	F. L. Kent.
	Corn Meal v. Grass with Stock Steers	D. A. Kent.
	Actinomycosis and the Iodid Treatment	W. B. Niles.
	Rainfall Record	W. H. Heileman.
Bulletin 26	The Russian Thistle	J. Wilson, L. H. Pammel, G. E. Patrick, and J. L. Budd.
1895.		
Bulletin 27	Soiling Crops, 1894. Growing Turnips	J. Wilson.
	Construction and Ventilation of Dairy Barns. Experimental Crop Notes for 1894.	C. F. Curtiss.
	Potato Scab and Its Prevention	
	Ruta-baga Rot	L. H. Pammel.
	Observations on Insects—Season of 1894	H. Osborn and C. W. Mally.
	Best Ferns for the North and Northwest	G. W. Carver.
Bulletin 28	Angus and Shorthorn Feeding Experiment	J. Wilson and C. F. Curtiss.
	Feeding Cotton Seed and Other Meals to Hogs	C. F. Curtiss.
	Sugar Beets in Iowa	G. E. Patrick.
	Two Noxious Weeds. Poisoning from Cow Bane	L. H. Pammel.

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IOWA STATION—Continued.

Publication.	Title.	Author.
1895.		
Bulletin 28	Second Report on the Sand Cherry as a Stock for the Plum and Cherry.	J. L. Budd and N. E. Hansen.
	Test of Dairy Salts	F. L. Kent and F. A. Leighton.
	Rainfall Record	W. H. Heileman.
Bulletin 29	Investigation of Bovine Tuberculosis, with Special Reference to its Existence in Iowa.	M. Stalker and W. B. Niles.
Bulletin 30	Treatment of Currants and Cherries to Prevent Spot Diseases.	L. H. Pammel and G. W. Carver.
	Squirrel-Tail Grass, or Wild Barley	L. H. Pammel, J. B. Weems, and W. H. Heileman.
Bulletin 31	Experiments with New Orchard Fruits, Trees, and Shrubs	J. L. Budd.
Biennial Report	Biennial Report for 1894 and 1895	
1896.		
Bulletin 32	Entomological Work for 1895	H. Osborn and C. W. Mally.
	Feeding Dairy Cows	J. Wilson.
	Feeding Cotton-Seed Meal to Dairy Cows. Maturing Skim-Milk Calves. Crop Notes, 1895.	C. F. Curtiss.
	Butter Flavor	G. L. McKay.
	Some of Our Advances in Breeding Fruits and Shrubs	J. L. Budd and N. E. Hansen.
	Milk Preservatives—Formalin. Soil Moisture, 1895	J. B. Weems and W. H. Heileman.
	Our Window Gardens	G. W. Carver.
Bulletin 33	Feeding Lambs. Steer and Heifer Beef, II	J. Wilson and C. F. Curtiss.
	Old v. New Process Linseed Meal	J. Wilson and C. D. Reed.
	Notes on Injurious Insects	H. Osborn.
	Fresh Cow v. Stripper Butter	G. L. McKay and C. H. Eckles.
1897.		
Bulletin 34	Studies of the Life Histories of Grass-Feeding Jassidæ	H. Osborn and E. D. Ball.
	Some Troublesome Weeds of the Mustard Family	L. H. Pammel.
	Notes on Dairy Bacteriology	L. H. Pammel and I. J. Mead.
	Home Propagation	J. L. Budd.
	Crop Notes, 1896	C. F. Curtiss.
Bulletin 35	Lamb Feeding, II. Fattening Range Lambs	C. F. Curtiss and J. W. Wilson.
	Raising Calves on Separator Milk	C. F. Curtiss.
	Hog Cholera and Swine Plague. Diseases of Sheep as Observed in Iowa.	W. B. Niles.
	Quick and Slow Ripening of Cream	G. L. McKay and C. H. Eckles.
Bulletin 36	Soil Moisture	J. B. Weems and J. J. Edgerton.
	Some Botanical Studies on Corn	L. H. Pammel and R. Combs.
	Seed Testing	C. R. Ball.
	The Alfalfa Leaf-Spot Disease	R. Combs.
	The San José Scale	H. Osborn.
	Effect of Period of Lactation on Milk and Quality of Butter	G. L. McKay and J. W. Wilson.
	Hybrid Roses, Gooseberries, and Strawberries	J. L. Budd.
	Index to Volume III, Bulletins 25–36	
Biennial Report	Biennial Report for 1896 and 1897	
1898.		
Bulletin 37	Sugar-Beet Investigations, 1897	C. F. Curtiss and J. Atkinson.
Bulletin 38	The Russian Thistle	L. H. Pammel.
Bulletin 39	Weeds of Corn Fields	Do.
1899.		
Bulletin 40	The Relation of Acid Fermentation to Butter Flavor and Aroma.	C. H. Eckles.
Bulletin 41	Some Reports from Trial Stations on New Orchard Fruits and Shrubs.	J. L. Budd.
Bulletin 42	Horse Nettle as a Troublesome Weed in Iowa. Two Other Troublesome Weeds.	L. H. Pammel.
	Potato Scab	C. R. Ball.
Bulletin 43	Some Injurious Scale Insects	W. Newell.

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KANSAS STATION.

Publication.	Title.	Author.
1888.		
Bulletin 1	Outline of Work	
Bulletin 2	Cultivated Grasses and Clovers in Kansas	E. M. Shelton.
Bulletin 3	Observations on Two Insect Pests	E. A. Popenoe.
Bulletin 4	Experiments with Wheat	E. M. Shelton.
Bulletin 5	Some Comparisons of Varieties of Sorghum	G. H. Failyer.
	Preliminary Report on Sorghum Blight	W. A. Kellerman.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 6	Silos and Silage	E. M. Shelton.
Bulletin 7	Experiments with Wheat	Do.
Bulletin 8	Preliminary Report on Smut in Oats	W. A. Kellerman and W. T. Swingle.
Bulletin 9	Experiments in Pig Feeding	E. M. Shelton and H. M. Cottrell.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 10	Notes on Conifers	E. A. Popenoe, S. C. Mason, and F. A. Marlatt.
Bulletin 11	Experiments with Wheat	C. C. Georgeson, H. M. Cottrell, and W. Shelton.
Bulletin 12	Preliminary Experiments with Fungicides for Stinking Smut of Wheat.	W. A. Kellerman and W. T. Swingle.
Bulletin 13	Experiments with Oats	C. C. Georgeson, H. M. Cottrell, and W. Shelton.
Bulletin 14	Winter Protection of the Peach Tree; Notes on Grapes	E. A. Popenoe, S. C. Mason, and F. A. Marlatt.
Bulletin 15	Additional Experiments and Observations on Oat Smut made in 1890.	W. A. Kellerman, and W. T. Swingle.
Bulletin 16	Experiments with Sorghum and Sugar Beets	G. H. Failyer and J. T. Willard.
Bulletin 17	Crossed Varieties of Corn, Second and Third Years	W. A. Kellerman and W. T. Swingle.
Bulletin 18	Experiments with Forage Plants	C. C. Georgeson, H. M. Cottrell, W. Shelton.
Bulletin 19	[Notes on Vegetables]	E. A. Popenoe, S. C. Mason, and F. A. Marlatt.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 20	Experiments with Wheat	C. C. Georgeson, H. M. Cottrell, and W. Shelton.
Bulletin 21	Second Report on Fungicides for Stinking Smut of Wheat.	W. A. Kellerman.
Bulletin 22	Smut of Oats in 1891; Test of Fungicides to Prevent Loose Smut of Wheat; Spraying to Prevent Wheat Rust.	Do.
Bulletin 23	Smuts of Sorghum; Corn Smut	Do.
Bulletin 24	Enzoötic Cerebritis or "Staggers" of Horses	N. S. Mayo.
Bulletin 25	Experiments with Sorghum	G. H. Failyer and J. T. Willard.
Bulletin 26	A Comparison of the Varieties of the Strawberry	E. A. Popenoe and S. C. Mason.
Bulletin 27	Crossed Varieties of Corn, Third Year	W. A. Kellerman and C. H. Thompson.
Bulletin 28	Second Report on Station Vineyard	E. A. Popenoe and S. C. Mason.
Bulletin 29	Experiment with Oats	C. C. Georgeson, F. C. Burtis, and W. Shelton.
Bulletin 30	Experiment with Corn	Do.
Bulletin 31	Sugar Beets	G. H. Failyer and J. T. Willard.
Bulletin 32	Analyses of Feeding Stuffs; Composition of Cereals at Different Stages of Growth.	Do.
	Test of Japanese Beans; Plaster and Oil Meal as Fertilizers for Millet; Plaster as a Fertilizer for Grasses.	C. C. Georgeson, F. C. Burtis, and W. Shelton.
Annual Report	Fourth Annual Report, 1891	

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KANSAS STATION—Continued.

Publication.	Title.	Author.
1892.		
Bulletin 33	Experiments with Wheat	C. C. Georgeson, F. C. Burtis, and W. Shelton.
Bulletin 34	Experiments in Feeding Steers, I	Do.
Bulletin 35	*Actinomycosis bovis* or "Lumpy-Jaw" of Cattle; Some Observations upon Loco.	N. S. Mayo.
Bulletin 36	Experiments with Sorghum and Sugar Beets	G. H. Failyer and J. T. Willard.
Bulletin 37	Experiments in Potato Culture	E. A. Popenoe, S. C. Mason, and F. A. Marlatt.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 38	Preliminary Report on Rusts of Grain	A. S. Hitchcock and M. A. Carleton.
Bulletin 39	Experiments in Feeding Steers, II	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 40	Experiments with Wheat	Do.
Bulletin 41	The Effect of Fungicides upon the Germination of Corn	A. S. Hitchcock and M. A. Carleton.
Bulletin 42	Experiments with Oats	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 43	Experiments with Sorghum and Sugar Beets	G. H. Failyer and J. T. Willard.
Bulletin 44	Further Study of Native Grapes	E. A. Popenoe and S. C. Mason.
Bulletin 45	Experiments with Corn	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 46	Rusts of Grain, II	A. S. Hitchcock and M. A. Carleton.
Bulletin 47	Experiments with Wheat. Experiments in Feeding Steers, III.	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 48	Six Years' Experience with Ensilage; Some Forage Plants; Renovating a Prairie Pasture.	Do.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 49	Cattle Poisoning by Potassium Nitrate; Mastitis	N. S. Mayo.
Bulletin 50	Kansas Weeds: I. Seedlings	A. S. Hitchcock and J. B. S. Norton.
Bulletin 51	Steer-Feeding Experiments: IV. A Comparison between Pure-bred Shorthorns and Scrubs.	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 52	Kansas Weeds: II. Preliminary Circular on Distribution	A. S. Hitchcock and J. B. S. Norton.
Bulletin 53	Pig-Feeding Experiments with Corn, Wheat, Kafir Corn, and Cotton Seed.	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 54	Experiments with Oats	Do.
Bulletin 55	Small Fruits by Irrigation	S. C. Mason and F. C. Sears.
Bulletin 56	Experiments with Corn; Experiments with Kafir Corn	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 57	Kansas Weeds: III. Descriptive List	A. S. Hitchcock and J. B. S. Norton.
Bulletin 58	Cornstalk Disease of Cattle: Preliminary Bulletin	N. S. Mayo.
Bulletin 59	Experiments with Wheat	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 60	Steer-Feeding Experiments, V	Do.
Bulletin 61	Kafir Corn, Corn, and Soja-Bean Meal for Pigs; Kafir Corn and Corn Meal for Cattle.	Do.
Bulletin 62	Corn Smut	A. S. Hitchcock and J. B. S. Norton.
Bulletin 63	Experiments with Oats	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Annual Report	Ninth Annual Report, 1896	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

KANSAS STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 64	Experiments with Corn	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 65	Grafting the Apple	S. C. Mason and I. Jones.
Bulletin 66	Kansas Weeds: IV. Fruits and Seeds	A. S. Hitchcock and G. L. Clothier.
Bulletin 67	Steer-Feeding Experiments, VI	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 68	Soil Moisture	G. H. Failyer and J. T. Willard.
Bulletin 69	Some Diseases of Cattle: Texas Itch, Blackleg, Tuberculosis, Texas Fever.	N. S. Mayo.
Bulletin 70	Vegetable Growing	S. C. Mason and W. L. Hall.
Bulletin 71	Experiments with Wheat	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 72	Growth of Young Stock	Do.
Bulletin 73	Fruit Notes	S. C. Mason and W. L. Hall.
Bulletin 74	Experiments with Oats	C. C. Georgeson, F. C. Burtis, and D. H. Otis.
Bulletin 75	Root Development of Some Forage Plants	C. C. Georgeson and J. E. Payne.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 76	Kansas Weeds: V. Vegetative Propagation of Perennial Weeds.	A. S. Hitchcock and G. L. Clothier.
Bulletin 77	Some Insects injurious to the Orchard	E. E. Faville and P. J. Parrott.
Bulletin 78	Sugar Beets	J. T. Willard.
Bulletin 79	Bovine Tuberculosis	P. Fischer.
Bulletin 80	Kansas Weeds: VI. Distribution and Other Notes	A. S. Hitchcock and G. L. Clothier.
Bulletin 81	Feed and Care of the Dairy Cow	H. M. Cottrell, F. C. Burtis, and D. H. Otis.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 82	The Potato-Stalk Weevil	E. E. Faville and P. J. Parrott.
Bulletin 83	Sugar Beets	J. T. Willard and R. W. Clothier.
Bulletin 84	Cold Storage for Fruit	E. E. Faville and W. L. Hall.
Bulletin 85	Investigations of the Growth of Alfalfa in Kansas	G. L. Clothier.
	Alfalfa Feeding Notes	H. M. Cottrell.
Bulletin 86 (Press Bulletins 1–34.)	Wheat Experiments. Keeping Milk in Hot Weather. The Fringed-Wing Apple-Bud Moth. Soil Moisture and Soil Stirring. Blackleg. The Sand Plum. Kafir Corn for Fattening Pigs. Some Reasons Why Fruit Does Not Set. The Peach Twig Borer. Fall Preparation for Alfalfa Seeding. Celery. Balanced Ration. Seed Breeding. The Fruit-Tree Bark-Beetle. Kansas Sugar Beets for 1898. Actinomycosis. Hardy Ornamental Shrubs. Notes on Weeds. The Potato-Stalk Weevil. Possibilities in Corn Improvement. Winter Protection of Peach Buds. Grazing Grasses of Western Kansas. The Spring Canker Worm. A New Crop for Kansas Farmers. Alfalfa Hay for Fattening Hogs. Fringed Tapeworm (*Tænia fimbriata*). Sugar-Beet Experiments for 1899. Treatment of Winter-Injured Trees. Milking Scrub Cows. Lice on Animals. Potato Scab. Blackleg—Treatment Get Ready for the Drought.	
Bulletin 87	Native Agricultural Grasses of Kansas	A. S. Hitchcock and G. L. Clothier.
Bulletin 88	Keeping Milk in Summer	H. M. Cottrell, F. C. Burtis, and D. H. Otis.
Bulletin 89	Soil Moisture	J. T. Willard and R. W. Clothier.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

KENTUCKY STATION.

Publication.	Title.	Author.
1885.		
Bulletin 1	Do Fertilizers Affect the Quality of Tobacco?	A. E. Menke.
1886.		
Bulletin 2	Corn Fodder as Food for Stock	M. A. Scovell.
Bulletin 3	Milk	A. E. Menke.
Bulletin 4	Distillery Slop	A. E. Menke and R. T. Gunn.
Bulletin 5	Analyses of Feeding Stuffs	M. A. Scovell.
Bulletin 6	Clover	A. E. Menke and H. F. Hillenmeyer.
Bulletin 7	Fertilizers	M. A. Scovell.
Bulletin 8	Experiments with Wheat	Do.
1887.		
Bulletin 9	Experiments with Potatoes	Do.
Bulletin 10	Fertilizer Analyses	Do.
Bulletin 11	Wheat Experiments	Do.
Bulletin 12	Fertilizer Analyses	Do.
1888.		
Bulletin 13	Commercial Fertilizers	Do.
Bulletin 14	Artificial or Commercial Fertilizers	Do.
Bulletin 15	Experiments with Wheat	Do.
Bulletin 16	Potato Experiments	M. A. Scovell and A. M. Peter.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 17	Corn Experiments	Do.
Bulletin 18	Hemp Experiments; Notes on the Treatment of an Old Apple Orchard.	
Bulletin 19	Experiments in Pig Feeding	J. H. Connell.
Bulletin 20	Commercial Fertilizers	M. A. Scovell.
Bulletin 21	Wheat Experiments	
	The Grain Louse	H. Garman.
Bulletin 22	Potato Experiments	
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 23	Experiments with Oats; Fertilizers on Meadow Land	
Bulletin 24	The Broom Rape of Hemp and Tobacco	Do.
Bulletin 25	Strawberries	
Bulletin 26	Experiments with Corn	
Bulletin 27	Experiments with Commercial Fertilizers on Hemp	
Bulletin 28	Experiments with Fertilizers on Tobacco	
Bulletin 29	Commercial Fertilizers	M. A. Scovell.
Bulletin 30	Experiments with Wheat	M. A. Scovell and C. L. Curtis.
	A New Wheat Fly	H. Garman.
Bulletin 31	Some Strawberry Pests	Do.
Circular 3	Means of Lessening Injuries from Insects and Fungi	Do.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 32	Strawberries and Vegetables	
Bulletin 33	Field Experiments with Fertilizers on Corn	
Bulletin 34	Commercial Fertilizers	M. A. Scovell.
Bulletin 35	Experiments with Wheat; Experiments with Oats	M. A. Scovell and C. L. Curtis.
Bulletin 36	Commercial Fertilizers	M. A. Scovell.
Bulletin 37	Experiments with Potatoes	
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 38	Vegetables; Strawberries	C. L. Curtis
Bulletin 39	Marls	A. M. Peter.
Bulletin 40	Some Common Pests of the Farm and Garden	H. Garman.
Bulletin 41	Commercial Fertilizers	M. A. Scovell.
Bulletin 42	Experiments with Wheat and Oats	
Bulletin 43	Commercial Fertilizers	Do.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 44	Bordeaux Mixture for Apple Pests	H. Garman.
Bulletin 45	Field Experiments with Fertilizers on Corn, Potatoes, and Tobacco.	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

KENTUCKY STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 46	Commercial Fertilizers	A. M. Peter and M. A. Scovell.
Bulletin 47	The Pests of Shade and Ornamental Trees; An Experiment on Plum Rot.	H. Garman.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 48	Commercial Fertilizers	M. A. Scovell.
Bulletin 49	Destructive Locusts in Kentucky; The Bud Worm of Tobacco.	H. Garman.
Bulletin 50	Fruit Growing in Kentucky; Notes upon Vegetables	C. W. Mathews.
Bulletin 51	Commercial Fertilizers	A. M. Peter and M. A. Scovell.
Bulletin 52	Commercial Fertilizers	M. A. Scovell.
Bulletin 53	Spraying for Codling Moth; The Use of Arsenites on Tobacco; The Use of Bisulphid of Carbon and Hydrocyanic-Acid Gas on Low-Growing Plants.	H. Garman.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 54	Notes on Vegetables	C. W. Mathews and A. T. Jordan.
Bulletin 55	Field Experiment with Fertilizers	
Bulletin 56	Analyses of Commercial Fertilizers	M. A. Scovell, A. M. Peter and H. E. Curtis.
Bulletin 57	Wheat Experiments. Oat Experiments	
Bulletin 58	Cutworms in Kentucky	H. Garman.
Bulletin 59	Spraying Experiments in 1895	H. Garman and A. M. Peter.
Bulletin 60	Analyses of Commercial Fertilizers; Official Analyses; Analyses of Farmers' and Inspectors' Samples.	M. A. Scovell, A. M. Peter, and H. E. Curtis.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 61	Potatoes: Experiments with Fertilizers	M. A. Scovell.
	Insects and Fungus Pests	H. Garman.
	Tests of Varieties	C. W. Mathews.
Bulletin 62	Strawberries	Do.
Bulletin 63	Tobacco	M. A. Scovell and A. M. Peter.
Bulletin 64	Analyses of Commercial Fertilizers	M. A. Scovell, A. M. Peter, and H. E. Curtis.
Bulletin 65	....do	Do.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 66	Tobacco	M. A. Scovell, R. J. Spurr, and H. Garman.
Bulletin 67	The San José Scale in Kentucky	H. Garman.
Bulletin 68	Analyses of Commercial Fertilizers	M. A. Scovell, A. M. Peter, and H. E. Curtis.
Bulletin 69	Wheat	H. Garman.
Bulletin 70	The Woolly Mullein; The Gape Disease of Poultry	Do.
Bulletin 71	Analyses of Commercial Fertilizers	M. A. Scovell, A. M. Peter, and H. E. Curtis.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 72	Potatoes	M. A. Scovell and H. Garman.
Bulletin 73	Strawberries	C. W. Mathews.
Bulletin 74	The Chinch Bug; Earthworms a Source of Gapes in Poultry.	H. Garman.
Bulletin 75	Commercial Fertilizers	M. A. Scovell, A. M. Peter, and H. E. Curtis.
Bulletin 76	....do	Do.
Bulletin 77	Wheat	H. Garman.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

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KENTUCKY STATION—Continued.

Publication.	Title.	Author.
1898.		
Bulletin 78	Ginseng: Its Nature and Culture	H. Garman.
Bulletin 79	Commercial Fertilizers	M. A. Scovell, A. M. Peter, and H. E. Curtis.
1899.		
Bulletin 80	Some Pests Likely to be Disseminated from Nurseries; The Nursery Inspection Law.	H. Garman.
Bulletin 81	A Method of Avoiding Lettuce Rot; Potato Scab Experiments.	Do.
Bulletin 82	Commercial Fertilizers	M. A. Scovell, A. M. Peter, and H. E. Curtis.
Bulletin 83	Wheat: Experiments with Fertilizers and Variety Tests; Notes and Descriptions.	H. Garman.

LOUISIANA STATIONS.

1885.		
Bulletin 1	Outline of Station Work	W. C. Stubbs.
1886.		
Bulletin 2	[Manures]	
Bulletin 3	[Field Experiments]	
Bulletin 4	Oats	Do.
Bulletin 5	Sorghum	Do.
Bulletin 6	Corn	Do.
1887.		
Bulletin 7	Sugar Cane	Do.
Bulletin 8	Cotton	Do.
Bulletin 9	Analyses and Valuation of Fertilizers	Do.
Bulletin 10	Sugar Cane	Do.
Bulletin 11	Oats and Potatoes	
1888.		
Bulletin 12	Sorghum	Do.
Bulletin 13	Cotton and its Products	Do.
Bulletin 14	Sugar Cane	Do.
Bulletin 15	Rice	Do.
Bulletin 16	Potatoes, Tomatoes, Peas, and Small Grains	D. N. Barrow.
Bulletin 17	Ensilage	W. C. Stubbs.
Bulletin 18	Analyses of Commercial Fertilizers	Do.
Bulletin 19	Sorghum: Field, Laboratory, and Sugarhouse Results	Do.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 20	Sugar Cane Field Experiments	Do.
Bulletin 21	Report of the State Station for 1888	
Bulletin 22	Annual Report of North Louisiana Experiment Station, 1888	
Bulletin 23	Sugar Cane—Diffusion Process	Do.
Bulletin 24	Rice and its By-Products	B. B. Ross and W. C. Stubbs.
Bulletin 25	Analyses of Commercial Fertilizers and Other Substances Useful to Agriculture.	W. C. Stubbs.
Bulletin 26	Report of the State Experiment Station for 1889	
Bulletin 27	Report of the North Louisiana Experiment Station for 1889	
Bulletin 28	Report of Sugar Station, 1889	
Annual Report	Second Annual Report, 1889	
SECOND SERIES.		
1890.		
Bulletin 1	Analyses of Commercial Fertilizers and Other Substances Useful to Agriculture.	Do.
Bulletin 2	Texas Screw Worm	H. A. Morgan.
Bulletin 3	Report of Horticultural Department	H. A. Morgan and J. G. Lee.
Bulletin 4	Irish Potatoes	W. C. Stubbs, H. A. Morgan, and J. G. Lee.
Annual Report	Third Annual Report, 1890	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

LOUISIANA STATIONS—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 5	Sugar Making on a Small Scale	W. C. Stubbs.
Bulletin 6	Field Experiments with Sugar Cane	Do.
Bulletin 7	Report of State Station	D. N. Barrow.
Bulletin 8	Report of North Louisiana Station	J. G. Lee.
Bulletin 9	Sugar-Cane Borer and its Parasite	H. A. Morgan.
Bulletin 10	Systematic Feeding of Work Stock a Preventive of Disease; Some Diseases of Farm Animals.	W. H. Dalrymple.
Bulletin 11	Report of the Sugarhouse and Laboratory for 1890	W. C. Stubbs.
Bulletin 12	Analyses of Commercial Fertilizers and Other Substances Useful to Agriculture.	Do.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 13	Sweet Potatoes	H. A. Morgan and B. B. Ross.
Bulletin 14	Sugar Cane	W. C. Stubbs.
Bulletin 15	Report of Veterinarian, 1891	W. H. Dalrymple.
Bulletin 16	Results of 1891 Obtained at the North Louisiana Experiment Station.	J. G. Lee.
Bulletin 17	Results of 1891 Obtained at the State Station	D. N. Barrow.
Bulletin 18	Analyses of Commercial Fertilizers and Other Substances Useful to Agriculture.	W. C. Stubbs.
Bulletin 19	Forage Crops, Grasses, Clovers, and Small Grains	Do.
Report	Geology and Agriculture: I. A Preliminary Report Upon the Hills of Louisiana.	O. Lerch.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 20	Tobacco Growing in Louisiana, with Results of Experiments at Calhoun.	W. C. Stubbs and J. G. Lee.
Bulletin 21	Report of Results for 1892 at Calhoun	J. G. Lee.
Bulletin 22	Results of the Year 1892 [State Station]	
Bulletin 23	Analyses of Commercial Fertilizers and Other Substances Useful to Agriculture.	W. C. Stubbs.
Special Bulletin	The Orange and Other Citrus Fruits	W. C. Stubbs and H. A. Morgan.
Report	Geology and Agriculture: II. A Preliminary Report Upon the Hills of Louisiana.	O. Lerch.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 24	Sugar Cane: Field Experiments—Physical and Physiological.	W. C. Stubbs.
Bulletin 25	Tobacco	J. G. Lee and W. C. Stubbs.
Bulletin 26	Sugar Cane: Field Experiments—Varieties of Cane, and Striped v. Purple.	W. C. Stubbs.
Bulletin 27	Horticulture: Results of the Year 1893	F. H. Burnette, G. Watson, and W. C. Stubbs.
Bulletin 28	Report of the Farm [State Station], 1893	D. N. Barrow.
	Report of the Veterinarian [State Station]	S. B. Staples.
	Report of the Entomologist [State Station]	H. A. Morgan.
Bulletin 29	Report of Results for 1893 at Calhoun, La	J. G. Lee.
Bulletin 30	Sweet Potatoes	F. H. Burnette.
Bulletin 31	Domestic and Commercial Fertilizers: Results of Five Years with Our Staple Crops.	W. C. Stubbs.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 32	Ramie	W. C. Stubbs.
Bulletin 33	Tobacco	J. G. Lee.
Bulletin 34	Cattle Feeding, with Results of Trials	W. C. Stubbs and D. N. Barrow.
Bulletin 35	Report for 1894. [North Louisiana]	J. G. Lee.
Bulletin 36	Horticulture: Results of the Year 1894	W. C. Stubbs, F. H. Burnette, and G. Watson.
Bulletin 37	Windrowed v. Standing Canes	W. C. Stubbs.
Bulletin 38	The Chemistry of Sugar Cane and its Products	G. C. Taylor, J. L. Beeson, and W. Maxwell.
Bulletin 39	Analyses of Commercial Fertilizers	W. C. Stubbs.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 40	Cowpea: Origin, Botanical Relations, Chemical Composition, Feeding Value, Restorative Virtues to the Soil, etc.	W. C. Stubbs, W. R. Dodson, and M. Bird.
Bulletin 41	Tobacco: Yellow-Leaf and Cigar Varieties	J. G. Lee and D. N. Barrow.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

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LOUISIANA STATIONS—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 42	Horticulture: Results of the Year 1895	F. H. Burnette, E. Watson, and W. C. Stubbs.
Bulletin 43	Bovine Tuberculosis in North Louisiana	S. B. Staples and W. H. Dalrymple.
Bulletin 44	Charbon, or Anthrax	Do.
Bulletin 45	Analyses of Commercial Fertilizers and Paris Green	W. C. Stubbs.
Report	Geology and Agriculture: III. A Preliminary Report upon the Florida Parishes of East Louisiana and the Bluff, Prairie, and Hill Lands of Southwest Louisiana.	W. W. Clendenin.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 46	Leguminous Root Tubercles	W. R. Dodson.
Bulletin 47	Results of Experiments at State Experiment Station, Baton Rouge, La., in Corn, Cotton, Forage Crops, Tobacco, etc.	D. N. Barrow.
Bulletin 48	Report of the Entomologist	H. A. Morgan.
Bulletin 49	Analyses of Commercial Fertilizers and Paris Green	W. C. Stubbs.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 50	Red Rice	W. R. Dodson.
Bulletin 51	Cattle Tick and Texas Fever	W. H. Dalrymple, H. A. Morgan, and W. R. Dodson.
Bulletin 52	Report for 1896 and 1897 of the Horticultural Department of State Experiment Stations.	W. C. Stubbs, F. H. Burnette, and E. Watson.
Bulletin 53	Grasses, Clovers, Forage, and Economic Crops	W. R. Dodson and W. C. Stubbs.
Bulletin 54	Analyses of Commercial Fertilizers and Paris Green	W. C. Stubbs.
Special Bulletin	Sugar Cane: History, Botany, and Agriculture	Do.
Annual Report	Eleventh Annual Report, 1898	
Report	Geology and Agriculture: IV. A Preliminary Report upon the Bluff and Mississippi Alluvial Lands of Louisiana.	W. W. Clendenin.
1899.		
Bulletin 55	Alfalfa, Spanish Peanuts, Unknown Cowpea, and Velvet Bean.	W. C. Stubbs.
Bulletin 56	Ticks and Texas Fever	H. A. Morgan.

MAINE STATION.

1885.		
Bulletin 1	Analysis and Valuation of Commercial Fertilizers	W. Balentine.
Bulletin 2	Remarks on Valuation of Commercial Fertilizers	W. H. Jordan.
Bulletin 3	Analysis of Ashes from Various Sources	Do.
Bulletin 4	Analysis of Harbor Mud and Wood Ashes	Do.
Annual Report	Annual Report, 1885	
1886.		
Bulletin 5	Examination of Condimental Cattle Foods	Do.
Bulletin 6	The Valuation of Fertilizers	Do.
Bulletin 7	Results of Analyses of Fertilizers	Do.
Bulletin 8	Estimated Values of Fertilizers	Do.
Bulletin 9	Fertilizer Analyses	Do.
Bulletin 10	Analyses of Molasses	Do.
Bulletin 11	Field Experiments with Fertilizers	Do.
Bulletin 12	Comparative Production from Different Forms of Phosphoric Acid.	Do.
Bulletin 13	Experiments with Fertilizers	Do.
Annual Report	Annual Report, 1886	
1887.		
Bulletin 14	Insecticides	Do.
Bulletin 15	Feeding Experiments	Do.
Bulletin 16	Feeding Stuffs	Do.
Bulletin 17	Fertilizers	Do.
Bulletin 18	Potatoes, Oats, and Barley	Do.
Bulletin 19	Fertilizers	Do.
Bulletin 20	do	Do.
Bulletin 21	Condition of Station	Do.
Annual Report	Annual Report, 1887	
1888.		
Bulletin 22	Organization and Work of the Station	Do.
Bulletin 23	Inspection of Fertilizers	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MAINE STATION—Continued.

Publication.	Title.	Author.
1888.		
Bulletin 24	Tests of Varieties	W. H. Jordan and F. L. Harvey.
Bulletin 25	Analyses of Fertilizers Sold in the State	W. H. Jordan.
Bulletin 26	Composition and Digestibility of Certain Cattle Foods	
Annual Report	Annual Report, 1888	
SECOND SERIES.		
1889.		
Bulletin 1	Analyses of Commercial Fertilizers	Do.
Bulletin 2	The Apple Maggot	F. L. Harvey.
Annual Report	Annual Report, 1889	
1890.		
Annual Report	Annual Report, 1890	
1891.		
Bulletin 3	The Babcock Milk Test, Adapted to Testing Cream	J. M. Bartlett.
Annual Report	Annual Report, 1891	
1892.		
Bulletin 4	Testing Cream and Milk; Fat Test and Lactometer	Do.
Annual Report	Annual Report for 1892	
Report	Director's Report for 1892	W. H. Jordan.
1893.		
Annual Report	Annual Report, 1893	
1894.		
Bulletin 5	Waste of Fat in Skimmed Milk by the Deep-Setting Process.	Do.
Bulletin 6	Fruit Culture; Varieties	W. M. Munson.
Bulletin 7	Inspection of Fertilizers	W. H. Jordan, J. M. Bartlett, and L. H. Merrill.
Bulletin 8	Spraying Experiments	W. M. Munson.
Bulletin 9	Tomatoes	Do.
Bulletin 10	Cauliflowers	Do.
Bulletin 11	Corn as a Silage Crop	W. H. Jordan.
Bulletin 12	Potatoes: A Comparison of the Trench System with Ordinary Culture.	W. M. Munson.
Bulletin 13	The Suppression of Bovine Tuberculosis and Glanders	F. L. Russell.
Bulletin 14	Inspection of Fertilizers	W. H. Jordan, J. M. Bartlett, and L. H. Merrill.
Bulletin 15	A Scheme for Paying for Cream by the Babcock Test in Butter Factories.	J. M. Bartlett.
Bulletin 16	Investigation on the Foraging Powers of Some Agricultural Plants for Phosphoric Acid.	W. Balentine.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 17	Important Facts About Corn	W. H. Jordan.
Bulletin 18	Inspection of Fertilizers, 1895	W. H. Jordan, J. M. Bartlett, and L. H. Merrill.
Bulletin 19	A Discussion of Certain Commercial Articles: Fertilizers	W. H. Jordan.
Bulletin 20	A Discussion of Certain Commercial Articles: Foods	Do.
Bulletin 21	Notes on Small Fruits	W. M. Munson.
Bulletin 22	Inspection of Fertilizers	W. H. Jordan, J. M. Bartlett, and L. H. Merrill.
Annual Report	Annual Report, 1895	
1896.		
Bulletin 23	Preservation of Cream for Market	F. L. Russell.
Bulletin 24	Cabbages	H. P. Gould.
Bulletin 25	Inspection of Fertilizers, 1896	W. H. Jordan, J. M. Bartlett, and L. H. Merrill.
Bulletin 26	Inspection of Glassware used by Creameries and Butter Factories to Determine the Value of Cream and Milk.	J. M. Bartlett
Bulletin 27	Peas; Sweet Corn	H. P. Gould.
Bulletin 28	Potato Rot: Bordeaux Mixture and Fungiroid as Preventives.	Do.
Bulletin 29	Notes on Spraying	W. M. Munson

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MAINE STATION—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 30	Fertilizer Inspection	C. D. Woods, J. M. Bartlett, and L. H. Merrill.
Bulletin 31	Modification of the Babcock Method	J. M. Bartlett.
Annual Report	Twelfth Annual Report, 1896	
1897.		
Bulletin 32	Three Troublesome Weeds: Orange Hawkweed, Wild Carrot, Buffalo Bur.	F. L. Harvey.
Bulletin 33	Fertilizer Inspection	C. D. Woods and J. M. Bartlett.
Bulletin 34	Box Experiments with Phosphates	L. H. Merrill.
Bulletin 35	The Currant Fly; Gooseberry Fruit Fly	F. L. Harvey.
Bulletin 36	Testing Seeds	C. D. Woods.
Bulletin 37	Feeding Stuff Inspection	Do.
Bulletin 38	Fertilizer Inspection	C. D. Woods and J. M. Bartlett.
Bulletin 39	Stock Feeding Suggestions	J. M. Bartlett.
Bulletin 40	Celery	W. M. Munson.
Annual Report	Thirteenth Annual Report, 1897	
1898.		
Bulletin 41	Dehorning Cows	G. M. Gowell and F L. Russell.
Bulletin 42	Ornamenting Home Grounds	W. M. Munson.
Bulletin 43	Fertilizer Inspection	C. D. Woods et al.
Bulletin 44	Feeding Stuff Inspection	C. D. Woods.
Bulletin 45	Fertilizer Inspection	Do.
Bulletin 46	Ornamental Plants for Maine	W. M. Munson.
Bulletin 47	Wheat Offals Sold in Maine in 1898	J. M. Bartlett, O. W. Knight, A. J. Patten, and C. D. Woods.
Annual Report	Fourteenth Annual Report, 1898	
1899.		
Bulletin 48	Feeding Stuff Inspection	Do.
Bulletin 49	Care of Orchards	W. M. Munson.
Bulletin 50	Fertilizer Inspection	C. D. Woods.
Bulletin 51	Feeding Stuff Inspection	Do.
Bulletin 52	The Spraying of Plants	W. M. Munson.
Bulletin 53	Fertilizer Inspection	C. D. Woods and J. M. Bartlett.

MARYLAND STATION.

1888.		
Bulletin 1	History, Organization, and Work of the Station	H. E. Alvord.
Bulletin 2	Cutting Seed Potatoes for Planting	Do.
Bulletin 3	Fodder Corn and Fodder Cane	Do.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 4	Experiment Orchards	W. H. Bishop.
Bulletin 5	Horticultural Department and Field Experiments	H. E. Alvord.
Bulletin 6	Commercial Fertilizers	H. E. Alvord and H. J Patterson.
Bulletin 7	Farm Manures	H. E. Alvord.
Spec. Bulletin A.	Facts About the Station	Do.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 8	Some Feeding Trials	A. I. Hayward.
Bulletin 9	Strawberries; Variety Comparisons, etc., in 1890	W. H. Bishop.
Bulletin 10	Wheat; Effects of Different Fertilizers, etc	A. I. Hayward.
Bulletin 11	Tomatoes in 1890	W. H. Bishop and H. J. Patterson.
Spec. Bulletin B.	Potash and Paying Crops	
Spec. Bulletin C.	Composition of Commercial Fertilizers Sold in the State	H. E. Alvord.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 12	Pig Feeding	H. E. Alvord and A. I. Hayward.
Bulletin 13	Strawberries, Season of 1891	J. S. Robinson.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MARYLAND STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 14	Wheat, Season of 1891	A. I. Hayward.
Bulletin 15	The Experiment Vineyard	T. L. Brunk.
Spec. Bulletin D.	Composition of Commercial Fertilizers Sold in the State	
Spec. Bulletin E.	do	H. E. Alvord.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 16	Wheat Insects	E. W. Doran.
Bulletin 17	Strawberries and Seed Potatoes	J. S. Robinson.
Bulletin 18	Sweet Potatoes	E. H. Brinkley.
Bulletin 19	Tomatoes	J. S. Robinson.
Spec. Bulletin F.	Agricultural Outlook for Maryland	E. Stake.
Spec. Bulletin G.	Commercial Fertilizers	H. E. Alvord.
Spec. Bulletin H.	Government Direction of Agriculture in Europe	J. E. Ray, jr.
Spec. Bulletin I.	Commercial Fertilizers	
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 20	The Composition and Digestibility of the Different Parts of Corn Fodder.	H. J. Patterson.
Bulletin 21	Soils of Maryland	M. Whitney.
Bulletin 22	Steer Feeding—A Well-Balanced v. A Poorly-Balanced Ration.	R. H. Miller.
Bulletin 23	Injurious Insects of Maryland	C. V. Riley.
Spec. Bulls. J, K	Commercial Fertilizers	H. B. McDonnell.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 24	Composition of Commercial Fertilizers Sold in this State	Do.
Bulletin 25	Corn, Potatoes, Tomatoes, Strawberries, Grapes, etc	R. H. Miller and E. H. Brinkley.
Bulletin 26	Tobacco	H. J. Patterson.
Bulletin 27	Composition of Commercial Fertilizers Sold in this State	H. B. McDonnell et al.
Bulletin 28	Experiments with Wheat and Barley	R. H. Miller and E. H. Brinkley.
Bulletin 29	Further Investigations on the Soils of Maryland	M. Whitney and S. Key.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 30	Composition of Commercial Fertilizers Sold in this State; The Fertilizer Law; Appendix; Table for Calculating Fertilizer Analyses and Valuations.	H. B. McDonnell et al.
Bulletin 31	Potato Experiments	R. H. Miller and E. H. Brinkley.
Bulletin 32	The San José Scale	C. V. Riley.
Bulletin 33	Small Fruits, Vegetables, and Field Corn	J. S. Robinson.
Bulletin 34	Composition of Commercial Fertilizers Sold in this State	H. B. McDonnell et al.
Bulletin 35	Wheat, Barley, Oats, and Hay Experiments	R. H. Miller and E. H. Brinkley.
Bulletin 36	Steer Feeding—A Well-Balanced v. A Poorly-Balanced Ration.	Do.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 37	Composition of Commercial Fertilizers Sold in this State	H. B. McDonnell et al.
Bulletin 38	Potato Experiments	R. H. Miller and E. H. Brinkley.
Bulletin 39	Spray Calendar	R. H. Miller.
Bulletin 40	Composition of Commercial Fertilizers Sold in this State	H. B. McDonnell et al.
Bulletin 41	Test of Methods of Preparing and Feeding Corn Fodder	H. J. Patterson.
Bulletin 42	The Maryland Trees and Nursery-Stock Law and Other Information of Special Interest to Nurserymen and Fruit Growers.	W. G. Johnson.
Bulletin 43	Report Upon the Value of a New Corn Product	H. J. Patterson.
Bulletin 44	The Soils of the Hagerstown Valley	C. W. Dorsey.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 45	Composition of Commercial Fertilizers Sold in this State	H. B. McDonnell et al.
Bulletin 46	Corn and Potato Experiments	R. H. Miller and E. H. Brinkley.
Bulletin 47	Dairy Farming	H. J. Patterson.
Bulletin 48	Some Common Injurious Plant Lice, with Suggestions for their Destruction.	W. G. Johnson.
Bulletin 49	Composition of Commercial Fertilizers Sold in this State	H. B. McDonnell et al.
Bulletin 50	Rust and Leopard Spot; Two Dangerous Diseases of Asparagus.	W. G. Johnson.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MARYLAND STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 51	Horse Feeding; Test of the Digestibility of Oats, Corn, Hay, and the New Corn Product.	H. J. Patterson.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 52	Composition of Commercial Fertilizers Sold in this State	H. B. McDonnell et al.
Bulletin 53	Special Investigation of the So-called "New" Horse Disease in Maryland.	S. S. Buckley.
Bulletin 54	Tomatoes	J. S. Robinson.
Bulletin 55	The Black Peach Aphis; Cutworms in Young Tobacco; Law Providing for the Suppression and Control of Insect Pests and Plant Diseases in Maryland.	W. G. Johnson.
Bulletin 56	Wheat, Winter Oats, Barley, and Lime Experiments	R. H. Miller and E. H. Brinkley.
Bulletin 57	Report on the San José Scale in Maryland and Remedies for its Suppression and Control.	W. G. Johnson.
Bulletin 58	The Hessian Fly	Do.
	Some Important Wheat Diseases	C. O. Townsend.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 59	Sweet Potato Insects	E. D. Sanderson.
Bulletin 60	Some Diseases of the Sweet Potato and How to Treat Them	C. O. Townsend.
Bulletin 61	The Sugar Beet in Maryland	H. W. Wiley.
Bulletin 62	Experiments with Wheat, Corn, and Potatoes	H. J. Patterson et al.

