TWENTY-SIXTH ANNUAL REPORT

FOR 1906-1907

METEOROLOGICAL SUMMARY,
PRESS BULLETINS,
INDEX.

OHIO
Agricultural Experiment Station.

WOOSTER, OHIO, U. S. A., JULY, 1907.

BULLETIN 185.

The Bulletins of this Station are sent free to all residents of the State who request them. Persons who desire their address changed should give both old and new address. All correspondence should be addressed to

EXPERIMENT STATION, Wooster, Ohio.

Twenty-Sixth Annual Report

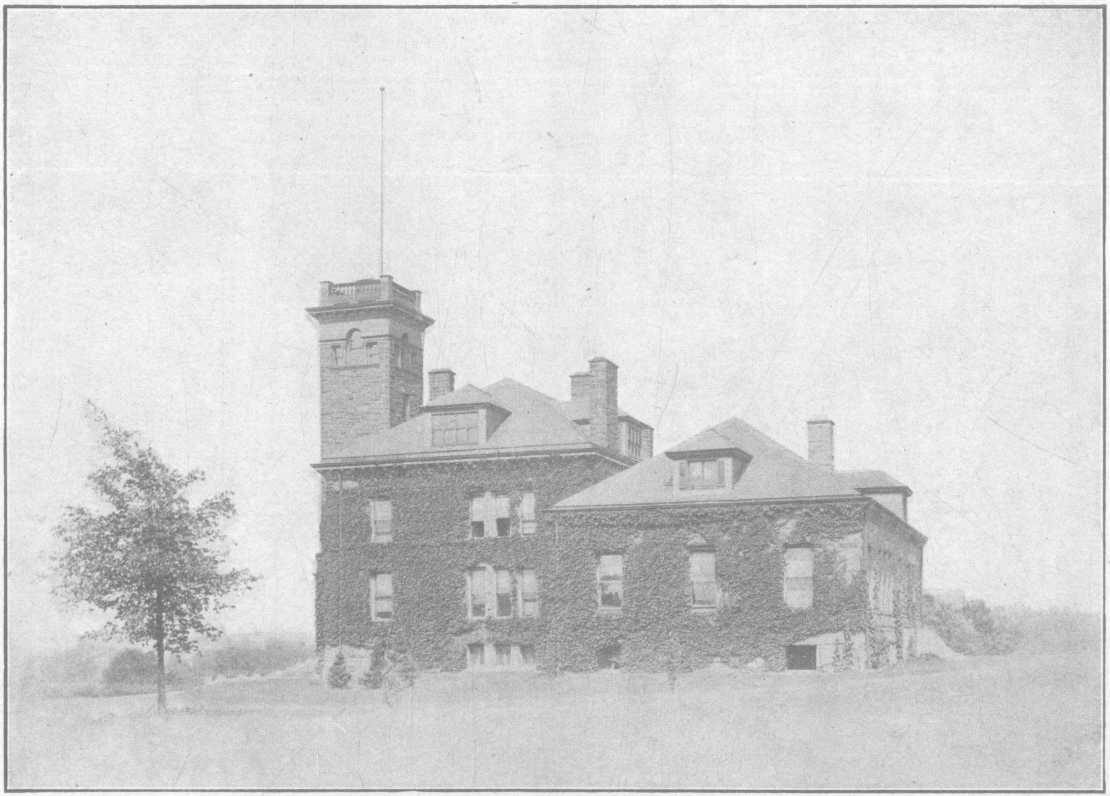
OF THE

Ohio Agricultural Experiment Station

For the Year ending June 30, 1907

Published by Order of the State Legislature

WOOSTER, OHIO
EXPERIMENT STATION PRESS
1907



ADMINISTRATION
BUILDING

ANNOUNCEMENT.

The Ohio Agricultural Experiment Station is organized under an act of the General Assembly of Ohio, passed April 17, 1882, and supplemented by an act of Congress, approved March 2, 1887.

WHAT THE STATION CAN DO.

The Station offers its advice and assistance to the farmers of Ohio along the following lines:

The maintenance of soil fertility, including the rotation of crops and the selection and use of manures and fertilizing materials.

The selection of varieties of grains, grasses and forage crops and methods of culture.

The selection of varieties of fruits and vegetables and the management of orchards.

The examination of seeds that are suspected of being unsound or adulterated; the identification of grasses, weeds and other plants; the prevention of fungous diseases of plants.

The identification of insects and the control of such as are injurious.

The feeding of animals, including calculation of rations and use of various feeding stuffs.

The planting and care of forest trees and the management of farm woodlots.

WHAT THE STATION CANNOT DO.

The Station is ***not*** prepared to analyze commercial fertilizers and feeding stuffs, as in Ohio that work is placed in charge of the SECRETARY OF THE STATE BOARD OF AGRICULTURE, at Columbus, to whom all requests for such analyses should be addressed.

The Station is ***not*** prepared to give advice respecting treatment of contagious diseases of animals, that function having been transferred to the State Board of Agriculture in its capacity of State Live Stock Commission. Requests for such advice should therefore be addressed to SECRETARY, STATE LIVE STOCK COMMISSION, Department of Agriculture, Columbus, Ohio.

The Station is ***not*** prepared to examine animals suspected of having been poisoned. Such examinations should be referred to the nearest Veterinarian.

The Station is ***not*** prepared to make official inspection of orchards and nurseries under the law requiring such inspection, that work having been transferred to the STATE BOARD OF AGRICULTURE to whose SECRETARY, Columbus, requests for such inspection should be addressed.

The Station is ***not*** prepared to examine foods, drugs and dairy products suspected of adulteration, as that work is in charge of the OHIO DAIRY AND FOOD COMMISSIONER, whose office is at Columbus.

The Station is ***not*** prepared to analyze drinking water; requests for such analysis should be addressed to the SECRETARY OF THE STATE BOARD OF HEALTH, Columbus.

Visitors to the Station or to its various test farms are welcome at all times during business hours. Persons or parties who contemplate such visits and who desire special attention are requested to write in advance, giving date of proposed visit and probable number of party.

Any citizen of Ohio has the right to apply to the Station for such assistance as it can give, and all such requests will receive prompt attention.

The Bulletins of this Station are sent free to all residents of the State who request them.

Address all communications to

EXPERIMENT STATION,
Wooster, Ohio.

ORGANIZATION OF THE
OHIO AGRICULTURAL EXPERIMENT STATION.

BOARD OF CONTROL.

JOHN COURTRIGHT, *President*.....Ashville
D. L. SAMPSON, *Secretary*.....Cincinnati
CARY W. MONTGOMERY, *Treasurer*.....Newark
DR. W. I. CHAMBERLAIN.....Hudson
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STATION STAFF.

DEPARTMENT CHIEFS.

	DEPARTMENT
CHARLES E. THORNE, M. S. A., *Director*	Administration. Soils
WILLIAM J. GREEN	Horticulture. Forestry
AUGUSTINE D. SELBY, B. S.	Botany
C. G. WILLIAMS	Agronomy
JOHN W. AMES, M. S.	Chemistry
H. A. GOSSARD, M. S.	Entomology
B. E. CARMICHAEL, B. S.	Animal Husbandry
L. H. GODDARD, C. E., *Assistant Director*	Cooperative Experiments
E. B. FORBES, Ph. D.	Nutrition

ASSISTANTS.

WILLIAM H. KRAMER, *Bursar*	Administration
F. A. WELTON, B. S.	Agronomy
GAIL T. ABBOTT, A. B	Agronomy
THOMAS F. MANNS, M. S.	Botany
TRUE HOUSER	Botany
W. F. PATE, B. S	Chemistry
L. L. LASHELL, B S	Chemistry
M. O. BUGBY, B. S.	Cooperative Experiments
W. H. GOODWIN, B. S.	Entomology
EDMUND SECREST, B. S	Forestry
F. H. BALLOU	Horticulture
H. S. WOODS, A. M	Nutrition
R. C. E. WALLACE, B. S.	Soils

FOREMEN AND CLERKS.