MASSACHUSETTS STATE STATION. *a*

1883.		
Bulletin 1	Organization. Fodder Analyses	C. A. Goessmann.
Bulletin 2	Fertilizer Analyses	Do.
Bulletins 3–6	Fodder Analyses. Fertilizer Analyses	Do.
Annual Report	First Annual Report, 1883	
1884.		
Bulletin 7	Observations in Regard to Insects Injurious to the Apple. Special Fertilizers in Fruit Culture. Experiments with Currants. Garden Crops. Fertilizer Analyses.	S. T. Maynard and C. A. Goessmann.
Bulletin 8	Fodder and Fodder Analyses. Valuation and Analyses of Fertilizers.	C. A. Goessmann.
Bulletin 9	Notes upon Insects Injurious to Farm and Garden Crops	S. T. Maynard.
	Fodder and Fodder Analyses. Fertilizer Analyses	C. A. Goessmann.
Bulletin 10	Observations Regarding the Vitality of the Seed of Various Weeds, and the Causes of Certain Diseases of Grasses.	S. T. Maynard.
	Feeding Experiments with Corn Ensilage. Fodder and Fodder Analyses.	C. A. Goessmann.
Bulletin 11	Notes on Feeding Experiments with Corn Ensilage, Continued. Fertilizer Analyses. Fodder and Fodder Analyses.	Do.
Bulletin 12	Notes on Feeding Experiments with Gluten Meal as a Constituent of Daily Diet of Milch Cows. Fodder and Fodder Analyses.	Do.
Bulletin 13	Notes on Feeding Experiments with Pigs. Fertilizer Analyses.	Do.
Annual Report	Second Annual Report, 1884	
1885.		
Bulletin 14	Fodder and Fodder Analyses Valuation and Analyses of Fertilizers.	Do.
Bulletin 15	Notes on Feeding Experiments with Milch Cows. Fertilizer Analyses. Fodder Analyses.	Do.
Bulletin 16	Fodder Analyses. Analyses of Garden Crops. Fertilizer Analyses.	Do.
Bulletin 17	Fodder Analyses. Analyses of Fruits. Analyses of Weeds. Fertilizer Analyses.	Do.
Bulletin 18	Notes on Feeding Experiments with Pigs. Fodder Analyses. Fertilizer Analyses.	Do.
Annual Report	Third Annual Report, 1885	

a In accordance with a State law, the Massachusetts State Station was consolidated with the Massachusetts Hatch Station June 18, 1895.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MASSACHUSETTS STATE STATION—Continued.

Publication.	Title.	Author.
1886.		
Bulletin 19	Valuation of Fertilizers and Fertilizer Analyses. Analyses of Articles of Feed with reference to Fertilizing Constituents.	C. A. Goessmann.
Bulletin 20	Fodder and Fodder Analyses. Fertilizing Constituents of Feed.	Do.
Bulletin 21	Fodder, Corn, and Corn Ensilage. Fertilizers	Do.
Bulletin 22	Feeding Experiments with Milch Cows. Fodder and Fodder Analyses.	Do.
Annual Report	Fourth Annual Report, 1886	
1887.		
Bulletin 23	Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals. Fodder and Fodder Analyses.	Do.
Bulletin 24	Suggestions upon Planting Trees and Small Fruits. Analyses of Fertilizing Material. Fodder and Fodder Analyses.	Do.
Bulletin 25	Notes on Feeding Experiments with Pigs	Do.
Bulletin 26	Food and Fodder Analyses. Fertilizer Analyses	Do.
Bulletin 27	Notes on Feeding Experiments with Milch Cows	Do.
Annual Report	Fifth Annual Report, 1887	
1888.		
Bulletin 28	[Fertilizer and Fodder Analyses]	Do.
Bulletin 29	[Analyses of Feed Stuffs]	Do.
Bulletin 30	Notes on Feeding Experiments with Pigs	Do.
Bulletin 31	On Commercial Fertilizers. Analyses of Commercial Fertilizers and Manurial Substances.	Do.
Circulars	Analyses of Fertilizers	Do.
Annual Report	Sixth Annual Report, 1888	
1889.		
Bulletin 32	[Experiments to Ascertain the Cost of Food for Production of Milk. Analyses of Fodder Articles.]	Do.
Bulletin 33	On Commercial Fertilizers	Do.
Bulletin 34	[Outlines of Work for Present Season]	J. E. Humphrey and C. A. Goessmann.
Bulletin 35	Feeding Experiments with Milch Cows	C. A. Goessmann.
Circulars	Analyses of Commercial Fertilizers	Do.
Annual Report	Seventh Annual Report, 1889	
1890.		
Bulletin 36	Meteorological Summary. Some Suggestions on the Economical Improvement of Farm Lands. Analyses of Corn, Ensilage, and Commercial Fertilizers.	Do.
Bulletin 37	Feeding Experiments with Lambs. Analyses of Feeding Stuffs and Fertilizers.	Do.
Bulletin 38	Feeding Experiments with Milch Cows	Do.
Circulars	Analyses of Fertilizers	Do.
Annual Report	Eighth Annual Report, 1890	
1891.		
Bulletin 39	Treatment of Fungus Diseases	J. E. Humphrey.
Bulletin 40	[Some Diseases of Lettuce and Cucumbers]	Do.
	[Fertilizers; Feeding Experiments with Steers. Weather Record from April to June.]	C. A. Goessmann.
Bulletin 41	Fertilizers. Feeding Experiments with Milch Cows. Weather Record for July and August.	Do.
Circulars	Analyses of Fertilizers	Do.
Annual Report	Ninth Annual Report, 1891	
1892.		
Bulletin 42	Feeding Experiments with Milch Cows	Do.
Bulletin 43	Weather Observations. Winter Feeding Experiments with Lambs. Miscellaneous Analyses of Materials Used for Manurial Purposes. Analyses of Licensed Commercial Fertilizers.	Do.
Bulletin 44	Meteorological Summary for August and September. Feeding Experiments with Steers.	Do.
Bulletin 45	On Fodder Articles and Fodder Supplies	Do.
Circulars	Analyses of Concentrated Feeding Stuffs and Commercial Fertilizers.	Do.
Circulars	Commercial Fertilizers	Do.
Annual Report	Tenth Annual Report, 1892	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MASSACHUSETTS STATE STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 46	Commercial Fertilizers	C. A. Goessman.
Bulletin 47	Meteorological Summary, January to April. Feeding Experiments with Pigs. Miscellaneous Analyses of Feeding Stuffs.	J. B. Lindsey and C. A. Goessmann.
Circulars	Commercial Fertilizers	C. A. Goessmann.
Bulletin 48	Meteorological Summary, May and June. Analyses of Fertilizers and Feeding Stuffs.	Do.
Bulletin 49	Meteorological Summary for July. Analyses of Fertilizers and Feeding Stuffs.	Do.
Bulletin 50	Meteorological Summary, August and September. Analyses of Commercial Fertilizers and Feeding Stuffs.	Do.
Annual Report	Eleventh Annual Report, 1893	
1894.		
Bulletin 51	General Discussion on Commercial Fertilizers. Analyses of Fodder Articles.	Do.
Bulletin 52	Meteorological Summary for Five Months Ending May 31, 1894. Analyses of Commercial Fertilizers Collected During 1894. Analyses of Fodder Articles.	Do.
Bulletin 53	Meteorological Summary for June. Analyses of Commercial Fertilizers Collected During 1894.	Do.
Bulletin 54	Meteorological Summary for July. Analyses of Commercial Fertilizers Collected During 1894.	Do.
Bulletin 55	Meteorological Summary for August and September. Analyses of Commercial Fertilizers Collected During 1894.	Do.
Bulletin 56	Meteorological Summary for October, 1894. Analyses of Commercial Fertilizers Collected During 1894. Analyses of Fodder Articles.	Do.
Annual Report	Twelfth Annual Report, 1894	
1895.		
Bulletin 57	Meteorological Record for January and February. Analyses of Human-Food Articles (Oats). Analyses of Fodder Articles. Analyses of Manurial Substances. Trade Values.	Do.

MASSACHUSETTS HATCH STATION.

1888.		
Bulletin 1	Reports of Departments	C. H. Fernald, S. T. Maynard, and C. D. Warner.
Bulletin 2	....do	C. H. Fernald and S. T. Maynard.
Annual Report	First Anuual Report, 1888	
1889.		
Bulletin 3	Tuberculosis	C. H. Fernald.
Bulletin 4	[Report of Division of Horticulture]	S. T. Maynard.
Bulletin 5	Household Pests	C. H. Fernald.
Bulletin 6	Greenhouse Heating	S. T. Maynard.
	Vegetable Pathology	J. E. Humphrey.
Special Bulletin	A Dangerous Insect Pest in Medford: The Gypsy Moth	C. H. Fernald and W. B. Sessions.
Meteorological Bulletins.	Meteorological Bulletins 1–12	C. D. Warner.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 7	Small Fruits and Vegetables	S. T. Maynard.
	Japanese Crops	W. P. Brooks.
	Gypsy Moth	C. H. Fernald.
Bulletin 8	Greenhouse Heating—Steam v. Hot Water. Observations on Peach Yellows.	S. T. Maynard.
	How far may a Cow be Tuberculous before her Milk becomes Dangerous as an Article of Food?	H. C. Ernst.
Bulletin 9	Soil Tests with Fertilizers	W. P. Brooks
Bulletin 10	Special Fertilizers for Greenhouse Crops. Injury to Peach Buds. Small Fruits.	S. T. Maynard.
Special Bulletin	The Most Profitable Use of Commercial Manures	P. Wagner, trans. by C. Wellington.
Meteorological Bulletins.	Meteorological Bulletins 13–24	C. D. Warner.
Annual Report	Third Annual Report, 1890	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MASSACHUSETTS HATCH STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 11	Conditions Affecting the Strength of the Stomach of the Calf for Rennet. Treatment of Potatoes with Lime for the Prevention of Rot. Report on Hay Caps. Report on Flandres Oats.	W. P. Brooks.
	Fungicides and Insecticides on the Apple, Pear, Plum, and Grape.	S. T. Maynard.
Bulletin 12	Report on Insects	C. H. Fernald.
Bulletin 13	Directions for the use of Fungicides and Insecticides	S. T. Maynard.
Bulletin 14	Fertilizers for Corn	W. P. Brooks.
Bulletin 15	Experiments in Greenhouse Heating. Special Fertilizers for Plants under Glass. Report on Varieties of Strawberries. Report on Varieties of Blackberries and Raspberries.	S. T. Maynard.
Meteorological Bulletins.	Meteorological Bulletins 25–36	C. D. Warner and A. T. Beals.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 16	A Brief Summary of Results in Electroculture	C. D. Warner.
Bulletin 17	Experiments with Fungicides and Insecticides. Notes on Grapes, Peaches, and Siberian Crab Apples. Report on Spraying Apparatus.	S. T. Maynard.
Bulletin 18	Soil Tests with Fertilizers. Experiments with Different Crops.	W. P. Brooks.
Bulletin 19	Report on Insects	C. H. Fernald.
Meteorological Bulletins.	Meteorological Bulletins 37–41	C. D. Warner and A. T. Beals.
	Meteorological Bulletins 42–48	C. D. Warner and F. L. Warren.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 20	Report on Insects	C. H. Fernald.
Bulletin 21	Report on Fruits	S. T. Maynard.
Bulletin 22	....do	Do.
Bulletin 23	Electroculture	C. D. Warner.
Meteorological Bulletins.	Meteorological Bulletins 49–60	C. D. Warner and F. L. Warren.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 24	Insecticides. The Horn Fly	C. H. Fernald.
Bulletin 25	Fungicides and Insecticides. Tests of Grapes	S. T. Maynard.
Bulletin 26	Strawberries, Blackberries, and Raspberries	Do.
Special Bulletin.	Green Manuring	J. Kuhn, trans. by E. W. Allen.
Bulletin 27	History of Tuberculosis in College Herd. Use of Tuberculin in Diagnosis. Outbreak of Bovine Rabies. Poisoning of Cattle by Nitrate of Soda.	J. B. Paige.
Meteorological Bulletins.	Meteorological Bulletins 61–72	C. D. Warner and F. L. Warren.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 28	Cankerworms, Army Worms, Corn Worms, Red-Humped Apple-Tree Caterpillar, Antiopa Butterfly, Currant-Stem Girdler, Imported Elm-Bark Louse, Greenhouse Orthezia.	C. P. Lounsbury.
Bulletin 29	Fungicides, Insecticides, Spraying Calendar	S. T. Maynard.
Bulletin 30	Commercial Fertilizers	C. A. Goessmann.
Bulletin 31	.....do	Do.
Bulletin 32	.....do	Do.
Bulletin 33	Glossary of Fodder Terms	E. B. Holland.
Bulletin 34	Analyses of Manurial Substances Sent for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station During 1895.	C. A. Goessmann.
Index	Index to all Bulletins and Annual Reports published to date, June, 1895.	
Bulletin 35	The Agricultural Value of Bone Meal	C. Wellington.
Meteorological Bulletins.	Meteorological Bulletins 73, 74	C. D. Warner and F. L. Warren.
	Meteorological Bulletins 75–79	F. L. Warren.
	Meteorological Bulletins 80–82	L. Metcalf and C. A. King.
	Meteorological Bulletin 83	L. Metcalf, C. A. King, and J. L. Bartlett.
	Meteorological Bulletin 84	L. Metcalf and J. L. Bartlett.
Annual Report	Eighth Annual Report, 1895	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MASSACHUSETTS HATCH STATION—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 36	Imported Elm-Leaf Beetle. Maple Pseudococcus. Abbot Sphinx. San José Scale.	R. A. Cooley.
Bulletin 37	Report on Fruits. Insecticides. Fungicides	S. T. Maynard and J. H. Putnam.
Bulletin 38	General Discussion on Commercial Fertilizers. Analyses of Fertilizing Materials sent on for Examination. Observations Regarding the Composition of Paris Green. Observations Concerning the Action of Muriate of Potash on the Lime Constituents of the Soil.	C. A. Goessmann.
Bulletin 39	Economic Feeding of Milch Cows	J. B. Lindsey.
Bulletin 40	Analyses of Manurial Substances sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1896.	C. A. Goessmann.
Bulletin 41	On the Use of Tuberculin	B. Bang.
Meteorological Bulletins.	Meteorological Bulletins 85, 88–96	L. Metcalf and J. L. Bartlett.
	Meteorological Bulletins 86 and 87	L. Metcalf and C. A. King.
Bulletin 42	Analyses of Manurial Substances sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1896. New Laws for the Regulation of the Trade in Commercial Fertilizers in Massachusetts.	C. A. Goessmann.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 43	Electro-Germination	A. S. Kinney.
Bulletin 44	Variety Tests of Fruits. Tests of Vegetable Seeds	S. T. Maynard, J. H. Putnam, and S. W. Fletcher.
Bulletin 45	General Discussion on Commercial Fertilizers. Analyses of Fertilizing Materials sent on for Examination. New Fertilizer Law.	C. A. Goessmann.
Bulletin 46	The Habits, Food, and Economic Value of the American Toad.	A. H. Kirkland.
Bulletin 47	On Field Experiments with Tobacco in Massachusetts	C. A. Goessmann.
Bulletin 48	Analyses of Manurial Substances sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1897.	Do.
Bulletin 49	do	Do.
Meteorological Bulletins.	Meteorological Bulletins 97–102	L. Metcalf and J. L. Bartlett.
Special Bulletin.	The Brown Tail Moth	C. H. Fernald and A. H. Kirkland.
Meteorological Bulletins.	Meteorological Bulletins 103, 104	J. E. Ostrander and J. L. Bartlett.
	Meteorological Bulletins 105–108	J. E. Ostrander and A. C. Monahan.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 50	The Feeding Value of Salt-Marsh Hay	J. B. Lindsey and B. K. Jones et al.
Bulletin 51	Analyses of Manurial Substances sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1897.	C. A. Goessmann.
Bulletin 52	Variety Tests of Fruits. Spraying Calendar	S. T. Maynard.
Bulletin 53	Concentrated Feed Stuffs	J. B. Lindsey et al.
Bulletin 54	Analyses of Manurial Substances sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1898.	C. A. Goessmann.
Bulletin 55	Nematode Worms	G. E. Stone and R. E. Smith.
Bulletin 56	Concentrated Feed Stuffs	J. B. Lindsey.
Bulletin 57	Analyses of Manurial Substances Sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1898.	C. A. Goessmann.
Meteorological Bulletins.	Meteorological Bulletins 109–120	J. E. Ostrander and A. C. Monahan.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 58	Manurial Requirements of Crops	W. P. Brooks.
	Notes on the Proper Handling of Barnyard Manure	C. Wellington.
Bulletin 59	Analyses of Manurial Substances Sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1898.	C. A. Goessmann.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MASSACHUSETTS HATCH STATION—Continued.

Publication.	Title.	Author.
1899.		
Bulletin 60	Spraying for the Destruction of Insects and Fungus Pests	S. T. Maynard.
Bulletin 61	The Asparagus Rust in Massachusetts	G. E. Stone and R. E. Smith.
Bulletin 62	Analyses of Manurial Substances sent on for Examination. Analyses of Licensed Fertilizers Collected by the Agent of the Station during 1899.	C. A. Goessmann.
Meteorological Bulletins.	Meteorological Bulletins 121–132	J. E. Ostrander and A. C. Monahan.
Special Bulletin	The Coccid Genera Chionaspis and Hemichionaspis	R. A. Cooley.

MICHIGAN STATION.

1885.		
Bulletin 1	Amber Cane for Forage	R. C. Kedzie.
Bulletin 2	Seed Testing	L. Knapper.
Bulletin 3	Wheat Isosoma	A. J. Cook.
Bulletin 4	Feeding Cattle	S. Johnson.
Bulletin 5	Seed Vitality	W. J. Beal.
Bulletin 6	Diseases of Animals	E. A. A. Grange.
Bulletin 7	Notes on Fruits, Vegetables, Trees, and Shrubs	L. H. Bailey.
Bulletin 8	Wintering Bees	A. J. Cook.
Bulletin 9	Marl	R. C. Kedzie.
1886.		
Bulletin 10	A Disease of Horses, the Result of Injudicious Feeding	
Bulletin 11	Making a Lawn	W. J. Beal.
Bulletin 12	Rural Adornment	L. H. Bailey.
Bulletin 13	Potato Culture	S. Johnson.
Bulletin 14	Codling Moth and Bark Louse	A. J. Cook.
Bulletin 15	Ashes and Manure	R. C. Kedzie.
Bulletin 16	Grasses	W. J. Beal.
Bulletin 17	Carpet Beetle	A. J. Cook.
Bulletin 18	Varieties of Wheat	S. Johnson.
Bulletin 19	Tomatoes	L. H. Bailey.
Bulletin 20	Fertilizer Analyses	R. C. Kedzie.
Bulletin 21	Growing Forest Trees	W. J. Beal.
1887.		
Bulletin 22	Epizoötic Ophthalmia	E. A. A. Grange.
Bulletin 23	Apples for Market	L. H. Bailey.
Bulletin 24	Feeding Cattle	S. Johnson.
Bulletin 25	Laminitis	E. A. A. Grange.
Bulletin 26	Codling Moth and Plant Louse	A. J. Cook.
Bulletin 27	Fertilizer Analyses	R. C. Kedzie.
Bulletin 28	Botanical Museum	W. J. Beal.
Bulletin 29	Maladie du Coit	E. A. A. Grange.
Bulletin 30	Feeding Cattle	S. Johnson.
Bulletin 31	Report on Tomatoes and other Horticultural Work	L. H. Bailey.
1888.		
Bulletin 32	Forestry Convention	
Bulletin 33	Arbor Day	W. J. Beal.
Bulletin 34	Potatoes and Oats	S. Johnson.
Bulletin 35	Weather Service Report	N. B. Conger.
Bulletin 36	Spaying Cattle	E. A. A. Grange.
Bulletin 37	Jack Pine Plains	R. C. Kedzie.
Bulletin 38	Experiments with Wheat and Fertilizers	S. Johnson.
Bulletin 39	Insecticides	A. J. Cook.
Bulletin 40	Horticultural Report	L. H. Bailey.
Bulletin 41	Warming Water for Dairy Cows	S. Johnson.
Bulletin 42	Oxygen Treatment for Horses	E. A. A. Grange.
Annual Report	First Annual Report for 1888	
1889.		
Bulletin 43	Report of Weather Service Department	N. B. Conger.
Bulletin 44	Feeding Steers of Different Breeds	S. Johnson.
Bulletin 45	Why not Plant a Grove?	W. J. Beal.
Bulletin 46	Potatoes, Roots, Fertilizers, and Oats	S. Johnson.
Bulletin 47	Silos and Ensilage	Do.
Bulletin 48	Potatoes, Kale, Squashes, and Tomatoes	L. R. Taft.
Bulletin 49	Chemical Composition of Cornstalks, Hay, and Screenings	R. C. Kedzie.
Bulletin 50	The Grain Plant Louse	A. J. Cook.
Bulletin 51	Enemies of the Wheat Aphis	Do.
Bulletin 52	Commercial Fertilizers	R. C. Kedzie.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

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MICHIGAN STATION—Continued.

Publication.	Title.	Author.
1889.		
Bulletin 53	Spraying with the Arsenites	A. J. Cook.
Bulletin 54	Experiments and Observations on the Jack Pine Plains	W. J. Beal.
Bulletin 55	Fruit Testing	T. T. Lyon.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 56	Rib Grass, or Narrow-Leaved Plantain	W. J. Beal.
Bulletin 57	Vegetables, Tests of Varieties and Methods of Culture	L. R. Taft.
Bulletin 58	Insecticides	A. J. Cook.
Bulletin 59	List of Fruits for Michigan. Apple Scab	L. R. Taft and B. T. Galloway.
Bulletin 60	Feeding Pigs of Different Breeds. Tests of Varieties of Vegetables.	E. Davenport.
Bulletin 61	Foul Brood	A. J. Cook.
Bulletin 62	The English Sparrow	C. B. Cook.
Bulletin 63	Greenhouse Construction and Heating	L. R. Taft.
Bulletin 64	Fertilizer Analyses	R. C. Kedzie.
Bulletin 65	Special Planting for Honey	A. J. Cook.
Bulletin 66	Fighting the Plum Curculio	Do.
Bulletin 67	Fruit Testing at the South Haven Substation	T. T. Lyon.
Bulletin 68	The Jack Pine Plains. Silage, Milk, and Fertilizer Analyses.	R. C. Kedzie.
Bulletin 69	Feeding Steers of Different Breeds	E. Davenport.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 70	Vegetables, Varieties and Methods of Culture	L. R. Taft.
Bulletin 71	Beet Sugar	R. C. Kedzie.
Bulletin 72	Six Worst Weeds	W. J. Beal.
Bulletin 73	Kerosene Emulsion. Some New Insects	A. J. Cook and G. C. Davis.
Bulletin 74	Foot Rot in Sheep	E. A. A. Grange.
Bulletin 75	Fertilizer Analyses	R. C. Kedzie.
Bulletin 76	Kerosene Emulsion	A. J. Cook.
Bulletin 77	Comparing the Yield of Old Meadows with those Recently Seeded.	W. J. Beal.
Bulletin 78	Glanders and Farcy	E. A. A. Grange.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 79	Vegetable Tests	L. R. Taft and H. P. Gladden.
Bulletin 80	Fruits	T. T. Lyon.
Bulletin 81	Fruit Notes	L. R. Taft.
Bulletin 82	Sugar Beets	R. C. Kedzie.
Bulletin 83	Insecticides and Fungicides	L. R. Taft.
Bulletin 84	Roots v. Silage for Fattening Lambs	P. M. Harwood and F. B. Mumford.
Bulletin 85	Potato Tests	L. R. Taft.
Bulletin 86	Fertilizer Analyses	R. C. Kedzie.
Bulletin 87	Smut in Oats and Wheat—Jensen or Hot Water Treatment	P. M. Harwood.
Bulletin 88	Fruit Report	T. T. Lyon.
Bulletin 89	Conformation of Horse Governing Selection	E. A. A. Grange.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 90	Vegetable Tests	L. R. Taft, H. P. Gladden, and R. J. Coryell.
Bulletin 91	Two Plants for Sandy Land—Spurry (*Spergula arvensis*) and Flat Pea (*Lathyrus sylvestris*).	O. Clute, O. Palmer, and F. B. Mumford.
Bulletin 92	Small-Fruit Notes. Spraying	L. R. Taft, H. P. Gladden, and R. J. Coryell.
Bulletin 93	Potatoes	P. M. Harwood and P. G. Holden.
Bulletin 94	Birds of Michigan	A. J. Cook.
Bulletin 95	Potatoes	P. M. Harwood.
Bulletin 96	Honey Analyses	A. J. Cook.
Bulletin 97	Fertilizer Analyses	R. C. Kedzie.
Bulletin 98	Locusts. The Horn Fly	G. C. Davis.
Bulletin 99	Michigan Soils	R. C. Kedzie.
Bulletin 100	Eighty New Strawberries	L. R. Taft and H. P. Gladden.
Bulletin 101	Composition of Wheat and Straw. Composition of Certain Forage Plants. Adulteration of Ground Feed. Mineral Residues in Sprayed Fruits.	R. C. Kedzie.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MICHIGAN STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 102	Insects Injurious to Celery	G. C. Davis.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 103	Peach and Plum Culture in Michigan	L. R. Taft.
Bulletin 104	A Year Among Fruits	T. T. Lyon.
Bulletin 105	Michigan Fruit List	L. R. Taft.
Bulletin 106	Strawberries and Raspberries	L. R. Taft and H. P. Gladden.
Bulletin 107	Fattening Lambs	F. B. Mumford.
Bulletin 108	Potatoes and Potato Scab	L. R. Taft and R. J. Coryell.
Bulletin 109	Variety Tests of Vegetables	L. R. Taft.
Bulletin 110	The External Conformation of the Horse	E. A. A. Grange.
Bulletin 111	The Cultivated Raspberries of the United States	A. A. Crozier.
Bulletin 112	Fertilizer Analyses	R. C. Kedzie.
Bulletin 113	Fattening Lambs	C. D. Smith and F. B. Mumford.
Bulletin 114	Rape as a Forage Plant	Do.
Bulletin 115	Management of Swamp Lands	R. C. Kedzie.
Bulletin 116	Insects of the Clover Field	G. C. Davis.
Bulletin 117	Millet	A. A. Crozier.
Spec. Bulletin 1	A Year with Bees	R. L. Taylor.
Spec. Bulletin 2	Millet	A. A. Crozier.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 118	Fruits at South Haven	T. T. Lyon.
Bulletin 119	Potatoes	L. R. Taft, H. P. Gladden, and U. P. Hedrick.
Bulletin 120	Vegetable Novelties and Notions	Do.
Bulletin 121	The Pests of the Orchard and Garden	L. R. Taft and G. C. Davis.
Bulletin 122	Small-Fruit Notes	L. R. Taft and H. P. Gladden.
Bulletin 123	Native Plums. Russian Cherries	U. P. Hedrick.
Bulletin 124	The Apple Orchard	L. R. Taft.
Bulletin 125	Crimson Clover and Other Topics	A. A. Crozier.
Bulletin 126	Fertilizer Analyses	R. C. Kedzie.
Bulletin 127	Dairy Records	C. D. Smith.
Bulletin 128	Fattening Lambs	F. B. Mumford.
Special Spraying Bulletin.	When and What to Spray	L. R. Taft.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 129	Fruits at South Haven	T. T. Lyon.
Bulletin 130	Fruits at the Agricultural College	L. R. Taft and H. P. Gladden.
Bulletin 131	Potatoes	L. R. Taft.
	Vegetable Tests	H. P. Gladden and U. P. Hedrick.
Bulletin 132	Some Injurious Insects	G. C. Davis.
Bulletin 133	Tuberculosis	E. A. A. Grange.
Bulletin 134	A Preliminary Bulletin on Pasteurization of Milk	C. D. Smith.
Bulletin 135	Fertilizer Analyses	R. C. Kedzie.
Bulletin 136	Fattening Lambs: A Comparison of Fodders	H. W. Mumford.
Bulletin 137	Feeding Corn Smut	C. D. Smith.
Bulletin 138	Pig Feeding	Do.
Bulletin 139	Bacteria: What they are and What they do	C. E. Marshall.
Bulletin 140	Ropiness in Milk	Do.
Spec. Bulletin 2	Pests of House and Ornamental Plants	G. C. Davis.
Spec. Bulletin 3	Lightning Rods and Protection of Farm Buildings from Lightning. A Good Rod for Five Dollars.	
Spec. Bulletin 4	The Apple Orchard. Spraying—Why and How	L. R. Taft.
Spec. Bulletin 5	Forecasts of Frosts	R. C. Kedzie.
Spec. Bulletin 6	Building Silos	C. D. Smith.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 141	Forage Crops and Wheat	A. A. Crozier.
Bulletin 142	Small Fruit Trials at the College	L. R. Taft and H. P. Gladden.
Bulletin 143	Fruit Tests at South Haven	T. T. Lyon.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

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MICHIGAN STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 144	Vegetables—Old and New	L. R. Taft, H. P. Gladden, and M. L. Dean.
Bulletin 145	Fertilizer Analyses	R. C. Kedzie.
Bulletin 146	Bacteria and the Dairy	C. E. Marshall.
Bulletin 147	Pasteurization of Milk	Do.
Bulletin 148	Strawberries	L. R. Taft and H. P. Gladden.
Bulletin 149	Feeding Dairy Cows	C. D. Smith.
Bulletin 150	Sugar Beets in Michigan in 1897	C. D. Smith and R. C. Kedzie.
Bulletin 151	Raspberries, Blackberries, and Grapes	L. R. Taft and H. P. Gladden.
Spec. Bulletin 7	A New Danger to Fruit Growers	L. R. Taft.
Spec. Bulletin 8	Planting Sugar Beets	R. C. Kedzie.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 152	Report of South Haven Substation	T. T. Lyon.
Bulletin 153	Vegetable Tests of 1897	L. R. Taft, H. P. Gladden, and M. L. Dean.
Bulletin 154	Some Experiments in Corn Raising	C. D. Smith.
Bulletin 155	Spraying Calendar for 1898	L. R. Taft.
Bulletin 156	Preliminary Report of State Inspector of Nurseries and Orchards, and Laws Relating to the Same.	L. R. Taft and D. W. Trine.
Bulletin 157	Hog Cholera	G. A. Waterman.
Bulletin 158	Some Experiments with Poultry	C. D. Smith and C. S. Brooks.
Bulletin 159	A Study of Normal Temperatures and the Tuberculin Test.	C. E. Marshall.
Bulletin 160	Some Insects of the Year 1897	W. B. Barrows and R. H. Pettit.
Bulletin 161	Fertilizer Analyses	R. C. Kedzie.
Bulletin 162	A Sketch of the Original Distribution of White Pine in the Lower Peninsula.	C. F. Wheeler.
	Present Condition of Forests and Stump Lands	F. C. Skeels.
	Reforesting Stump Lands	W. J. Beal.
	Meteorology of the Forests	R. C. Kedzie.
	Forestry Legislation	C. D. Smith.
Bulletin 163	Strawberry Culture. Notes on Varieties	L. R. Taft and H. P. Gladden.
Bulletin 164	Methods and Results of Tillage	M. W. Fulton.
Bulletin 165	Draft of Farm Implements	Do.
Spec. Bulletin 9	Suggestions on Farm Accounts	C. D. Smith.
1899.		
Bulletin 166	A Grade Dairy Herd	Do.
Bulletin 167	A Discussion of Farm Dairy Methods	G. H. True.
Bulletin 168	Michigan Fruit List	L. R. Taft.
Bulletin 169	Notes from the South Haven Substation	L. R. Taft and T. T. Lyon.
Bulletin 170	Vegetable Tests for 1898	L. R. Taft, H. P. Gladden, and M. L. Dean.
Bulletin 171	Bush Fruits for 1898	L. R. Taft and H. P. Gladden.
Bulletin 172	Combating Disease-Producing Germs	C. E. Marshall.
Bulletin 173	Killing the Tubercle Bacillus in Milk	Do.
Bulletin 174	Fertilizer Analyses	R. C. Kedzie and L. S. Munson.
Bulletin 175	Some Insects of the Year 1898	W. B. Barrows and R. H. Pettit.
Bulletin 176	Strawberry Notes for 1899	L. R. Taft and H. P. Gladden.
Spec. Bulletin 10.	Sugar Beets	C. D. Smith and R. C. Kedzie.
Spec. Bulletin 11.	Frozen Trees and their Treatment	L. R. Taft.
Spec. Bulletin 12.	Spraying Calendar. Formulas for Insecticides and Fungicides.	L. R. Taft and C. D. Smith.

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[Titles which have been changed from their original form are inclosed in brackets.]

MINNESOTA.

Publication.	Title.	Author.
1886.		
Annual Report ..	Supplement to Report of Board of Regents of the University of Minnesota.	
1888.		
Bulletin 1.....	Reports on Russian Apples. Wheat Experiments and Potato Culture.	E. D. Porter.
Bulletin 2.....	Silos and Ensilage. Tests of Varieties of Corn for Feeding Values. Examination of Beets and Other Roots for Sugar and Feeding Values.	J. A. Dodge.
Bulletin 3.....	Our Russian Apples at the Opening of their Fourth Season. Natural and Artificial Fertilization of Plants.	S. B. Green.
	Report on Rocky Mountain Locusts	O. Lugger.
Bulletin 4.....	Comparative Value of Cold and Warm Water for Stock in Food Consumed and in the Production of Milk, Butter, and Beef.	E. D. Porter.
	Fungi which Kill Insects, Especially as Affecting Chinch Bugs and Locusts.	O. Lugger.
	Tuberculosis, or Consumption, in Domestic Animals	M. J. Treacy.
Biennial Report .	Supplement to Report of Board of Regents of the University of Minnesota.	
1889.		
Bulletin 5.....	Indian Corn.....	W. M. Hays.
	Russian Willows and Poplars from Hard Wood Cuttings. Native Plums. Comparative Tests of Varieties of Cabbage.	S. B. Green.
	New Method of Potato Culture	C. Povmeroulie.
	Frosted and Rusted Wheat	O. Lugger.
Bulletin 6.....	Notes on the Effects of Frost and Rust on the Germination of Wheat.	E. D. Porter.
	Experiments in Germination and Growth of Damaged Wheat and Barley.	S. B. Green.
Bulletin 7.....	Soil Temperatures. Comparative Tests of Varieties of Corn for Ensilage.	E. D. Porter.
	Selection and Cross Fertilization of Corn	W. M. Hays.
	Washing and Salting Butter	W. M. Hays and D. N. Harper.
	Construction of Greenhouse Walls. Comparative Tests of Varieties of Potatoes.	S. B. Green.
	The Chemistry of Wheat under Various Conditions	D. N. Harper.
	Influence of Food upon the Formation of the Skull and Teeth of Pigs.	O. Schwartzkopff.
Bulletin 8.....	Siloing Clover.....	N. W. McLain.
	Sources of our Home Made Manures.....	W. M. Hays.
	The By-Products of Wheat.....	W. M. Hays and D. N. Harper.
	The Rocky Mountain Locust in Ottertail County, Minn....	O. Lugger.
Bulletin 9.....	Russian Willows and Poplars—Descriptions and Value for Minnesota.	S. B. Green.
	Insects Affecting Poplars and Willows	O. Lugger.
1890.		
Bulletin 10.....	Onions on Land Plowed and Unplowed. Trial of Cabbage. London Purple for Curculio on Native Plums. Bagging Grapes. Rollingstone Plum. Potatoes at Different Depths.	S. B. Green.
	Oak Caterpillars	O. Lugger.
Bulletin 11.....	Corn Experiments. Peas, Beans, Flax, and Other Crops ...	W. M. Hays.
	Results of Seeding Rusted, Frosted, and Frozen Wheat of 1888.	D. N. Harper.
Bulletin 12.....	Meadows and Pastures in Minnesota	W. M. Hays.
	Preserving Vegetables in Carbonic-Acid Gas. American Grown Cauliflower Seed.	S. B. Green.
	Protection from Frost	H. A. Hazen.
Bulletin 13.....	A Treatise on Flax Culture	O. Lugger.
Biennial Report.	Biennial Report, 1889 and 1890.....	
1891.		
Bulletin 14.....	Pig Feeding for Profit. Swine Breeding	N. W. McLain.
	Sugar Beets	D. N. Harper and W. M. Hays.
Bulletin 15..	Wheat Experiments	D. N. Harper.
Bulletin 16.....	Sheep Scab, and How to Cure It.....	O. Lugger.
Bulletin 17.....	Migratory Locusts in Minnesota in 1891	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

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MINNESOTA STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 18	Notes on Strawberries and Raspberries, 1891. Notes on Sand Cherries, Buffalo Berry, and Russian Mulberry. Evergreens from Seed. Summer Propagation of Hardy Plants.	S. B. Green.
1892.		
Bulletin 19	Dehorning	C. D. Smith, T. L. Haecker, and O. Schwartzkopff.
	Cream Raising by Cold Deep Setting. Experiments in Cheese Making.	H. Snyder.
	The Babcock Test and Churn	C. D. Smith and T. L. Haecker.
Bulletin 20	Oats Sown with Field Peas. Field Peas and Rape in Minnesota. Improvement of Timothy.	W. M. Hays.
	Fertilizers in Minnesota	W. M. Hays and D. N. Harper.
Bulletin 21	Sugar Beets	D. N. Harper and W. M. Hays.
	Sorghum	D. N. Harper.
Bulletin 22	Comparison of Different Foods for Pigs	C. D. Smith and W. M. Hays.
Bulletin 23	Wheat—Milling and Baking Tests	D. N. Harper.
	Cooperative Tests with Selected Seed Wheat	D. N. Harper, A. C. Clausen, and T. C. Hodson.
	The Frit Fly—Preliminary Report upon an Insect Injurious to Wheat.	O. Lugger.
Bulletin 24	Ornamental and Timber Trees, Shrubs, and Herbaceous Plants in Minnesota.	S. B. Green.
Bulletin 25	Report on Small Fruits. Renewing Old Strawberry Beds. Shading Strawberry Beds. Seedling Fruits. Analyses of Grapes. Spraying Grapevines.	
Biennial Report.	Biennial Report, 1891 and 1892	
1893.		
Bulletin 26	Digestion Experiments with Cows and Pigs	H. Snyder.
Bulletin 27	The Composition of Fodders and Grains. The Composition of Dairy Products. Sugar Beets.	Do.
Bulletin 28	The Classification of Insects and their Relation to Agriculture.	O. Lugger.
Bulletin 29	Wheat	H. Snyder.
Bulletin 30	Soils: The Composition of Native and Cultivated Soils and the Effects of Continuous Cultivation upon their Fertility.	Do.
Bulletin 31	Practical Rations for Lambs. Lambs v. Wethers for Fattening.	W. M. Hays.
	Field Experiments in 1893	A. Boss.
Bulletin 32	Late Blight and Rot of the Potato. Potato Scab. Cross Fertilization of Grapes. Conservation of Moisture in the Soil. Fruits: Notes on Varieties.	S. B. Green.
Annual Report	Annual Report, 1893	
1894.		
Bulletin 33	The Russian Thistle, or Russian Tumble Weed	W. M. Hays.
Bulletin 34	The Chemical Development and Value of Red Clover. The Russian Thistle: Its Food Value and Draft upon the Soil.	H. Snyder.
Bulletin 35	Dairy Herd Record for 1893. Cost of Butter Production in Winter. Comparing Prairie Hay with Timothy. Rearing Dairy Calves. Cooperative Creameries. Manufacture of Sweet-Curd Cheese.	T. L. Haecker.
Bulletin 36	Miscellaneous Analyses of Feeding Stuffs. The Digestibility of Wheat.	H. Snyder.
Bulletin 37	The Chinch Bug	O. Lugger.
Bulletin 38	Garden Tillage and Implements	S. B. Green.
Bulletin 39	Potatoes: Variety Tests; Potato Scab; Blight and Internal Brown Rot. Tomatoes: Variety Tests; Training. Strawberries: Variety Tests. Apple-Tree Sun Scald. Raspberries: Variety Tests; Cane Rust.	Do.
Bulletin 40	Grain and Forage Crops	W. M. Hays.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 41	The Essential Elements of Soil Fertility. Humus as a Factor of Soil Fertility. The Chemical and Mechanical Analyses of Soils. The Action of Organic and Mineral Acids upon Soils. Comparison of Different Methods of Farming upon the Conservation of Soil Fertility.	H. Snyder.

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MINNESOTA STATION—Continued.

Publication.	Title.	Author.
1895.		
Bulletin 42	The Composition, Digestibility, and Food Value of Potatoes.	H. Snyder.
Bulletin 43	Insects Injurious in 1895	O. Lugger.
Bulletin 44	Fattening Steers in Winter. Fattening Lambs in Winter.	T. Shaw.
Bulletin 45	Potatoes: Variety Tests; Treatment for Potato Scab and Blight; Internal Brown Rot. Tomatoes: Variety Tests: Treatment for Rot. Small Fruits: Variety Tests. Spray Pumps: A New Form of and Strainer for.	S. B. Green.
Bulletin 46	Forage and Grain Crops. Cross Rotation Experiments. Smut in Wheat. Three Annual Weeds. Tillage Experiments.	W. M. Hays.
	Meteorological Records	E. A. Beals.
Annual Report	Annual Report, 1895	
1896.		
Bulletin 47	Flax: The Draft of Flax on the Soil, and the Composition of Flax Soils. The Feeding Value of Flax Products.	H. Snyder.
Bulletin 48	Insects Injurious in 1896	O. Lugger.
Bulletin 49	Rate of Increase on the Cut-over Timber Lands of Minnesota.	S. B. Green and A. B. Ayres.
Bulletin 50	Progress at the Several Experiment Farms in 1896. Variety Tests of Beans, Barley, Corn, Oats, Wheat. Root Crops: Wheat, Smallest v. Largest v. Hardest Kernels for Seed. Rotation of Crops. Cross-Rotation Experiments.	W. M. Hays, T. A. Hoverstad, W. W. Pendergast, and A. Boss.
Bulletin 51	Bovine Tuberculosis	M. H. Reynolds.
Bulletin 52	Potatoes: Variety Tests in 1896. Potato Implements	S. B. Green.
Annual Report	Annual Report, 1896	
1897.		
Bulletin 53	Effects of the Rotation of Crops upon the Humus Content and the Fertility of Soils. Production of Humus from Manure.	H. Snyder.
Bulletin 54	Human Food Investigations. The Gluten of Wheat. The Digestibility and Composition of Bread. The Loss of Food Value by Prolonged Fermentation in Bread Making. The Digestibility of Potatoes, and the Loss of Food Value when Potatoes, Carrots, and Cabbages are Boiled in Different Ways. The Rational Feeding of Men.	Do.
Bulletin 55	Grasshoppers, Locusts, Crickets, Cockroaches, etc., of Minnesota.	O. Lugger.
1898.		
Bulletin 56	Sugar Beets: Summary of Investigations from 1888 to 1898.	H. Snyder and A. Boss.
Bulletin 57	Fattening Lambs in Winter	T. Shaw.
Bulletin 58	Fattening Steers in Winter	Do.
Bulletin 59	Fattening Lambs and Wethers in Winter	Do.
Bulletin 60	Beef Cattle and Swine	Do.
Bulletin 61	Butterflies and Moths: Injuries to our Fruit-Producing Plants.	O. Lugger.
Annual Report	Annual Report, 1898	
1899.		
Bulletin 62	Wheat: Varieties, Breeding, and Cultivation	W. M. Hays and A. Boss.
Bulletin 63	Miscellaneous Analyses. Composition of Tomatoes. Proteids of Wheat Flour.	H. Snyder.
Bulletin 64	The Black Rust or Summer Rust. The Hessian Fly. Migratory Locusts or Grasshoppers.	O. Lugger.
Bulletin 65	Soil Investigations	H. Snyder.

MISSISSIPPI STATION.

1888.		
Bulletin 1	Organization	S. M. Tracy.
Bulletin 2	Cotton Worm	Do.
Bulletin 3	Analyses of Commercial Fertilizers	J. A. Myers.
Bulletin 4	The Marls of Mississippi	W. L. Hutchinson.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 5	Fertilizers	S. M. Tracy.
Bulletin 6	Charbon	Do.
Bulletin 7	Hay Presses	Do.
Bulletin 8	Stock Feeding	B. Irby.
Bulletin 9	Diseases of Sheep and Calves, Bitterweed	D. L. Phares.
Bulletin 10	Dishorning	Do.
Annual Report	Second Annual Report, 1889	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MISSISSIPPI STATION—Continued.

Publication.	Title.	Author.
1890.		
Bulletin 11	Charbon	G. C. Creelman.
Bulletin 12	Cotton-Leaf Worm	S. M. Tracy.
Bulletin 13	Feeding for Milk and Butter	E. R. Lloyd.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 14	Injurious Insects	H. E. Weed.
Bulletin 15	Feeding	E. R. Lloyd.
	Milk-Testing Apparatus	L. G. Patterson.
Bulletin 16	Glanders	T. Butler.
Bulletin 17	Insects Injurious to Stored Grain	H. E. Weed.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 18	Varieties of Cotton	E. R. Lloyd.
Bulletin 19	The Southern Tomato Blight	B. D. Halsted.
Bulletin 20	Grasses and Forage Plants	S. M. Tracy.
Bulletin 21	Insects Injurious to the Cabbage	H. E. Weed.
	A New Method for Testing Milk	L. G. Patterson.
	Feeding for Milk and Butter	E. R. Lloyd.
Bulletin 22	Grapes	S. M. Tracy and F. S. Earle.
Technical Bulletin 1.	A Chemical Study of the Cotton Plant	W. L. Hutchinson and L. G. Patterson.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 23	Varieties of Cotton	E. R. Lloyd.
Bulletin 24	Fertilizers for Cotton	W. L. Hutchinson and L. G. Patterson.
Bulletin 25	Colic in Horses and Mules	T. Butler.
Bulletin 26	Small Fruits	A. B. McKay.
Bulletin 27	Insecticides and their Application	H. E. Weed.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 28	The Horn Fly	Do.
Bulletin 29	Exhaustion and Restoration of Soil Fertility	W. L. Hutchinson.
	Fertilizers and their Use	S. M. Tracy.
Bulletin 30	A Kerosene Attachment for Knapsack Pumps	H. E. Weed.
Bulletin 31	Lameness in Horses and Mules	T. Butler.
Bulletin 32	A New Kerosene Attachment for Knapsack Sprayers	H. E. Weed.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 33	Corn	S. M. Tracy and E. R. Lloyd.
Bulletin 34	Mississippi Fungi	S. M. Tracy and F. S. Earle.
Bulletin 35	Hog Raising	T. Butler.
Bulletin 36	Insects Injurious to Corn	H. E. Weed.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 37	Fruits and Vegetables on the Gulf Coast	F. S. Earle.
Bulletin 38	Mississippi Fungi. (Continuation of Bulletin 34)	S. M. Tracy and F. S. Earle.
Bulletin 39	Feeding for Beef	E. R. Lloyd and J. S. Moore.
Bulletin 40	The Cowpea	S. M. Tracy and E. R. Lloyd.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 41	The Colorado Potato Beetle in Mississippi	H. E. Weed.
Bulletin 42	Acclimation Fever, or Texas Fever	J. C. Robert.
Annual Report	Tenth Annual Report, 1897	
1898.		
Spec. Bulletin 42	Analyses of Commercial Fertilizers on Sale in the State	B. W. Kilgore et al.
Spec. Bulletin 43	"Natural Plant Food:" Claims Made For It and Its Value	B. W. Kilgore.
Bulletin 44	Winter Pasture	E. R. Lloyd.
Spec. Bulletin 45	Analyses of Commercial Fertilizers on Sale in the State	B. W. Kilgore et al.
Bulletin 46	Cooperative Experiments with Small Fruit	D. T. Price.
Spec. Bulletin 47	Analyses of Commercial Fertilizers on Sale in the State	B. W. Kilgore et al.
Bulletin 48	Analyses of Commercial Fertilizers	B. W. Kilgore.
Spec. Bulletin 49	Analyses of Commercial Fertilizers on Sale in the State	B. W. Kilgore et al.
Bulletin 50	Winter and Summer Pasture in Mississippi	E. R. Lloyd.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MISSISSIPPI STATION—Continued.

Publication.	Title.	Author.
1899.		
Bulletin 51	Analyses of Commercial Fertilizers on Sale in the State	B. W. Kilgore et al.
Bulletin 52	....do	Do.
Bulletin 53	Some Insects Injurious to Stock, and Remedies Therefor	G. W. Herrick.
Bulletin 54	Irish Potato Culture	A. B. McKay.
Bulletin 55	Analyses of Commercial Fertilizers on Sale in the State	B. W. Kilgore et al.
Bulletin 56	Grapes	J. S. Moore.
Bulletin 57	Analyses of Commercial Fertilizers	B. W. Kilgore.
Bulletin 58	Soils of Mississippi: Texture and Water Conditions	W. L. Hutchinson.
Bulletin 59	Analyses of Commercial Fertilizers on Sale in the State	B. W. Kilgore et al.
Bulletin 60	Feeding Cotton Seed, Cotton-Seed Meal, and Corn to Dairy Cows; Influence of the Feed on the Quality of Milk and Butter.	J. S. Moore.
	Feeding Cotton Seed, Cotton-Seed Meal, and Corn to Beef Steers; Cost of Wintering the Beef Herd; Feeding Cotton Seed to Hogs.	E. R. Lloyd.
	Fertilizing Constituents of Feeds Recovered in the Manure.	W. R. Perkins and E. B. Ferris.

MISSOURI STATION.*a*

1883.		
Bulletin 1	Experiment with Pigs	J. W. Sanborn.
Bulletin 2	Feeding Steers	Do.
Bulletin 3	Report of Test of Varieties of Wheat and Corn	Do.
Bulletin 4	Mulching	Do.
Bulletin 5	Relation of Tillage to Soil Moisture	Do.
Bulletin 6	Relation of Dew to Soil Moisture	Do.
1884.		
Bulletin 7	Feeding Wheat and Corn	Do.
Bulletin 8	Meal-Feeding Stock at Pasture	Do.
Bulletin 9	Grass-Fed Pigs	Do.
Bulletin 10	Pig-Feeding Experiments	Do.
Bulletin 11	Value of Corn Fodder as Stock Food	Do.
Bulletin 12	Seed Potatoes	Do.
Bulletin 13	Good Roads and Broad Wheel Tires	Do.
1885.		
Bulletin 14	Feeding for Lean Meat	Do.
Bulletin 15	Contagious Pleuro-Pneumonia	P. Paquin.
Bulletin 16	Report of State Veterinarian on Animal Diseases.	
Bulletin 17	General Observations on Forage Crops	J. W. Sanborn.
Bulletin 18	Subsoiling	Do.
1886.		
Bulletin 19	Feeding for Lean Meat	Do.
Bulletin 20	Observations in Horticultural Department; Small Fruits and Vegetables.	L. R. Taft.
Bulletin 21	Plants and Their Uses	S. M. Tracy.
Bulletin 22	Corn Harvesting—Seasonable Suggestions	J. W. Sanborn.
Bulletin 23	Relation of Dew to Soil Moisture	Do.
Bulletin 24	Contagious Diseases and Their Prevention	P. Paquin.
Bulletin 25	Shrinkage of Hay in Stacks; Corn, How to Plant; Test of Varieties.	
1887.		
Bulletin 26	Fruits and Vegetables, Variety Tests	L. R. Taft.
Bulletin 27	Calf-Feeding Experiments	J. W. Sanborn.
Bulletin 28	Maintenance Rations for Pigs	Do.
Bulletin 29	Rotation of Crops	Do.
Bulletin 30	Fertilization	Do.
Bulletin 31	Texas Fever and Other Diseases	P. Paquin.
1888.		
Bulletin 32	Plows and Plowing	J. W. Sanborn.
Bulletin 33	Glanders, Mad Itch of Cattle, etc	P. Paquin.
Bulletin 34	Experimental Farming	
Bulletin 35*a*	Grasses for Pastures and for Meadows	J. W. Sanborn.
Bulletin 1	Organization of Station	P. Schweitzer.
Bulletin 2	Grasses for Pastures and Meadows	J. W. Sanborn.

a The first thirty-five bulletins in this list were issued as publications of the Missouri Agricultural College, University of the State of Missouri. Bulletin No. 35 of this series is the same as Station Bulletin No. 2.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MISSOURI STATION—Continued.

Publication.	Title.	Author.
1888.		
Bulletin 3	Spaying	P. Paquin.
Bulletin 4	A Test of Tillage Implements	J. W. Sanborn.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 5	Soil; Weather; Field Trials with Corn	P. Schweitzer.
Bulletin 6	Experiments on Seed Germination, Pea Weevil, and Apples.	J. W. Clark.
Bulletin 7	Green v. Dry Storage of Fodder	J. W. Sanborn.
Bulletin 8	Feeding Ensilage v. Dry Fodder	
Bulletin 9	Study of the Life History of Corn at its Different Periods of Growth.	P. Schweitzer.
1890.		
Bulletin 10	Report of Department of Horticulture	J. W. Clark.
Bulletin 11	Texas Fever	P. Paquin.
Bulletin 12	Blackleg	Do.
1891.		
Bulletin 13	Report of Department of Horticulture	J. W. Clark.
Bulletin 14	Field Experiments with Corn	H. J. Waters.
Bulletin 15	Test of Varieties of Wheat and Oats, Change of Seed Wheat, Oats, and Potatoes.	Do.
Bulletin 16	Winter Protection of Fruit Trees; Spread of Pear Blight; Meteorological Observations; Experiments with Strawberries, Potatoes, and Seedling Fruits.	J. W. Clark.
1892.		
Bulletin 17	Sugar Beets	C. P. Fox.
Bulletin 18	Strawberries	C. A. Keffer.
Bulletin 19	Soils and Fertilizers, I	P. Schweitzer.
1893.		
Bulletin 20	Soils and Fertilizers, II	Do.
Bulletin 21	Field Experiments with Wheat	C. M. Conner.
Bulletin 22	Seedling Strawberries	C. A. Keffer.
Bulletin 23	Grape Culture	Do.
1894.		
Bulletin 24	Comparative Tests of Different Breeds of Beef Cattle	P. Schweitzer.
Bulletin 25	An Inquiry into the Composition of the Flesh of Cattle	Do.
Bulletin 26	Dairy Management	A. M. Soule.
Bulletin 27	Spraying Apple Trees for Destruction of Insects and Prevention of Fungus Diseases.	C. A. Keffer.
1895.		
Bulletin 28	Feeding Tests with Different Breeds of Beef Cattle	P. Schweitzer.
Bulletin 29	Feeding Wheat to Pigs	Do.
Bulletin 30	Spray Calendar	
Bulletin 31	Spraying Orchards and Vineyards	J. C. Whitten.
Bulletin 32	Field Experiments with Corn	H. J. Waters and C. M. Conner.
1896.		
Bulletin 33	Inquiry into the Principle of Potato Growing and Tests of Varieties.	P. Schweitzer.
Bulletin 34	Manures and Fertilizers. 1. Report on the Enforcement of the Fertilizer Control Law. 2. Fertilizer Tests with Wheat. 3. The Waste of Farm Manures. 4. Green Manuring.	H. J. Waters.
Bulletin 35	The Woolly Aphis of the Apple	J. M. Stedman.
Bulletin 36	The Lesser Apple-Leaf Folder; The Leaf Crumpler	Do.
Annual Report	Annual Report, 1896	
Circular 3	San José Scale in Missouri	Do.
1897.		
Bulletin 37	Texas Fever. 1. Experiments Confirming the "Tick Theory." 2. Experiments on the Prevention of Texas Fever. 3. Disinfection of Pastures. 4. Experiments to Determine if the Australian Cattle Fever is Identical with Texas Fever.	J. W. Connaway.
Bulletin 38	Winter Protection of the Peach; Peach Growing in Missouri.	J. C. Whitten.
Bulletin 39	Influence of Width of Tire on Draft of Wagons	H J. Waters.
Bulletin 40	The Sugar Beet	Do.
Annual Report	Annual Report, 1897	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

MISSOURI STATION—Continued.

Publication.	Title.	Author.
1898.		
Bulletin 41	The San José Scale in Missouri	J. M. Stedman.
Bulletin 42	A New Orchard Pest: The Fringed-Wing Apple-Bud Moth	Do.
Bulletin 43	Winter Forcing of Asparagus in the Open Field; Asparagus Culture for Missouri.	J. C. Whitten.
Bulletin 44	The Fruit-Tree Bark-Beetle; The Common Apple-Tree and Peach-Tree Borers.	J. M. Stedman.
Annual Report	Annual Report, 1898	
1899.		
Bulletin 45	The Sugar Beet	H. J. Waters.
Bulletin 46	The Grape. 1. A Study of Types and Varieties. 2. A Study of the Pollination of Cultivated Grapes. 3. Methods Pursued by Practical Growers.	J. C. Whitten.
Bulletin 47	The Tarnished Plant Bug	J. M. Stedman.
Bulletin 48	Texas Fever	J. W. Connaway and M. Francis.

MONTANA STATION.

1894.		
Bulletin 1	Organization: Announcements	S. M. Emery.
Bulletin 2	Smuts of Wheat, Oats, and Barley	L. Foster.
Bulletin 3	Pig Feeding	Do.
Bulletin 4	Glanders	W. L. Williams.
Bulletin 5	First Annual Report, 1894	
1895.		
Bulletin 6	Measurement of Water	A. M. Ryon.
Bulletin 7	Small Grains and Potatoes	L. Foster.
Bulletin 8	Second Annual Report, 1895	
1896.		
Bulletin 9	Potatoes: Methods of Successful Growers; Variety Test; Depth of Planting; Quantity of Seed; Time of Cutting; Treatment to Prevent Scab.	Do.
Bulletin 10	Small Grains: Wheat, Oats, and Barley; Methods of Soil Preparation and Seeding in General Practice; Quantity of Seed per Acre; Variety Comparisons; Methods of Preserving Smuts.	Do.
Bulletin 11	Devices for Obtaining a Constant Flow in Laterals with Variable Heads in the Main Canals or Reservoirs.	A. M. Ryon.
Bulletin 12	Third Annual Report, 1896	
	The Spaying of Mares	W. L. Williams.
1897.		
Bulletin 13	Drinking Water	F. W. Traphagen.
Bulletin 14	Montana Swine Feeding	F. Beach.
Bulletin 15	Larkspur Poisoning of Sheep	E. V. Wilcox.
1898.		
Bulletin 16	Fourth Annual Report, 1897	
Bulletin 17	The Grain Aphis; An Army Cutworm	Do.
Bulletin 18	The Alkali Soils of Montana	F. W. Traphagen.
Bulletin 19	The Sugar Beet in Montana	Do.

NEBRASKA STATION.

1887.		
Bulletin 1	Irrigation in Nebraska	L. E. Hicks.
Bulletin 2	Twenty-Two Common Insects of Nebraska	C. McMillan.
Annual Report	First Annual Report, 1887	
1888.		
Bulletin 3	Southern Cattle Plague and Yellow Fever, from the Etiological and Prophylactic Standpoints.	F. S. Billings.
Bulletin 4	Swine Plague: Its Causes, Nature, and Prevention	Do.
Annual Report	Second Annual Report, 1888	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEBRASKA STATION—Continued.

Publication.	Title.	Author.
1889.		
Bulletin 5	Some Injurious Insects of the Year 1888	L. Bruner.
Bulletin 6	Report of Progress, including a History of the Fields and Description of the Animals Available for Experimentation.	H. H. Wing.
	Field Experiments and Observations	J. G. Smith.
	Meteorological Record	D. B. Brace.
Bulletins 7–10	Original Investigations of Cattle Diseases in Nebraska, 1886–1888.	F. S. Billings.
Bulletin 11	The Smut of Wheat and Oats	J. C. Arthur and C. E. Bessey.
	The Smut of Indian Corn	C. E. Bessey.
	A Preliminary Enumeration of the Rusts and Smuts of Nebraska.	H. J. Webber and C. E. Bessey.
	Notes on the Fungi of Economic Interest Observed in Lancaster County, Nebraska, during the Summer of 1889.	R. Pound.
	Observations on the Cottonwood	A. F. Woods.
Annual Report	Third Annual Report	
1890.		
Bulletin 12	Field Experiments for 1889	J. G. Smith.
Bulletin 13	Experiments in the Culture of the Sugar Beet in Nebraska.	H. H. Nicholson and R. Lloyd.
Bulletin 14	Insects Injurious to Young Trees on Tree Claims	L. Bruner.
Bulletin 15	Meteorological Report	D. B. Brace.
	Soil Temperatures. Farm Notes	J. G. Smith.
Annual Report	Fourth Annual Report, 1890	
1891.		
Bulletin 16	Experiments in the Culture of the Sugar Beet in Nebraska.	H. H. Nicholson and R. Lloyd.
Bulletin 17	Field Experiments and Observations for 1890	J. G. Smith.
	Meteorological Observations for 1890	D. B. Brace and H. N. Allen.
Bulletin 18	Preliminary Report on the Native Trees and Shrubs of Nebraska.	C. E. Bessey.
Bulletin 19	Farm Notes for 1891	C. L. Ingersoll.
Bulletin 20	Meteorological Observations for 1891	D. B. Brace.
Annual Report	Fifth Annual Report, 1891	
1892.		
Bulletin 21	Experiments in the Culture of the Sugar Beet in Nebraska	H. H. Nicholson and R. Lloyd.
Bulletins 22, 23	The Corn-Fodder Disease in Cattle and Other Farm Animals, with Special Relation to Contagious Pleuro-Pneumonia in American Beeves in England.	F. S. Billings.
Bulletin 24	Notes on Certain Caterpillars Attacking Sugar Beets	L. Bruner.
Bulletin 25	Detasseling Corn	C. L. Ingersoll.
Annual Report	Sixth Annual Report, 1892	
1893.		
Bulletin 26	Meteorological Observations for 1892	D. B. Brace.
Bulletin 27	Experiments in the Culture of Sugar Beets in Nebraska	H. H. Nicholson and T. L. Lyon.
Bulletin 28	Southern Cattle Plague	F. S. Billings.
Bulletin 29	Cost of Farm Crops	C. L. Ingersoll and S. W. Perin.
Bulletin 30	The Influences of Changes of Food and Temperature on the Quality and Quantity of Milk of Dairy Cows.	C. L. Ingersoll and H. B. Duncanson.
Bulletin 31	The Russian Thistle in Nebraska	C. E. Bessey.
Annual Report	Seventh Annual Report, 1893	
1894.		
Bulletin 32	Wheat and Some of its Products	C. L. Ingersoll et al.
Bulletin 33	Meteorological Observations for 1893	D. B. Brace.
Bulletin 34	Chinch Bugs	L. Bruner and H. G. Barber.
Bulletin 35	Alfalfa. Farm Notes	C. L. Ingersoll.
Bulletin 36	Experiments in the Culture of the Sugar Beet in Nebraska	H. H. Nicholson and E. E. Nicholson.
Bulletin 37	Monthly Weather Review, January to May	G. D. Swezey and G. A. Loveland.
Bulletin 38	Nebraska and the Beet-Sugar Industry	M. Hollrung, translated by H. H. Nicholson.
Annual Report	Eighth Annual Report, 1894	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

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NEBRASKA STATION—Continued.

Publication.	Title.	Author.
1895.		
Bulletin 39	Some Obstacles to Successful Fruit Growing	F. W. Card.
Bulletin 40	A Preliminary List of the Honey-Producing Plants of Nebraska.	C. E. Bessey.
Bulletin 41	Water Supply in Nebraska	O. V. P. Stout.
Bulletin 42	Nebraska Weather Review for 1895	G. D. Swezey and G. A. Loveland.
Bulletin 43	The Conservation of Soil Moisture by Means of Subsoil Plowing.	T. L. Lyon.
Annual Report	Ninth Annual Report, 1895	
1896.		
Bulletin 44	Experiments in the Culture of the Sugar Beet in Nebraska	H. H. Nicholson and T. L. Lyon.
Bulletin 45	The Rainfall of Nebraska	G. D. Swezey and G. A. Loveland.
Bulletin 46	Nebraska Weather and Climate for 1896	Do.
Annual Report	Tenth Annual Report, 1896	
1897.		
Bulletin 47	Serum Therapy in Hog Cholera	A. T. Peters.
Bulletin 48	Windbreaks	F. W. Card.
Bulletin 49	Suggestions for Chicory Culture	T. L. Lyon.
Bulletin 50	Notes on Pruning	F. W. Card.
Bulletin 51	Observations on the Codling Moth	Do.
Annual Report	Eleventh Annual Report, 1897	
1898.		
Bulletin 52	Cornstalk Disease	A. T. Peters.
Bulletin 53	A Preliminary Report on Experiments with Forage Crops	T. L. Lyon.
Bulletin 54	The Effect of Certain Methods of Soil Treatment upon the Corn Crop.	Do.
Bulletin 55	Ornamental Planting	F. W. Card.
Bulletin 56	Methods of Tree Planting	Do.
Annual Report	Twelfth Annual Report, 1898	
1899.		
Bulletin 57	Proceedings of Agricultural Students' Association, 1898–1899.	
Bulletin 58	Annual Forage Plants for Summer Pasture	T. L. Lyon and A. L. Haecker.
Bulletin 59	The Homemade Windmills of Nebraska	E. H. Barbour.
Bulletin 60	Experiments in the Culture of the Sugar Beet in Nebraska.	H. H. Nicholson and T. L. Lyon.

NEVADA STATION.

1888.		
Bulletin 1	History, Organization, and Proposed Work of the Station	
Bulletin 2	The Investigation of the Independence of Plant Life and Climatic Conditions of Nevada.	W. McN. Miller and L. D. Brown.
Bulletin 3	Meteorological Report for 1888	W. McN. Miller.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 4	Meteorological Report for January, February, and March	Do.
Bulletin 5	Meteorological Report for April, May, and June	W. S. Devol.
Bulletin 6	Meteorological Report for July, August, and September	Do.
Bulletin 7	Meteorological Report for October, November, and December.	Do.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 8	The Codling Moth	F. H. Hillman.
Bulletin 9	A Serious Rose Pest	Do.
Bulletin 10	The Pear and Cherry Slug	Do.
Bulletin 11	Plant Lice Infesting the Apple	Do.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 12	Sugar-Beet Culture	R. H. McDowell.
Bulletin 13	Sugar-Beet Experiments	R. H. McDowell and N. E. Wilson.

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[Titles which have been changed from their original form are inclosed in brackets.]

NEVADA STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 14	Potato Experiments	R. H. McDowell and N. E. Wilson.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 15	Dodder	F. H. Hillman.
Bulletin 16	The Creamery Industry	N. E. Wilson.
Bulletin 17	The Woolly Aphis of the Apple	F. H. Hillman.
Bulletin 18	Cheese and Its Manufacture	N. E. Wilson.
Bulletin 19	Sugar Beets	R. H. McDowell and N. E. Wilson.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 20	Potatoes. Tobacco	R. H. McDowell.
Bulletin 21	Nevada Weeds, I	F. H. Hillman.
Bulletin 22	Nevada Weeds, II	Do.
Bulletin 23	Sugar Beets	N. E. Wilson.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 24	Early Flora of the Truckee Valley	F. H. Hillman.
Bulletin 25	Irrigation	R. H. McDowell.
Bulletin 26	Feeding Stuffs	N. E. Wilson and F. Stadtmuller.
Bulletin 27	Grain: Thick and Thin Seeding. Potatoes: Different Dates of Planting.	R. H. McDowell.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 28	An Important Elm Insect	F. H. Hillman.
Bulletin 29	The San José Scale	Do.
Bulletin 30	Wheat: Cutting at Different Dates	R. H. McDowell.
Bulletin 31	Texas Cattle Fever	W. McN. Miller.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 32	Sugar Beets	N. E. Wilson.
Bulletin 33	Field Notes on Some Nevada Grasses	F. H. Hillman.
Bulletin 34	Drinking Water	N. E. Wilson.
Bulletin 35	Hops	R. H. McDowell.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 36	Some Common Injurious Insects of Western Nevada	F. H. Hillman.
Bulletin 37	Sugar Beets	R. H. McDowell and N. E. Wilson.
Bulletin 38	Nevada Weeds, III	F. H. Hillman.
Bulletin 39	Some Nevada Soils	N. E. Wilson.
Annual Report	Tenth Annual Report, 1897	

NEW HAMPSHIRE STATION.

1888.		
Bulletin 1	Ensilage	G. H. Whitcher.
Bulletin 2	Feeding Experiments	Do.
Bulletin 3	When to Cut Corn for Ensilage	Do.
Bulletin 4	The Science and Practice of Stock Feeding	Do.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 5	Fertilizers and Fertilizing Materials	Do.
Bulletin 6	Experiments with Fertilizers	Do.
Bulletin 7	Test of Dairy Apparatus	Do.
Bulletin 8	Feeding Experiments	Do.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 9	Effect of Food upon Milk	Do.
Bulletin 10	Cooperative Fertilizer Experiments	Do.
Bulletin 11	Results of Feeding Skim Milk and Corn Meal v. Corn Meal and Middlings to pigs.	Do.
	Determination of the Digestibility of Rations	F. W. Morse.
Annual Report	Third Annual Report, 1890	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW HAMPSHIRE STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 12	Fertilizer Experiments	G. H. Whitcher.
Bulletin 13	Effect of Food on the Hardness of Butter	A. H. Wood and C. L. Parsons.
	Effect of Food on the Quantity of Milk	G. H. Whitcher.
Bulletin 14	Ensilage in Dairy Farming	Do.
Bulletin 15	Patent Cattle Foods	Do.
Annual Report	Fourth Annual Report, 1891–92	
1892.		
Bulletin 16	Effect of Food on Composition of Butter Fat	F. W. Morse.
Bulletin 17	Stock-feeder's Guide, with Chart for use in Barn	
Bulletin 18	Effect of Food on Milk	A. H. Wood.
1893.		
Annual Report	Fifth Annual Report, 1893	
1894.		
Bulletin 19	Spraying Apples and Pears against Fungi	H. H. Lamson.
Bulletin 20	Effect of Food on Milk: Feeding with Fats	A. H. Wood.
Bulletin 21	Farmyard Manures and Artificial Fertilizers	G. H. Whitcher.
Bulletin 22	Prevention of Potato Blight	H. H. Lamson.
Bulletin 23	Some Dangerous Fruit Insects	C. M. Weed.
Annual Report	Sixth Annual Report, 1894	
1895.		
Bulletin 24	The Flow of Maple Sap	A. H. Wood.
Bulletin 25	The Composition of Maple Sap	F. W. Morse and A. H. Wood.
Bulletin 26	Analyses of Fertilizers and Wood Ashes	F. W. Morse.
Bulletin 27	Spraying Experiments in 1894	H. H. Lamson.
Bulletin 28	Remedies for the Horn Fly	C. M. Weed.
Bulletin 29	Remedies for Flea Beetles	Do.
Bulletin 30	An Experiment in Road Making	C. H. Pettee.
Bulletin 31 *a*	Seventh Annual Report, 1895	
Bulletin 32	Studies of Maple Sap	F. W. Morse.
Bulletin 33	Two Shade-Tree Pests	C. M. Weed.
1896.		
Bulletin 34	Surface and Subirrigation Out of Doors	F. W. Rane.
Bulletin 35	The Codling Moth and The Apple Maggot	C. M. Weed.
Bulletin 36	Analyses of Three Common Insecticides	F. W. Morse.
Bulletin 37	Crimson Clover	F. W. Rane.
Bulletin 38	The Tent Caterpillar	C. M. Weed.
Bulletin 39	The Army Worm	Do.
Bulletin 40	Eighth Annual Report, 1896	
1897.		
Bulletin 41	Potatoes: Varieties, Fertilizers, and Scab	F. W. Rane and L. Hunt.
Bulletin 42	Tomato Growing in New Hampshire; Notes on Tomato Breeding.	Do.
Bulletin 43	Some Inferior Wood Ashes	F. W. Morse.
Bulletin 44	The Cankerworm	C. M. Weed.
Bulletin 45	Fruit and Potato Diseases	H. H. Lamson.
Bulletin 46	An Experiment with a Steam Drill; Methods of Road Maintenance.	C. H. Pettee.
Bulletin 47	Strawberries in New Hampshire	F. W. Rane.
Bulletin 48	Ninth Annual Report, 1897	
1898.		
Bulletin 49	The Inspection of Fertilizers in 1897 in Cooperation with the State Board of Agriculture.	F. W. Morse.
Bulletin 50	Dehorning Cattle	F. W. Rane and H. H. Lamson.
Bulletin 51	Sweet Corn for New Hampshire	F. W. Rane.
Bulletin 52	Growing Muskmelons in the North	Do.
Bulletin 53	The Farm Water Supply	F. W. Morse.
Bulletin 54	The Winter Food of the Chickadee	C. M. Weed.
Bulletin 55	The Feeding Habits of the Chipping Sparrow	Do.
Bulletin 56	Poisonous Properties of Wild Cherry Leaves	F. W. Morse and C. D. Howard.
Bulletin 57	Experiments with Roots and Forage Crops	F. W. Rane.
Bulletin 58	The Cost of Raising Calves	F. W. Morse.
Bulletin 59	Tenth Annual Report, 1898	

a Hereafter the Annual Reports will appear as a Bulletin of the regular series. The previous reports were issued as Part II of the College Report.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW HAMPSHIRE STATION—Continued.

Publication.	Title.	Author.
1899.		
Bulletin 60	Green Corn under Glass	F. W. Rane.
Bulletin 61	The Inspection of Fertilizers in 1898	F. W. Morse.
Bulletin 62	Forcing Pole Beans under Glass	F. W. Rane.
Bulletin 63	Third Potato Report	Do.
Bulletin 64	The Forest Tent Caterpillar	C. M. Weed.
Bulletin 65	Notes on Apple and Potato Diseases	H. H. Lamson.
Bulletin 66	Experiments in Pig Feeding	C. W. Burkett.

NEW JERSEY STATIONS. *a*

1880.		
Bulletin 1	Suggestions in Regard to the Cranberry Rot and its Cure	
Bulletin 2	Raspberry Disease and Suggestions for Overcoming it	G. H. Cook.
Bulletin 3	Analyses of Land Plaster	Do.
Bulletin 4	Analyses of Guanos, Superphosphates, and Special Manures.	Do.
Bulletin 5	Analyses of Bone Dust	
Bulletin 6	Analyses of Fertilizers	
Bulletin 7	....do	Do.
Bulletin 8	....do	Do.
Bulletin 9	....do	Do.
Annual Report	First Annual Report, 1880	
1881.		
Bulletin 10	Rational System of Feeding Milch Cows	Do.
Bulletin 11	Ensilage	Do.
Bulletin 12	Valuation of Fertilizers	Do.
Bulletin 13	Land Plaster and Ground Bone	Do.
Bulletin 14	Clover Seed Midge	Do.
Bulletin 15	Commercial Fertilizers, their Composition and Valuation	Do.
Bulletin 16	Commercial Fertilizers	Do.
Bulletin 17	....do	Do.
Bulletin 18	Sorghum Sugar Cane	Do.
Annual Report	Second Annual Report, 1881	
1882.		
Bulletin 19	Green Fodder Corn; Dried Fodder Corn; Ensilage	Do.
Bulletin 20	Valuation of Fertilizers	Do.
Bulletin 21	Chemical Fertilizers (Incomplete)	Do.
Bulletin 22	Chemical Fertilizers (Complete and Incomplete)	Do.
Bulletin 23	Commercial Fertilizers	Do.
Bulletin 24	Sorghum; Feeding Experiments with Sorghum Seed	Do.
Bulletin 25	Sorghum and Sugar: Experiments and Investigations of 1882.	Do.
Spec. Bulletin A	Yellow Tobacco	H. Garnier and G. H. Cook.
Annual Report	Third Annual Report, 1882	
1883.		
Bulletin 26	Field Experiments	G. H. Cook.
Bulletin 27	Prices of Nitrogen, Phosphoric Acid, and Potash, and Analyses of Incomplete Fertilizers.	Do.
Bulletin 28	Analyses and Valuations of Complete Manures and Special Fertilizers.	Do.
Bulletin 29	Analyses and Valuations of Nitrogenous Superphosphates, Ground Bones, Plain Superphosphates, Poudrettes, and Miscellaneous Fertilizers.	Do.
Bulletin 30	Results of Field and Laboratory Experiments with Sorghum for the Season of 1883.	Do.
Bulletin 31	Nitrate of Soda or Chili Saltpeter as a Top-Dressing for Wheat.	Do.
Annual Report	Fourth Annual Report, 1883	
1884.		
Bulletin 32	Prices of Nitrogen, Phosphoric Acid, and Potash	Do.
Bulletin 33	Analyses and Valuations of Complete Fertilizers	Do.
Bulletin 34	Analyses and Valuations of Incomplete Fertilizers	Do.
Annual Report	Fifth Annual Report, 1884	
1885.		
Bulletin 35	Meaning of Stations' Valuations, Schedule of Trade Values for 1885, and Chemical Composition, Retail Prices, and Guaranteed Analyses of Fertilizer Supplies.	G. H. Cook.

a The publications for the years 1880 to 1887, inclusive, were issued by the New Jersey State Experiment Station.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW JERSEY STATIONS—Continued.

Publication.	Title.	Author.
1885.		
Bulletin 36	Analyses and Valuations of Complete Fertilizers	G. H. Cook.
Bulletin 37	Miscellaneous Fertilizers	Do.
Bulletin 38	The Rio Grande Sorghum Sugar Works	Do.
Annual Report	Sixth Annual Report, 1885	
1886.		
Bulletin 39	Meaning of Stations' Valuations; Schedule of Trade Values for 1886.	Do.
Bulletin 40	Analyses and Valuations of Complete Fertilizers	Do.
Annual Report	Seventh Annual Report, 1886	
1887.		
Bulletin 41	The Extraction of Sugar from Sorghum at Rio Grande, Cape May County, New Jersey.	
Bulletin 42	Analyses and Valuations of Complete Fertilizers	Do.
Bulletin 43	Analyses and Valuations of Complete Fertilizers, Ground Bones, and Miscellaneous Material.	Do.
Spec. Bulletin B	Alfalfa, or Lucern	Do.
Annual Report	Eighth Annual Report, 1887	
1888.		
Bulletin 44	Sorghum and Sugar Making	Do.
	A Report upon Experiments made at Rio Grande during the Season of 1887.	A. T. Neale.
Bulletin 45	Prices of Nitrogen, Phosphoric Acid, and Potash	G. H. Cook.
Bulletin 46	Insect Pests and the Means for Destroying them	G. D. Hulst.
Bulletin 47	Analyses and Valuations of Incomplete Fertilizers	G. H. Cook.
Bulletin 48	Analyses and Valuations of Complete Fertilizers	Do.
Bulletin 49	Analyses and Valuations of Complete Fertilizers, Ground Bone, and Miscellaneous Samples of Other Fertilizing Materials.	Do.
Bulletin 50	Insects Injurious to the Cabbage and the Best Means of Preventing their Ravages.	G. D. Hulst.
Bulletin 51	Sorghum and Sugar Making	G. H. Cook.
	A Report upon Experiments Made at Rio Grande during the Season of 1888.	A. T. Neale.
Annual Report	Ninth Annual Report of the State Station and First of the College Station, 1888.	
1889.		
Bulletin 52	What are the Worst Weeds of New Jersey	B. D. Halsted.
Bulletin 53	Prices of Nitrogen, Phosphoric Acid, and Potash	G. H. Cook.
Bulletin 54	Potash as a Fertilizer	E. B. Voorhees.
Bulletin 55	Entomological Suggestions and Inquiries	J. B. Smith.
Bulletin 56	Analyses and Valuations of Complete Fertilizers	G. H. Cook.
Bulletin 57	Experiments with Different Breeds of Dairy Cows	Do.
Bulletin 58	Analyses of Incomplete Fertilizers	Do.
Bulletin 59	Analyses and Valuations of Complete Fertilizers	E. B. Voorhees.
Bulletin 60	Ground Bones and Miscellaneous Samples	Do.
Bulletin 61	Experiments with Different Breeds of Dairy Cows	M. E. Gates.
Bulletin 62	The Horn Fly	J. B. Smith.
Bulletin 63	Experiments on Tomatoes	E. B. Voorhees.
Bulletin 64	Some Fungus Diseases of the Cranberry	B. D. Halsted.
Spec. Bulletin C	Pollen v. Rain	Do.
Spec. Bulletin D	Memoranda about Cranberry Insects	J. B. Smith.
Spec. Bulletin E	Oyster Interests of New Jersey	J. Nelson.
Spec. Bulletin F	The Horn Fly	J. B. Smith.
Spec. Bulletin G	The Potato Rot	B. D. Halsted.
Spec. Bulletin H	The Cranberry Scald	Do.
Spec. Bulletin I	Questions Relative to General Farm Practice	E. B. Voorhees.
Spec. Bulletin J	The Sweet Potato Rot	B. D. Halsted.
Annual Report	Tenth Annual Report of the State Station and Second of the College Station, 1889.	
1890.		
Bulletin 65	Experiments with Different Breeds of Dairy Cows	M. E. Gates.
Bulletin 66	Fertilizing Materials	E. B. Voorhees.
Bulletin 67	Note on the Wheat Louse	J. B. Smith.
Bulletin 68	Experiments with Different Breeds of Dairy Cows	M. E. Gates.
Bulletin 69	Analyses and Valuations of Complete Fertilizers	E. B. Voorhees.
Bulletin 70	Some Fungus Diseases of the Spinach	B. D. Halsted.
Bulletin 71	Analyses of Incomplete Fertilizers and the Value of Home Mixtures.	E. B. Voorhees.
Bulletin 72	Plant Lice and How to Deal with Them	J. B. Smith.
Bulletin 73	Analyses and Valuations of Complete Fertilizers	E. B. Voorhees.
Bulletin 74	Ground Bones and Miscellaneous Samples	Do.
Bulletin 75	Insecticides and How to Apply Them	J. B. Smith.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW JERSEY STATIONS—Continued.