WILLIAM HOLMES, *Farm Foreman*	Agronomy
CHARLES A. PATTON, *Meteorological Observer*	Agronomy
ORA FLACK, *Horticultural Foreman*	Horticulture
W. E. BONTRAGER, *Florist*	Horticulture
CARY WELTY, *Mechanic*	Administration
F. W. GLASS, *Printer*	Administration
FAYE BLAYNEY, *Mailing Clerk*	Administration
MARY M. LEE, *Stenographer*	Administration
VALERIA RILEY, *Stenographer*	Forestry

IN CHARGE OF TEST FARMS.

EDWARD MOHN, Supt. Northeastern Test-farm, Strongsville	Administration
HENRY M. WACHTER, Supt. Southwestern Test-farm, Germantown	Administration
LEWIS SCHULTZ, Supt. Southeastern Test-farm, Carpenter	Administration

The Bulletins of this Station are issued at irregular intervals. They are paged consecutively and an index is included with the Annual Report, which constitutes the final number of each yearly volume.

REPORT OF THE BOARD OF CONTROL

To His Excellency, ANDREW L. HARRIS, *Governor of Ohio:*

SIR:—I have the honor to submit herewith the twenty-sixth annual report of the Ohio Agricultural Experiment Station, for the year ended June 30, 1907.

STATE APPROPRIATIONS.

The following state appropriations for the support of the Station are available for the year 1907:

For expenses of the Board of Control	$ 800
" bulletin publication	4,500
" special work in entomology, botany, chemistry and horticulture	7,000
" sub-stations for field experiments	7,000
" general repairs, labor and supplies	10,000
" special work in animal industry	6,000
" library equipment and care	400
" general construction	4,000
" cooperative experiments	6,500
" forestry investigations	5,000
Total	51,200

These appropriations, following the similar sums appropriated for 1906, have enabled the Station to materially extend its work, but it yet falls far short of meeting the demands of the agricultural and allied industries of the state.

There is probably no other equal area on the globe within which agriculture is more greatly diversified and at the same time more evenly balanced in its leading features than Ohio. With a soil and climate adapted to the growth of every staple product of the soil except cotton, sugar cane and other plants which cannot endure frost; with a great and rapidly growing urban population within its territory and on its borders; with a mile of steam railroad for every five square miles of its area, besides its lake and river transportation facilities, Ohio offers opportunities for the development of agriculture such as are surpassed nowhere else in the world.

As repeatedly stated in the reports of this Station, it has been its policy to try to do a few things well, rather than to dissipate its energies in the effort to study all the problems in our varied agriculture, and consequently numerous questions of great importance have been left untouched.

From its first organization the Station has given a large share of attention to the improvement of the cereal grains by the testing of varieties and showing which sorts are the most productive, and there can be no reasonable doubt that a part of the increase in the

yield of wheat in Ohio during the past 20 years should be ascribed to this work; farmers who had inferior varieties being induced to change their seed, and those who had the better sorts being encouraged to continue growing them.

But productiveness is not the only desirable feature in a farm product. There must be quality as well if it is to occupy a permanent place. Improvement in quality, however, is a far more intricate task than merely increasing the number of bushels per acre, and one which has required years of research of the most elaborate kind before it could be undertaken with any prospect of success.

The Station now stands ready, however, to enter upon this work, provided the State desires to have it done, preliminary studies having demonstrated that there is abundant reason to believe that it is possible to accomplish a very considerable improvement in quality without any sacrifice of productivness. That there is a demand for such work is shown by the following resolutions, recently adopted by the Ohio Grain Dealers' Association.

Resolved:—That the Ohio Grain Dealers' Association, acting upon the suggestion of its committee on Experiment Station work, which has recently investigated the work and plans of the Ohio Station, do urge the General Assembly of Ohio at its coming session to give our Experiment Station liberal support in all its departments, and especially the work in fertility and cereal crops. We would indorse the following propositions of the Station: To secure an assistant in milling and baking, together with the necessary equipment for the study of the milling and baking qualities of the varieties of wheat grown in Ohio, as well as the improved strains which it is now developing; To establish special corn breeding and testing work upon two to four representative corn farms in different sections of the Ohio corn belt, and to erect a suitable fire proof store and work house for plant breeding operations.