Publication.	Title.	Author.
1890.		
Bulletin 76	Some Fungus Diseases of the Sweet Potato	B. D. Halsted.
Bulletin 77	Experiments with Different Breeds of Dairy Cows	
Spec. Bulletin K	The Insects Injuriously Affecting Cranberries	J. B. Smith.
Spec. Bulletin L	Observations on the Peach for 1890	B. D. Halsted.
Annual Report	Eleventh Annual Report of the State Station and Third of the College Station, 1890.	
1891.		
Bulletin 78	Destroy the Black Knot of Plum and Cherry	Do.
Bulletin 79	Experiments with Nitrate of Soda on Tomatoes	E. B. Voorhees.
Bulletin 80	Experiments with Fertilizers on Potatoes and Wheat	Do.
Bulletin 81	Incomplete Fertilizers and Home Mixtures	Do.
Bulletin 82	The Rose Chafer	J. B. Smith.
Bulletin 83	Analyses and Valuations of Complete Fertilizers	E. B. Voorhees.
Bulletin 84	Ground Bone and Miscellaneous Samples	Do.
Bulletin 85	Farm Practice and Fertilizers to Control Insect Injury	J. B. Smith.
Spec. Bulletin M	Field Experiments with Soil and Black Rot of Sweet Potatoes.	B. D. Halsted.
Spec. Bulletin N	Insects Injurious to the Blackberry	J. B. Smith.
Annual Report	Twelfth Annual Report of the State Station and Fourth of the College Station, 1891.	
1892.		
Bulletin 86	Spraying for Insect and Fungus Pests of the Orchard and Vineyard.	J. B. Smith and B. D. Halsted.
Bulletin 87	Analyses of Commercial Feeds	E. B. Voorhees.
Bulletin 88	Analyses of Home Mixtures and Incomplete Fertilizers	Do.
Bulletin 89	Analyses and Valuations of Complete Fertilizers and Ground Bone.	Do.
Bulletin 90	Grasshoppers; Locusts; Crickets	J. B. Smith.
Bulletin 91	Some Fungus Diseases of the Quince Fruit	B. D. Halsted.
Spec. Bulletin O	Experiments with Nitrate of Soda upon Tomatoes	E. B. Voorhees.
Spec. Bulletin P	Experiments with Fertilizers upon White and Sweet Potatoes.	Do.
Spec. Bulletin Q	Some Fungus Diseases of the Celery	B. D. Halsted.
Annual Report	Thirteenth Annual Report of the State Station and Fifth of the College Station, 1892.	
1893.		
Bulletin 92	Feeding Experiments with Horses; Dried Brewers' Grains v. Oats.	E. B. and L. A. Voorhees.
Bulletin 93	Analyses and Study of Home-mixed Fertilizers and Fertilizer Materials.	L. A. Voorhees and J. P. Street.
Bulletin 94	Insects Injurious to Cucurbits	J. B. Smith.
Bulletin 95	The Periodical Cicada	Do.
Bulletin 96	Cornstalks and Straw as Hay Substitutes	E. B. Voorhees.
Bulletin 97	Analyses and Valuations of Fertilizers	E. B. and L. A. Voorhees and J. P. Street.
Bulletin 98	Club Root of Cabbage and Its Allies	B. D. Halsted.
Annual Reports	Fourteenth Annual Report of the State Station and Sixth of the College Station, 1893.	
1894.		
Bulletin 99	The Pear Midge	J. B. Smith.
Bulletin 100	Crimson, or Scarlet, Clover: Its Growth, Composition, and Usefulness.	E. B. Voorhees.
Bulletin 101	The Use of Koch's Lymph in the Diagnosis of Tuberculosis of Cattle.	J. Nelson.
Bulletin 102	Analyses of Fertilizing Materials and Home Mixtures; The Experience of Farmers with Home Mixtures.	L. A. Voorhees and J. P. Street.
Bulletin 103	Some Insects Injurious to Shade Trees	J. B. Smith.
Bulletin 104	Analyses and Valuation of Complete Fertilizers, Ground Bone, and Miscellaneous Samples.	E. B. and L. A. Voorhees and J. P. Street.
Bulletin 105	Gluten Feeds: Their Source, Composition, and Methods of Use.	E. B. Voorhees.
Bulletin 106	The San José Scale in New Jersey	J. B. Smith.
Annual Report	Fifteenth Annual Report of the State Station and Seventh of the College Station, 1894.	
1895.		
Bulletin 107	Some Fungus Diseases of Beets	B. D. Halsted.
Bulletin 108	Field Experiments with Fungicides (Turnips, Cabbage, Tomatoes, Potatoes, and Beans).	B. D. Halsted and J. A. Kelsey.
Bulletin 109	Cutworms; The Sinuate Pear Borer; The Potato-Stalk Borer; Bisulphid of Carbon as an Insecticide.	J. B. Smith.
Bulletin 110	The Hessian Fly	Do.
Bulletin 111	"Raupenleim" and "Dendrolene"	Do.
Bulletin 112	Field Experiments with Potatoes	B. D. Halsted.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW JERSEY STATIONS—Continued.

Publication.	Title.	Author.
1895.		
Bulletin 113.....	Analyses of Fertilizer Supplies and Home Mixtures. Analyses and Valuations of Commercial Fertilizers and Ground Bone.	L. A. Voorhees and J. P. Street.
Bulletin 114.....	Suggestions in Reference to Systematic Methods of Manuring.	E. B. Voorhees.
Bulletin 115.....	Irrigation of Garden Crops	B. D. Halsted and J. A. Kelsey.
Annual Report..	Sixteenth Annual Report of the State Station and Eighth of the College Station, 1895.	
1896.		
Bulletin 116.....	The Pernicious, or San José, Scale	J. B. Smith.
Bulletin 117.....	Analyses of Fertilizer Supplies and Home Mixtures; Analyses and Valuations of Commercial Fertilizers and Ground Bone.	L. A. Voorhees and J. P. Street.
Bulletin 118.....	The Suppression and Prevention of Tuberculosis of Cattle and its Relation to Human Consumption.	J. Nelson.
Annual Report..	Seventeenth Annual Report of the State Station and Ninth of the College Station, 1896.	
1897.		
Bulletin 119.....	Apple Growing in New Jersey	E. B. Voorhees.
Bulletin 120.....	Field Experiments with Potatoes for 1896	B. D. Halsted.
Bulletin 121.....	The Harlequin Cabbage Bug and the Melon Plant Louse	J. B. Smith.
Bulletin 122.....	The Cost and Feeding Value of the Dry Matter of Dried Corn Fodder and of Silage.	E. B. Voorhees and C. B. Lane.
Bulletin 123.....	Milk: Its Value as a Food, and Studies which Suggest a Different Method of Sale.	Do.
Bulletin 124.....	Analyses of Fertilizer Supplies and Home Mixtures: Analyses and Valuations of Commercial Fertilizers and Ground Bone.	L. A. Voorhees and J. P. Street.
Bulletin 125.....	The San José Scale and How it May be Controlled	J. B. Smith.
Bulletin 126.....	Small Fruits	A. T. Jordan.
Bulletin 127.....	The Prevalence, Cause, and Treatment of Bovine Abortion; Milk Fever and Garget.	J. Nelson.
Spec. Bulletin R.	Catalogue of Reports and Bulletins. Index of Reports, 1880–1897.	
Annual Report..	Eighteenth Annual Report of the State Station and Tenth of the College Station, 1897.	
1898.		
Bulletin 128.....	The Peach Borer; Experiments with Hydraulic Cement	J. B. Smith.
Bulletin 129.....	The Asparagus Rust: Its Treatment and Natural Enemies.	B. D. Halsted.
Bulletin 130.....	Forage Crops	E. B. Voorhees and C. B. Lane.
Bulletin 131.....	Feeds Rich in Protein; The Advantage of a Guaranteed Composition.	E. B. Voorhees.
Bulletin 132	Analyses of Fertilizer Supplies and Home Mixtures: Analyses and Valuations of Commercial Fertilizers and Ground Bone.	L. A. Voorhees and J. P. Street.
Annual Report..	Nineteenth Annual Report of the State Station and Eleventh of the College Station, 1898.	
1899.		
Bulletin 133	Peach Growing in New Jersey	A. T. Jordan.
Bulletin 134	Fermentation in Germ Life	J. Nelson.
Bulletin 135	The Poisonous Plants of New Jersey	B. D. Halsted.
Bulletin 136	Field Experiments with Nitrogenous Fertilizers	E. B. Voorhees.
Bulletin 137	Dairy Experiments	C. B. Lane.
Bulletin 138	Crude Petroleum as an Insecticide	J. B. Smith.
Bulletin 139	Analyses of Fertilizer Supplies and Home Mixtures; Analyses and Valuations of Commercial Fertilizers and Ground Bone.	L. A. Voorhees and J. P. Street.
Bulletin 140	Three Common Orchard Scales	J. B. Smith.

NEW MEXICO STATION.

1890.		
Bulletin 1.....	Announcements	H. Hadley.
Bulletin 2.....	.....do.....	A. E. Blount and H. Hadley.
Annual Report..	First Annual Report, 1890	
1891.		
Bulletin 3.....	A Preliminary Account of Some Insects Injurious to Fruits.	C. H. T. Townsend.
Bulletin 4.....	Horticultural Work	A. E. Blount.
Annual Report..	Second Annual Report, 1891	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW MEXICO STATION—Continued.

Publication.	Title.	Author.
1892.		
Bulletin 5	Notes on Fruit Insects	C. H. T. Townsend.
Bulletin 6	Cereals, Forage Plants, Grasses, Clovers, Textile Plants, and Sorghums.	A. E. Blount.
Bulletin 7	Scale Insects in New Mexico	C. H. T. Townsend.
Bulletin 8	Experiments with Various Field Crops	A. E. Blount and A. Goss.
Bulletin 9	Insecticides and their Appliances	C. H. T. Townsend.
Annual Report	Third Annual Report, 1892	
1893.		
Bulletin 10	Insects of 1893: The Army Worm; The San José Scale; The Cochineal Insect; The Cottony Scale of the Osage Orange; Miscellaneous Insects.	T. D. A. Cockerell.
Bulletin 11	Notes on Cañaigre	A. E. Blount.
	Meteorological Data and Deductions	H. H. Griffin.
Bulletin 12	The Value of Rio Grande Water for the Purpose of Irrigation.	A. Goss.
Annual Report	Fourth Annual Report, 1893	
1894.		
Bulletin 13	New Mexico Weeds, I	E. O. Wooton.
Bulletin 14	Cañaigre	A. E. Blount.
Annual Report	Fifth Annual Report, 1894	
1895.		
Bulletin 15	Entomological Observations in 1894; Life Zones in New Mexico; Entomological Diary at Santa Fe.	T. D. A. Cockerell.
Bulletin 16	Russian Thistle	E. O. Wooton.
Bulletin 17	Principles of Stock Feeding and Some New Mexico Feeding Stuffs.	A. Goss.
Annual Report	Sixth Annual Report, 1895	
1896.		
Bulletin 18	Some New Mexico Forage Plants	E. O. Wooton.
Bulletin 19	Report of Entomologist, I	T. D. A. Cockerell.
Bulletin 20	Seeds	G. Vestal.
Annual Report	Seventh Annual Report, 1896	
1897.		
Bulletin 21	Results of Experiments at the San Juan Substation	H. H. Griffin.
Bulletin 22	Alkali in the Rio Grande and Animas Valleys	A. Goss and H. H. Griffin.
Bulletin 23	Sugar Beets	C. T. Jordan.
Bulletin 24	Life Zones in New Mexico	T. D. A. Cockerell.
1898.		
Bulletin 25	Preliminary Notes on the Codling Moth	Do.
Bulletin 26	New Mexico Sugar Beets, 1897	A. Goss.
Bulletin 27	Report on Plums	C. Vestal and F. Garcia.
Bulletin 28	Life Zones in New Mexico, II	T. D. A. Cockerell.
Bulletin 29	New Mexico Sugar Beets, 1898	A. Goss and A. M. Holt.
Bulletin 30	The Effect of Spring Frosts on the Peach Crop; with Cultural Notes on the Peach in New Mexico.	F. Garcia.
Annual Report	Eighth and Ninth Annual Reports, 1897 and 1898	

NEW YORK STATE STATION.

1882.		
Bulletin 1	Test of Small Fruits and Vegetables; Culture Experiments with Wheat, Corn, and Potatoes; Description of Lysimeters.	E. L. Sturtevant.
Bulletin 2	Potato Experiments with Seed Cut Different Sizes	Do.
Bulletin 3	Corn Culture; Root Washing of the Potato; Analyses of Pigweed (*Chenopodium album*).	Do.
Bulletin 4	Wheat	Do.
Bulletin 5	Cultivation of the Soil to Retard Evaporation; Tests of Peas, Cabbages, and Tomatoes; Analysis of Redweed (*Amaranthus retroflexus*).	Do.
Bulletin 6	Corn, Potatoes, Sorghum, and Cabbage, and Cabbage Worm and Borer.	Do.
Bulletin 7	Potatoes, Pacey Ray Grass, *Soja hispida* (Japanese Bean), and Analyses of Cowpea.	Do.
Bulletin 8	Teosinte, Pearl Millet, Chinese Bean, Cowpeas, Tomato Rot, and Peas.	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW YORK STATE STATION—Continued.

Publication.	Title.	Author.
1882.		
Bulletin 9	Sorghum; Filling Silo with Corn; Stirring Soil to Retard Evaporation; Cucumbers.	E. L. Sturtevant.
Bulletin 10	Soja Bean, Pasture Grasses, Seed Improvement, Analysis of Tomato, and Sugar in Corn.	Do.
Bulletin 11	Oats, Cowpeas, and Weeds	Do.
Bulletin 12	Barley, and Agricultural Museum	Do.
Bulletin 13	Corn, Butt and Tip Kernels of, for Seed; Fertilizer Experiments with Corn.	Do.
Bulletin 14	Garden Vegetables, Potatoes, and Corn	Do.
Bulletin 15	Corn Hybridization	Do.
Bulletin 16	Twenty-eight Varieties of Cabbage Tested	Do.
Bulletin 17	Fertilizers as Adapted to Plant Growth	Do.
Bulletin 18	Potato Planting	Do.
Bulletin 19	Potato Culture	Do.
Bulletin 20	Clover and Tobacco	Do.
Bulletin 21	Amber Cane	Do.
Bulletin 22	Sugar from Corn	Do.
Bulletin 23	Seed Testing	Do.
Bulletin 24	....do	Do.
Annual Report	First Annual Report, 1882	
1883.		
Bulletin 25	Milk	Do.
Bulletin 26	Germination of Corn	Do.
Bulletin 27	Corn	Do.
Bulletin 28	Potato Experiments	Do.
Bulletin 29	Germination of Seeds	Do.
Bulletin 30	Improvement of Varieties	Do.
Bulletin 31	Planting Corn from Different Parts of the Ear	Do.
Bulletin 32	Corn Culture	Do.
Bulletin 33	Influence of Food on Milk	Do.
Bulletin 34	The Feeding of Cows	Do.
Bulletin 35	....do	Do.
Bulletin 36	Feeding Experiments with Cows	Do.
Bulletin 37	Digestibility of Corn Silage	Do.
Bulletin 38	Influence of Seed from Different Parts of Plant	Do.
Bulletin 39	Test of Seeds	Do.
Bulletin 40	The Weather during the Winter of 1882–83	Do.
Bulletin 41	The Cutting of Seed Potatoes	Do.
Bulletin 42	Fertilizer Analyses	Do.
Bulletin 43	Experiments in Cross-Fertilization	Do.
Bulletin 44	Variations in Seeding Plants	Do.
Bulletin 45	Germination Tests of Varieties of Wheat	Do.
Bulletin 46	Cross Fertilization of Corn	Do.
Bulletin 47	Observations on Corn Plants	Do.
Bulletin 48	Experiments with Insecticides	Do.
Bulletin 49	Grass Experiments	Do.
Bulletin 50	Seed Selection	Do.
Bulletin 51	....do	Do.
Bulletin 52	Peas	Do.
Bulletin 53	Seed Selection	Do.
Bulletin 54	Peach Curl	Do.
Bulletin 55	Selection of Varieties of Corn	Do.
Bulletin 56	Soil Analysis	Do.
Bulletin 57	Ash Analysis of the Corn Plant	Do.
Bulletin 58	Analysis of Plantain and Ox-Eye Daisy	Do.
Bulletin 59	Variations in Plants	Do.
Bulletin 60	Races of Corn	Do.
Bulletin 61	Root Pruning of Barley	Do.
Bulletin 62	Seed Tests	Do.
Bulletin 63	Insecticides	Do.
Bulletin 64	Potato Seed from Different Parts of the Tuber	Do.
Bulletin 65	Mulching for Potatoes	Do.
Bulletin 66	Variations in the Results of Plat Experiments with Potatoes.	Do.
Bulletin 67	The Effect of Planting Corn Along with Other Crops	Do.
Bulletin 68	Sunflowers	Do.
Bulletin 69	Experiments with Potatoes	Do.
Bulletin 70	Analyses of Corn	Do.
Bulletin 71	Effect of Fertilizers on Tobacco	Do.
Bulletin 72	Cross Fertilization of Corn	Do.
Bulletin 73	Analyses of Corn and Alfalfa	Do.
Bulletin 74	Corn	Do.
Bulletin 75	Apple Maggot	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW YORK STATE STATION—Continued.

Publication.	Title.	Author.
1883.		
Circular 1	Directions for Arresting Chinch-Bug Invasion in Northern New York.	J. A. Lintner.
Annual Report	Second Annual Report, 1883	
1884.		
Bulletin 76	Maize	
Bulletin 77	Onions, Strawberries, and Cauliflowers	E. L. Sturtevant.
Bulletin 78	Sorghum Analyses	Do.
Bulletin 79	Coal Ashes	
Bulletin 80	Influence of Climate upon the Action of Fertilizer in its Relation to Crop.	
Bulletin 81	Celery and Tomatoes	Do.
Bulletin 82	Corn Analyses	
Bulletin 83	Varieties of Sweet Corn	Do.
Bulletin 84	Silage for Cows	Do.
Bulletin 85	Digestibility of Fodder Corn and the Same Ensilaged	
Bulletin 86	Corn Cutworms	Do.
Bulletin 87	Varieties of Peas	Do.
Bulletin 88	Insecticides for the Turnip Flea Beetle	Do.
Bulletin 89	Cross Fertilization of Beans	Do.
Bulletin 90	Insecticides	Do.
Bulletin 91	Vegetables	Do.
Bulletin 92	Pear Blight	
Bulletin 93	Corn Analyses	Do.
Bulletin 94	Varieties of Raspberries	E. S. Goff and E. L Sturtevant.
Bulletin 95	Ripe v. Immature Seed	E. L. Sturtevant
Bulletin 96	List of Station Farm Products Exhibited at the New York State Fair of 1884.	Do.
Bulletin 97	Smut in Oats	Do.
Bulletin 98	Tomatoes	Do.
Bulletin 99	Cross Fertilization of Barley	Do.
Bulletin 100	An Insect New to the State (*Isosoma tritici*)	J. A. Lintner.
Bulletin 101	The Root Systems of Certain Vegetables	E. L. Sturtevant.
Bulletin 102	Varieties of Oats	Do.
Bulletin 103	Varieties of Flint Corn	Do.
Bulletin 104	Feeding for Milk	Do.
Bulletin 105	Varieties of Barley	Do.
Bulletin 106	Influence of Acid and Putrefactive Food upon Cows and Their Milk; Brewers' Grains.	Do.
Annual Report	Third Annual Report, 1884	
1885.		
Bulletin 107	Policy of the Station	Do.
Bulletin 108	Variations in the Yield of Potatoes	Do.
Bulletin 109	Experiments with Potato Seed	Do.
Bulletin 110	Influence of Feeding Acid Food to Cows; Corn Feed or Slump.	Do.
Bulletin 111	Causes of the Failure of Corn to Germinate	Do.
Bulletin 112	Drying Corn for Seed	Do.
Bulletin 113	By-Products from Glucose and Starch Factories	
Bulletin 114	Influence of Feeding Acid Food to Cows	Do.
Bulletin 115	The Absorption of the Seed Tuber of the Potato during Growth of the Plant.	Do.
NEW SERIES. [a]		
Bulletin 1	Fertilizers	Do.
Bulletin 2	Pear Blight	J. C. Arthur.
Bulletin 3	Descriptive Circular. (For use at State Fair)	E. L. Sturtevant.
Bulletin 4	Experiments with Oats	Do.
Bulletin 5	Cooked v. Raw Food for Stock	E. F. Ladd.
Bulletin 6	Hay v. Damaged Hay	E. L. Sturteva...
Annual Report	Fourth Annual Report, 1885	
1886.		
Bulletin 7	Slug Shot	Do.
Bulletin 8	Corn	Do.
Annual Report	Fifth Annual Report, 1886	
1887.		
Bulletin 9	Was it Poison or Overfeeding?	Do.
Annual Report	Sixth Annual Report, 1887	
1888.		
Bulletin 10	Influence of Fertilizers on the Chemical Composition of Plants; Analyses of Feeding Stuffs; Feeding and Digestion Experiment.	E. F. Ladd.

[a] No. 1 of this series is No. 116 of the old series.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW YORK STATE STATION—Continued.

Publication.	Title.	Author.
1888.		
Bulletin 11	Experiments in Cultivation; Root Growth; Fertilizers; Insecticides; Fungicides; Potatoes; and Sorghum.	E. S. Goff.
Bulletin 12	Fertilizer Laws; Statistics of Fertilizers; the Maynard Bill.	P. Collier.
Bulletin 13	Farm and Field Experiments	F. E. Emery.
Bulletin 14	Chemical Composition of Some Feeding Stuffs	E. F. Ladd.
Bulletin 15	Fruits	E. S. Goff.
Annual Report	Seventh Annual Report, 1888	
1889.		
Bulletin 16	A Study of the Corn Plant: Lucern, or Alfalfa	E. F. Ladd.
Bulletin 17	Cattle Foods and Feeding Rations	Do.
Bulletin 18	Testing of Dairy Breeds	Do.
Annual Report	Eighth Annual Report, 1889	
1880.		
Bulletin 19	A Method for the Determination of Fat in Milk and Cream.	E. F. Ladd and W. H. Whalen.
Bulletin 20	Pedigrees of Dairy Animals under Investigation	P. Collier.
Bulletin 21	Testing of Dairy Breeds	E. F. Ladd.
Bulletin 22	Pig Feeding Experiments without Milk	W. P. Wheeler.
Bulletin 23	Comparative Test of Cows; Loss in Keeping Manure	F. E. Emery.
Bulletin 24	Experiments with Strawberries	C. E. Hunn.
Bulletin 25	The New York Fertilizer Control and Fertilizer Analyses	L. L. Van Slyke.
Annual Report	Ninth Annual Report, 1890	
1891.		
Bulletin 26	History, Use, and Analyses of Fertilizers	L. L. Van Slyke.
Bulletin 27	General Principles Underlying the Use of Fertilizers	Do.
Bulletin 28	Pig Feeding Experiments with Coarse Foods	W. P. Wheeler.
Bulletin 29	Feeding Experiments with Laying Hens	Do.
Bulletin 30	Cabbages and Cauliflowers; Imported v. American Seed Tomatoes.	C. E. Hunn.
Bulletin 31	Commercial Valuation of the Food and Fertilizing Constituents of Feeding Materials.	P. Collier.
Bulletin 32	Description of Materials Used in Making Commercial Fertilizers; Fertilizer Materials Produced on Farms; Fertilizing Composition and Valuation of Various Products.	L. L. Van Slyke et al.
Bulletin 33	Explanation of Terms of Chemical Analysis; Commercial Valuations of Fertilizers; Composition of Various Chemical Compounds.	L. L. Van Slyke.
Bulletin 34	Comparison of Dairy Breeds of Cattle with Reference to Production of Butter.	Do.
Bulletin 35	Some of the most Common Fungi and Insects with Preventives.	C. E. Hunn and G. W. Churchill.
Bulletin 36	The Strawberry: Insect Enemies. The Raspberry: Diseases and Insect Enemies. The Blackberry. The Currant: Insect Enemies. The Gooseberry: Gooseberry Mildew.	C. E. Hunn.
Bulletin 37	Investigation of Cheese: Experiments in the Manufacture of Cheese; Influence of the Composition of Milk on Composition and Yield of Cheese; A Study of the Process of Ripening of Cheese.	L. L. Van Slyke.
Annual Report	Tenth Annual Report, 1891	
1892.		
Bulletin 38	Oyster Shells as Food for Laying Hens	W. P. Wheeler.
Bulletin 39	Feeding Experiments with Poultry	Do.
Bulletin 40	Black Knot of Plum and Cherry	S. A. Beach.
Bulletin 41	Experiments with Fungicides	S. A. Beach and L. L. Van Slyke.
Bulletin 42	Analyses of Commercial Fertilizers	L. L. Van Slyke.
Bulletin 43	Experiments in the Manufacture of Cheese during May	Do.
Bulletin 44	Strawberries	C. E. Hunn.
Bulletin 45	Experiments in the Manufacture of Cheese during June	L. L. Van Slyke.
Bulletin 46	Experiments in the Manufacture of Cheese during July and August.	Do.
Bulletin 47	Experiments in the Manufacture of Cheese during September and October.	Do.
Bulletin 48	Some Bean Diseases	S. A. Beach.
Annual Report	Eleventh Annual Report, 1892	
1893.		
Bulletin 49	Treatment of Potato Scab; Use of Bordeaux Mixture for Potato Blight.	Do.
Bulletin 50	Summary of Results of Experiments made in the Manufacture of Cheese during the Season of 1892.	L. L. Van Slyke.
Bulletin 51	Some Celery Diseases	S. A. Beach.

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NEW YORK STATE STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 52	Analyses of Commercial Fertilizers	L. L. Van Slyke.
Bulletin 53	Feeding Experiments with Capons	W. P. Wheeler.
Bulletin 54	Experiments in the Manufacture of Cheese: Manufacture of Cheese from Normal Milk Rich in Fat; Study of Cheese-Ripening Process.	L. L. Van Slyke.
Bulletin 55	General Principles Relating to the Composition and Use of Fertilizers.	Do.
Bulletin 56	Experiments in the Manufacture of Cheese: The Manufacture of Edam Cheese; The Manufacture of Gouda Cheese.	Do.
Bulletin 57	Feeding Experiments with Laying Hens; Keeping Males with the Laying Stock; Observations on Feather Eating, General Observations.	W. P. Wheeler.
Bulletin 58	Analyses of Commercial Fertilizers Collected in Long Island in the Spring of 1893.	L. L. Van Slyke.
Bulletin 59	Analyses of Commercial Fertilizers Collected in the Spring of 1893.	Do
Bulletin 60	Investigations Relating to the Manufacture of Cheese, I	Do.
Bulletin 61	Investigations Relating to the Manufacture of Cheese, II	Do
Bulletin 62	Investigations Relating to the Manufacture of Cheese, III	Do.
Bulletin 63	Some Experiences with Blackberries, Dewberries, and Raspberries.	S. A. Beach.
Annual Report	Twelfth Annual Report, 1893	
1894.		
Bulletin 64	Some Experiences with Strawberries; Strawberry Crosses	Do.
Bulletin 65	Investigations Relating to the Manufacture of Cheese, IV	L. L. Van Slyke.
Bulletin 66	Analyses of Commercial Fertilizers Collected in the Fall of 1893.	Do.
Bulletin 67	Experiments in Preventing Pear Scab in 1893	S. A. Beach.
Bulletin 68	Investigations Relating to the Manufacture of Cheese, V	L. L. Van Slyke.
Bulletin 69	Vegetables Grown for Exhibition	S. A. Beach.
Bulletin 70	Some Reasons why the Legal Milk Standard of New York State Should be Changed.	L. L. Van Slyke.
Bulletin 71	Some Reasons why there Should be a Legal Standard for Cheese in New York State.	Do.
Bulletin 72	Preventing Leaf Blight of Plum and Cherry Nursery Stock	S. A. Beach.
Bulletin 73	Analyses of Commercial Fertilizers Collected during the Spring of 1894.	L. L. Van Slyke.
Bulletin 74	Observations on the Application of Fungicides and Insecticides.	S. A. Beach and W. Paddock.
Bulletin 75	Some Insects Injurious to Squash, Melon, and Cucumber Vines; The Asparagus Beetle.	V. H. Lowe.
Bulletin 76	Notes on Strawberries for 1894	S. A. Beach.
Bulletin 77	Comparison of Different Breeds of Dairy Cattle: I. The Cost of Milk Production.	L. L. Van Slyke.
Bulletin 78	Comparison of Different Breeds of Dairy Cattle: II. The Cost of Butter and Cream Production.	Do.
Bulletin 79	Comparison of Different Breeds of Dairy Cattle: III. The Cost of Cheese Production.	Do.
Bulletin 80	Alfalfa Forage for Milch Cows	W. P. Wheeler.
Bulletin 81	Variety Tests with Blackberries, Dewberries, and Raspberries; Raspberry Anthracnose.	S. A. Beach and W Paddock.
Bulletin 82	Results of Investigations Relating to the Manufacture of Cheese for the Season of 1894.	L. L. Van Slyke.
Bulletin 83	Insects Affecting Late Cabbage; Notes on the Stalk Borer; Insecticides.	F. A. Sirrine.
Annual Report	Thirteenth Annual Report, 1894	
1895.		
Bulletin 84	Spraying Pear and Apple Orchards in 1894	S. A. Beach.
Bulletin 85	Analyses of Commercial Fertilizers Collected During the Fall of 1894.	L. L. Van Slyke.
Bulletin 86	Treatment of Common Diseases and Insects Injurious to Fruits and Vegetables.	S. A. Beach and W. Paddock.
Bulletin 87	The San José, or Pernicious, Scale	F. A. Sirrine.
Bulletin 88	Forcing Lettuce in Pots; Mushrooms as a Greenhouse Crop.	S. A. Beach.
Bulletin 89	Comparative Profits Derived from Selling Milk, Butter, Cream, and Cheese.	F. A. Sirrine.
Bulletin 90	Feeding Experiments with Laying Hens: A Comparison of Rations Containing Moistened Ground Grain with Others Containing Dry Whole Grain.	W. P. Wheeler.
Bulletin 91	A New Strawberry; Notes on Strawberries, Raspberries, Blackberries, and Dewberries.	S. A. Beach and W. Paddock.
Bulletin 92	Analyses of Commercial Fertilizers Collected During the Spring of 1895.	L. L. Van Slyke.

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NEW YORK STATE STATION—Continued.

Publication.	Title.	Author.
1895.		
Bulletin 93	Comparative Field Test of Commercial Fertilizers Used in Raising Potatoes.	L. L. Van Slyke.
Bulletin 94	The Composition and Use of Fertilizers: Science Applied to Feeding Plants.	Do.
Bulletin 95	Currants	S. A. Beach.
Bulletin 96	Report of Analyses of Commercial Fertilizers Collected During the Fall of 1895.	L. L. Van Slyke.
Bulletin 97	Corn Silage for Milch Cows	W. P. Wheeler.
Annual Report	Fourteenth Annual Report, 1895	
1896.		
Bulletin 98	Plum-Leaf Spot; Cherry-Leaf Spot and Fruit Rot	S. A. Beach.
Bulletin 99	The Spinach Leaf Maggot or Miner	F. A. Sirrine.
Bulletin 100	Combating Carnation Rust	F. C. Stewart.
Bulletin 101	Potato Diseases on Long Island in the Season of 1895	Do.
Bulletin 102	Silage and Silo	W. P. Wheeler.
Bulletin 103	Provisions of the New Fertilizer Law of New York	L. L. Van Slyke.
Bulletin 104	Notes on the Recent Invasion of the Army Worm	V. H. Lowe.
Bulletin 105	Effects of Drought upon Milk Production	L. L. Van Slyke.
Bulletin 106	Feeding Experiments with Laying Hens: The Relative Efficiency of Whole and Ground Grains	W. P. Wheeler.
Bulletin 107	Report of Analyses of Commercial Fertilizers for the Spring of 1896.	L. L. Van Slyke.
Bulletin 108	The Real Value of "Natural Plant Food."	Do.
Bulletin 109	Strawberries	W. Paddock.
Bulletin 110	Milk Fat and Cheese Yield	L. L. Van Slyke.
Bulletin 111	Variety Tests with Blackberries, Dewberries, and Raspberries.	W. Paddock.
Bulletin 112	Economy in using Fertilizers for Raising Potatoes	L. L. Van Slyke.
Bulletin 113	The Cucumber Flea-Beetle as the cause of "Pimply" Potatoes.	F. C. Stewart.
Annual Report	Fifteenth Annual Report, 1896	
1897.		
Bulletin 114	Gooseberries	S. A. Beach.
Bulletin 115	Director's Report for 1896	W. H. Jordan.
Bulletin 116	Report of Analyses of Commercial Fertilizers for the Fall of 1896.	L. L. Van Slyke.
Bulletin 117	Treatment of Leaf Spot in Plum and Cherry Orchards in 1896.	S. A. Beach.
Bulletin 118	Alfalfa	W. P. Wheeler.
Bulletin 119	The Downy Mildew of the Cucumber: What it is and How to Prevent it.	F. C. Stewart.
Bulletin 120	A Practical Method of Fighting Cutworms in Onion Fields.	F. A. Sirrine.
Bulletin 121	Spray Pumps and Spraying	W. Paddock.
Bulletin 122	The Pistol Case Bearer	V. H. Lowe.
Bulletin 123	Spraying Potatoes on Long Island in the Season of 1896	F. C. Stewart.
Bulletin 124	Anthracnose of the Black Raspberry	W. Paddock.
Bulletin 125	Forcing Tomatoes: Comparison of Methods of Training and Benching: Note on a Tomato Disease.	S. A. Beach.
Bulletin 126	Feeding Experiments with Chicks and Capons	W. P. Wheeler.
Bulletin 127	Strawberries in 1897	W. Paddock.
Bulletin 128	Variety Tests with Raspberries, Blackberries, and Dewberries.	Do
Bulletin 129	Report of Analyses of Commercial Fertilizers for the Spring of 1897.	L. L. Van Slyke.
Bulletin 130	A Bacterial Disease of Sweet Corn	F. C. Stewart.
Bulletin 131	Results with Oat Smut in 1897	C. P. Close.
Bulletin 132	The Source of Milk Fat	W. H. Jordan and C. G. Jenter.
Bulletin 133	Spraying in 1897 to Prevent Gooseberry Mildew	C. P. Close.
Bulletin 134	Report of Analyses of Commercial Fertilizers for the Fall of 1897.	L. L. Van Slyke
Bulletin 135	Conditions Required for the Successful Growth of Sugar Beets.	Do.
	The Outlook for the Sugar-Beet Industry	W. H. Jordan.
	The Station Experiments with Sugar Beets	G. W. Churchill.
Bulletin 136	Inspection of Nurseries and Treatment of Infested Nursery Stock.	V. H. Lowe.
Bulletin 137	Commercial Fertilizers for Potatoes	W. H. Jordan.
Bulletin 138	Experiments and Observations on Some Diseases of Plants.	F. C. Stewart.
Bulletin 139	Plant Lice: Descriptions, Enemies, and Treatment	V. H. Lowe.
Bulletin 140	Wood Ashes and Apple Scab	S. A. Beach.

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Publication.	Title.	Author.
1897.		
Bulletin 141	Digestion and Feeding Experiments	W. H. Jordan and C. G. Jenter.
Bulletin 142	Director's Report for 1897	W. H. Jordan.
Popular Edition.		
Bulletin 114	Gooseberries: Best Varieties and How to Grow them	F. H. Hall.
Bulletin 117	Spraying for Plum and Cherry Leaf Spot: How Often? When?	Do.
Bulletin 118	Alfalfa: Its Value, Culture, and Use	Do.
Bulletin 119	The Downy Mildew of the Cucumber and its Treatment	Do.
Bulletin 120	Onion Cutworms: Their Ravages and Treatment	Do.
Bulletin 121	Spraying Mixtures and Their Application	Do.
Bulletin 122	A Peculiar Insect Enemy of the Apple	Do.
Bulletin 123	Does it Pay to Spray Potatoes?	Do.
Bulletin 124	Preventive Treatment of Raspberry Anthracnose	Do.
Bulletin 125	Tomato Forcing: Methods of Training and Benching	Do.
Bulletin 126	Ground Grain v. Whole Grain for Chicks and Capons	Do.
Bulletin 127–128	Notes on Small Fruits Grown in 1897	Do.
Bulletin 130	A New Disease of Sweet Corn	Do.
Bulletin 131	Oat Smut and New Preventives	Do.
Bulletin 132	Milk Fat from Fat-Free Food	Do.
Bulletin 133	The Best Remedy for Gooseberry Mildew	Do.
Bulletin 136	Nursery Stock Pests and their Repression	Do.
Bulletin 137	Profitable Potato Fertilizing	Do.
Bulletin 138	Work upon Some Diseases of Plants in 1897	Do.
Bulletin 139	Combating Plant Lice	Do.
Bulletin 140	Wood Ashes not an Apple Scab Preventive	Do.
Bulletin 141	Some Results in Stock Feeding	Do.
Annual Report	Sixteenth Annual Report, 1897	
1898.		
Bulletin 143	Cottonwood-Leaf Beetle; Green Arsenite	V. H. Lowe.
Bulletin 144	A Spraying Mixture for Cauliflower and Cabbage Worms	F. A. Sirrine.
Bulletin 145	Report of Analyses of Commercial Fertilizers for the Spring of 1898.	L. L. Van Slyke.
Bulletin 146	Some Experiments in Forcing Head Lettuce	S. A. Beach.
Bulletin 147	Variety Tests of Strawberries, Raspberries, and Blackberries	W. Paddock.
Bulletin 148	Report of Analyses of Commercial Fertilizers for the Fall of 1898.	L. L. Van Slyke.
Bulletin 149	The Economy of Using Animal Food in Poultry Feeding	W. P. Wheeler.
Bulletin 150	The Raspberry Sawfly; Preliminary Notes on the Grape-vine Flea-Beetle.	V. H. Lowe.
Bulletin 151	Experiments in Ringing Grapevines	W. Paddock.
Bulletin 152	Two Destructive Orchard Insects	V. H. Lowe.
Bulletin 153	Director's Report for 1898	W. H. Jordan.
Bulletin 154	Commercial Fertilizers for Potatoes, II	Do.
Bulletin 155	Sugar-Beet Investigations in 1898	L. L. Van Slyke.
Bulletin 156	Spraying Cucumbers in the Season of 1898	F. A. Sirrine and F. C. Stewart.
Bulletin 157	Self-Fertility of the Grape	S. A. Beach.
Popular Edition.		
Bulletin 143	A Destructive Beetle and a Remedy	F. H. Hall and V. H. Lowe.
Bulletin 144	Combating Cabbage Pests	F. H. Hall and F. A. Sirrine.
Bulletin 146	Forcing Head Lettuce: Soils and Fertilizers	F. H. Hall and S. A. Beach.
Bulletin 147	Some Good Berries	F. H. Hall and W. Paddock.
Bulletin 149	Will Poultry Thrive on Grain Alone?	F. H. Hall and W. P. Wheeler.
Bulletin 150	Two Small-Fruit Pests	F. H. Hall and V. H. Lowe.
Bulletin 151	How Ringing Affects Grapes	F. H. Hall and W. Paddock.
Bulletin 152	Two Apple Pests and How to Check Them	F. H. Hall and V. H Lowe.
Bulletin 154	Profitable Potato Fertilizing, II	F. H. Hall and W. H. Jordan.
Bulletin 155	Sugar Beet Success for the Season	F. H. Hall and L. L. Van Slyke.
Bulletin 156	Spraying Will Save the Pickle Crop	F. H. Hall, F A. Sirrine, and F. C. Stewart.
Bulletin 157	Why Some Grapes Fail to Fruit	F. H. Hall and S. A. Beach.

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[Titles which have been changed from their original form are inclosed in brackets.]

NEW YORK STATE STATION—Continued.

Publication.	Title.	Author.
1899.		
Bulletin 158	Combating the Striped Beetle on Cucumbers	F. A. Sirrine.
Bulletin 159	The Forest Tent Caterpillar	V. H. Lowe.
Bulletin 160	Report of Analyses of Commercial Fertilizers for the Spring of 1899.	L. L. Van Slyke.
Bulletin 161	Treatment for Gooseberry Mildew	C. P. Close.
Bulletin 121—Appendix.	Spray Pumps and Spraying	W. Paddock.
Popular Edition.		
Bulletin 158	How to Handle the Striped Beetle on Cucumbers	F. H. Hall and F. A. Sirrine.
Bulletin 159	A Pest of Woodland and Grove	F. H. Hall and V. H. Lowe.
Bulletin 161	Gooseberry Mildew Held in Check	F. H. Hall and C. P. Close.

NEW YORK CORNELL STATION.