Resolved:—That a copy of this resolution be sent to each member of the Legislature, to the Press of Columbus and the various Grain Dealers' Journals.

The same resolutions were subsequently adopted by the Ohio Millers' Association.

One of the most important branches of Ohio's Agriculture is that of dairy husbandry, but the present resources of the Station in men and equipment are altogether inadequate for the proper conduct of researches in this industry, as shown by the following resolutions adopted by a committee from the Ohio Dairy Association, after a personal inspection of the Station's facilities for work in this field:

Whereas, the undersigned committee from the Ohio Dairy Association found, in visiting the Ohio Agricultural Experiment Station, that the dairy equipment there is inadequate for properly carrying on the work of dairy investigation, and since the dairy interests of Ohio are of such magnitude and importance, and experimental work in the breeding, rearing and feeding of dairy cattle so needful be it

Resolved, that we ask the legislature for an appropriation of sufficient funds to provide a dairy barn, equipment, and dairy stock sufficient for research work, to employ an assistant in dairy husbandry, and to provide such other help as may be needed.

There can be no question of the value of scientific research in the two fields above mentioned, but if such research is to be undertaken with any prospect of a successful outcome the Station must be provided with facilities more complete than any it now possesses.

HORTICULTURE.

The lines of investigation above mentioned require the assistance of the chemist for their successful prosecution, and can be carried on to best advantage in close proximity to the Station's laboratories, but there are other problems of prime importance which cannot be studied in any one locality. One of these is fruit growing, and the leading horticulturists of the State are insisting that the Station should establish a test farm within the fruit growing district of the lake shore, on which to study the special problems of that region.

The test farm at Germantown, established primarily for the study of the problems confronting the tobacco grower, has clearly demonstrated the great practical value of this method of research. To have attempted to solve these tobacco problems on the Station's farm at Wooster would have only resulted in failure; but by going into the region where tobacco is grown and taking up the work there it is able to carry on most successfully a line of work which serves at once the purposes of scientific investigation and of practical demonstration.

MAINTENANCE OF FERTILITY.

The study of the problems pertaining to the maintenance of soil fertility has been a prominent feature of the Station's work since its first organization. That the prosperity of agriculture, as well as of all other forms of industry, depends upon the successful solution of these problems needs only to be stated to be acknowledged, and it is equally evident that these problems cannot be solved for the entire state by work limited to one soil formation.

Experience has shown, however, that the study of a particular soil, to have any value, must be persistently continued, on a systematic plan, for a long term of years. For more than half a century chemists have been endeavoring in vain to find an easier and shorter way of determining the requirements of a soil than that of long continued experiment in the field itself. The fact is that soil fertility is not merely a chemical problem, but one lying also within the domains of physics and biology. Moreover, while it is evident that no two soils are exactly alike, a fact for which every practical farmer will vouch, it is also true that the same soil is constantly changing in character. The conclusions, therefore, that are war-

ranted by the results obtained this year must be modified by the outcome of next year's work, and thus if the Experiment Station is to be the safe guide which it should be in respect to soil management it must be equipped with farms located on typical soils and indefinitely maintained.

The Station now owns two farms, located on typical soils—the farm at the main Station and the test farm in Meigs county. It also holds under lease two other farms, one at Strongsville, Cuyahoga county and one at Germantown, Montgomery county. The Strongsville farm is located on one of the most refractory soils in the state. The bringing of this soil into profitable production and holding it there would mean the doubling of the value of the land on a very large area. That such an outcome is possible is shown by the fact that several plots in the Station's tests on this land have made a 6-year average yield of 20 bushels of wheat and over, against an average of only 7 bushels on the untreated land.