1882–83.		
Annual Report	Report of Agricultural Department of Cornell University	
1888.		
Bulletin 1	Experimental Dairy House	I. P. Roberts.
Bulletin 2	Comparative Value of Feed Stuffs for Sheep	Do.
Bulletin 3	The Insectary of Cornell University: On Preventing the Ravages of Wireworms; On the Destruction of Plum Curculio.	J. H. Comstock.
Bulletin 4	Growing Corn for Fodder and Ensilage; Economic Seed Manure; Curwin's Hog Powder.	I. P. Roberts.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 5	On the Production of Lean Meat in Mature Animals; Does Heating Milk Affect the Quality or Quantity of Butter?	Do.
Bulletin 6	On the Determination of Hydroscopic Water in Air-Dried Fodders; The Determination of Nitrogen by the Azotometric Treatment of the Solution Resulting from the Kjeldahl Digestion; Fodders and Feeding Stuffs.	W. P. Cutter.
Bulletin 7	On the Influences of Certain Conditions upon the Sprouting of Seeds.	L. H. Bailey.
Bulletin 8	On the Effect of Different Rations on Fattening Lambs	I. P. Roberts and H. H. Wing.
Bulletin 9	A Study of Wind-Breaks in their Relations to Fruit Growing.	L. H. Bailey.
Bulletin 10	Tomatoes	
Bulletin 11	On a Sawfly Borer in Wheat	J. H. Comstock.
Bulletin 12	A New Apparatus for Drying Substances in Hydrogen and for Extraction of the Fat.	G. C. Caldwell.
Bulletin 13	On the Deterioration of Farmyard Manure by Leaching and Fermentation; On the Effect of a Grain Ration for Cows at Pasture.	I. P. Roberts and H. H. Wing.
Bulletin 14	On the Strawberry-Leaf Blight; On Another Disease of the Strawberry.	W. R. Dudley.
Bulletin 15	Sundry Investigations Made during the Year	I. P. Roberts et al.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 16	Growing Corn for Fodder and Silage	I. P. Roberts and H. H. Wing.
Bulletin 17	A Description of Cochran's Method for the Determination of Fat in Milk, for the Use of Dairymen.	G. C. Caldwell.
Bulletin 18	Experience in Spraying Plants	L. H. Bailey.
Bulletin 19	Report on the Condition of Fruit Growing in Western New York.	Do.
Bulletin 20	Cream Raising by Dilution; Variations in Fat of Milk Served to Customers in Dipping from Cans.	H. H. Wing and C. D. Smith.
Bulletin 21	Notes on Tomatoes	L. H. Bailey and W. M. Munson.
Bulletin 22	On the Effects of a Grain Ration for Cows with Pasturage and with Green Fodder.	I. P. Roberts and H. H. Wing.
Bulletin 23	Insects Injurious to Fruits	J. H. Comstock and M. V. Slingerland.
Bulletin 24	The Clover Rust	J. K. Howell.
Bulletin 25	Sundry Investigations Made during the Year	I. P. Roberts et al.
Annual Report	Third Annual Report, 1890	

Publications of the Agricultural Experiment Stations of the United States, 1875-1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW YORK CORNELL STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 26	Notes on Eggplants	L. H. Bailey and W. M. Munson.
Bulletin 27	The Production and Care of Farm Manures	I. P. Roberts.
Bulletin 28	Experiments in the Forcing of Tomatoes	L. H. Bailey.
Bulletin 29	Cream Raising by Dilution; The Effect of a Delay in Setting on the Efficiency of Creaming; Application of Dr. Babcock's Centrifugal Method to the Analyses of Milk, Skim Milk, Buttermilk, and Butter; The Relation of Fibrin to the Effectual Creaming of Milk.	H. Snyder.
Bulletin 30	Some Preliminary Studies of the Influence of the Electric Arc Lamp upon Greenhouse Plants.	L. H. Bailey.
Bulletin 31	The Forcing of English Cucumbers	Do.
Bulletin 32	Tomatoes	Do.
Bulletin 33	Wireworms	J. H. Comstock and M. V. Slingerland.
Bulletin 34	Dewberries	L. H. Bailey.
Bulletin 35	Combinations of Fungicides and Insecticides, and Some New Fungicides.	E. G. Lodeman.
Bulletin 36	The Effect of a Grain Ration for Cows at Pasture	I. P. Roberts and H. H. Wing.
Bulletin 37	Sundry Investigations Made during the Year	I. P. Roberts et al.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 38	The Cultivated Native Plums and Cherries	L. H. Bailey.
Bulletin 39	Creaming and Aërating Milk	H. H. Wing.
Bulletin 40	Removing Tassels from Corn	G. C. Watson.
Bulletin 41	The Comparative Merits of Steam and Hot Water for Greenhouse Heating.	F. W. Card and L. H. Bailey.
Bulletin 42	Second Report upon Electro-Horticulture	L. H. Bailey.
Bulletin 43	Some Troubles of Winter Tomatoes	Do.
Bulletin 44	The Pear-Tree Psylla	M. V. Slingerland.
Bulletin 45	Tomatoes	L. H. Bailey and L. C. Corbett.
Bulletin 46	Mulberries	L. H. Bailey.
Bulletin 47	Feeding Lambs and Pigs	I. P. Roberts and G. C. Watson.
Bulletin 48	Spraying Apple Orchards in a Wet Season	E. G. Lodeman.
Bulletin 49	Sundry Investigations of the Year	I. P. Roberts et al.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 50	The Bud Moth	M. V. Slingerland.
Bulletin 51	Four new Types of Fruits	L. H. Bailey.
Bulletin 52	Cost of Milk Production; Variation in Individual Cows	H. H. Wing.
Bulletin 53	Œdema of the Tomato	G. F. Atkinson.
Bulletin 54	Dehorning	I. P. Roberts.
Bulletin 55	Greenhouse Notes	L. H. Bailey.
Bulletin 56	The Production of Manure	G. C. Watson.
Bulletin 57	Raspberries and Blackberries	F. W. Card.
Bulletin 58	The Four-Lined Leaf Bug	M. V. Slingerland.
Bulletin 59	Does Mulching Retard the Maturity of Fruits?	L. H. Bailey.
Bulletin 60	The Spraying of Orchards	E. G. Lodeman.
Bulletin 61	Sundry Investigations of the Year	I. P. Roberts et al.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 62	The Japanese Plums in North America	L. H. Bailey.
Bulletin 63	Cooperative Test of Sugar Beets	I. P. Roberts.
Bulletin 64	On Certain Grass-Eating Insects	E. P. Felt.
Bulletin 65	Tuberculosis in Relation to Animal Industry and Public Health.	J. Law.
Bulletin 66	Test of Cream Separators	H. H. Wing.
Bulletin 67	Some Recent Chinese Vegetables	L. H. Bailey.
Bulletin 68	The Cultivated Poplars; with Remarks upon the Planting of Grounds.	Do.
Bulletin 69	Hints on the Planting of Orchards	Do.
Bulletin 70	The Native Dwarf Cherries	Do.
Bulletin 71	Apricot Growing in Western New York	Do.
Bulletin 72	The Cultivation of Orchards	Do.
Bulletin 73	Leaf Curl and Plum Pockets	G. F. Atkinson.
Bulletin 74	Impressions of the Peach Industry in Western New York	L. H. Bailey.
Bulletin 75	Peach Yellows	Do.
Bulletin 76	Some Grape Troubles of Western New York	E. G. Lodeman.
Bulletin 77	The Grafting of Grapes	Do.
Bulletin 78	The Cabbage-Root Maggot, with Notes on the Onion Maggot and Allied Insects.	M. V. Slingerland.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW YORK CORNELL STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 79	Varieties and Leaf Blight of the Strawberry	L. H. Bailey.
Bulletin 80	The Quince in Western New York	Do.
Bulletin 81	Black Knot of Plums and Cherries, and Methods of Treatment.	E. G. Lodeman.
Bulletin 82	Experiments with Tuberculin on Nontuberculous Cows	J. Law.
Bulletin 83	A Plum Scale in Western New York	M. V. Slingerland.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 84	The Recent Apple Failures of Western New York	L. H. Bailey.
Bulletin 85	Whey Butter	H. H. Wing.
Bulletin 86	The Spraying of Orchards	E. G. Lodeman.
Bulletin 87	The Dwarf Lima Beans	L. H. Bailey.
Bulletin 88	Early Lamb Raising	G. C. Watson.
Bulletin 89	Feeding Pigs	Do.
Bulletin 90	The China Asters; with Remarks upon Flower Beds	L. H. Bailey.
Bulletin 91	Recent Chrysanthemums	M. Barker.
Bulletin 92	On the Effect of Feeding Fat to Cows	H. H. Wing.
Bulletin 93	The Cigar-Case Bearer in Western New York	M. V. Slingerland.
Bulletin 94	Damping Off	G. F. Atkinson.
Bulletin 95	Winter Muskmelons	L. H. Bailey.
Bulletin 96	Forcing House Miscellanies	L. H. Bailey and E. G Lodeman.
Bulletin 97	Studies in Artificial Cultures of Entomogenous Fungi	R. H. Pettit.
Bulletin 98	Cherries	L. H. Bailey and G. H. Powell.
Bulletin 99	Blackberries	L. H. Bailey.
Bulletin 100	Evaporated Raspberries in Western New York	Do.
Bulletin 101	Notions about the Spraying of Trees, with Remarks on the Cankerworm.	Do.
Bulletin 102	General Observations Respecting the Care of Fruit Trees, with Some Reflections Upon Weeds.	Do.
Bulletin 103	Soil Depletion in Respect to the Care of Fruit Trees	I. P. Roberts.
Bulletin 104	Climbing Cutworms in Western New York	M. V. Slingerland.
Bulletin 105	Tests of Cream Separators	H. H. Wing.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 106	Revised Opinions of the Japanese Plums	L. H. Bailey.
Bulletin 107	Wireworms and the Bud Moth	M. V. Slingerland.
Bulletin 108	The Pear Psylla and the New York Plum Scale	Do.
Bulletin 109	Geological History of the Chautauqua Grape Belt	R. S. Tarr.
Bulletin 110	Extension Work in Horticulture	L. H. Bailey.
Bulletin 111	Sweet Peas	L. H. Bailey and A. P. Wyman.
Bulletin 112	The 1895 Chrysanthemums	L. H. Bailey, W. Miller, and C. E. Hunn.
Bulletin 113	Diseases of the Potato	E. G. Lodeman.
Bulletin 114	Spray Calendar	Do.
Bulletin 115	The Pole Lima Beans	L. H. Bailey.
Bulletin 116	Dwarf Apples	E. G. Lodeman.
Bulletin 117	Fruit Brevities	L. H. Bailey.
Bulletin 118	Food Preservatives and Butter Increasers	G. W. Cavanaugh.
Bulletin 119	The Texture of the Soil	L. H. Bailey.
Bulletin 120	The Moisture of the Soil and its Conservation	L. A. Clinton.
Bulletin 121	Suggestions for the Planting of Shrubbery	L. H. Bailey.
Bulletin 122	Second Report upon Extension Work in Horticulture	Do.
Bulletin 123	Green Fruit Worms	M. V. Slingerland.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 124	The Pistol-Case Bearer in Western New York	Do.
Bulletin 125	A Disease of Currant Canes	E. J. Durand.
Bulletin 126	The Currant-Stem Girdler and the Raspberry Cane Maggot	M. V. Slingerland.
Bulletin 127	A Second Account of Sweet Peas	A. P. Wyman and M. S. Kains.
Bulletin 128	A Talk about Dahlias	W. Miller.
Bulletin 129	How to Conduct Field Experiments with Fertilizers	G. C. Caldwell.
Bulletin 130	Potato Culture	I. P. Roberts and L. A. Clinton.
Bulletin 131	Notes upon Plums for Western New York	S. D. Willard and L. H. Bailey.
Bulletin 132	Notes upon Celery	B. M. Duggar and L. H. Bailey.
Bulletin 133	The Army Worm in New York	M. V. Slingerland.
Bulletin 134	Strawberries under Glass	C. E. Hunn and L. H. Bailey

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NEW YORK CORNELL STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 135	Forage Crops	I. P. Roberts and L. A. Clinton.
Bulletin 136	Chrysanthemums of 1896	L. H. Bailey and W. Miller.
Bulletin 137	Agricultural Extension Work: Sketch of its Origin and Progress.	
Bulletin 138	Studies and Illustrations of Mushrooms, I	G. F. Atkinson.
Bulletin 139	Third Report upon Japanese Plums	L. H. Bailey.
Bulletin 140	Second Report on Potato Culture	I. P. Roberts and L. A. Clinton.
Bulletin 141	Powdered Soap as a Cause of Death Among Swill-Fed Hogs.	V. A. Moore.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 142	The Codling Moth	M. V. Slingerland.
Bulletin 143	Sugar-Beet Investigations	G. C. Caldwell and G. W. Cavanaugh et al.
Bulletin 144	Notes on Spraying and on the San José Scale	H. P. Gould.
Bulletin 145	Some Important Pear Diseases	B. M. Duggar.
Bulletin 146	Fourth Report of Progress on Extension Work	I. P. Roberts.
Bulletin 147	Fourth Report upon Chrysanthemums	W. Miller.
Bulletin 148	The Quince Curculio	M. V. Slingerland.
Bulletin 149	Some Spraying Mixtures	G. W. Cavanaugh.
Bulletin 150	Tuberculosis in Cattle and its Control	J. Law.
Bulletin 151	Gravity or Dilution Separators	H. H. Wing.
Bulletin 152	Studies in Milk Secretion	H. H. Wing and L. Anderson.
Bulletin 153	Impressions of our Fruit-Growing Industries	L. H. Bailey.
Bulletin 154	Tables for Computing Rations for Farm Animals	J. L. Stone.
Bulletin 155	Second Report on the San José Scale, with Remarks on the Effects of Kerosene on Foliage.	H. P. Gould.
Bulletin 156	Third Report on Potato Culture	I. P. Roberts and L. A. Clinton.
Bulletin 157	The Grapevine Flea-Beetle	M. V. Slingerland.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 158	An Inquiry Concerning the Source of Gas and Taint Producing Bacteria in Cheese Curd.	V. A. Moore and A. R. Ward.
Bulletin 159	An Effort to Help the Farmer	I. P. Robertts.
Bulletin 160	Hints on Rural School Grounds	L. H. Bailey.
Bulletin 161	Annual Flowers	G. N. Lauman and L. H. Bailey.
Bulletin 162	The Period of Gestation in Cows	H. H. Wing.
Bulletin 163	Three Important Fungus Diseases of the Sugar Beet	B. M. Duggar.
Bulletin 164	Peach-Leaf Curl and Notes on the Shot-Hole Effect of Peaches and Plums.	Do.
Bulletin 165	Ropiness in Milk and Cream	A. R. Ward.
Bulletin 166	Sugar-Beet Investigations for 1898	J. L. Stone, L. A. Clinton, G. W. Cavanaugh, and A. L. Knisely.
Bulletin 167	The Construction of the Stave Silo	L. A. Clinton.
Bulletin 168	Studies and Illustrations of Mushrooms, II	G. F. Atkinson.
Bulletin 169	Studies in Milk Secretion	H. H. Wing and L. Anderson.
Bulletin 170	Emergency Report on Tent Caterpillars	M. V. Slingerland.
Bulletin 171	Concerning Patents on Gravity or Dilution Separators	H. H. Wing.
Bulletin 172	The Cherry Fruit Fly: A New Cherry Pest	M. V. Slingerland.
Bulletin 173	The Relation of Food to Milk Fat	L. Anderson.
Bulletin 174	The Problem of Impoverished Lands	L. H. Bailey.
Bulletin 175	Fourth Report on Japanese Plums	Do.
Annual Report	Twelfth Annual Report, 1899	

NORTH CAROLINA STATION.

1878.		
	Directions for Making Vinegar	
	Analyses and Valuations of Fertilizers for 1877–78 (republished in 1879).	
	Ville's Formulas for Composting, and Others Furnished by Dr. Ledoux.	
	The Sugar Beet in North Carolina	
	Silica v. Ammonia; Results of Comparative Soil Tests of Popplein's Silicated Phosphate with a Number of Ammoniated Guanos.	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
1879.		
	Report of the Director to the Legislature	
	Analyses and Valuations of Fertilizers	
	Formulas for Composting	
Annual Report	Annual Report, 1879	
1880.		
Annual Report	Third Report of the Station for 1880, including Analyses of Fertilizers for that Year.	
Biennial Report	First Biennial Report, 1879 and 1880	
1881.		
	Report to the Legislature	
	Analyses of Drinking Waters	
	Value of Active Ingredients of Fertilizers	
	The Use of Agricultural Chemicals	
	Analyses and Valuations of Fertilizers and Chemicals	
	Adulterated Chemicals	
	Analyses and Valuations of Fertilizers, Second Edition	
Annual Report	Annual Report, 1881	
1882		
	Trade in Fertilizers; Extension in Cotton Culture	
	Homemade Manures; High Manuring on Cotton	
	Does Cotton Exhaust? Cotton Seed and its Uses	
	Stable Manure Saved and Composted; Rice Products as a Feeding Stuff.	
	Analyses of Fertilizers	
	Analyses of Fertilizers, Second Edition	
	Rice and its Products; Food and Fodder Plants	
	Experience with Homemade Manures	
	Report of Work Done for the State Board of Health	
	Treatment of Cotton Lands; Station at State Fair	
	Horn, Leather, and Wool Waste, and the Fertilizers Made from Them.	
	Finely Ground Phosphates, or "Floats"	
	Kainit	
Annual Report	Annual Report, 1882	
Biennial Report	Second Biennial Report, 1881 and 1882	
1883.		
	The Soja Bean; Waste Products of Tobacco Factories	
	Analyses of Fertilizers	
	Analyses of Fertilizers, Second Edition	
	Cotton Seed and its Products	
	North Carolina Resources for Commercial Fertilizers: Ammoniates; Potash Sources; Phosphates	
Annual Report	Annual Report, 1883	
1884.		
	The Trade in Fertilizers during 1883	
	Cost of the Ingredients of Fertilizers	
	The Phosphate Investigation	
	Analyses of Fertilizers, Season of 1884	
	Composition of North Carolina Phosphates	
	Report on North Carolina Phosphates	
	Analyses of Fertilizers, Season of 1885	
	Analyses of Fertilizers, Second Edition	
Annual Report	Annual Report, 1884	
Biennial Report	Third Biennial Report, 1883 and 1884	
1885.		
	Analyses of Fertilizers, Additional	
	Analyses of Composts	
	Injurious Insects and Diseases of Stock	
	Report of Station	
	Instructions for Voluntary Observers and Displaymen	
Annual Report	Annual Report, 1885	
1886.		
Annual Report	Annual Report, 1886	
Biennial Report	Fourth Biennial Report, 1885 and 1886	
1887.		
	Formulas for Composts	
	Report of North Carolina Weather Service for 1887	
	Composts and Ingredients Composing Them	
Annual Report	Tenth Annual Report, 1887	
Annual Report	Annual Report of the North Carolina State Weather Service, 1887.	H. B. Battle and H. McP. Baldwin.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
1888.		
Bulletin 57*a*	Field Experiments	H. B. Battle.
Bulletin 58	Details of Field Experiments	Do.
	Examination of North Carolina Drinking Waters	R. G. Grisson.
	Meteorological Summary for June	H. McP. Baldwin.
Bulletin 59	Purity and Vitality of Seed, with Tests of Seed Sold in North Carolina.	G. McCarthy.
	Meteorological Summary for July–August	H. McP. Baldwin.
Bulletin 60	Lucern, its Value as a Forage Crop	G. McCarthy.
	Meterological Summary for September–October	
Biennial Report	Fifth Biennial Report, 1887 and 1888	
Annual Report	Eleventh Annual Report, 1888	
Annual Report	Annual Report, Meteorological Division, 1888	H. B. Battle and C. F. von Herrmann.
1889.		
Bulletin 61	Composts: Formulas, Analyses, and Values	H. B. Battle.
Bulletin 61½	Fertilizer Analyses; Seed Examination for Planters	
Bulletin 62	Fertilizer Analyses	Do.
Bulletin 62½	Fertilizer Analyses and Fertilizer Control	Do.
Bulletin 63	Tests of Seeds; Rust on Wheat and Cotton	G. McCarthy.
	Laboratory Notes	F. B. Dancy and H. B. Battle.
Bulletin 64	Practical Stock Feeding on Scientific Principles	F. B. Dancy.
Bulletin 65	Cooperative Field Tests During 1888	H. B. Battle.
Bulletin 66	Stock Feeding as Practiced in North Carolina	F. B. Dancy.
	Indian Corn	G. McCarthy.
Bulletin 67	Seed Tests	Do.
Bulletin 67a	Technical Bulletin No. 1, Seed Tests	Do.
Bulletin 68	Farm and Dairy Buildings	J. R. Chamberlain.
Bulletin 68a	Meteorological Summary for October	H. B. Battle and C. F. von Herrmann.
Bulletin 68b	Meteorological Summary for November	Do.
Annual Report	Twelfth Annual Report, 1889	
Annual Report	Annual Report, Meteorological Division, 1889	Do.
1890.		
Bulletin 68c	Meteorological Summary for December, 1889	Do.
Bulletin 69	Fertilizer Analyses and Fertilizer Control	
Bulletin 69a	Meteorological Summary for January	Do.
Bulletin 69b	Meteorological Summary for February	Do.
Bulletin 70	The Weed Pests of the Farm; Japan Clover, Its Value as a Renovater of Worn Soils.	G. McCarthy.
Bulletin 70a	Meteorological Summary for March and April	H. B. Battle and C. F. von Herrmann.
Bulletin 71	Cooperative Field Tests during 1889	H. B. Battle.
	Hillside Ditches	J. R. Chamberlain.
Bulletin 72	The work of the Horticultural Division	W. F. Massey.
	The Value of Pea-Vine Manuring for Wheat	J. R. Chamberlain.
Bulletin 72a	Meteorological Summary for May	H. B. Battle and C. F. von Herrmann.
Bulletin 72b	Meteorological Summary for June	Do.
Bulletin 72c	Meteorological Summary for July and August	Do.
Bulletin 73	The Best Agricultural Grasses	G. McCarthy.
Bulletin 73a	Meteorological Summary for September	H. B. Battle and C. F. von Herrmann.
Bulletin 73b	Meteorological Summary for October and November; Origin of Cold Waves.	Do.
Bulletin 74	Tests of Garden Vegetables and Fruits; Culture of Figs	W. F. Massey.
Bulletin 74a	Meteorological Summary for December	H. B. Battle and C. F. von Herrmann.
Meteor. Report	Annual Report, Meteorological Division, 1890	Do.
Annual Report	Thirteenth Annual Report, 1890	
Biennial Report	Sixth Biennial Report, 1889 and 1890	
1891.		
Bulletin 74b	Meteorological Summary for January	Do.
Bulletin 75	Fertilizer Analyses and Fertilizer Control	
Bulletin 75c	Meteorological Summary for February and March	Do.
Bulletin 76	Plant Diseases and How to Combat Them	G. McCarthy.
Bulletin 77	Value of Pea-Vine Manuring for Wheat	J. R. Chamberlain.
Bulletin 77a	Special Bulletin 1. Diseases of the Horse	C. B. Michener et al.
Bulletin 77b	Technical Bulletin No. 2, July. The Injury of Foliage by Arsenites; A Cheap Arsenite; Combination of Arsenites with Fungicides.	B. W. Kilgore.
Bulletin 78	Some Injurious Insects	G. McCarthy.

a The previous Bulletins (Nos. 1–56), published during 1877–1888, were not numbered consecutively or issued regularly.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 78a	Meteorological Summary for April and May	H. B. Battle and C. F. von Herrmann.
Bulletin 79	Facts for Farmers	W. F. Massey.
Bulletin 79a	Meteorological Summary for June and July	H. B. Battle and C. F. von Herrmann.
Bulletin 80	Silos and Silage	F. E. Emery.
Bulletin 80a	Special Bulletin 2. Synopsis of the Published Work of the Entomological and Botanical Divisions of the Station.	G. McCarthy.
Bulletin 80b	Meteorological Summary for August	H. B. Battle and C. F. von Herrmann.
Bulletin 80b	Special Bulletin 3. Illustrative Exhibit at the Southern Exposition, Raleigh, N. C., October and November, 1891.	
Bulletin 80c	Technical Bulletin 3. The Digestibility of Cotton-Seed Hulls; The Digestibility of a Ration of Cotton-Seed Hulls and Cotton-Seed Meal; Comparison of Composition and Digestibility of Wheat Straw and Cotton-Seed Hulls; The Fertilizing Constituents Recovered in Manure in these Experiments.	F. E. Emery and B. W. Kilgore.
Bulletin 80d	Meteorological Summary for September	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Butletin 80e	Meteorological Summary for October	Do.
Bulletin 81	Feeding Cotton-Seed Hulls and Meal for the Production of Beef.	J. R. Chamberlain and F. E. Emery.
Bulletin 81a	Meteorological Summary for November and December	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Annual Report	Fifth Annual Report. Meteorological Division, 1891. Climatology of North Carolina, 1820–1892.	Do.
Annual Report	Fourteenth Annual Report, 1891	
1892.		
Bulletin 82	Fertilizer Analyses and Fertilizer Control	H. B. Battle.
Bulletin 82a	Special Bulletin 4. Fertilizer Analyses	Do.
Bulletin 82b	Special Bulletin 5. Fertilizer Analyses	Do.
Bulletin 83	Growing Celery in the South; Cultivation of Onions; Notes on Horticultural Work During 1891.	W. F. Massey.
Bulletin 83a	Meteorological Summary for January	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 83b	Special Bulletin 6. Fertilizer Analyses	H. B. Battle.
Bulletin 83c	Special Bulletin 7. Fertilizer Analyses	Do.
Bulletin 83d	Meteorological Summary for February	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 83e	Special Bulletin 8. Fertilizer Analyses	H. B. Battle.
Bulletin 84	Some Enemies of Truck and Garden Crops	G. McCarthy.
Bulletin 85	The Late Crop of Irish Potatoes in the South	W. F. Massey.
Bulletin 85a	Meteorological Summary for March	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 86	Tobacco Curing by the Leaf Cure on Wire and Stalk Processes.	H. B. Battle, T. L. Blalock, and F. B. Carpenter.
Bulletin 86a	Meteorological Summary for April	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 86b	Special Bulletin 9. Fertilizer Analyses	H. B. Battle.
Bulletin 86c	Meteorological Summary for May	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 86d	Meteorological Summary for June	Do.
Bulletin 87	Publications of the Station from March, 1877, to September, 1892.	H. B. Battle.
Bulletin 87a	Meteorological Summary for July	H. B. Battle, C. F. von Herrmann, and R. Nunn.
	Summary of Proceedings of American Association of State Weather Services, August, 1892.	R. E. Kerkan.
Bulletin 87b	Meteorological Summary for August	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 87c	Meteorological Summary for September	Do.
Bulletin 87d	Technical Bulletin 4. Digestion Experiments with Pulled Fodder, Crimson Clover Hay, Cowpea Vine Hay, Corn Silage, Soja-Bean Silage, Raw Cotton Seed, Roasted Cotton Seed, Cotton-seed Hulls, and Cotton-Seed Meal.	F. E. Emery and B. W. Kilgore.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
1892.		
Bulletin 87e	Meteorological Summary for October; Brief Statement of Rules for Making Local Weather Forecasts.	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 87f	Meteorological Summary for November	Do.
Annual Report	Sixth Annual Report, Meteorological Division, 1892	Do.
Annual Report	Fifteenth Annual Report, 1892	
Biennial Report	Seventh Biennial Report, 1891 and 1892	
1893.		
Bulletin 88	Fertilizer Analyses and Fertilizer Control	H. B. Battle.
Bulletin 88a	Meteorological Summary for December, 1892	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 88b	Special Bulletin 10. Fertilizer Analyses and Fertilizer Control.	H. B. Battle.
Bulletin 88c	Special Bulletin 11. Fertilizer Analyses and Fertilizer Control.	Do.
Bulletin 88d	Meteorological Summary for January	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 89	Cooperative Field Tests during 1891 and 1892	F. E. Emery.
Bulletin 89a	Special Bulletin 12. Fertilizer Analyses	H. B. Battle.
Bulletin 89b	Meteorological Summary for February	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 90	Practical Stock Feeding	B. W. Kilgore.
Bulletin 90a	Technical Bulletin 5. Results of Chemical Analyses of Tobacco Cured by the Leaf Cure on Wire and the Stalk Processes.	F. B. Carpenter.
Bulletin 90b	Technical Bulletin 6. Chemical Analyses of Some Native North Carolina Grasses, Forage Plants, Grains, Seeds, and By-products.	B. W. Kilgore.
Bulletin 90c	Special Bulletin 14. Fertilizer Analyses	H. B. Battle.
Bulletin 90d	Meteorological Summary for March	H. B. Battle, C. F. von Herrmann, and R. Nunn.
	Has the Moon any Influence on the Weather?	C. A. Young.
Bulletin 91	Some Experiments in Wheat Culture	F. E. Emery.
Bulletin 91a	Thunderstorm Observations in North Carolina, June 1 to August 31, 1893. Meteorological Summary for April.	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 91b	Special Bulletin 15. Fertilizer Analyses	H. B. Battle.
Bulletin 91c	Meteorological Summary for May	H. B. Battle, C. F. von Herrmann, and R. Nunn.
	The Oxford Tornado of May 3, 1893	C. F. von Herrmann.
Bulletin 91d	Technical Bulletin 7. Investigations upon the Phosphoric Acid in Crude Fertilizing Materials and upon Methods of Fertilizer Analysis.	B. W. Kilgore and R. E. Noble.
Bulletin 91e	Meteorological Summary for June	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 92	The Culture of Orchard and Garden Fruits	W. F. Massey.
	Diseases and Insects Affecting Fruit Trees and Plants, with Remedies for their Destruction.	G. McCarthy.
Bulletin 92a	Meteorological Summary for July	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 92b	Meteorological Summary for August	Do.
Bulletin 93	Feeding Experiments: Experiments in Fattening Stock for Beef with Cotton-Seed Hulls and Meal; Corn Silage and Soja-Bean Silage with Cotton-Seed Meal for Beef; Exclusive Silage Feeding; and What is a Maintenance Ration?	F. E. Emery.
Bulletin 93a	Meteorological Summary for September	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 93b	Meteorological Summary for October	Do.
Bulletin 93c	Meteorological Summary for November	Do.
	Circular Inviting Attention to the Work of the State Weather Service.	H. B. Battle and C. F. von Herrmann.
Bulletin 93d	Meteorological Summary for December	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Annual Report	Sixteenth Annual Report, 1893	
Annual Report	Seventh Annual Report of the Meteorological Division, 1893.	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 94	Horticultural Tests and Results with Garden Vegetables, Fruits, and Bulb Culture.	W. F. Massey.
Bulletin 95	The Fertilizer Control During 1893	H. B. Battle.
Bulletin 96	Miscellaneous Agricultural Topics Contained in the Press Service Bulletins.	
Bulletin 97	Digestion Experiments	F. E. Emery and B. W. Kilgore.
Bulletin 98	Some Leguminous Crops and their Economic Value	G. McCarthy and F. E. Emery.
Bulletin 99	Thread Worm of Pork (*Trichina spiralis*)	F. P. Williamson.
Bulletin 100	Our Common Insects	G. McCarthy.
Bulletin 101	The Progress of the Dairy Industry in North Carolina	H. B. Battle.
Bulletin 102	Encouragement to the Dairy Interests of North Carolina through the Medium of the State Fairs.	F. E. Emery.
Bulletin 103	Miscellaneous Agricultural Topics Contained in the Press Service Bulletins of January to June, 1894.	
Bulletin 104	Why Pull Your Corn Fodder?	F. E. Emery.
Bulletin 105	The Chestnut and its Weevil	G. McCarthy.
	Nut Culture for North Carolina	W. A. Taylor.
Bulletin 106	Rational Stock Feeding	F. E. Emery and B. W. Kilgore.
Bulletin 107	Flowering Bulbs in North Carolina, and their Propagation for Florists' Use.	W. F. Massey.
Bulletin 108	Seed Testing: Its Uses and Methods	G. McCarthy.
Bulletin 109	Feeding Trials with Animals	F. E. Emery.
Bulletin 110	The Marls and Phosphates of North Carolina	F. B. Carpenter
Special.		
Bulletin 16	Fertilizer Analyses and the Fertilizer Control	H. B. Battle.
Bulletin 17	....do	Do.
Bulletin 18	....do	Do.
Bulletin 19	....do	Do.
Bulletin 20	....d	Do.
Bulletin 21	....do	Do.
State Weather Service.		
Bulletin 52	Meteorological Summary for January	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 53	Meteorological Summary for February	Do.
Bulletin 54	Meteorological Summary for March	Do.
Bulletin 55	Meteorological Summary for April	Do.
Bulletin 56	Meteorological Summary for May	Do.
Bulletin 57	Meteorological Summary for June	Do.
Bulletin 58	Meteorological Summary for July	Do.
Bulletin 59	Meteorological Summary for August	Do.
Bulletin 60	Meteorological Summary for September	Do.
Bulletin 61	Meteorological Summary for October	Do.
Bulletin 62	Meteorological Summary for November	Do.
Bulletin 63	Meteorological Summary for December	Do.
Annual Report	Seventeenth Annual Report, 1894	
Biennial Report	Eighth Biennial Report, 1893 and 1894	
Annual Report	Eighth Annual Report of the Meteorological Division, 1894.	Do.
1895.		
Bulletin 111	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 112	Trucking in the South	W. F. Massey.
Bulletin 113	The Testing of Milk	F. E. Emery.
Bulletin 114	Tests of Dairy Implements and Practices	Do.
Bulletin 115	Miscellaneous Agricultural Topics	
Bulletin 116	Milk Records and Tests	Do.
Bulletin 117	Tuberculosis and its Prevention	F. P. Williamson.
Bulletin 118	Cotton-Seed Hulls and Meal for Beef Production	F. E. Emery and B. W. Kilgore.
Bulletin 119	Volumetric Estimation of Phosphoric Acid	B. W. Kilgore and C. B. Williams.
Bulletin 120	The Peach Tree and its Parasites	G. McCarthy.
	The Planting, Pruning, and Cultivation of the Peach	W. F. Massey.
Bulletin 121	Hillside Terraces or Ditches	F. E. Emery.
Bulletin 122	Types of Tobacco and their Analyses	F. B. Carpenter.
Bulletin 123	Miscellaneous Agricultural Topics	
Special.		
Bulletin 22	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 23	....do	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
1895.		
Special—Cont'd.		
Bulletin 24	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 25	do	Do.
Bulletin 26	do	Do.
Bulletin 27	do	Do.
Bulletin 28	Agricultural Suggestions to the Waldensians	W. F. Massey.
Bulletin 29	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 30	do	Do.
State Weather Service.		
Bulletin 64	North Carolina Weather during January	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 65	North Carolina Weather during February	Do.
Bulletin 67 *a*	North Carolina Weather during Mareh	Do.
Bulletin 67	North Carolina Weather during April	Do.
Bulletin 68	North Carolina Weather during May	Do.
Bulletin 69	North Carolina Weather during June	Do.
Bulletin 70	North Carolina Weather during July	Do.
Bulletin 71	North Carolina Weather during August	Do.
Bulletin 72	North Carolina Weather during September	Do.
Bulletin 73	North Carolina Weather during October	Do.
Bulletin 74	North Carolina Weather during November	Do.
Bulletin 75	North Carolina Weather during Deeember	Do.
Annual Report	Eighteenth Annual Report, 1895	
Annual Report	Ninth Annual Report of the Meteorological Division, 1895	Do.
1896.		
Bulletin 124	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 125	Forage Grasses and Hay Making: I. Tests of Forage Grasses. II. The Formation and Care of Grass Lands. III. Haying Tools and Hay Making.	G. McCarthy and F. E Emery.
Bulletin 126	Why Not Improve Your Poultry?	F. E. Hege.
Bulletin 127	Parasites of Domestic Animals	G. McCarthy.
Bulletin 128	Pests of Grain Crops	Do.
Bulletin 129	Hortieultural Experiments at Southern Pines, 1895	
Bulletin 130	Poultry Keeping for Profit	F. E. Hege.
Bulletin 131	Parasites of Poultry	G. McCarthy.
Bulletin 132	The Home Vegetable Garden	W. F. Massey.
	Pests of Vegetable Crops and their Treatment	G. McCarthy.
Bulletin 133	Some New Forage, Fiber, and Other Useful Plants	Do.
Bulletin 134 *b*	Not published.	
Bulletin 135 *b*	Not published.	
Speeial.		
Bulletin 31	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 32	do	Do.
Bulletin 33	Spraying Formulas and Applieations	G. McCarthy.
Bulletin 34	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 35	do	Do.
Bulletin 36	do	Do.
Bulletin 37	do	Do.
Bulletin 38	do	Do.
Bulletin 39	do	Do.
State Weather Service.		
Bulletin 76	North Carolina Weather during January	H. B. Battle, C. F. von Herrmann, and R. Nunn.
Bulletin 77	North Carolina Weather during February	Do.
Bulletin 78	North Carolina Weather during Mareh	Do.
Bulletin 79	Weather Report for April	H. B. Battle and C. F. von Herrmann.
Bulletin 80	Weather Report for May	Do.
Bulletin 81	Weather Report for June	Do.
Bulletin 82	Weather Report for July	Do.
Bulletin 83	Weather Report for August	Do.
Biennial Report	Ninth Biennial Report, 1895 and 1896	
Annual Report	Nineteenth Annual Report, 1896	

a Should be 66.
b The subject intended for this bulletin has been reserved for future treatment.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 136	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 137	A Warning in Regard to Compost Peddlers	Do.
Bulletin 138	The San José Scale in North Carolina	G. McCarthy.
Bulletin 139	Home-Mixed Fertilizers and Composts	H. B. Battle.
Bulletin 140	Volumetric Estimation of Phosphoric Acid	B. W. Kilgore.
Bulletin 141	A New Tobacco Pest	G. McCarthy.
Bulletin 142	Comfortable Low-Cost Barns	F. E. Emery.
Bulletin 143	Feeding Experiments, Milk Records, etc	Do.
Bulletin 144	Ornithology of North Carolina	J. W. P. Smithwick.
Bulletin 145	Crimson Clover	F. E. Emery.
Bulletin 146	Miscellaneous Farm Bulletin	Do.
Special.		
Bulletin 40	Fertilizer Analyses of the Fertilizer Control	H. B. Battle.
Bulletin 41	....do	Do.
Bulletin 42	....do	Do.
Bulletin 43	....do	Do.
Bulletin 44	....do	Do.
Bulletin 45	....do	Do.
Bulletin 46	....do	Do.
Bulletin 47	....do	Do.
Bulletin 48	Experiment Station Staff; Equipment and Work; Recent Bulletins.	W. A. Withers.
1898.		
Bulletin 147	A Study of Lettuces	W. F. Massey.
Bulletin 148	Digestion Experiments	F. E. Emery and B. W. Kilgore.
	Pasteurization of Milk	F. E. Emery.
Bulletin 149	The Apple in North Carolina	W. F. Massey.
Bulletin 150	Medicinal Plants	C. W. Hyams.
Bulletin 151	The Fertilizer Control for 1897	W. A. Withers.
Bulletin 152	Poultry Notes	F. E. Hege.
Bulletin 153	Vinegar Adulteration	W. A. Withers and J. A. Bizzell.
Bulletin 154	The Adulteration of Coffee and Tea	W. A. Withers and G. S. Fraps.
Bulletin 155	Baking Powders on Sale in North Carolina	W. A. Withers and J. A. Bizzell.
Bulletin 156	The Adulteration of Flour	W. A. Withers and G. S. Fraps.
Bulletin 157	Mineraline	W. A. Withers and H. W. Primrose.
Bulletin 158	The Fertilizer Control for 1898	A. W. Blair.
Bulletin 159	Horticultural Experiments at Southern Pines, 1896	
Biennial Report	Biennial Report, 1897 and 1898	
Annual Reports	Twentieth and Twenty-first Annual Reports, 1897 and 1898.	
Special.		
Bulletin 49	Sugar Beets	W. A. Withers.
Bulletin 50	The Station and its Exhibit	Do.
Bulletin 51	Catalogue of Herbarium Specimens for Exchange	C. W. Hyams.
1899.		
Bulletin 160	Digestion Experiments	F. E. Emery.
Bulletin 161	Drinking Water: City, Town, and Rural Supplies	A. W. Blair.
Bulletin 162	Farming in North Carolina	W. F. Massey.
Bulletin 163	Rational Stock Feeding	F. E. Emery and J. M. Johnson.
Bulletin 164	The Flora of North Carolina	C. W. Hyams.
Bulletin 165	Preservatives in Canned Foods Offered for Sale in North Carolina.	W. A. Withers and H. W. Primrose.
Bulletin 166	Butter: Its Composition, Artificial Imitation and Adulterants; Butter Adulteration in North Carolina.	W. A. Withers and J. M. Pickel.
Bulletin 167	Poultry Experiments during the Year 1898–99	F. E. Emery.
Bulletin 168	Experiments with Field and Forage Crops	Do.
Bulletin 169	Feeding Experiments and Milk Records	F. E. Emery and J. M. Johnson.
Special.		
Bulletin 52	Cattle Quarantine Line	C. Curtice.
Bulletin 53	Food Adulteration in North Carolina	W. A. Withers.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH DAKOTA STATION.

Publication.	Title.	Author.
1890.		
Annual Report ..	First Annual Report, 1890	
1891.		
Bulletin 1	Grain Smuts	H. L. Bolley.
Bulletin 2	Small Fruits	C. B. Waldron.
Bulletin 3	Diseases of Sheep	T. D. Hinebaueh.
Bulletin 4	Potato Scab and Possibilities for Prevention; A Disease of Beets Identical with "Deep Scab" of Potatoes; Hastening the Maturity of Potatoes.	H. L. Bolley.
Annual Report ..	Second Annual Report, 1891	
1892.		
Bulletin 5	Sugar Beets	E. F. Ladd.
Bulletin 6	The Mustard Family	C. B. Waldron.
Bulletin 7	Rheumatism in Horses	T. D. Hinebauch.
Bulletin 8	Wheat Growing and Dairying for North Dakota	E. F. Ladd and W. M. Whalen.
Annual Report ..	Third Annual Report, 1892	
1893.		
Bulletin 9	The Conditions Affecting the Value of Wheat for Seed; Prevention of Potato Scab.	H. L. Bolley.
Bulletin 10	Grain and Forage Crops	W. M. Hays.
Bulletin 11	do	Do.
Annual Report ..	Fourth Annual Report, 1893	
1894.		
Bulletin 12	Transplanting Onions	C. B. Waldron.
Bulletin 13	Rational Selection of Wheat for Seed; Typhoid Fever	H. L. Bolley.
Bulletin 14	Tuberculosis	T. D. Hinebauch.
Bulletin 15	Chemical Composition of Foods	E. F. Ladd.
Bulletin 16	Dairy Herd Record, 1894; Pasture v. Pasture and Grain; Dehorning.	J. H. Shepperd.
	Butter Making	E. E. Kaufman.
Annual Report ..	Fifth Annual Report, 1894	
1895.		
Bulletin 17	The Effect of Seed Exchange upon the Culture of Wheat; Distribution of Weed Seeds by Winter Winds.	H. L. Bolley.
Bulletin 18	Some Profitable Vegetables for North Dakota	C. B. Waldron.
Bulletin 19	Treatment of Smut in Wheat; Treatment of Potato Scab	H. L. Bolley.
Bulletin 20	Winter Rations for Horses; Grain Rations for Work Horses.	J. H. Shepperd.
Bulletin 21	Cleanliness in Handling Milk; Bacteriological Considerations.	H. L. Bolley.
Annual Report ..	Sixth Annual Report, 1895	
1896.		
Bulletin 22	The Creamery Industry	E. E. Kaufman.
Bulletin 23	Grain and Forage Crops	J. H. Shepperd.
Bulletin 24	North Dakota Soils	E. F. Ladd.
Bulletin 25	Tree Culture	C. B. Waldron.
Bulletin 26	Feeding of Millet to Horses	T. D. Hinebauch.
Annual Report ..	Seventh Annual Report, 1896	
1897.		
Bulletin 27	New Studies upon the Smut of Wheat, Oats, and Barley, With a Résumé of Treatment Experiments for the Last Three Years.	H. L. Bolley.
Bulletin 28	Grain Rations for Fattening Sheep; Value of Straw in a Ration, and the Gains Made after Twelve Weeks' Feeding.	J. H. Shepperd.
	"Diseases of Sheep," (a reprint of Bulletin 3)	T. D. Hinebauch.
Bulletin 29	A Study of Methods of Cultivation. I. At the Station. II. At Other Points in the State.	J. H. Shepperd and J. A. Jeffrey.
Bulletin 30	Preliminary Report upon the Selection of Potatoes for Planting.	H. L. Bolley.
Annual Report ..	Eighth Annual Report, 1897	
1898.		
Bulletin 31	Experiment Station Notes on Miscellaneous Subjects	J. H. Worst.
Bulletin 32	Chemical Studies	E. F. Ladd.
Bulletin 33	Fattening Cattle	J. H. Shepperd.
Bulletin 34	Some Destructive Insects	C. B. Waldron.
Annual Report ..	Ninth Annual Report, 1898	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

NORTH DAKOTA STATION—Continued.

Publication.	Title.	Author.
1899.		
Bulletin 35	Some Chemical Problems Investigated	E. F. Ladd.
Bulletin 36	A Study of the Root Systems of Wheat, Oats, Flax, Corn, Potatoes, and Sugar Beets, and of the Soil in which they Grew.	A. M. Ten Eyck.
Bulletin 37	The Prevention of the Smuts of Cereal Grains, and Prevention of Potato Scab.	H. L. Bolley.
Bulletin 38	Cultivation Experiment with Wheat, and a Special Study of the Moisture and Temperature of the Soil under the Campbell and Ordinary Treatments.	J. H. Shepperd and A. M. Ten Eyck.
Bulletin 39	Crop Report for 1898	Do.
Bulletin 40	Grass and Forage Crops	J. H. Shepperd.

OHIO STATION.

1882.		
Annual Report	First Annual Report	
1883.		
Bulletin 1*a*	Experiments with Wheat, 1882–83	
Bulletin 12*a*	Varieties of Corn	
Bulletin 16*a*	Test of Varieties of Wheat	
Annual Report	Second Annual Report, 1883	
1884.		
Annual Report	Third Annual Report, 1884	
1885.		
Annual Report	Fourth Annual Report, 1885	
1886.		
Annual Report	Fifth Annual Report, 1886	
1887.		
Annual Report	Sixth Annual Report, 1887	
1888.		
SECOND SERIES.*b*		
Bulletin 1	History, Organization, and Work of Station	C. E. Thorne.
Bulletin 2	Small Fruits and Vegetables	W. J. Green.
Bulletin 3	The Spring and Summer Treatment of Apple Orchards to Prevent Insect Injuries; Experiments with Remedies for the Plum Curculio.	C. M. Weed.
Bulletin 4	Experiments in Preventing Curculio Injury to Cherries; The Chinch Bug in Ohio—Midsummer Remedies.	Do.
Bulletin 5	Small Fruits	W. J. Green.
Bulletin 6	Experiments with Wheat	J. F. Hickman.
Bulletin 7	Corn: Fertilizer Experiments	C. E. Thorne.
Annual Report	Seventh Annual Report, 1888	
1889.		
Bulletin 8 (Vol. II, No. 1).	Insects and Insecticides	C. M. Weed.
Bulletin 9 (Vol. II, No. 2).	Colic of Horses	H. J. Detmers.
Bulletin 10 (Vol. II, No. 3).	Silos and Ensilage	J. F. Hickman.
	Ensilage v. Field Beets as Food for Cows	C. E. Thorne and J. F. Hickman.
Bulletin 11 (Vol. II, No. 4).	Experiments with Small Fruits; Effect of Early and Late Picking upon Keeping Quality of Apples.	W. J. Green.
Bulletin 12 (Vol. II, No. 5).	Experiments in Wheat Seeding; Comparative Tests of Varieties of Wheat.	J. F. Hickman.
Bulletin 13 (Vol. II, No. 6).	Remedies for the Plum Curculio; Remedies for the Striped Cucumber Beetle; Strawberry-Root Louse and Grain Plant Louse; Notes on Little-Known Injurious Insects; Preventing the Injuries of Potato Rot.	C. M. Weed.
Bulletin, Vol. I, No. 1. (Tech. ser.)	Preparatory Stages of the 20-Spotted Ladybird; Studies in Pond Life; A Partial Bibliography of Insects Affecting Clover.	Do.

a Bulletins in this series were printed in the form of newspaper slips, but were reprinted in the first six annual reports of the station. With the exception of Bulletins Nos. 1, 12, and 16, we are unable to give the titles of the publications.

b The first seven bulletins of the second series were published in the Seventh Annual Report.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

OHIO STATION—Continued.

Publication.	Title.	Author.
1889.		
Bulletin 14 (Vol. II, No. 7.).	Cabbage and Cauliflower	W. J. Green.
	Notes on Experiments with Remedies for Certain Diseases of Plants.	C. M. Weed.
Bulletin 15 (Vol. II, No. 8).	Eighth Annual Report, 1889	
1890.		
Bulletin, Vol. I, No. 2. (Tech. ser.)	A Catalogue of the Uncultivated Flowering Plants Growing on the Ohio State University Grounds.	M. Craig.
	Fourth Contribution to a Knowledge of the Life History of Certain Little-Known Plant Lice.	C. M. Weed.
	A Descriptive Catalogue of the Shells of Franklin County, Ohio.	H. A. Surface.
Bulletin 16 (Vol. III, No. 1).	Experiments with Potatoes	W. J. Green.
Bulletin 17 (Vol. III, No. 2).	Commercial Fertilizers	C. E. Thorne and N. W. Lord.
Bulletin 18 (Vol. III, No. 3).	Experiments with Corn; Experiments with Oats	J. F. Hickman.
	Actinomycosis	H. J. Detmers.
Bulletin 19 (Vol. III, No. 4).	Spraying to Prevent Insect Injury; Bark Lice of the Apple and Pear; Buffalo Tree Hopper; Insects Affecting Corn in Southern Ohio; Ox-Warble Fly or Botfly; Fungus Diseases of Plants and their Remedies.	C. M. Weed.
	Directions for Collecting, Preserving, and Studying Plants.	H. J. Detmers.
Bulletin 20 (Vol. III, No. 5).	Corn Silage v. Sugar Beets as Food for Milk Production	C. E. Thorne and J. F. Hickman.
Bulletin 21 (Vol. III, No. 6).	Experiments in Wheat Seeding; Comparative Tests of Varieties of Wheat; Smut in Wheat; Results of Experiments with Fertilizers on Wheat.	J. F. Hickman and C. E. Thorne.
Bulletin 22 (Vol. III, No. 7).	Strawberries; Raspberries	W. J. Green.
Bulletin 23 (Vol. III, No. 8).	Plum Curculio Experiments; Remedies for the Striped Cucumber Beetle; The Rhubarb Curculio; The Clover-Stem Borer; Potato-Blight Experiments.	C. M. Weed.
Bulletin 24 (Vol. III, No. 9).	Asparagus; Transplanting Onions	W. J. Green.
Bulletin 25 (Vol. III, No. 10).	Experiments in Preventing Downy Mildew or Brown Rot of Grapes.	C. M. Weed.
	The Smut of Indian Corn	C. E. Bessey.
Bulletin 26 (Vol. III, No. 11).	Ninth Annual Report, 1890	
1891.		
Bulletin 27 (Vol. IV, No. 1).	Experiments with Corn	J. F. Hickman and C. E. Thorne.
Bulletin 28 (Vol. IV, No. 2).	Miscellaneous Experiments in the Control of Injurious Insects.	C. M. Weed.
Bulletin 29 (Vol. IV, No. 3).	Commercial and Other Fertilizers on Wheat	C. E. Thorne and J. F. Hickman.
Bulletin 30 (Vol. IV, No. 4).	Experiments in Wheat Seeding, including Treatment of Seed for Smut; Comparative Tests of Varieties of Wheat.	J. F. Hickman.
Bulletin 31 (Vol. IV, No. 5).	The Wheat Midge	F. M. Webster.
Bulletin 32 (Vol. IV, No. 6).	Experiments with Small Fruits in 1891	W. J. Green.
	Diseases of the Raspberry and Blackberry	F. Detmers.
Bulletin 33 (Vol. IV, No. 7).	The Hessian Fly	F. M. Webster.
Bulletin 34 (Vol. IV, No. 8).	Forty Years of Wheat Culture in Ohio	C. E. Thorne.
Bulletin 35 (Vol. IV, No. 9).	Apple Scab	F. Detmers.
	Spraying of Orchards	W. J. Green.
Bulletin 36 (Vol. IV, No. 10).	Tenth Annual Report, 1891	
1892.		
Bulletin 37 (Vol. V, No. 1).	Oats	J. F. Hickman.
Bulletin 38 (Vol. V, No. 2)	Mangel-Wurzels and Sugar Beets	Do.
Bulletin 39 (Vol. V, No. 3).	Field Experiments with Commercial Fertilizers	C. E. Thorne and J. F. Hickman.
Bulletin 40 (Vol. V, No. 4).	Insects which Burrow in the Stems of Wheat	F. M. Webster.
Bulletin 41	Not published.	
Bulletin 42	Field Experiments with Wheat	J. F. Hickman.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

OHIO STATION—Continued.

Publication.	Title.	Author.
1892.		
Bulletin 43	Greenhouses and Greenhouse Work	W. J. Green.
	Tomatoes as a Greenhouse Crop	E. C. Green.
	Lettuce as a Greenhouse Crop	W. S. Turner.
	The Food of the Robin	E. V. Wilcox and F. M. Webster.
Bulletin 44	A Preliminary List of the Rusts of Ohio Wheat Scab	F. Detmers.
	Wild Lettuce—a Pestiferous Weed	C. E. Thorne.
Bulletin 45	Insects Affecting the Blackberry and Raspberry	F. M. Webster.
Bulletin 46	Underground Insect Destroyers of the Wheat Plant	Do.
Bulletin 47	Meteorological Summary for 1892	F. J. Falkenbach.
	Eleventh Annual Report, 1892	
1893.		
Bulletin 48	Profit in Spraying Orchards and Vineyards	W. J. Green.
Bulletin 49	Field Experiments with Commercial Fertilizers	C. E. Thorne and J. F. Hickman.
Bulletin 50	Experiments in Feeding for Milk	C. E. Thorne, J. F Hickman, and F. J Falkenbach.
Bulletin 51	Miscellaneous Entomological Papers	F. M. Webster.
Bulletin 52	Meteorological Summary for 1893	F. J. Falkenbach.
	Twelfth Annual Report, 1893	
Bulletin, Vol. I, No. 3 (Tech. ser.)	Entomological and Botanical Papers	
1894.		
Bulletin 53	Field Experiments with Commercial Fertilizers	C. E. Thorne and J. F. Hickman.
Bulletin 54	Strawberries: Cultural Notes, Comparison of Varieties	W. J. and E. C. Green.
Bulletin 55	The Russian Thistle in Ohio, and Weeds in General	A. D. Selby.
Bulletin 56	The San José Scale	F. M. Webster.
Bulletin 57	Oats	J. F. Hickman.
Bulletin 58	Meteorological Summary for 1894	C. A. Patton.
	Thirteenth Annual Report, 1894	
1895.		
Bulletin 59	Noxious Weeds along Thoroughfares and their Destruction	A. D. Selby.
Bulletin 60	Feeding for Beef	C. E. Thorne.
Bulletin 61	Subirrigation in the Greenhouse	W. J. and E. C. Green.
Bulletin 62	The Grape-Root Worm	F. M. Webster.
Bulletin 63	Orchard Spraying: Notes on Varieties of Raspberries	W. J. Green.
Bulletin 64	The Smut of Oats and its Prevention	A. D. Selby.
Bulletin 65	Potatoes: Comparison of Varieties; Experiments with Fertilizers.	W. J. Green and H. O. McFadden.
Bulletin 66	Meteorological Summary for 1895	C. A. Patton.
	Fourteenth Annual Report, 1895	
1896.		
Bulletin 67	Oats: Comparison of Varieties in 1895; Effect of Smut; Methods of Seeding; Preparation of Seed Bed.	J. F. Hickman.
Bulletin 68	Some Destructive Insects; Spraying with Arsenites v. Bees; Carnivorous Habits of *Limax campestris*.	F. M. Webster.
Bulletin 69	The Chinch Bug	Do.
Bulletin 70	Forage Crops	J. F. Hickman.
Bulletin 71	The Maintenance of Fertility; Field Experiments with Fertilizers; The Sources and Cost of Fertilizing Materials; The Home Mixing of Fertilizers.	C. E. Thorne J. F. Hickman, and W. J. Green.
	A Fertilizer with Misleading Name	A. D. Selby.
Bulletin 72	Peach Yellows, Black Knot, and San José Scale	Do.
Bulletin, Vol. I, No. 4 (Tech. ser.)	A Preliminary List of the Birds of Wayne County, Ohio	H. C. Oberholser.
Bulletin 73	Investigation of Plant Diseases in Forcing House and Garden: I. Diseases of Lettuce. II. Diseases Caused by Nematodes. III. Leaf Mildews—Spraying With Fungicides under Glass. IV. Diseases of Cucurbits. V. Tomato Diseases.	A. D. Selby.
Bulletin 74	Fifteenth Annual Report, 1896	
	Meteorological Summary for 1896	C. A. Patton.
1897.		
Bulletin 75	Beet-Sugar Production	C. E. Thorne.
Bulletin 76	Potatoes: Cultural Notes; Variety Tests; Experiments with Fertilizers.	W. J. Green.
Bulletin 77	The Chinch Bug and Other Destructive Insects	F. M. Webster.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

OHIO STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 78	Corn: Cultural Investigations; Comparison of Varieties, and Corn Smut.	J. F. Hickman.
Bulletin 79	Some Diseases of Orchard and Garden Fruits	A. D. Selby.
Bulletin 80	The Maintenance of Fertility; Field Experiments with Fertilizers in 1896.	C. E. Thorne, J. F. Hickman, and W. J. Green.
Bulletin 81	The San José Scale in Ohio	F. M. Webster.
Bulletin 82	Field Experiments with Wheat; Comparison of Varieties; Cultural Investigations.	J. F. Hickman.
Bulletin 83	A First Ohio Weed Manual	A. D. Selby.
Bulletin 84	Sixteenth Annual Report, 1897	
Bulletin 85	Strawberries	W. J. Green.
Bulletin 86	The Story of the Lives of a Butterfly and a Moth	F. M. Webster.
Bulletin 87	The Periodical Cicada (*Cicada septendecim*), or So-called Seventeen-year Locusts, in Ohio.	Do.
Bulletin 88	Cooperative Experiments made by the Ohio Agricultural Students' Union in 1896.	L. M. Bloomfield and J. S. Hine.
Bulletin 89	Prevalent Diseases of Cucumbers, Melons, and Tomatoes	A. D. Selby.
1898.		
Bulletin 90	Sugar-Beet Investigations in 1897	A. D. Selby and L. M. Bloomfield.
Bulletin 91	The Lung and Stomach Worms of Sheep	C. E. Thorne.
Bulletin 92	Preliminary Report upon Diseases of the Peach; Experiments in Spraying Peach Trees.	A. D. Selby.
Bulletin 93	The Home Mixing of Fertilizers	C. E. Thorne.
Bulletin 94	The Maintenance of Fertility	C. E. Thorne and A. D. Selby.
Bulletin 95	Meteorological Summary for 1897 Seventeenth Annual Report, 1898	C. A. Patton.
Bulletin 96	The Army Worm and Other Insects	F. M. Webster and C. W. Mally.
Bulletin 97	Some Diseases of Wheat and Oats	A. D. Selby.
	Experiments in the Prevention of Grain Smuts and the Treatment of Unsmutted Wheat Seed.	J. F. Hickman and A. D. Selby.
1899.		
Bulletin 98	Small Fruits: Cultural Notes and Comparison of Varieties	W. J. Green.
Bulletin 99	Sugar-Beet Investigations in 1898	A. D. Selby.
Bulletin 100	The Home Mixing of Fertilizers	C. E. Thorne.
Bulletin 101	Experiments with Oats	J. F. Hickman.
Bulletin 102	Seed and Soil Treatment and Spray Calendar for Insect Pests and Plant Diseases.	W. J. Green, A. D. Selby, and F. M. Webster.
Bulletin 103	The San José Scale Problem in Ohio	F. M. Webster.
Bulletin 104	Further Studies upon Spraying Peach Trees and upon Diseases of the Peach.	A. D. Selby.
Bulletin 105	Further Studies of Cucumber, Melon, and Tomato Diseases, with Experiments.	Do.
Bulletin 106	I. The Chinch Bug. II. Experiments with Insecticides	F. M. Webster.
Bulletin 107	The Hessian Fly	Do.
Bulletin 108	Bovine Tuberculosis	C. E. Thorne.

OKLAHOMA STATION.

1891.		
Bulletin 1	General Information, Organization, and History	J. C. Neal and A. C. Magruder.
1892.		
Bulletin 2	Station Work in Progress	J. C. Neal.
Bulletin 3	Insects and Insecticides	Do.
Bulletin 4	Tests of Varieties—Oats, Corn, Spring Wheat, Irish and Sweet Potatoes.	A. C. Magruder.
Special Bulletin 1	Texas Cattle Fever	J. C. Neal and M. Francis.
1893.		
Bulletin 5	Some Soil Analyses	G. L. Holter and J. C. Neal.
Bulletin 6	Notes of Progress	J. C. Neal.
	Analyses	G. L. Holter.
Bulletin 7	Water Analyses	Do.
Bulletin 8	Tests of Varieties of Wheat	A. C. Magruder.
1894.		
Bulletin 9	Test of Varieties of Vegetables in 1893	F. A. Waugh.
	Financial Report, 1893	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

OKLAHOMA STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 10	Corn	A. C. Magruder.
Bulletin 11	Press Bulletin Excerpts	
Bulletin 12	Wheat	Do.
Bulletin 13	Wheat Feeding	J. C. Neal.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 14	Grapes, 1894	F. A. Waugh.
Bulletin 15	Garden Vegetables, 1894	Do.
Bulletin 16	Oats	A. C. Magruder.
Bulletin 17	Oklahoma Weeds	J. C. Neal.
1896.		
Bulletin 18	Irrigation for Oklahoma	G. E. Morrow.
Bulletin 19	Methods of Destroying Chinch Bugs	Do.
Bulletin 20	Wheat Experiments, 1895–96	Do.
	Food Value of Corn Scorched by Hot Winds	G. L. Holter.
	Fruit Culture in Oklahoma	H. E. Glazier.
	Peach Rosette; The Melon Louse (*Aphis cucumeris*)	E. E. Bogue.
Bulletin 21	Experiments in Corn Culture, 1896	G. E. Morrow and J. H. Bone.
	Road Making and Repairing	G. E. Morrow.
1897.		
Bulletin 22	Climate and Crops in Oklahoma; Field Experiments with Kafir Corn.	G. E. Morrow.
Bulletin 23	Cotton Culture in Oklahoma	Do.
Bulletin 24	Oklahoma Soil Studies	J. H. Bone.
Bulletin 25	Loss by Exposure of Corn Stover and Teosinte; Composition of Pie Melon; Fertilizer Analyses of Castor Bean Plant.	G. L. Holter and J. Fields.
Bulletin 26	Some Injurious Orchard Insects	E. E. Bogue.
Bulletin 27	Glanders; Texas Fever; Symptomatic Anthrax	L. L. Lewis.
Bulletin 28	Experiments with Wheat, 1896–97	G. E. Morrow and J. H. Bone.
Bulletin 29	A Study of Waters for Irrigation; The Irrigation Plant	G. L. Holter and J. Fields.
Annual Report	Annual Report, 1897	
1898.		
Bulletin 30	Oklahoma Weather and Crops for 1897	G. E. Morrow.
Bulletin 31	Strawberries; Grapes; Stimulating and Holding Fruit Buds.	H. E. Glazier.
Bulletin 32	Practical Chemistry of Soils and Crops; A Study of the Castor-oil Plant.	G. L. Holter and J. Fields.
Bulletin 33	Experiments with Field Crops, 1897	G. E. Morrow and J. H. Bone.
Bulletin 34	The San José Scale in Oklahoma	E. E. Bogue.
Bulletin 35	Summary of Digestion Experiments with Kafir	
Bulletin 36	Summary of Experiments with Corn and Wheat, 1898	
Annual Report	Annual Report, 1898	
1899.		
Bulletin 37	Digestion Experiments and Fodder Analyses	G. L. Holter and J. Fields.
Bulletin 38	Analyses of Waters for Irrigation	Do.
Bulletin 39	Texas Fever	L. L. Lewis.
Bulletin 40	Bacteriology of Milk	Do.
Bulletin 41	Weeds of Oklahoma	E. E. Bogue.
Bulletin 42	Oklahoma Soil Studies	J. H. Bone.
Bulletin 43	Fruits for Oklahoma	O. M. Morris.
Annual Report	Annual Report, 1899	

OREGON STATION.

1888.		
Bulletin 1	History and Organization	E. Grimm.
1889.		
Bulletin 2	Preparation and Notes on Future Horticultural Work	E. R. Lake.
Bulletin 3	Practical Work with Insecticides	Do.
	Corn Worm; Insecticides; Spraying Machines; Directions for Sending Insects.	F. L. Washburn.
	Some Investigations on Plants Poisonous to Stock	P. H. Irish.
Annual Report	First Annual Report, 1889	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

OREGON STATION—Continued.

Publication.	Title.	Author.
1890.		
Bulletin 4	Notes on Farm Crops	E. Grimm.
	Horticultural Notes	E. R. Lake.
	Chemical Analyses	P. H. Irish and W. D. Bigelow.
Bulletin 5	Entomological Notes; Gophers and Rabbits	F. L. Washburn.
	Analysis of Bone Meal	P. H. Irish and W. D. Bigelow.
Bulletin 6	Examination of Cattle Foods	P. H. Irish.
	Economic Zoology	F. L. Washburn.
Bulletin 7	Comparative Tests of Small Fruits and Vegetables	G. Coote.
Annual Report	Second Annual Report, 1890	
1891.		
Bulletin 8	Notes on Varieties of Wheat and Flax	H. T. French.
Bulletin 9	Silos and Ensilage	Do.
Bulletin 10	Experiments with Codling Moth and with a Combined Fungicide and Insecticide; Description of Spraying Apparatus; Notes on the Hop Louse.	F. L. Washburn.
Bulletin 11	Notes on Grasses and Potatoes	H. T. French.
Bulletin 12	Comparative Test of Strawberries for 1891	G. Coote.
	Meteorological Summary	J. Fulton.
Bulletin 13	Mineral and Mineral Water Analyses; Soils and Agricultural Survey.	G. W. Shaw.
Bulletin 14	Notes on Insects	F. L. Washburn.
Annual Report	Third Annual Report, 1891	
1892.		
Bulletin 15	Horticulture	G. Coote.
Bulletin 16	Notes on Varieties and Yield of Wheat	H. T. French and C. D. Thompson.
Bulletin 17	Sugar Beets	G. W. Shaw and D. Lotz.
Bulletin 18	Insects Injurious to Young Fruit Trees—Codling Moth; Wire Worms; Flea Beetles.	F. L. Washburn.
Bulletin 19	Some Oregon Weeds and How to Destroy Them	M. Craig.
Bulletin 20	Experiments in Pig Feeding	H. T. French.
Bulletin 21	Soils of Oregon	G. W. Shaw and D. Lotz.
Annual Report	Annual Report, 1892	
1893.		
Bulletin 22	Comparative Tests of Small Fruits and Vegetables; Renovation of Old Orchards.	G. Coote.
Bulletin 23	Experiments in the Culture of the Sugar Beet in Oregon	G. W. Shaw.
Bulletin 24	Potatoes; Roots	H. T. French.
Bulletin 25	Codling Moth and Hop Louse; Gophers and Moles	F. L. Washburn.
Bulletin 26	Drainage	J. M. Bloss.
Bulletin 27	Plant Diseases: Their Cause and Prevention	M. Craig.
1894.		
Bulletin 28	Continuation of Experiments in Pig Feeding	H. T. French.
Bulletin 29	Notes on Vegetables, Fruits, Pruning, etc	G. Coote.
Bulletin 30	Potatoes; Roots	H. T. French.
Bulletin 31	Progress of Work: Codling Moth, Hop Louse, Flea-Beetles, Radish Flies, Cutworms and Wireworms, Tent Caterpillars, Illustrations of Oregon Insects and Insect Work, Gophers and Moles, Capons and Caponizing.	F. L. Washburn.
Bulletin 32	Five Farmers' Foes: Canada Thistle, Sow Thistle, Russian Thistle, Bull Thistle, Chinese Thistle.	M. Craig.
Bulletin 33	Tent Caterpillars; The Grain Plant Louse; The Pear-Leaf Blister; The Clover Mite; Koebele's Resin Wash.	F. L. Washburn.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 34	Notes on the Comparative Date of Blooming and Pollen Production of Varieties of Apples, Pears, Plums, and Cherries; Notes on Vegetables.	G. Coote.
Bulletin 35	Forage Plants; Pig Feeding	H. T. French.
Bulletin 36	Composition and Use of Fertilizers	G. W. Shaw.
Bulletin 37	Experiments in Cattle Feeding	H. T. French.
Bulletin 38	Fruit Pests	F. L. Washburn.
Bulletin 39	Oat Straw; Cheat; Orchard Grass; Tall Oat Grass; Red Clover.	G. W. Shaw.
Annual Report	Financial Report, 1895	
1896.		
Bulletin 40	Prunes, Apples, and Pears in Oregon	U. P. Hedrick.
Bulletin 41	Spraying Bulletin	U. P. Hedrick and A. B. Cordley.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

OREGON STATION—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 42	Feeding Sheaf Wheat: Pigs; Steers. Feeding Potatoes to Pigs.	H. T. French.
Circular 1	Dairying in Oregon	H. T. French, G. W. Shaw, and F. L. Kent.
1897.		
Bulletin 43	Flax Culture	H. T. French.
Bulletin 44	A Review of Oregon Sugar Beets	G. W. Shaw.
Bulletin 45	Prunes in Oregon	U. P. Hedrick et al.
Bulletin 46	A Plant that Poisons Cattle: Cicuta	U. P. Hedrick.
Bulletin 47	The Relative Digestibility of Cheat and Clover	G. W. Shaw and H. T. French.
Annual Report	Annual Report, 1897	
1898.		
Bulletin 48	Spraying	A. B. Cordley.
Bulletin 49	Paris Green	G. W. Shaw and J. F. Fulton.
Bulletin 50	The Fertility of Oregon Soils	G. W. Shaw.
Bulletin 51	Marketing Fruit	M. Craig.
Bulletin 52	The Cultivation of the Hazel Nut; also Notes on Varieties of Pears and Peaches.	G. Coote.
Bulletin 53	Sugar Beets, 1897	G. W. Shaw.
Bulletin 54	I. Notes on Flax and Hemp. II. Dairy Rations. III. Fresh v. Stripper Cow Butter. IV. Feeding Pumpkins to Pigs. V. Feeding Artichokes to Pigs.	H. T. French and F. L. Kent.
Bulletin 55	Chemical Studies of Oregon Fruits; Cherries	G. W. Shaw.
1899.		
Bulletin 56	Points on Prune Dipping	Do.
Bulletin 57	Brown Rot	A. B. Cordley.
Bulletin 58	Rose Culture in Oregon	G. Coote.
Bulletin 59	Sugar Beet Experiments of 1898 and Final Conclusions	G. W. Shaw.

PENNSYLVANIA STATION.[a]

1869–1881.		
Annual Reports	Annual Reports for 1869, 1870, 1872, 1873, 1874, 1875, 1876, 1877, 1879–80, and 1881.	
1882.		
Bulletin 1	The Results of an Experiment Showing the Effect of Various Fertilizers on the Quantity and Quality of the Wheat Crop.	W. H. Jordan.
Bulletin 2	The Results of Experiments with Various Fertilizers on Corn and Oats.	Do.
	An Examination of Agricultural Seeds	R. Tait.
Annual Report	Annual Report, 1882	
1883.		
Bulletin 3	The Composition, Valuation, and Purchase of Commercial Fertilizers.	W. H. Jordan.
Bulletin 4	The Use of Commercial Fertilizers	Do.
Bulletin 5	Results of Experiments on the Effect of Cutting Timothy and Clover Grass at Different Stages of Growth.	Do.
Bulletin 6	Feeding Experiments	
Bulletin 7	Note on an Experiment with Native Potatoes	W. A. Buckhout.
Annual Report	Annual Report, 1883	
1884.		
Bulletin 8	The Results of Experiments Showing the Effect of Various Fertilizers on the Growth of Corn, Oats, Wheat, and Grass.	
Bulletin 9	The Results of Experiments Showing the Effect of Various Fertilizers on the Growth of Corn, Oats, and Wheat.	
Annual Report	Annual Report, 1884	
1885.		
Bulletin 10	Feeding Experiments	
Bulletin 11	Experiments with Fertilizers, 1884	
Annual Report	Annual Report, 1885	

[a] The bulletins and reports for 1869 to 1886, inclusive, were issued by the Pennsylvania State College.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

PENNSYLVANIA STATION—Continued.

Publication.	Title.	Author.
1886.		
Bulletin 12	Feeding Experiments	
Bulletin 13	Course in Mechanic Arts	L. E. Reber.
Bulletin 14	The Grass Crops of 1885	
Bulletin 15	The Composition of Soiling Rye	
Bulletin 16	The Composition and Food Value of Desiccated Apple Pomace.	
Annual Report	Annual Report, 1886	
1887.		
Bulletin 1	Historical Sketch of the Agricultural Experiments Conducted by the Pennsylvania State College, 1857–1887; Studies upon the Composition and Development of Soiling Crops.	W. Frear.
Annual Report	Annual Report, 1887	
1888.		
Bulletin 2	Field Experiments with Phosphates	H. P. Armsby.
Bulletin 3	Composition and Digestibility of Corn Stover	Do.
Bulletin 4	Seed Germinations	G. C. Butz.
Bulletin 5	The Digestibility of Soiling Rye	W. Frear.
Annual Report	Annual Report, 1888	
1889.		
Bulletin 6	Tests of Varieties: Wheat, Oats, Barley, Potatoes, Forage Crops, etc.	W. H. Caldwell.
Bulletin 7	Tests of Varieties of Field Corn	Do.
	Analyses and Valuation of Fertilizers	W. Frear.
Bulletin 8	Testing New Varieties; Germination Tests	G. C. Butz.
Bulletin 9	Digestibility of Corn Fodder and Silage	H. P. Armsby and W. H. Caldwell.
Annual Report	Annual Report, 1889	
1890.		
Bulletin 10	Should Farmers Raise Their Own Vegetable Seeds? Notes on New Varieties of Vegetables.	G. C. Butz.
	Tests of Agricultural Varieties, 1889	W. H. Caldwell.
Bulletin 11	Indian Corn as a Grain and Forage Crop	Do.
Bulletin 12	Simple Methods of Determining Milk Fat	W. Frear and G. L. Holter.
	Dried Brewers' Grains	W. Frear.
Bulletin 13	Black Knot on Plums; A Few Ornamental Plants	G. C. Butz.
Annual Report	Annual Report, 1890	
1891.		
Bulletin 14	Tests of Varieties of Vegetables for 1890	Do.
Bulletin 15	Influence of Variety and of Rate of Seeding on the Yield of Ensilage Corn.	H. P. Armsby.
Bulletin 16	Culture of the Chestnut for Fruit	W. A. Buckhout.
	Analyses of Several Varieties of Chestnuts	W. Frear.
Bulletin 17	The Value of Cotton-Seed Meal as Compared with Bran for the Production of Butter.	T. F. Hunt.
Annual Report	Annual Report, 1891	
1892.		
Bulletin 18	Notes on New and Old Varieties of Orchard Fruits and Small Fruits.	G. C. Butz.
Bulletin 19	Information on Spraying Fruits	Do.
Bulletin 20	Tests of Dairy Apparatus	H. P. Armsby, H. J. Waters, and W. H. Caldwell.
Bulletin 21	The Koch Test for Tuberculosis	H. P. Armsby.
Annual Report	Annual Report, 1892	
1893.		
Bulletin 22	Tests of Dairy Apparatus	W. H. Caldwell.
Bulletin 23	Forest Fires	W. A. Buckhout.
	Experience with Evergreens in Pennsylvania	G. C. Butz.
Bulletin 24	Influence of Quality of Food upon Economy of Milk and Butter Production.	H. J. Waters, W. H. Caldwell, and R. J. Weld.
Bulletin 25	Small Fruits in 1893	G. C. Butz.
Annual Report	Annual Report, 1893	
1894.		
Bulletin 26	Mangels and Sugar Beets v. Silage—Yield, Cost, and Feeding Value.	H. J. Waters and R. J. Weld.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

PENNSYLVANIA STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 27	Tests of Cream Separators	H. P. Armsby, W. H. Caldwell, and L. E. Reber.
Bulletin 28	Cotton-Seed Feed for Dairy Cows	H. P. Armsby and E. H. Hess.
Bulletin 29	Tuberculosis of Cattle	L. Pearson.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 30	Tobacco Experiments	W. Frear and E. J. Haley.
Bulletin 31	Report of the Director for 1894	H. P. Armsby.
Bulletin 32	Small Fruits in 1894	G. C. Butz.
Bulletin 33	Directions for Using the Babcock Milk Test	H. Hayward and M. E. McDonnell.
Annual Report	Annual Report, 1895	
1896.		
Bulletin 34	A Phospate Deposit in Juniata County	M. C. Ihlseng.
Bulletin 35	A Soil Test with Fertilizers	H. P. Armsby.
Bulletin 36	Chestnut Culture for Fruit	W. A. Buckhout.
Bulletin 37	Peach Industry in Pennsylvania	G. C. Butz.
Bulletin of Information No. 1.	The Computation of Rations for Farm Animals	H. P. Armsby.
Annual Report	Annual Report, 1896	
1897.		
Bulletin 38	A Test of Hand Separators	H. Hayward.
Bulletin 39	Wheat, Oats, and Potatoes	G. C. Watson and E. H. Hess.
Bulletin 40	The Sugar Beet in Pennsylvania	H. P. Armsby.
Bulletin 41	Tests of Dairy Feeds	H. Hayward and R. J. Weld.
Bulletin of Information No. 2.	Composition of Full-Cream Cheese	W. Frear.
1898.		
Bulletin 42	The Maintenance Ration of Cattle	H. P. Armsby.
Bulletin 43	Apples in Pennsylvania	G. C. Butz.
Bulletin 44	Commercial Butter Cultures	H. Hayward and M. E. McDonnell.
Bulletin 45	Heated Milk for Butter Making	H. Hayward and F. F. Pepper.
Annual Report	Annual Report, 1897–98	
1899.		
Bulletin 46	Variety Tests of Wheat	G. C. Watson and E. H. Hess.

RHODE ISLAND STATION.

1888.		
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 1	Organization	C. O. Flagg.
Bulletin 2	The Farm: Historical, Physical, and Geological Description.	Do.
Bulletin 3	Stock Feeding	H. J. Wheeler.
Bulletin 4	Bee Keeping; Establishment of the Apiary	S. Cushman.
Bulletin 5	Potatoes; Meteorological Summary	L. F. Kinney.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 6	Milk Fever, or Parturient Apoplexy, in Cows	
Bulletin 7	Catalogue of Fruits; Meteorological Summary	Do.
	Spring Report of the Apiarist	S. Cushman.
Bulletin 8	Soils and Fertilizers	H. J. Wheeler.
Bulletin 9	Experiments in Apiculture; Foul Brood	S. Cushman.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 10	Mixed Foods in Cases of Faulty Appetite in Horses and Neat Stock; Patented and Proprietary Foods; Sore Shoulders in Horses.	F. E. Rice.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

RHODE ISLAND STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 11	The State Fertilizer Law as it Is and as it Might Be; Commercial Value of Fertilizer Stock; Analyses of Commercial Fertilizers; State Inspection, 1891; Analyses of Miscellaneous Materials Sent on for Examination; Meteorological Summary.	H. J. Wheeler.
Bulletin 12	Further Analyses of Commerical Fertilizers Collected under the State Inspection, 1891, with Comments.	H. J. Wheeler and B. L. Hartwell.
Bulletin 13	Fertilizers	Do.
Bulletin 14	Potato Scab; The Bordeaux Mixture as a Preventive of Potato Scab and Potato Blight; Transplanting Onions.	L. F. Kinney.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 15	Treatment of Loose Smut of Oats	C. O. Flagg.
	Fungicides and Insecticides and Their Use	L. F. Kinney.
Bulletin 16	The New Fertilizer Law for Rhode Island; Analyses of Commereial Fertilizers.	H. J. Wheeler and B. L. Hartwell.
Bulletin 17	Analyses of Commereial Fertilizers	Do.
Bulletin 18	——do	Do.
Bulletin 19	——do	Do.
Bulletin 20	Production and Market Value of Capons	S. Cushman.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 21	Seaweeds: Their Agricultural Value; the Chemieal Composition of Certain Speeies.	H. J. Wheeler and B. L. Hartwell.
Bulletin 22	Strawberries	L. F. Kinney.
Bulletin 23	Fertilizers, Commercial and Miscellaneous	H. J. Wheeler and B. L. Hartwell.
Bulletin 24	Analyses of Commereial Fertilizers	Do.
Bulletin 25	Turkeys: Experiments with; Management of by Successful Producers; Wild Turkey Crosses, their Desirability, and Where They may be Obtained.	S. Cushman.
Bulletin 26	Fertilizers	H. J. Wheeler and B. L. Hartwell.
	Oats	C. O. Flagg and J. D. Towar.
	Potato Scab	H. J. Wheeler and J. D. Towar.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 27	Leaf Blight of the Pear; Raspberries; Distribution of Plants.	L. F. Kinney.
Bulletin 28	Rhode Island Soils; Fertilizers	H. J. Wheeler and B. L. Hartwell.
Bulletin 29	Fertilizers: Commercial and Speeial Formula	Do.
Bulletin 30	Fertilizers; Potato Scab	Do.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 31	Some Speeial Orehard Treatment of the Apple, Pear, and Quince.	L. F. Kinney.
Bulletin 32	Analyses of Commereial Fertilizers	H. J. Wheeler, B. L. Hartwell, and C. L. Sargent.
Bulletin 33	Fertilizers	Do.
	Potatoes	H. J. Wheeler, J. D. Towar, and G. M. Tucker.
	Potato Scab	H. J. Wheeler and G. M. Tucker.
Bulletin 34	Analyses of Fertilizers	H. J. Wheeler, B. L. Hartwell, and C. L. Sargent.
	Home-Mixed Fertilizers	H. J. Wheeler and B. L. Hartwell.
Bulletin 35	Garden Seeds	L. F. Kinney and G. E. Adams.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 36	Potato Culture: Hastening Maturity	C. O. Flagg, J. D. Towar, and G. M. Tucker.
Bulletin 37	Apple Culture	L. F. Kinney.
Bulletin 38	The Bordeaux Mixture: Its Use in the Potato Field	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

RHODE ISLAND STATION—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 39	Analyses of Commercial Fertilizers	H. J. Wheeler, B. L. Hartwell, and C. L. Sargent.
Bulletin 40	Fertilizers	Do.
	Potato Scab	H. J. Wheeler and G. M. Tucker.
Bulletin 41	Spinach	L. F. Kinney.
Bulletin 42	Fertilizers	H. J. Wheeler, B. L. Hartwell, and C. L. Sargent.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 43	Additional Tests of Garden Seeds	L. F. Kinney and G. E. Adams.
Bulletin 44	Celery	L. F. Kinney.
Bulletin 45	The Loganberry from Seed to Fruitage	Do.
Bulletin 46	Lime and Liming	H. J. Wheeler.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 47	Lime, Nitrogen, and Soda	H. J. Wheeler.
Bulletin 48	Analyses of Commercial Fertilizers	H. J. Wheeler and B. L. Hartwell.
Bulletin 49	Liming in Rhode Island; Legumes	H. J. Wheeler and G. E. Adams.
Bulletin 50	The Utilization of Waste Products and Waste Places. I. The Nitrogen Problem.	G. W. Field.
Bulletin 51	The Utilization of Waste Products and Waste Places. II. The Clam; The Cultivation of Tidal Mud Flats.	Do.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 52	Suggestions as to Spraying	J. A. Tillinghast and G. E. Adams.
Bulletin 53	The Practical Bearing of Some of the Field and Pot Experiments Conducted at this Station.	H. J. Wheeler.
Bulletin 54	Commercial Fertilizers	H. J. Wheeler, B. L. Hartwell, and C. F. Kenyon.
Bulletin 55	Forcing Rhubarb	F. W. Card.
Bulletin 56	Analyses of Commercial Fertilizers	H. J. Wheeler, B. L. Hartwell, and C. F. Kenyon.
Bulletin 57	Quantities of Nitrogen for Grass	H. J. Wheeler and J. A. Tillinghast.
Bulletin 58	Financial Gain from Liming Grass Land	Do.

SOUTH CAROLINA STATION.

1886.		
	Reports of the Work of the Experimental Farm of the South Carolina College, 1883, 1884, 1885, and 1886.	
1888.		
Bulletin 1	Tests of Varieties of Cotton	J. M. McBryde.
Bulletin 2	Tests of Commercial Seeds	R. H. Loughridge.
Bulletin 3	Analyses of Fertilizers and Feeding Stuffs	W. B. Burney and R. H. Loughridge.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 4	Entomology	G. F. Atkinson.
Bulletin 5	Oats and Wheat	J. M. McBryde.
Bulletin 6	Hog Cholera	W. B. Niles and B. M. Bolton.
Bulletin 7	Meteorological Data	M. Whitney.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 8	Chemical Composition of Corn Silage, Cowpeas, and Soja Beans in South Carolina.	J. B. McBryde.
Annual Report	Third Annual Report, 1890	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

SOUTH CAROLINA STATION—Continued.

Publication.	Title.	Author.
NEW SERIES.		
1891.		
Bulletin 1	Table of Analyses of Commercial Fertilizers	
Bulletin 2	Cotton: Experiments with Varieties and Fertilizers	J. B. McBryde.
Bulletin 3	Table of Analyses of Commercial Fertilizers	
Bulletin 4	Fertilizer Tests with Wheat; Varieties of Wheat and Oats	J. F. Duggar.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 5	Methods of Keeping Sweet Potatoes	Do.
Bulletin 6	Analyses of Commercial Fertilizers	
Bulletin 7	Experiments with Oats and Wheat	Do.
Bulletin 8	Occurrence of Phosphoric Acid in Cotton-Seed Meal	M. B. Hardin.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 9	Experiments with Irish Potatoes	J. F. C. Du Pre.
Bulletin 10	Notes on Varieties of Beans	Do.
Bulletin 11	Analyses of Commercial Fertilizers	
Bulletin 12	Cooperative Soil Tests of Fertilizers	J. S. Newman.
Bulletin 13	Analyses of Commercial Fertilizers	
Bulletin 14	Experiments with Corn	Do.
Annual Report	Sixth Annual Financial Report, 1893	
1894.		
Bulletin 15	Fertilizer Experiments with Corn	Do.
Bulletin 16	Experiments with Tomatoes	J. F. C. Du Pre.
Bulletin 17	Analyses of Commercial Fertilizers	
Bulletin 18	Fertilizer Experiments with Cotton	J. N. Hook.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 19	Dairying	J. W. Hart.
Bulletin 20	Analyses of Commercial Fertilizers	
Bulletin 21	The Determination of the Oxids of Iron and Aluminum in Presence of Phosphoric Acid, Lime, and Magnesia.	F. S. Shiver.
Bulletin 22	Colic in Horses and Mules	W. E. A. Wyman.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 23	Lameness in Horses and Mules	Do.
Bulletin 24	Analyses of Commercial Fertilizers	Do.
Bulletin 25	Distemper in Horses and Mules	Do.
Bulletin 26	Founder in Horses and Red Water in Cattle	Do.
Bulletin 27	Wounds and Their Treatment	Do.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 28	The Sweet Potato as a Starch Producer	F. S. Shiver.
Bulletin 29	Analyses of Commercial Fertilizers	
Bulletin 30	The Determination of Starch in the Sweet Potato	Do.
Bulletin 31	Hog Cholera and Swine Plague	W. E. A. Wyman.
Bulletin 32	Protection and Improvement of Worn Soils	J. S. Newman.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin 33	Tests of Dairy Methods and Apparatus	J. W. Hart.
	Comparative Tests of Butter Fat	F. S. Shiver.
Bulletin 34	Sugar Beets	M. B. Hardin et al.
Bulletin 35	Analyses of Commercial Fertilizers	
Bulletin 36	Diseases of Plants	A. P. Anderson.
Bulletin 37	Wheat	J. S. Newman and C. M. Conner.
1899.		
Bulletin 38	The Asparagus Rust in South Carolina	A. P. Anderson.
Bulletin 39	Suggestions to Auxiliary Clubs	
Bulletin 40	Farm Manures for Cotton	C. M. Conner.
Bulletin 41	Rice Blast and a New Smut on the Rice Plant	A. P. Anderson.
	Preliminary Report on Treatment for Rice Smut	E. Walker.
Bulletin 42	Varieties of Cotton	J. S. Newman.
Bulletin 43	Analyses of Commercial Fertilizers	M. B. Hardin.
Bulletin 44	Corn	J. S. Newman.
Bulletin 45	Analyses of Commercial Fertilizers	
Bulletin 46	Cotton	Do.
Bulletin 47	A Chemical Study of the Sea Island Cotton Plant	F. S. Shiver.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

SOUTH DAKOTA STATION.

Publication.	Title.	Author.
1887.		
Bulletin 1	Notes on the Growth of Trees in the College Grounds	C. A. Keffer.
1888.		
Bulletin 2	Organization; Growth of Grains Tabulated; Potatoes; Clover.	
Bulletin 3	Arbor Day: Why to Plant, What to Plant, How to Plant	Do.
Bulletin 4	Reports of Departments of Agriculture, Forestry, Horticulture, and Entomology.	C. A. Keffer, L. Foster, and I. H. Orcutt.
Bulletin 5	Garden Notes, with Table of Meteorological Observations	C. A. Keffer.
Bulletin 6	Garden Notes and Other Field Observations; Meteorological Tables.	
Bulletin 7	Notes on Small Fruits; The Orchard and Ornamental Plants.	Do.
Bulletin 8	The Drinking Waters of Dakota	J. H. Shepard.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 9	Corn	L. Foster.
Bulletin 10	The Germination of Frosted Grain	C. A. Keffer.
Bulletin 11	Small Grain	L. Foster.
Bulletin 12	Forestry, Horticulture, and Botany	C. A. Keffer.
Bulletin 13	Entomology	I. H. Orcutt.
Bulletin 14	The Sugar Beet	J. H. Shepard.
Bulletin 15	Forestry	C. A. Keffer.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 16	The Sugar Beet	L. Foster and J. H. Shepard.
Bulletin 17	Small Grain	L. Foster.
Bulletin 18	Cutworms	I. H. Orcutt and J. M. Aldrich.
Bulletin 19	The Sugar Beet	L. Foster and J. H. Shepard.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 20	Forestry	C. A. Keffer.
Bulletin 21	Experiments with Small Grains	L. Foster.
Bulletin 22	Injurious Insects	I. H. Orcutt and J. M. Aldrich.
Bulletin 23	Forest Trees, Fruits, and Vegetables	C. A. Keffer.
Bulletin 24	Corn	L. Foster.
Bulletin 25	Glanders	C. A. Cary.
Bulletin 26	Strawberries, the Sand Cherry, and Orchard Notes	C. A. Keffer.
Bulletin 27	The Sugar Beet in South Dakota	J. H. Shepard.
Bulletin 28	Irrigation	L. Foster and C. A. Duncan.
Bulletin 29	Forestry	C. A. Keffer.
	Fungi	T. A. Williams.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 30	Report of Entomologist	I. H. Orcutt and J. M. Aldrich.
Bulletin 31	Meteorology	
Bulletin 32	Forestry	J. C. Whitten.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 33	Some Plants Injurious to Stock	T. A. Williams.
Bulletin 34	The Sugar Beet	J. H. Shepard.
Bulletin 35	Fungus Diseases and Insect Pests	T. A. Williams and L. C. Corbett.
Bulletin 36	Scab; Lumpy Jaw; Anthrax	D. A. Cormack.
Bulletin 37	Tomatoes	L. C. Corbett.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 38	Feeding Wheat to Hogs	E. C. Chilcott.
Bulletin 39	Milk Tests and Comparison Tables	A. H. Wheaton.
Bulletin 40	Native and Introduced Forage Plants	J. H. Shepard.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 41	The Artesian Waters of South Dakota	Do.
Bulletin 42	Squashes	L. C. Corbett.

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[Titles which have been changed from their original form are inclosed in brackets.]

SOUTH DAKOTA STATION—Continued.

Publication.	Title.	Author.
1895.		
Bulletin 43	Native Trees and Shrubs	T. A. Williams.
Bulletin 44	Forestry	L. C. Corbett.
Bulletin 45	Forage Plants	T. A. Williams.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 46	Building Creameries and Organization of Cooperative Creamery Companies.	J. N. Trueman.
Bulletin 47	Tomatoes, Beans, Onions; A Cheap Hothouse	L. C. Corbett.
Bulletin 48	Potato Scab; Three Injurious Insects	T. A. Williams.
Bulletin 49	Shallow Artesian Wells of South Dakota	J. H. Shepard.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 50	Fruit Culture	N. E. Hansen.
Bulletin 51	Forage Plants of South Dakota; Silos and Silage	E. C. Chilcott.
Bulletin 52	Irrigation in South Dakota	J. H. Shepard and E. C. Chilcott.
Bulletin 53	Forestry in South Dakota	L. C. Corbett.
Bulletin 54	Subsoiling	N. E. Hansen.
Bulletin 55	Feeding Sheep in South Dakota	E. C. Chilcott and E. A. Burnett.
Annual Report	Annual Report, 1897	
1898.		
Bulletin 56	Sugar Beets in South Dakota	J. H. Shepard.
Bulletin 57	Four Injurious Insects	D. A. Saunders.
Bulletin 58	Moisture Investigations for 1897	E. C. Chilcott and A. B. Holm.
Bulletin 59	Forage and Garden Crops in the James River Valley	J. H. Shepard and E. C. Chilcott.
Bulletin 60	Millet	E. C. Chilcott and D. A. Saunders.
Annual Report	Annual Report, 1898	
1899.		
Bulletin 61	Forage and Garden Crops in the James River Valley	E. C. Chilcott and R. S. Roe.
Bulletin 62	Sugar Beets in South Dakota	J. H. Shepard and W. H. Knox.
Bulletin 63	Pig Feeding in South Dakota	E. A. Burnett.
Bulletin 64	Ferns and Flowering Plants of South Dakota	D. A. Saunders.
Bulletin 65	Root Killing of Apple Trees	N. E. Hansen.

TENNESSEE STATION.

1882.		
Report *a*	Experiments in Wheat Culture, Ensilage, and Other Crops. Top Dressings on Clover and Grass.	J. M. McBryde.
1884.		
Bulletin 1 *a*	Analyses and Tests of Manures and Fertilizers for 1883–84	J. W. Glenn.
Biennial Report	Biennial Report, 1883–84	
1885–86.		
Report *a*	Wheat Culture and Forage Crops	Do.
Biennial Report	Biennial Report, 1885–86	
Biennial Report	Biennial Report, 1886–87	
1888.		
Bulletin Vol. I, No. 1.	Dehorning Cattle	
	History and Reorganization	C. S. Plumb.
Bulletin Vol. I, No. 2.	The Experiment Station; Building and Laboratories; Germination of Seed Corn; Analyses of Commercial Fertilizers.	C. W. Dabney and C. S. Plumb.
Bulletin Vol. I, No. 3.	Weeds of the Farm	F. L. Scribner and C. L. Newman.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin Vol. II, No. 1.	Notes on Fertilizers and Fertilizing Materials	W. E. Stone.
Bulletin Vol. II, No. 2.	Diseases of the Irish Potato	F. L. Scribner.

a Report of work in the Agricultural Department and the University of Tennessee.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

TENNESSEE STATION—Continued.

Publication.	Title.	Author.
1889.		
Bulletin Vol. II, No. 3.	Cotton-Seed Hulls and Meal as Food for Live Stock	W. E. Stone.
Bulletin Vol. II, No. 4.	Grasses of Mountain Meadows and Deer Parks	F. L. Scribner.
Spec. Bulletin A.	Chemical Composition and Tests of Varieties of Strawberries.	W. E. Stone.
Spec. Bulletin B.	The Army Worm. How to Prevent its Ravages on Cotton	
Annual Report	Analyses of Commercial Fertilizers	Do.
1890.	Second Annual Report, 1889	
Bulletin Vol. III, No. 1.	Experiments in Growing Potatoes	C. S. Plumb.
Bulletin Vol. III, No. 2.	Field Experiments with Barley, Corn, Oats, Wheat, Sorghum, and Clover.	Do.
Bulletin Vol. III, No. 3.	Points about Country Roads	W. W. Carson.
Bulletin Vol. III, No. 4.	Practical Experiments in Reclaiming "Galled" or Washed Lands; Notes on Mulch and Mulch Materials.	P. F. Kefauver.
Bulletin Vol. III. No. 5.	Fruit Trees at the Experiment Station	R. L. Watts.
Bulletin Vol. III, No. 6.	Index to Vols. I, II, and III	
Spec. Bulletin C.	The Treatment of Certain Fungus Diseases of Plants	F. L. Scribner.
Spec. Bulletin D.	Potash and Paying Crops	
Spec. Bulletin E.	The Cotton Worm; The Hessian Fly	H. E. Summers.
Annual Report	Third Annual Report	
1891.		
Bulletin Vol. IV, No. 1.	Crab-Grass Hay; Sorghum as a Forage Plant; Test of Feed Value of First and Second Crops of Clover; Pasture Grasses; Black Knot of the Plum and Cherry; Pruning Fruit Trees; The Glassy Winged Soldier Bug; Diseases of Live Stock; Experiment Station Record.	C. W. Dabney et al.
Bulletin Vol. IV, No. 2.	The Peanut Crop of Tennessee, Statistics, Culture, and Chemistry.	L. P. Brown.
Bulletin Vol. IV, No. 3.	The True Bugs or Heteroptera of Tennessee	H. E. Summers.
Bulletin Vol. IV, No. 4.	Some Fungus Diseases of the Grape	F. L. Scribner.
Bulletin Vol. IV, No. 5.	A Chemical Study of the Cotton Plant	J. B. McBryde.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin Vol. V, No. 1.	Fruit Trees and Experiments with Vegetables	R. L. Watts.
Bulletin Vol. V, No. 2.	Grasses of Tennessee, I	F. L. Scribner.
Bulletin Vol. V, No. 3.	A Contribution to the Study of the Economies of Milk Production.	C. F. Vanderford.
Bulletin Vol. V, No. 4.	Experiments with Fruit Trees and Vegetables	R. L. Watts.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin Vol. VI, No. 1.	Some Injurious Insects of the Apple	C. E. Chambliss.
Bulletin Vol. VI, No. 2.	Rational Use of Feeding Stuffs; Winter Dairying in Tennessee.	C. F. Vanderford.
Bulletin Vol. VI, No. 3.	Small Fruits: Strawberries, Raspberries, Blackberries, and Grapes.	R. L. Watts.
Bulletin Vol. VI, No. 4.	Field Experiments with Tomatoes and Onions	Do.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin Vol. VII, No. 1.	Grasses of Tennessee, II	F. L. Scribner.
Bulletin Vol. VII, No. 2.	Fruits: Grapes, Strawberries, Raspberries, Blackberries, Pears, Apples, and Peaches.	R. L. Watts.
Bulletin Vol. VII, No. 3.	Cooperative Experimentation	
Bulletin Vol. VII, No. 4.	Dehorning Cattle; Notes to Correspondents	
Annual Report	Seventh Annual Report, 1894	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

TENNESSEE STATION—Continued.

Publication.	Title.	Author.
1895.		
Bulletin Vol. VIII, No. 1.	Spraying Apparatus	R. L. Watts.
	Insecticides	C. E. Chambliss.
	Fungicides; Spraying Calendar	S. M. Bain.
Bulletin Vol. VIII, No. 2.	The Wild Onion	R. L. Watts.
Bulletin Vol. VIII, No. 3.	Some Experiments with Fungicides on Peach Foliage	S. M. Bain.
Bulletin Vol. VIII, No. 4.	The Chinch Bug (*Blissus leucopterus*)	C. E. Chambliss.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin Vol. IX, No. 1.	Apples of Tennessee Origin	R. L. Watts.
Bulletin Vol. IX, No. 2.	Strawberries	Do.
Bulletin Vol. IX, No. 3.	A Contribution to the Study of Southern Feeding Stuffs	J. B. McBryde.
Bulletin Vol. IX, No. 4.	Varieties of Grapes	R. L. Watts.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin Vol. X, No. 1.	Apples of Tennessee Origin (Second Report)	Do.
Bulletin Vol. X, No. 2.	Pot Culture of Lettuce	Do.
Bulletin Vol. X, No. 3.	The Soils of Tennessee	C. F. Vanderford.
Bulletin Vol. X, No. 4.	Scale Insects: San José and other Species	C. E. Chambliss.
Annual Report	Tenth Annual Report, 1897	
1898.		
Bulletin Vol. XI, No. 1.	Persimmons	R. L. Watts.
Bulletin Vol. XI, No. 2.	Grasses and Forage Plants: I. Domesticated Grasses	J. B. Killebrew.
Bulletin Vol. XI, No. 3.	Grasses and Forage Plants: II. Leguminous Plants	Do.
Bulletin Vol. XI, No. 4.	Grasses and Forage Plants: III. Meadows and Wild Pastures.	Do.
Annual Report	Eleventh Annual Report, 1898	

TEXAS STATION.

1883.		
Bulletin 1*a*	Preliminary	G. W. Curtis.
1884.		
Bulletin 2*a*	Notes and Experiments	Do.
1885.		
Bulletin 3*a*	....do	Do.
1886.		
Bulletin 4*a*	Acclimating Cattle	Do.
1887.		
Bulletin 5*a*	Tests of Value of Different Fertilizers for Corn. Report, 1887.	Do.
1888.		
Bulletin 1	Plan of Organization	
Bulletin 2	Experiments in Cattle Feeding; Analyses of Fertilizers and Ores; Horticultural Department; Meteorological Department.	
Bulletin 3	Grasses and Other Forage Plants	T. L. Brunk.
Bulletin 4	Root Rot of Cotton or "Cotton Blight"	L. H. Pammel.
Annual Report	First Annual Report, 1888	

a Bulletins of the Agricultural and Mechanical College.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

TEXAS STATION—Continued.

Publication.	Title.	Author.
1889.		
Bulletin 5	Creameries in Texas	F. A. Gulley and G. W. Curtis.
Bulletin 6	Feeding Experiment	F. A. Gulley and H. H. Harrington.
Bulletin 7	Cotton-Root Rot	L. H. Pammel.
Bulletin 8	Work in Horticulture	T. L. Brunk.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 9	Pear Stocks	T. L. Brunk.
	Some Parasitic Fungi of Texas	H. S. Jennings.
Bulletin 10	Feeding Experiment	F. A. Gulley and J. W. Carson.
Bulletin 11	Effect of Cotton Seed and Cotton-Seed Meal on Butter; Quality of Butter from Sweet and Sour Cream.	G. W. Curtis.
Bulletin 12	The Screw Worm	M. Francis.
Bulletin 13	Sorghum; Teosinte	H. H. Harrington, D. Adriance, and P. S. Tilson.
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 14	Effect of Cotton Seed and Cotton-Seed Meal in the Dairy Ration on Gravity and Centrifugal Creaming of Milk.	G. W. Curtis.
Bulletin 15	Influence of Climate on the Composition of Corn; Digestibility of Food Stuffs; Miscellaneous Analyses.	H. H. Harrington.
Bulletin 16	Drainage Experiments; Irish Potatoes; Cabbage; Strawberries; Russian Fruits and Ornamental Trees; Lists of Fruits on Trial; Forest Trees Successful to Date.	S. A. Beach.
Bulletin 17	General Information Relating to the Texas Agricultural Experiment Station.	G. W. Curtis.
Bulletin 18	Liver Flukes	M. Francis.
Bulletin 19	Corn Fodder	G. W. Curtis.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 20	Grasses and Grains; Forage Plants	H. H. Harrington.
Bulletin 21	Effect of Cotton Seed and Cotton-Seed Meal in Feeding Hogs	G. W. Curtis and J. W. Carson.
Bulletin 22	Alfalfa Root Rot	G. W. Curtis.
Bulletin 23	Black Rot of the Grape	R. H. Price.
Bulletin 24	The Cattle Tick	C. Curtice and M. Francis.
Bulletin 25	Texas Soils; a Study of Chemical Composition	H. H. Harrington.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 26	Cost of Cotton Production and Profit per Acre	G. W. Curtis and J. W. Carson.
Bulletin 27	Steer Feeding	J. H. Connell and J. W. Carson.
Bulletin 28	Sweet Potatoes	R. H. Price.
Bulletin 29	Effects of Cotton Seed and Cotton-Seed Meal on Butter, Beef Tallow, Lard, and Sheep Suet.	H. H. Harrington and D. Adriance.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 30	Veterinary Science: Glanders Experiments; Tuberculin Experiments; Lump Jaw of Cattle; Notes on Parasites; Texas Fever Experiments; Device for Destroying Ticks.	M. Francis.
Bulletin 31	Insects Injurious to Stored Grain	R. H. Price.
Bulletin 32	Varieties of Plums; Injurious Fungi and Insects, Varieties of Apricots; Varieties of Japan Persimmons.	Do.
Bulletin 33	Feeding Milch Cows	J. H. Connell and J. Clayton.
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 34	Field Experiments at McKinney Substation and Wichita Falls Substation with Wheat, Corn, Cotton, Grasses, and Manures; Field Experiments at College Station with Corn, Cotton, Grasses, Peas, and Manures.	Do.
Bulletin 35	Miscellaneous Chemical Analyses	D. Adriance, P. S. Tilson, and H. H. Harrington.
Bulletin 36	Vegetables: Varieties of Sweet Potatoes, Onions, Melons, Celery, Beans, Cabbage, Cauliflower, and Tomatoes: Insecticides.	R. H. Price et al.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

TEXAS STATION—Continued.

Publication.	Title.	Author.
1895.		
Bulletin 37	Sundry Brief Articles, Compiled from "Press Notes" Published During the Years 1894 and 1895.	
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 38	Cañaigre, the New Tanning Plant	H. H. Harrington and D. Adriance.
Bulletin 39	The Peach	R. H. Price.
Bulletin 40	Field Experiments at College Station with Corn, Cotton, and Forage Plants.	J. H. Connell and J. Clayton.
Bulletin 41	Steer Feeding	J. H. Connell and J. W. Carson.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 42	The Irish Potato	R. H. Price.
Bulletin 43	Report from Beeville Station: I. Soils. II. Climate. III. Water Supply. IV. Irrigation Equipment.	J. H. Connell and S. A. McHenry.
Bulletin 44	Paints and Painting Materials, and Miscellaneous Analyses.	H. H. Harrington and P. S. Tilson.
Bulletin 45	Cotton and Corn Experiments	B. C. Pittuck.
Bulletin 46	Grasses and Forage Plants	Do.
1898.		
Bulletin 47	The Effect of Food on Economic Dairy Production	A. M. Soule.
Bulletin 48	The Grape: I. Experimental Work. II. Care and Management of the Grape.	R. H. Price and H. Ness.
Bulletin 49	Field Tests with Corn	B. C. Pittuck.
	Best Varieties of Corn	J. H. Connell and B. C. Pittuck.
Annual Report	Tenth Annual Report, 1898	
1899.		
Bulletin 50	Cotton Experiments	B. C. Pittuck.
Bulletin 51	"Fertilizer and Fertilizer Analyses," with the New Law Controlling the Sale of Fertilizers and Poisonous Insecticides in the State.	H. H. Harrington.

UTAH STATION.

1890.		
Bulletin 1	Investigations in Progress at the Station	J. W. Sanborn.
Bulletin 2	Plow Trials	Do.
Annual Report	First Annual Report, 1890	
1891.		
Bulletin 3	Experiments with Garden Vegetables	E. S. Richman.
Bulletin 4	Dynamometer Tests with Wagons	J. W. Sanborn.
Bulletin 5	Potato Trials	J. W. Sanborn, W. P. Cutter, and E. S. Richman.
Bulletin 6	Trials of Sleds and Tillage Tools	J. W. Sanborn.
Bulletin 7	Draft of Mowing Machines	Do.
Bulletin 8	Ensilage	Do.
Bulletin 9	Time of Watering Horses; Whole v. Ground Grain for Horses.	Do.
Bulletin 10	Experiments with Strawberries, Peas, and Beans	E. S. Richman.
Annual Report	Second Annual Report, 1891	
1892.		
Bulletin 11	Blanketing Horses and Cattle; Sheltered v. Unsheltered Cattle; Exercise v. Nonexercise for Stock.	J. W. Sanborn.
Bulletin 12	Experiments with Garden Vegetables	E. S. Richman.
Bulletin 13	Feeding Hay and Grain Mixed to Horses; Feeding Cut Hay v. Whole Hay to Horses.	J. W. Sanborn.
Bulletin 14	Horticulture and Entomology	E. S. Richman.
Bulletin 15	Soiling Steers, or Green v. Dry Food	J. W. Sanborn.
Bulletin 16	The Digestibility of Green and Dry Timothy	W. P. Cutter.
Bulletin 17	Feeding Root Crops v. Dry Food	J. W. Sanborn.
Bulletin 18	Notes on Forest and Fruit Trees	E. S. Richman.
Bulletin 19	Feeding Ensilage v. Dry Food	
Annual Report	Third Annual Report, 1892	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

UTAH STATION—Continued.

Publication.	Title.	Author.
1893.		
Bulletin 20	Report of Horticultural Department	E. S. Richman.
Bulletin 21	Feeding Ruminants on Grain Alone	J. W. Sanborn.
	Night v. Day Irrigation	
Bulletin 22	Grass v. Nongrass Fed Pigs; Exercise v. Nonexercise of Pigs.	Do.
	Value of Natural Waters for Crop Growth	W. P. Cutter.
Bulletin 23	Shelter of Stock; Exercise v. Nonexercise of Stock. Early v. Late Irrigation.	J. W. Sanborn.
Bulletin 24	Irrigation	Do.
Bulletin 25	Fruits; and Forest, Shade, and Ornamental Trees	E. S. Richman.
Bulletin 26	Subirrigation v. Surface Irrigation	J. W. Sanborn.
	Water for Irrigation	S. Fortier.
Annual Report	Fourth Annual Report, 1893	
1894.		
Bulletin 27	Early, Late, and Usual Irrigation	J. W. Sanborn.
Bulletin 28	The Value of Grass in the Production of Pork; Exercise v. Nonexercise for Pigs.	A. A. Mills.
Bulletin 29	Irrigation: Amount of Water to Use. Relative Feeding Values of Timothy, Lucern, and Wild Hay.	J. W. Sanborn.
Bulletin 30	Narrow v. Wide Nutritive Rations for Horses	Do.
Bulletin 31	Time to Harvest Lucern; Mulching	Do.
Bulletin 32	Roots and Plants of Farm Crops	Do.
Bulletin 33	Grazing Values of Varieties of Grass; Drilling v. Broadcasting Grass Seed.	Do.
Bulletin 34	Relative Value of Wheat, Peas, Corn, and Barley in the Production of Pork.	A. A. Mills.
Bulletin 35	The Value of Straw and Grain as a Substitute for Hay. Short Spring Periods of Grain Feeding; Relative Value of Ensilage, Roots, and Straw as Condiments; Value of Different Grain Rations.	Do.
Bulletin 36	Relative Value of Corn and Oats for Horses	Do.
Bulletin 37	Fruits and Fruit Trees; Ornamental, Forest, and Shade Trees.	E. S. Richman.
Annual Report	Fifth Annual Report, 1894	
1895.		
Bulletin 38	Preliminary Report on Seepage Water and the Underflow of Rivers.	S. Fortier.
Bulletin 39	Farm Irrigation	A. A. Mills.
	Orchard and Vineyard Irrigation	E. S. Richman.
Bulletin 40	The Economic Production of Pork	A. A. Mills.
Bulletin 41	Tuberculosis	W. Brewer.
Annual Report	Sixth Annual Report, 1895	
1896.		
Bulletin 42	Creaming Experiments	F. B. Linfield.
Bulletin 43	Dairy Herd Record for 1894–95; Winter Feeding Experiments with Dairy Cows; Some Suggestions on the Building and Equipment of Factories.	Do.
Bulletin 44	Alfalfa, or Lucern	A. A. Mills.
Bulletin 45	Experiments with Vegetables and Fruits	E. S. Richman.
Bulletin 46	Earthen Dams	S. Fortier.
Annual Report	Seventh Annual Report, 1896	
1897.		
Bulletin 47	The Climate of Utah	J. Dryden.
Bulletin 48	Alfalfa, or Lucern: Its Chemical Life History	J. A. Widtsoe.
Bulletin 49	Spraying	F. C. Sears.
Bulletin 50	The Water Supply of Cache Valley	S. Fortier.
Bulletin 51	Poultry Experiments	J. Dryden.
Annual Report	Eighth Annual Report, 1897	
1898.		
Bulletin 52	The Chemical Composition of Utah Soils	J. A. Widtsoe et al.
Bulletin 53	Utah Sugar Beets, 1897	J. A. Widtsoe.
Bulletin 54	Cattle Feeding: Comparison of Utah Feeding Stuffs	L. Foster and L. A. Merrill.
	Digestion Experiments with Lucern, Timothy, and Wheat Bran.	J. A. Widtsoe et al.
Bulletin 55	Orchard Pests	U. P. Hedrick.
Bulletin 56	Field Experiments with Wheat, Oats, and Barley	L. A. Merrill.
Bulletin 57	By-products of the Dairy	F. B. Linfield.
Bulletin 58	The Chemical Life History of Lucern, II	J. A. Widtsoe, J. Stewart et al.
Annual Report	Ninth Annual Report, 1898	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

UTAH STATION—Continued.

Publication.	Title.	Author.
1899.		
Bulletin 59	Utah Sugar Beets in 1898	J. Stewart.
Bulletin 60	Poultry Experiments	J. Dryden.
Bulletin 61	Alfalfa, or Lucern: The Cutting Time; Its Feeding Value	L. Foster and L. A. Merrill.

VERMONT STATION.

1887.		
Bulletin 1	Analysis of Fertilizers	W. W. Cooke.
Bulletin 2	....do	Do.
Bulletin 3	Analyses of Bone Meal	Do.
Bulletin 4	Experiments with New Fodder Plants	Do.
Annual Report	First Annual Report, 1887	
1888.		
Bulletin 5	Analyses of Fertilizers	Do.
Bulletin 6	....do	Do.
Bulletin 7	Conference on Acceptance of the Hatch Act	
Bulletin 8	Analyses of Fertilizers	Do.
Bulletin 9	Smut in Oats, Insecticides, and Fertilizer Analyses	Do.
Bulletin 10	New Organization	Do.
Bulletin 11	Cooperation in the Study of Insects	G. H. Perkins.
Bulletin 12	Insecticides; Seed Tests; Miscellaneous Analyses	W. W. Cooke.
Bulletin 13	Methods of Cutting and Planting Potatoes; Fertilizer Analyses.	Do.
Annual Report	Second Annual Report, 1888	
1889.		
Bulletin 14	Analyses of Fertilizers	Do.
Bulletin 15	Effect of Fertilizers on the Composition of Corn; Analysis of Hay.	Do.
Bulletin 16	Testing Milk at Creameries	
Bulletin 17	Test of Dairy Cows	Do.
Annual Report	Third Annual Report, 1889	
1890.		
Bulletin 18	Pig Feeding	Do.
Bulletin 19	Questions Concerning Injurious Insects	G. H. Perkins.
Bulletin 20	Fertilizer Analyses	W. W. Cooke.
Bulletin 21	A New Milk Test; Testing Milk at Creameries and Cheese Factories; Notes for the Laboratory.	
Bulletin 22	Test of Dairy Cows; Home v. Fair Grounds	J. L. Hills.
Annual Report	Fourth Annual Report, 1890	
1891.		
Bulletin 23	Analyses of Fertilizers	J. L. Hills.
Bulletin 24	Potato Blight and Rot	L. R. Jones.
Bulletin 25	The Bounty on Maple Sugar	W. W. Cooke.
Bulletin 26	Maple Sugar	W. W. Cooke and J. L. Hills.
Annual Report	Fifth Annual Report, 1891	
1892.		
Bulletin 27	Tests of Dairy Apparatus	J. L. Hills.
Bulletin 28	Plant Diseases	L. R. Jones.
Bulletin 29	Analyses of Fertilizers	J. L. Hills.
Bulletin 30	Results of the Bounty on Maple Sugar	W. W. Cooke and J. L. Hills.
Annual Report	Sixth Annual Report, 1892	
1893.		
Bulletin 31	Feeding Tests with Sugar Meal, Cream Gluten Meal, and Germ Feed.	W. W. Cooke.
Bulletin 32	Oat Smut	L. R. Jones.
Bulletin 33	Record of the Station Herd for the Year 1892	W. W. Cooke.
Bulletin 34	Analyses of Fertilizers	J. L. Hills.
Bulletin 35	....do	Do.
Bulletin 36	Potato Blights and their Remedies	L. R. Jones,
Bulletin 37	Annual Report of the Director, I	W. W. Cooke.
Bulletin 38	Annual Report of the Director, II	Do.
Bulletin 39	Annual Report of the Director, III	Do.
Bulletin 40	Spraying Potatoes	L. R. Jones.
Annual Report	Seventh Annual Report, 1893	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

VERMONT STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 41	Analyses of Commercial Fertilizers	J. L. Hills and B. O. White.
Bulletin 42	Bovine Tuberculosis	J. L. Hills and F. A. Rich.
Bulletin 43	Household Pests: Buffalo Beetle; Clothes Moths	G. H. Perkins.
Bulletin 44	Spraying Orchards and Potato Fields	L. R. Jones.
Annual Report	Eighth Annual Report, 1894	
1895.		
Bulletin 45	Analyses of Commercial Fertilizers	J. L. Hills and B. O. White.
Bulletin 46	do	Do.
Bulletin 47	Commercial Fertilizers	Do.
Bulletin 48	Gluten Feeds and Meals	J. L. Hills.
Bulletin 49	Potato Blights and Fungicides	L. R. Jones.
Annual Report	Ninth Annual Report, 1895	
1896.		
Bulletin 50	Analyses of Commercial Fertilizers	J. L. Hills and B. O. White.
Bulletin 51	do	Do.
Bulletin 52	do	J. L. Hills, B. O. White, and C. H. Jones.
Bulletin 53	The Pollination of Plums	F. A. Waugh.
Bulletin 54	Salad Plants and Plant Salads	Do.
Bulletin 55	Apple Growing in Grand Isle County	Do.
Annual Report	Tenth Annual Report, 1896	
1897.		
Bulletin 56	Orange Hawkweed, or "Paint Brush"	L. R. Jones and W. A. Orton.
Bulletin 57	Analyses of Commercial Fertilizers	J. L. Hills, B. O. White, and C. H. Jones.
Bulletin 58	do	Do.
Bulletin 59	do	Do.
Bulletin 60	Insects of the Year	G. H. Perkins.
Bulletin 61	Hardy Apples for Cold Climates	F. A. Waugh.
Annual Report	Eleventh Annual Report, 1897–98	
1898.		
Bulletin 62	Home-grown Grapes in Vermont	F. A. Waugh.
Bulletin 63	Analyses of Commercial Fertilizers	J. L. Hills, B. O. White, and C. H. Jones.
Bulletin 64	do	Do.
Bulletin 65	do	Do.
Bulletin 66	Club Root and Black Rot—Two Diseases of the Cabbage and Turnip.	L. R. Jones.
Bulletin 67	Hybrid Plums	F. A. Waugh.
1899.		
Bulletin 68	Inspections of Milk Tests and Feeding Stuffs	J. L. Hills.
Bulletin 69	Analyses of Commercial Fertilizers	J. L. Hills, C. H. Jones, and B. O. White.
Bulletin 70	do	Do.
Bulletin 71	do	Do.
Bulletin 72	Certain Potato Diseases and Their Remedies	L. R. Jones.

VIRGINIA STATION.

1889.		
Bulletin 1	Application of Fertilizers to Wheat	
Bulletin 2	Experiment Orchard; Small Fruits	W. B. Alwood.
Bulletin 3	Steer Feeding	D. O. Nourse.
	Meteorological Record	W. H. Reynolds.
1890.		
Bulletin 4	Tomatoes	W. B. Alwood and W. Bowman.
Bulletin 5	Notes on Feeding Stuffs	W. Bowman.
Bulletin 6	Variety Tests with Potatoes	W. B. Alwood and R. H. Price.
Bulletin 7	Variety Tests with Strawberries	W. B. Alwood
Annual Report	Annual Report, 1889–90	

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VIRGINIA STATION—Continued.

Publication.	Title.	Author.
1891.		
Bulletin 8	Potato Tests	W. B. Alwood.
Bulletin 9	Tomatoes	Do.
Bulletin 10	Steer and Pig Feeding	D. O. Nourse.
Bulletin 11	Vegetables	W. B. Alwood.
Annual Report	Annual Report, 1891	
1892.		
Bulletin 12	Tests of Fertilizers on Tobacco	
Bulletin 13	Antiseptic Treatment of Wounds; Infectious Abortion in Cows.	E. P. Niles.
Bulletin 14	Chemistry of the Tobacco Plant	R. J. Davidson.
Bulletin 15	Treatment of the Diseases of the Grape	W. B. Alwood.
Bulletin 16	Cooperative Corn Tests	D. O. Nourse.
Bulletin 17	Four Diseases of the Apple	W. B. Alwood.
Bulletin 18	Antiseptics in Relation to the Treatment of Wounds	E. P. Niles.
Bulletin 19	Test of Varieties of Wheat	D. O. Nourse.
Bulletin 20	A New Fodder Plant—*Lathyrus sylvestris*	E. A. Smyth, jr.
Bulletin 21	Test of Fertilizers on Wheat	D. O. Nourse.
Bulletin 22	Bush Fruits	W. B. Alwood.
Bulletin 23	Test of Fertilizers on Corn	D. O. Nourse.
Annual Report	Annual Report, 1892	
1893.		
Bulletin 24	Injurious Insects and Diseases of Plants, with Remedial Measures.	W. B. Alwood.
Bulletin 25	Dorset Horn Sheep	D. O. Nourse.
Bulletin 26	Tuberculosis and the Koch Test	E. P. Niles.
Bulletin 27	Strawberries	W. B. Alwood.
Bulletin 28	Tests of Varieties of Wheat	D. O. Nourse.
Bulletin 29	Tests of Fertilizers on Wheat	Do.
Bulletin 30	Grape Culture	W. B. Alwood.
Bulletin 31	Tests of Fertilizers on Corn	D. O. Nourse.
Bulletin 32	The Cow in Relation to Public Health	E. P. Niles.
Bulletin 33	Corn Husker and Fodder Cutter	D. O. Nourse.
Bulletin 34	Roads and Road Making	Do.
Bulletin 35	Fertilizer Tests on Grapes	A. L. Holladay.
Annual Report	Annual Report, 1893	
1894.		
Bulletin 36	The Horse's Teeth	E. P. Niles.
Bulletin 37	Strawberry Culture	W. B. Alwood.
Bulletin 38	Are All Birds of Prey Injurious to the Farmer?	E. A. Smyth, jr.
Bulletin 39	Tuberculosis	E. P. Niles.
Bulletin 40	Ripe Rot, or Bitter Rot, of Apples	W. B. Alwood.
Bulletin 41	Tests of Varieties of Wheat	D. O. Nourse.
Bulletin 42	Tests of Fertilizers on Wheat	Do.
Bulletin 43	Veterinary Materia Medica for Farmers	E. P. Niles.
Bulletin 44	Crimson Clover (*Trifolium incarnatum*)	D. O. Nourse.
Bulletin 45	Veterinary Materia Medica for Farmers, II	E. P. Niles.
Bulletin 46	Principles of Horseshoeing	Do.
Bulletin 47	Tests of Fertilizers on Wheat	D. O. Nourse.
Annual Report	Annual Report, 1894	
1895.		
Bulletin 48	Evaporating Apples	W. B. Alwood.
Bulletin 49	Pear Culture	Do.
Bulletin 50	Analyses of Parts of Tobacco Plant at Different Stages of Growth.	R. J. Davidson.
Bulletin 51	Analyses of Different Grades of Manufacturing Tobacco	Do.
Bulletin 52	Percentages of Nicotin in Tobacco	Do.
Bulletin 53	Silos and Silage	D. O. Nourse.
Bulletin 54	Shoeing for Special Purposes	E. P. Niles.
Bulletin 55	A Chemical Study of the Irish Potato: I. Analyses of the Tubers.	T. L. Watson.
Bulletin 56	A Chemical Study of the Irish Potato: II. Comparison of Tubers Grown in Different States.	Do.
Bulletin 57	The Utilization of Unmerchantable Apples	W. B. Alwood.
Bulletin 58	A New Plan for the Construction of a Storage Cellar	Do.
Bulletin 59	Experiment Garden Notes, I	Do.
Annual Report	Annual Report, 1895	
1896.		
Bulletin 60	Experiment Garden Notes, II	Do.
Bulletin 61	Splenetic or Texas Cattle Fever	E. P. Niles.
Bulletin 62	The San José, or Pernicious Scale	W. B. Alwood.
Bulletin 63	Laboratory Tests of Creolin as a Disinfectant	F. S. Roop.

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[Titles which have been changed from their original form are inclosed in brackets.]

VIRGINIA STATION—Continued.

Publication.	Title.	Author.
1896.		
Bulletin 64	Some Parasitical Diseases of Sheep	E. A. Smyth, jr., and E. P. Niles.
Bulletin 65	Notes on the Cherry Orchard	W. B. Alwood.
Bulletin 66	The Distribution of the San José Scale in Virginia	Do.
Bulletin 67	Notes on the Plum Orchard	Do.
Bulletin 68	Silage for Hogs	D. O. Nourse.
Bulletin 69	Tests of Fertilizers on Wheat	Do.
Bulletin 70	Cheap Silos in Virginia	Do.
Bulletin 71	An Experiment in Generating Vinegar	W. B. Alwood.
Annual Report	Annual Report, 1896	
1897.		
Bulletin 72	Notes on Treatment of San José Scale, with Directions for Winter Work.	Do.
Bulletin 73	Preservation of Corn Stover	D. O. Nourse.
Bulletin 74	Legislation for the Suppression of the San José Scale; Summer Treatment for the San José Scale.	W. B. Alwood.
Bulletin 75	Black Leg	E. P. Niles.
Bulletin 76	The Cattle Tick in Virginia	Do.
Bulletin 77	Tests of Fertilizers on Wheat	D. O. Nourse.
Bulletin 78	Virginia Marls	W. B. Ellett and A. T. Eskridge.
Bulletin 79	Inspection and Remedial Treatment of San José Scale	W. B. Alwood.
Bulletin 80	Silage for Horses	D. O. Nourse.
Bulletin 81	Grasses	E. A. Smyth, jr.
Bulletin 82	Meteorological Data and Bloom Notes of Fruits	W. B. Alwood and H. L. Priee.
Bulletin 83	Index to Preceeding Bulletins	
Annual Report	Annual Report, 1897	
1898.		
Bulletin 84	Dehorning	E. P. Niles.
Bulletin 85	Tetanus	C. McCulloch.
Bulletin 86	A Preliminary Study of Ticks	E. P. Niles.
Bulletin 87	Canine Distemper	C. McCulloch.
Bulletin 88	Growing Forest-Tree Seedlings	W. B. Alwood and J. L. Phillips.
Bulletin 89	Equine Distemper	C. McCulloch.
Bulletin 90	Blackleg Vaccine	E. P. Niles.
Bulletin 91	Variety Tests of Strawberries	W. B. Alwood and H. L. Priee.
Bulletin 92	The Influenee of Commereial Fertilizers upon the Quality of the Irish Potato.	R. J. Davidson.
Bulletin 93	Tests of Fertilizers on Wheat	D. O. Nourse.
Bulletin 94	The Experimental Vineyard—Second Report	W. B. Alwood.
Annual Report	Annual Report, 1898	

WASHINGTON STATION.

1891.		
Bulletin 1	Announcements	G. Lilley.
Annual Report	First Annual Report, 1891	
1892.		
Bulletin 2	Report of Farmers' Institute held at Colton, Washington	
Bulletin 3	Report of Farmers' Institute held at Garfield, Washington	
Bulletin 4	Wireworms	J. O'B. Scobey.
Bulletin 5	Report of Farmers' Institute held at Pomeroy, Washington	
Bulletin 6	Horticultural Information	E. R. Lake.
Annual Report	Second Annual Report, 1892	
1893.		
Bulletin 7	Two Injurious Insects	C. V. Piper.
Bulletin 8	Common Fungus Diseases and Methods of Prevention; Dodder.	Do.
Bulletin 9	Sugar Beets	E. Fulmer.
Bulletin 10	Wheats, Barleys, Oats, Peas, and Forage Crops	E. R. Lake.
	Review of the Weather and Crops in Washington for 1893	H. F. Alciatore.
Annual Report	Third Annual Report, 1893	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

WASHINGTON STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 11	Preliminary Report of a Feeding Test with Swine	E. R. Lake.
Bulletin 12	Forest-Tree Plantation	J. A. Balmer.
Bulletin 13	Washington Soils	E. Fulmer and C. Fletcher.
Bulletin 14	Silos and Ensilage	W. J. Spillman.
Annual Report	Fourth Annual Report, 1894	
1895.		
Bulletin 15	Sugar Beets in Washington	E. Fulmer.
Bulletin 16	Feeding Wheat to Hogs	W. J. Spillman.
Bulletin 17	Insect Pests of the Garden, Farm, and Orchard	C. V. Piper.
Bulletin 18	The Babcock Milk Test	W. J. Spillman.
Annual Report	Fifth Annual Report, 1895	
1896.		
Bulletin 19	Notes on the Crops of 1895	J. A. Balmer.
Bulletin 20	Fiber Flax in Washington	A. W. Thornton.
Bulletin 21	Susceptibility of Spermophiles to Pathogenic Bacteria	A. B. Kibbe.
Bulletin 22	Influenza	S. B. Nelson.
Bulletin 23	Some Notes Concerning the Nitrogen Content of Soils and Humus.	E. Fulmer.
Bulletin 24	The Acid Test for Milk and Cream	W. J. Spillman.
Bulletin 25	Pruning Orchard Trees	J. A. Balmer.
Bulletin 26	Experiments in the Culture of the Sugar Beet in Washington for 1895 and 1896.	E. Fulmer.
Annual Report	Sixth Annual Report, 1896	
1897.		
Bulletin 27	A Few Facts about Insects	R. W. Doane.
Bulletin 28	Clearing Land	F. A. Huntley.
Bulletin 29	Rational Stock Feeding	W. J. Spillman.
Bulletin 30	A Report on Damage to Fruit Trees Caused by the Severe Freeze of November 26–28, 1896.	J. A. Balmer.
Bulletin 31	Irrigation Experiments in Sugar-Beet Culture in the Yakima Valley.	E. Fulmer.
1898.		
Bulletin 32	Correction of Babcock Test for Cream; Effect of Richness of Cream on Acid Test.	W. J. Spillman.
Bulletin 33	Fiber Flax Investigations	F. A. Huntley.
Bulletin 34	The Russian Thistle in Washington	C. V. Piper.
Bulletin 35	Miscellaneous Injurious Insects	C. V. Piper and R. W. Doane.
Bulletin 36	Insects Injurious to Currants and Gooseberries	Do.

WEST VIRGINIA STATION.

1888.		
Bulletin 1	Organization and Work of Station	J. A. Myers.
Bulletin 2	The History, Properties, Source of the Ingredients, Mode of Application, and Uses of Commercial Fertilizers.	A. R. Whitehill.
Bulletin 3	Birds of West Virginia	W. D. Doan.
Annual Report	First Annual Report, 1888	
1889.		
Bulletin 4	The Creamery Industry: Its Adaptability to West Virginia.	A. C. Magruder.
Bulletin 5	The Selection of Milch Cows	Do.
Bulletin 6	Six Months' Experience in Running a Creamery; Improved Process of Handling Cream and Churning.	J. A. Myers.
Annual Report	Second Annual Report, 1889	
1890.		
Bulletin 7	Experiments upon Wheat, Fruit Trees, Garden Seeds, Grasses, Forage Crops, and Miscellaneous Subjects.	Do.
Bulletin 8	Summary of Meteorological Observations and Reports of Correspondents on Condition of Agriculture.	Do.
Bulletin 9	Additional Reports upon Wheat Distributed in 1889; Meteorological Report for July; Reports of Correspondents upon Meteorology and Crops for July.	Do.
Bulletin 10	Meteorological Report for August; Reports of Correspondents upon Meteorology and Crops for August.	Do.
Bulletin 11	Meteorological Report for September; Reports of Correspondents upon Meteorology and Crops for September.	Do.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

WEST VIRGINIA STATION—Continued.

Publication.	Title.	Author.
1890.		
Bulletin 12	The Canada Thistle	C. F. Millspaugh.
Special Bulletin	Potash and Paying Crops	
Annual Report	Third Annual Report, 1890	
1891.		
Bulletin 13	The Creamery Industry	J. A. Myers.
Bulletin 14	Farm and Garden Insects; Notes of the Season	A. D. Hopkins.
Bulletin 15	Raspberry Gouty-Gall Beetle	Do.
Bulletin 16	Forest and Shade-Tree Insects; Yellow Locusts	Do.
Bulletin 17	Forest and Shade-Tree Insects; Black Spruce	Do.
Bulletin 18	Commercial Fertilizers	J. A. Myers.
Bulletin 19	Your Weeds and Your Neighbors, I	C. F. Millspaugh.
Annual Report	Fourth Annual Report, 1891	
1892.		
Bulletin 20	Potato Culture and Fertilization; Tests of Varieties of Tomatoes.	D. D. Johnson.
Bulletin 21	Injurious Insects and Plant Diseases	A. D. Hopkins and C. F. Millspaugh.
Bulletin 22	Your Weeds and Your Neighbors, II	C. F. Millspaugh.
Bulletin 23	Your Weeds and Your Neighbors, III	Do.
Bulletin 24	Flora of West Virginia	Do.
Bulletin 25	Plat Experiments with Commercial Fertilizers on Wheat	D. D. Johnson.
Bulletin 26	Law and Regulations Concerning Sale of Commercial Fertilizers in the State of West Virginia; Analyses.	
Bulletin 27	Notes on Pruning	F. W. Rane.
Bulletin 28	Plat Experiments with Commercial Fertilizers on Corn	D. D. Johnson.
Annual Report	Fifth Annual Report, 1892	
1893.		
Bulletin 29	Experiments on Potatoes at the Station; Experiments on Corn at the Outstations.	Do.
Bulletin 30	Sheep	A. D. Hopkins.
Bulletin 31	Catalogue of West Virginia Scolytidæ and their Enemies	Do.
Bulletin 32	West Virginia Forest and Shade Tree Insects	A. D. Hopkins.
Bulletin 33	Subirrigation in the Greenhouse	F. W. Rane.
Bulletin 34	Fertilizer Analyses for the Year Ending December 31, 1893.	R. J. J. De Roode.
Special Bulletin	Fertilizers	J. A. Myers.
Annual Report	Sixth Annual Report, 1893	
1894.		
Bulletin 35	Defects in Wood Caused by Insects	A. D. Hopkins.
Bulletin 36	Black Holes in Wood	Do.
Bulletin 37	Electro-Horticulture: Incandescent Lamps	F. W. Rane.
Bulletin 38	Potatoes: Potato Blight; Potato Scab	Do.
Special Bulletin	Fertilizer Analyses	R. J. J. De Roode.
Special Bulletin	do	R. J. J. De Roode et al.
Special Bulletin 2	Celebration upon the Completion of the Station Building	
Annual Report	Seventh Annual Report, 1894	
1895.		
Bulletin 39	Vegetables	F. W. Rane.
Bulletin 40	Commercial Fertilizers	B. H. Hite.
Special Bulletin	Fertilizer Analyses	J. A. Myers.
Annual Report	Eighth Annual Report, 1895	
1896.		
Bulletin 41	Potatoes	L. C. Corbett.
Bulletin 42	Vegetables	Do.
Bulletin 43	Why, When, What, and How to Spray	Do.
Bulletin 44	Practical Entomology: Insects Injurious to Farm and Garden Crops; the Character of the Injury; the Insect Causing it; the Remedy.	A. D. Hopkins and W. E. Rumsey.
Bulletin 45	Chickens	J. A. Myers.
Bulletin 46	Fertilizer Analyses	B. H. Hite.
Bulletin 47	Apples	L. C. Corbett.
Bulletin 48	Raspberries	Do.
Special Bulletin	Fertilizer Analyses	B. H. Hite.
Annual Report	Ninth Annual Report, 1896	
1897.		
Bulletin 49	Vegetables	L. C. Corbett.
Special Bulletin	Fertilizers	B. H. Hite and T. F. Watson.
Annual Report	Tenth Annual Report, 1897	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

WEST VIRGINIA STATION—Continued.

Publication.	Title.	Author.
1898.		
Bulletin 50	The Periodical Cicada in West Virginia	A. D. Hopkins.
Bulletin 51	Commercial Fertilizers	B. H. Hite.
Bulletin 52	Strawberries	L. C. Corbett.
Bulletin 53	Commercial Fertilizers	J. H. Stewart and B. H. Hite.
Folio	Spray Calendar	L. C. Corbett.
Special Bulletin	Fertilizers	B. H. Hite.
Annual Report	Eleventh Annual Report, 1898	
1899.		
Bulletin 54	Nursery Hints	L. C. Corbett.
Bulletin 55	Sugar Beet Investigation in 1898	J. H. Stewart and B. H. Hite.
Bulletin 56	Report on Investigations to Determine the Cause of Unhealthy Conditions of the Spruce and Pine from 1880–1893.	A. D. Hopkins.
Bulletin 57	Commercial Fertilizers	B. H. Hite and T. F. Watson.
Bulletin 58	The Effect of Pressure in the Preservation of Milk	B. H. Hite.
Bulletin 59	Whole Corn Compared with Corn Meal for Fattening Hogs.	J. H. Stewart and H. Atwood.
Bulletin 60	Poultry Experiments	Do.

WISCONSIN STATION.

1883.		
Bulletin 1	Sweet Skim Milk: Its Value as Food for Pigs and Calves	
Annual Report	First Annual Report, 1883	
1884.		
Bulletin 2	Amount and Condition of Seed Corn in Wisconsin	
Bulletin 3	Composition and Digestibility of Fodders	
Bulletin 4	Experiments on Milk Production	
Annual Report	Second Annual Report, 1884	
1885.		
Bulletin 5	Analyses of Feeding Stuffs	
Bulletin 6	Experiments on Calf Feeding	W. A. Henry.
	Analyses of Fertilizers	H. P. Armsby.
Bulletin 7	Experiments on Calf Feeding	W. A. Henry.
	The Cooley System of Creaming Milk	H. P. Armsby.
Bulletin 8	Oil Meal v. Corn Meal for Milk	Do.
Annual Report	Third Annual Report, 1885	
1886.		
Bulletin 9	Report on Oats, Potatoes, and Corn for 1885	W. A. Henry.
Bulletin 10	Tests of Dairy Cows	H. P. Armsby.
Annual Report	Fourth Annual Report, 1886	
1887.		
Bulletin 11	Report on Wheat, Oats, Barley, Potatoes, and Corn for 1886	
Bulletin 12	The Oil Test for Cream	H. P. Armsby and F. G. Short.
1888.		
Bulletin 13	Report on Wheat, Oats, Barley, Corn, and Potatoes for 1887	L. H. Adams.
	The Station Vineyard	W. A. Henry.
Bulletin 14	Artificial Fertilizers and Land Plaster	S. M. Babcock.
Bulletin 15	Ensilage v. Corn Fodder for Milk Production	F. W. Woll.
Bulletin 16	A New Method for Determining Fat in Milk	F. G. Short.
Bulletin 17	Report on Corn, Oats, Barley, and Potatoes	L. H. Adams.
	Grape Growing	W. A. Henry.
Annual Report	Fifth Annual Report, 1888	
1889.		
Bulletin 18	The Constitution of Milk and Some of the Conditions which Affect the Separation of Cream.	S. M. Babcock.
Bulletin 19	Notes on Ensilage	W. A. Henry, L. H. Adams, and F. G. Short.
Bulletin 20	Noxious Weeds of Wisconsin	E. S. Goff.
Bulletin 21	Comparative Value of Warm and Cold Water for Milch Cows in Winter.	F. H. King.
Annual Report	Sixth Annual Report, 1889	

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

WISCONSIN STATION—Continued.

Publication.	Title.	Author.
1890.		
Bulletin 22	Oats and Barley	L. H. Adams.
	Potatoes	E. S. Goff.
Bulletin 23	Prevention of Apple Scab	Do.
Bulletin 24	A New Method for the Estimation of Fat in Milk, Especially Adapted to Creameries and Cheese Factories.	S. M. Babcock.
Bulletin 25	Feeding Bone Meal and Hard-Wood Ashes to Hogs Living on Corn.	W. A. Henry.
Annual Report	Seventh Annual Report, 1890	
1891.		
Bulletin 26	Sugar-Beet Culture in Wisconsin	W. A. Henry and F. W Woll.
Bulletin 27	The Feeding Value of Whey	W. A. Henry.
Bulletin 28	The Construction of Silos	F. H. King.
Bulletin 29	Creaming Experiments	S. M. Babcock.
Annual Report	Eighth Annual Report, 1891	
1892.		
Bulletin 30	Sugar-Beet Experiments, 1891	F. W. Woll.
Bulletin 31	Notes on the Use of the Babcock Test and the Lactometer.	S. M. Babcock.
Bulletin 32	Feeding Grain to Lambs	J. A. Craig.
Bulletin 33	Rations for Dairy Cows	F. W. Woll.
Annual Report	Ninth Annual Report, 1892	
1893.		
Bulletin 34	Preventive Treatment for Apple Scab, Downy Mildew, and Brown Rot of Grape, Potato Blight, and Smut of Wheat and Oats.	E. S. Goff.
Bulletin 35	Insects and Diseases Injurious to Cranberries	Do.
Bulletin 36	Directions for Using the Babcock Milk Test and the Lactometer.	S. M. Babcock.
Bulletin 37	The Russian Thistle	E. S. Goff.
Annual Report	Tenth Annual Report, 1893	
1894.		
Bulletin 38	One Hundred American Rations for Dairy Cows	F. W. Woll.
Bulletin 39	Noxious Weeds	E. S. Goff.
Bulletin 40	Tuberculosis and the Tuberculin Test	H. L. Russell.
Bulletin 41	Grain Feeding Lambs for Market	J. A. Craig.
Bulletin 42	Destructive Effects of Winds on Sandy Soils and Light Sandy Loams, with Methods for Protection.	F. H. King.
Annual Report	Eleventh Annual Report, 1894	
1895.		
Bulletin 43	The Agricultural Possibilities of Douglas County and Northwest Wisconsin.	Do.
	Horticultural Possibilities of Northwest Wisconsin	E. S. Goff.
	Dairy and Sheep Farming at Superior	J. A. Craig.
Bulletin 44	Pasteurization of Milk and Cream for Direct Consumption.	H. L. Russell.
Bulletin 45	Apple Culture: Notes and Data from 172 Orchards	E. S. Goff.
Bulletin 46	Power Tests of Centrifugal Cream Separators	A. W. Richter.
Bulletin 47	Wisconsin's Fertilizer Law	W. A. Henry.
Annual Report	Twelfth Annual Report, 1895	
1896.		
Bulletin 48	The Conn Culture (B 41) in Butter Making	E. H. Farrington and H. L. Russell.
Bulletin 49	The Maintenance of Soil Fertility: Commercial Fertilizers.	F. W. Woll.
Bulletin 50	The Hot-Water Treatment for the Prevention of Smut on Oats, Wheat, and Barley.	E. S. Goff.
Bulletin 51	The Marls of Wisconsin	F. W. Woll.
Bulletin 52	A Comparison of the Babcock Test and the Gravimetric Method of Estimating Fat in Skim Milk; The Alkaline Tablet Test of Acidity in Milk or Cream.	E. H. Farrington.
Bulletin 53	Analyses of Licensed Commercial Fertilizers	F. W. Woll.
Bulletin 54	The Restoration of the Consistency of Pasteurized Cream	S. M. Babcock and H. L. Russell.
Annual Report	Thirteenth Annual Report, 1896	
1897.		
Bulletin 55	Beet-Sugar Production: Possibilities for a New Industry in Wisconsin.	W. A. Henry.
Bulletin 56	Statistics from Fifty-two Wisconsin Separator Creameries	E. H. Farrington.
Bulletin 57	Analyses of Licensed Fertilizers	F. W. Woll.
Bulletin 58	The Rape Crop: Its Growth and Value for Soiling and Fattening Sheep and Swine.	J. A. Craig.

Publications of the Agricultural Experiment Stations of the United States, 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

WISCONSIN STATION—Continued.

Publication.	Title.	Author.
1897.		
Bulletin 59	The Construction of Silos and the Making and Handling of Silage.	F. H. King.
Bulletin 60	The Cheese Industry: Its Development and Possibilities in Wisconsin.	S. M. Babcock and H. L. Russell.
Bulletin 61	The Constitution of Milk with Especial Reference to Cheese Production.	S. M. Babcock.
Bulletin 62	Tainted or Defective Milks: Their Causes and Methods of Prevention.	H. L. Russell.
Bulletin 63	The Culture of Native Plums in the Northwest	E. S. Goff.
Annual Report	Fourteenth Annual Report, 1897	
1898.		
Bulletin 64	Sugar-Beet Investigations in Wisconsin During 1897	F. W. Woll.
Bulletin 65	A Bacterial Rot of Cabbage and Allied Plants	H. L. Russell.
Bulletin 66	Analyses of Licensed Commercial Fertilizers	F. W. Woll.
Bulletin 67	Factory Tests for Milk	S. M. Babcock, H. L. Russell, and J. W. Decker.
Bulletin 68	One Year's Work Done by a Sixteen-foot Geared Windmill.	F. H. King.
Bulletin 69	Pasteurization as Applied to Butter Making	E. H. Farrington and H. L. Russell.
Annual Report	Fifteenth Annual Report, 1898	
1899.		
Bulletin 70	Construction of Cheese-Curing Rooms for Maintaining Temperatures of 58° to 68° F.	F. H. King.
Bulletin 71	Sugar-Beet Investigations in Wisconsin during 1898	F. W. Woll.
Bulletin 72	Small Fruits in 1898	E. S. Goff.
Bulletin 73	Analyses of Licensed Commercial Fertilizers, 1899	F. W. Woll and A. Vivian.
Bulletin 74	A Study of Dairy Salt	F. W. Woll.
Bulletin 75	Testing Cows at the Farm	E. H. Farrington.
Bulletin 76	Noxious Weeds of Wisconsin	E. S. Goff.
Bulletin 77	Effects of the February Freeze of 1899 Upon Nurseries and Fruit Plantations in the Northwest.	Do.
Bulletin 78	The History of a Tuberculous Herd of Cows	H. L. Russell.

WYOMING STATION.

1891.		
Bulletin 1	The Organization and Proposed Work of the Station	D. McLaren.
Bulletin 2	Plant Lice	F. J. Niswander.
Bulletin 3	The Sugar Beet in Wyoming	D. McLaren and E. E. Slosson.
Bulletin 4	Meteorology for 1891	B. C. Buffum.
Annual Report	First Annual Report, 1891	
1892.		
Bulletin 5	Best Varieties and Breeds for Wyoming	D. McLaren and B. C. Buffum.
Bulletin 6	Soils of the Agricultural Experiment Farms	J. D. Conley and E. E. Slosson.
Bulletin 7	Insecticides	F. J. Niswander.
Bulletin 8	Irrigation and Duty of Water	B. C. Buffum.
Bulletin 9	Sugar Beets in 1892	E. E. Slosson.
Bulletin 10	Meteorology for 1892	B. C. Buffum.
Annual Report	Second Annual Report, 1892	
1893.		
Bulletin 11	Crop Reports for 1892	A. A. Johnson and F. J. Niswander.
Bulletin 12	Ground Squirrels (Gophers)	F. J. Niswander.
Bulletin 13 *a*	The Feeding and Management of Cattle	W. A. Henry and A. A. Johnson.
Bulletin 14	Geology of Wyoming Experimental Farm and Notes on Mineral Resources of the State.	W. C. Knight.
Bulletin 15	The Winterkilling of Trees and Shrubs	A. Nelson.
Bulletin 16	Grasses and Forage Plants	B. C. Buffum.
Annual Report	Third Annual Report, 1893	

a Reprinted from United States Department of Agriculture, Bureau of Animal Industry, Special Report on Diseases of Cattle

Publications of the Agricultural Experiment Stations of the United States. 1875–1899—Continued.

[Titles which have been changed from their original form are inclosed in brackets.]

WYOMING STATION—Continued.

Publication.	Title.	Author.
1894.		
Bulletin 17	Crop Report for 1893. Cost and Profit of Growing Wheat. Garden Vegetables, and Tobacco. Progress Report on Fruits and Trees. Meteorology for 1893.	B. C. Buffum.
	Sugar Beets in 1893	E. E. Slosson.
Bulletin 18	The Reclamation of Arid Lands. The Harvey Water Motor.	A. A. Johnson.
Bulletin 19	Squirrel-Tail Grass	A. Nelson.
Bulletin 20	The Artesian Wells of Southern Wyoming: Their History and Relation to Irrigation.	J. D. Conley.
Annual Report	Fourth Annual Report, 1894	
1895.		
Bulletin 21	The Grain Smuts and Potato Scab	A. Nelson.
Bulletin 22	Onions. Crop Report, 1894. Cost and Profit of Growing Wheat. Small Fruits at Laramie.	B. C. Buffum.
Bulletin 23	Notes on Climate	J. D. Conley.
Bulletin 24	Water Analyses	E. E. Slosson.
Bulletin 25	Results of Three Years' Experiments in Cost and Profit of Growing Wheat.	B. C. Buffum.
Bulletin 26	Garden Peas	Do.
Index Bulletin A	Index to First Twenty-six Bulletins of the Station	G. R. Hebard.
Annual Report	Fifth Annual Report, 1895	
1896.		
Bulletin 27	Meteorology for 1895, and Notes on Climate from 1891 to 1896.	J. D. Conley.
Bulletin 28	First Report on the Flora of Wyoming	A. Nelson.
Bulletin 29	Alkali: Some Observations and Experiments	B. C. Buffum.
Bulletin 30	Stock-Feeding Experiments at Lander	Do.
Bulletin 31	The Worst Weeds of Wyoming, and Suggested Weed Legislation.	A. Nelson.
Annual Report	Sixth Annual Report, 1896	
1897.		
Bulletin 32	Potatoes	B. C. Buffum.
Bulletin 33	The Composition of Prepared Cereal Foods	E. E. Slosson.
Bulletin 34	Fruit Growing in Wyoming	B. C. Buffum.
Bulletin 35	Mechanical Analysis and Water Content of Wyoming Soils.	C. B. Ridgaway.
Annual Report	Seventh Annual Report, 1897	
1898.		
Bulletin 36	Wyoming Sugar Beets	E. E. Slosson.
Bulletin 37	Stooling of Grains	B. C. Buffum.
Bulletin 38	Cultivated Shade and Forest Trees	Do.
Bulletin 39	Alkali Studies, II	E. E. Slosson.
Annual Report	Eighth Annual Report, 1898	
1899.		
Bulletin 40	The Trees of Wyoming and How to Know Them	A. Nelson.
Annual Report	Ninth Annual Report, 1899	

THE CARD INDEX OF EXPERIMENT STATION LITERATURE.

United States Department of Agriculture, Office of Experiment Stations.

GENERAL PLAN OF THE INDEX.

The general plan on which the index is constructed may be briefly outlined as follows:

The subjects with which agricultural science deals have been grouped under a limited number of general topics. These topics have been divided and subdivided only so far as seemed necessary to facilitate references to the individual entries of the index. As the work of the stations reaches out in many directions into the domain of pure as distinguished from applied science, a section of the index has been set apart for entries relating to the general principles of the various sciences which lie at the foundation of experimental investigations in agriculture. This affords a wide opportunity for the extension of the index by individual students for their own special purposes.

The index is printed on cards of a standard library size. The divisions and subdivisions are arranged on a decimal system and are plainly indicated by the use of division cards of different colors.

Each index card contains the title of an article, the name of its author, a reference to the publication in which it appeared and to the Experiment Station Record, and a condensed statement of its contents. At the upper right-hand corner of the card is a number indicating under what head the card should be placed in the index The order in which the cards are arranged is indicated at the lower left-hand corner.

A key to the index, containing the system of classification, is sent with the first installment of cards.

One copy of the index is sent without charge to each of the agricultural colleges and experiment stations and the State boards and commissioners of agriculture. Besides this free distribution the office is prepared, under the authority of the law, to furnish a limited number of sets of the index at a price only sufficient to cover additional cost of printing. This is estimated at $2 per thousand cards. For the division cards an additional charge of $1.25 is made.

KEY TO THE INDEX.

1. GENERAL SCIENCES:

(Including only such general subjects as can not be conveniently indexed under the categories directly relating to agricultural and economic investigations.)

.1 Physics.
.2 Chemistry.
.01 Physical.
.02 Inorganic.
.03 Organic.
.04 Physiological.
.05 Technical.
.06 Analytical.
.001 Methods.
.002 Analyses.
.3 Mineralogy. Geology.
.4 Botany.
.01 Systematic.
.02 Physiological.
.03 Variations in plants.
.001 Crossing (including hybridization).
.002 Acclimatization.
.04 Distribution of plants.

1. GENERAL SCIENCES—Continued.
   .5 FERMENTATION. BACTERIOLOGY.
   .6 ANIMAL PHYSIOLOGY.
   .7 ZOOLOGY.
      (Including comparative anatomy and distribution of fauna.)
   .8 METEOROLOGY. CLIMATOLOGY.
2. AIR AND WATER:
   .1 PHYSICS.
   .2 CHEMISTRY.
   .3 METHODS OF INVESTIGATION.
3. SOILS:
   .1 HISTORY AND CLASSIFICATION.
   .2 PHYSICS.
   .3 CHEMISTRY.
   .4 TILLAGE.
   .5 RECLAMATION AND RENOVATION.
   .6 METHODS OF INVESTIGATION.
4. FERTILIZERS:
   .1 HISTORY, NATURE, USES.
   .2 FARM MANURES.
      (Animal and green manures, composts, etc.)
   .3 COMMERCIAL FERTILIZERS.
   .4 EXPERIMENTS.
   .5 INSPECTION (laws, methods).
      (For action of fertilizers on soils, see SOILS, physics and chemistry. For fertilizers for special crops, see FIELD CROPS, manuring. For methods of analysis, see CHEMISTRY, analytical.)
5. PLANTS:
   .1 FIELD CROPS.
      (Cereals, textile crops, forage plants, potatoes, root crops, sugar beets, sugar cane, sorghum, tobacco, etc.)
      .01 History and uses.
      .02 Species, varieties (including crosses and hybrids).
      .03 Composition.
      .04 Culture (planting, cultivation, harvesting, etc.).
      .05 Manuring (see also FERTILIZERS, experiments).
      .06 Curing and storage.
      .07 Rotation.
   .2 HORTICULTURE.
      .01 Vegetables.
      .02 Orchard fruits.
      .03 Small fruits.
      .04 Grapes.
      .05 Nuts.
      .06 Ornamental horticulture.
   .3 FORESTRY.
   .4 SEEDS.
   .5 WEEDS.
   .6 DISEASES OF PLANTS.
      .01 Parasitic.
         .001 Diseases due to vegetable organisms (fungi, bacteria, etc.)—Economic mycology.
         .002 Diseases due to animal organisms.
            (For diseases due to insects, see ENTOMOLOGY.)
      .02 Nonparasitic.
      .03 Remedies—Fungicides, fungicide appliances, etc.

6. FOODS:

(Including animal and vegetable substances used for food for domestic animals and man.)

.1 Composition and valuation.

.2 Nutritive values.

(Including digestibility and potential energy.)

.3 Preparation and use.

.4 Food accessories, condiments.

.5 Beverages.

.6 Adulterations.

.7 Preservation.

(For methods of analysis, see Chemistry, analytical. For methods of feeding, see Animal production. For functions in nutrition, see Animal physiology.)

7. ANIMALS:

.1 History and general principles.

.2 Breeds and breeding.

.3 Animal production.

.01 Cattle raising.

.02 Dairy farming.

.03 Sheep husbandry.

.04 Swine husbandry.

.05 Horse and mule husbandry.

.06 Aviculture.

.07 Fish culture, oyster culture, etc.

.4 Diseases. Veterinary science.

8. ENTOMOLOGY:

.1 Beneficial insects.

.01 Apiculture.

.02 Sericulture.

.2 Injurious insects.

.01 Insects affecting animals.

.02 Insects affecting plants.

.03 Repression—Insecticides, insecticide appliances, etc.

.3 Insect parasites and diseases.

9. DAIRYING:

(Deals with milk after it is drawn from the animal. For feeding and care of animals, see Animal production, dairy farming.)

.1 History and general principles.

.2 Composition and properties of milk and its products.

.3 Changes in milk.

.01 Fermentative changes (bacteria, etc.).

.02 Creaming of milk.

.4 Handling of milk (milk supply).

.5 Inspection (laws, methods).

.6 Butter making, creameries.

.7 Cheese making, cheese factories.

10. TECHNOLOGY:

.1 Milling.

.2 Starch and sugars.

.3 Liquors.

.4 Fats, oils.

.5 Dyes and tanning.

.6 Textiles.

11. AGRICULTURAL ENGINEERING:
    .1 Properties of materials.
    .2 Drainage.
    .3 Irrigation.
    .4 Farm implements.
    .5 Roads and bridges.
    .6 Fences.
    .7 Farm buildings.
12. STATISTICS:
    (Agricultural schools and stations.)
    .1 History and organization.
    .2 Legislation.
    .3 Equipment.
        .01 Apparatus.
        .02 Buildings.
        .03 Farms.
        .04 Implements.
        .05 Live stock.
    .4 Finances.
    .5 Bibliography.
13. MISCELLANEOUS:
    .1 Rural economy.
    .2 Agricultural statistics.

N. B.—The index is arranged on a decimal system, the number on the card before the decimal point representing one of the grand divisions of the index and the numbers after the decimal point representing subdivisions of the several grades. Thus on a card numbered 12.34; 12=Statistics, .3=Equipment, .04=Implements. A card numbered 1.432 belongs under acclimatization (of plants); 3.3, chemistry of soils; 9.32, creaming of milk.

SPECIMEN CARDS.

Phosphoric Acid, Volumetric Estimation.—B. W. Kilgore. 1.261

North Carolina Bul. No. 140, May, 1897, pp. 123–128 (E. S. R., vol. 9, p. 416).

This is an account of comparative tests of the Pemberton method as modified by Kilgore and others on North Carolina, South Carolina, Florida, Tennessee, and Pennsylvania phosphates, cotton-seed meal, tankage, sodium phosphate, aluminum phosphate, Thomas slag, bone meal, acid phosphate, and mixed fertilizers, to determine the accuracy of the method as applied to substances of widely varying composition, and to ascertain the amount of washing necessary to free the yellow precipitate from acid. The method gave as good results as the gravimetric method on all the samples analyzed. Reprinted in the report of the station for 1897–98, p. 75.

18198

Cheese Making, Losses in. 9.7

Vermont Report for 1891, pp. 95–100 (E. S. R., vol. 4, p. 493).

The losses in a three days' test of cheese making were determined. The mechanical loss was found to be very slight, the main source of loss being the whey and the drippings from the cheese press. About 90.5 per cent of the fat and 97 per cent of the casein in milk were recovered in the cheese. The percentages of the whole amount of the milk ingredients which appear in the cheese, the whey, and the drippings are estimated. The changes in cheese in ripening are mentioned.

3438

Corn, Planting at Different Dates.—E. Davenport and W. J. Fraser. 5.14

Illinois Bul. No. 42, Mar., 1896, pp. 173–175, 179 (E. S. R., vol. 7, p. 945).

Results of experiments in continuation of those reported in Bulletin 37 of the station (see card). Nine plantings of the same variety of corn were made one week apart between April 22 and June 17. Medium plantings gave the highest yields.

15722

Aspidiotus perniciosus, Notes.—F. L. Washburn. 8.22

Oregon Bul. No. 18, Mar., 1892, pp. 3, 4, fig. 1 (E. S. R., vol. 3, p. 889).

A popular account of the San José scale, with suggestions as to remedies.

8806

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CATALOGUE OF THE COLLECTIVE EXHIBIT OF THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES AT THE PARIS EXPOSITION OF 1900.

The agricultural experiment stations in the United States will be represented at the Paris Exposition of 1900 by a collective exhibit prepared by a committee of the Association of American Agricultural Colleges and Experiment Stations. The members of this committee are H. P. Armsby, director of the Pennsylvania Experiment Station, chairman; W. H. Jordan, director of the New York State Experiment Station; A. W. Harris, president of the University of Maine; M. A. Scovell, director of the Kentucky Experiment Station; and A. C. True, Director of the Office of Experiment Stations. The exhibit has been prepared in cooperation with the United States Department of Agriculture, through the Office of Experiment Stations, and illustrates the methods and results of the work of the stations and of the Office of Experiment Stations by means of objects, charts, photographs, and publications arranged to show the main features of the experiment-station enterprise in this country rather than the work of the individual stations.

OBJECTS.

Soil apparatus.—Electric devices for determining the salt content, temperature, and moisture of soils, with samples illustrative of typical agricultural soils of the United States. Exhibit of Division of Soils, United States Department of Agriculture.

Soil elutriator.—For the mechanical analysis of soils. Designed by Dr. E. W. Hilgard. Exhibit of California Station.

California agricultural soils.—Six typical agricultural soils of the State, with samples showing results of mechanical analysis of each. Exhibit of California Station.

Soil map of California.—Showing the distribution of various soil areas throughout the State. Exhibit of California Station.

Gas desiccator.—For use in drying gases in various experiments. Designed by Prof. S. W. Johnson. Exhibit of Connecticut State Station.

Auxanometer.—For determining the rate of plant growth. Designed by Prof. L. C. Corbett. Exhibit of West Virginia Station.

Transpiration apparatus.—For determining the rate of transpiration of plants. Designed by Prof. L. C. Corbett. Exhibit of West Virginia Station.

Centrifuge.—For ascertaining the effect of gravity and centrifugal force upon germinating seeds. Designed by Dr. J. C. Arthur. Exhibit of Indiana Station.

Vegetable proteids.—A collection of chemically pure proteids separated from the seeds of various plants. Arranged by Dr. T. B. Osborne. Exhibit of Connecticut State Station.

Root cages.—Showing the distribution of the roots of maize, wheat, flax, and brome grass. Exhibit of North Dakota Station.

Distribution of roots in soil.—Illustration showing the distribution in the soil of the roots of maize, clover, apple trees, raspberries, strawberries, etc. Exhibit of Wisconsin Station.

Crosses of cotton.—Seventy-two selected and cross-bred varieties of cotton. Exhibit of Alabama College Station.

Saltbush.—A forage plant that has proved to be of value for growing on strongly alkaline soils. Exhibit of California Station.

Fruit and vegetable models.—Models of sweet potatoes, peppers, apples, and plums, illustrating varietal differences. Exhibit of Iowa and Minnesota Stations.

Olive exhibit.—Fifty samples of olive oils and more than 200 samples of olive pits used in the classification of varieties of olives. Exhibit of California Station.

Winter protection of peach trees.—Showing the effect of whitening trees in retarding their development in the spring. Exhibit of Missouri Station.

Weed seeds.—Specimens of the seeds of 100 common weeds in the United States. Arranged by Dr. B. D. Halsted. Exhibit of New Jersey Stations.

Leaf-spot diseases.—Showing 18 leaf-spot diseases. Exhibit of Massachusetts Station.

Insect cabinet.—Designed by Prof. C. W. Woodworth. Exhibit of California Station.

Respiration and bomb calorimeters.—Exhibit of Connecticut Storrs Station.

Animal and vegetable fats.—Samples of a number of animal and vegetable fats. Exhibit of Missouri Station.

Meat models.—Ten models and 8 photographs showing the effect of ration on the production of lean and fat meat, as shown by experiments conducted at the Kansas, Iowa, Wisconsin, and New York Cornell stations. Exhibit of the committee on the collective exhibit.

Sheep crossing.—Effect of crossing different races of sheep on wool production. Exhibit of Missouri Station.

Age of hens.—Showing effect of age of hens on egg production. Exhibit of Utah Station.

Columbian dairy test records.—Exhibit of committee conducting the test.

Dairy bacteria.—Forty-eight cultures of bacteria isolated from various dairy products. Prepared by Dr. H. W. Conn. Exhibit of Connecticut Storrs Station.

Overflow pipette and Scovell milk-sampling tube.—Exhibit of Kentucky Station.

Babcock milk-testing machine.—The original machine, as designed by Dr. S. M. Babcock in 1888. Exhibit of Wisconsin Station.

Facile milk tester and accessories.—A modified form of the Babcock machine. Exhibit of Wisconsin Station.

Russian Babcock machine and accessories.—A modified form of the Babcock machine. Exhibit of Wisconsin Station.

Milk test glassware.—Accessories to other apparatus. Exhibit of Wisconsin Station.

Minor dairy apparatus.—Consists of the Swiss acid bottle and of apparatus for the Wisconsin curd test and the Marshall Rennet test. Exhibit of Wisconsin Station.

Milk pressure apparatus.—For the preservation of milk by pressure. Exhibit of West Virginia Station.

Cheese models.—Designed to show size of cheese made from equal quantities of milk, but of different fat content. Exhibit of New York State Station.

Wine cooler.—Designed for the rapid cooling of wines in process of manufacture. Exhibit of California Station.

Drawings of wine vat and cooler.—Exhibit of California Station.

Water register.—Office of Experiment Stations water register used in measuring the amount of water flowing through streams, flumes, and ditches. Designed by Prof. Elwood Mead. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Current meter.—Used in measuring rate of water flow in streams, ditches, flumes, etc. Designed by Prof. Elwood Mead. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Hydrophore.—Used in irrigation investigations to determine the amount of silt carried by water. Designed by Prof. Elwood Mead. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Wyoming nilometer.—Used in measuring the amount of water passing through streams, flumes, and ditches. Designed by Prof. Elwood Mead. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Irrigation pipe.—Three specimens of sheet steel pipe extensively used in irrigation works over rough regions instead of ditches or flumes. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Irrigation models.—Models of Cippoletti weir and measuring flume. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Truss and flume.—Models of a truss and flume over a canyon. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Irrigation photographs.—Set of eight. Exhibit of Office of Experiment Stations, Irrigation Investigations.

Stave silo.—Model of a round stave silo. Exhibit of New York Cornell Station.

Round silo.—Model of round silo showing construction. Exhibit of Wisconsin Station.

Hawaiian exhibit.—Samples of rocks, lavas, lava products, and soils; varieties of sugar cane, and samples of agricultural products, such as coffee, rice, and sugar. Prepared by Dr. Walter Maxwell. Exhibit of Hawaiian Islands Station.

CHARTS AND PHOTOGRAPHS.

The specific nature of galactase as a cheese ripening ferment. 9 charts. Exhibit of Wisconsin Station.

The structure and development of nematode worms. 5 charts. Exhibit of Massachusetts Station.

Composition and comparative value of silage. 5 charts. Exhibit of Vermont Station.

The effect of alkali on the germination of wheat. 7 charts. Exhibit of Wyoming Station.

Meteorological, mycological, and entomological investigations. 9 charts. Exhibit of Virginia Station.

Composition of grain and straw of oats and wheat at different stages of growth. 6 charts. Exhibit of Michigan Station.

Results of tobacco investigations. 10 charts. Exhibit of Virginia Station.

Average digestion coefficients of feeding stuffs. 9 charts. Exhibit of New York State Station.

Results of experiments on the maintenance of soil fertility. 5 charts. Exhibit of Ohio Station.

Investigations on the source of milk fat. 7 charts. Exhibit of New York State Station.

Experiments in crossbreeding wheat. 4 charts. Exhibit of Minnesota Station.

Classification of the races of the peach. 1 chart. Exhibit of Texas Station.

Effect of commercial fertilizers on the production of maize. 8 charts. Exhibit of Kentucky Station.

Bromide enlargements showing divers plant diseases. In portfolios. Exhibit of New Jersey Stations.

Bromide enlargements showing the effect of lime on acid soils. In portfolios. Exhibit of Rhode Island Station.

Bromide enlargements showing effect of crossing vegetables. In portfolios. Exhibit of New York Cornell Station.

Irrigation scenes and structures and detailed drawings of many of the more important structures. In portfolios. Exhibit of Office of Experiment Stations.

The directors and staffs, and the buildings, grounds, laboratories, experimental plats, apparatus, etc., of the individual stations. In portfolios. Exhibit of Office of Experiment Stations.

PUBLICATIONS.

Set of publications of the Office of Experiment Stations and the individual stations. 566 volumes. Exhibit of Office of Experiment Stations.

Books and monographs by authors connected with the stations. 138 volumes. Exhibit of the Office of Experiment Stations.

Card index of experiment station literature. 19,000 cards. Exhibit of Office of Experiment Stations.

Press notices, posters, and miscellaneous publications used to advertise the stations. In portfolios. Exhibit of Office of Experiment Stations.

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