The Station's lease on this land will expire February 28, 1909. It now holds an option on the land at a very reasonable price considering that it lies only 15 miles from Cleveland, and has an electric railway on one side and a steam railway station at one corner. The Experiment Station has drained the land (in cooperation with the owners) and has established on it a system of field experiments which are equaled in completeness and in duration of test by only five others in the world. As a foundation for scientific investigation of the soil this farm has a value which cannot be computed in money. It would be a calamity to Ohio's Agriculture if the State should fail to provide for the continuance of its work.

One of the most important soil types of the State has as yet been untouched by the Station's investigations, namely: the black lands of the north-western counties. The superior productiveness of these soils when first brought under cultivation and the relative slowness with with which they deteriorate lead many to treat them as if their fertility were inexhaustible; but experience elsewhere has shown that such soils will eventually lose their fertility under exhaustive husbandry as surely as do the clays. The warning of what will eventually happen to this region has been given in the reduced yields obtained there the past season. One of the first signs of a soil's deterioration is a greater susceptibility to crop injury from unfavorable climatic conditions.

The sugar beet industry, which is being developed in this region, is one well worth fostering by the State, and such encouragement may be given to much better purpose through the combined researches and demonstrations of the Experiment Station than through bounties.

FORESTRY.

The Department of Forestry, established at the Station by direction of the General Assembly, has been engaged in making a general estimate of the forest conditions in the State and in accumulating data showing the rate of growth of various species of forest trees and the conditions under which they thrive best. It has also distributed many thousands of seedling trees, chiefly of Catalpa and Yellow Locust, which are being planted in cooperation with the Station by farmers over the State. 466 land owners in 84 counties are cooperating in this work, to whom have been sent half a million trees. As stated, this work is strictly cooperative, the Station requiring regular reports on the management and growth of the trees, and personally inspecting as many of the plantations each year as possible.

The Board of Control has also been so fortunate as to secure a cooperative agreement with the Board of Trustees of the Boys Industrial School, at Lancaster, under which the Experiment Station assumes the management of several hundred acres of forest belonging to the Industrial School, the Station furnishing plans and superintendence and the School providing labor, the proceeds of all sales of forest products being turned over to the School.

By this arrangement the Station is afforded the opportunity to study the conditions affecting the growth of forest trees on a large scale and at the minimum of cost, while the School obtains, at merely the cost of board, the services of a trained forester for the management of its woodlands.

A somewhat similar cooperative agreement has been entered into with the Board of Waterworks of Oberlin, under which the Station is superintending the planting of a considerable area around the source of water supply of that city.

It would seem that this form of cooperation might be considerably extended between the various State Institutions and the Station, giving to the former the advantage of expert service, and to the latter enlarged opportunities for scientific investigation in forestry. A detailed report of this work will be furnished at a later date.

THE STATION'S ORGANIZATION.

For convenience in administration the Station is organized in separate departments, each in charge of a chief, but all under the general supervision of the Director. At the time of our last annual report these departments were nine in number, namely: those of Administration, Agronomy, Animal Husbandry, Botany, Chemistry, Cooperative Experiments, Entomology, Horticulture and Forestry. The department of Administration also included the work of soil

investigation. To these departments was added in June, 1907, a department of Nutrition, the purpose of which is to conduct investigations looking especially to the function of the mineral elements in animal nutrition. This department is organized under the Adams Fund, appropriated to the Stations by the National Congress.

PERSONNEL.

The term of office of Mr. D. L. Sampson, as a member of the Board of Control, having expired in March, he was reappointed by you for a term of five years.

At the annual meeting of the Board, held in March, the following officers were elected for the current year: President, T. C. Laylin; Secretary, D. L. Sampson; Treasurer, John Courtright.

Respectfully submitted,

D. L. SAMPSON,
Secretary of the Board of Control.

REPORT OF THE BURSAR.

MR. T. C. LAYLIN, *President of the Board of Control:*

SIR:—I respectfully submit herewith the financial report of the Station for the fiscal year ending June 30, 1907.

In statements A, B, C, D, and E, respectively, will be found a record of the receipts and expenditures from the various funds; statements A and B being a statement of account with the appropriations received from the U. S. Treasury, and a copy of the report made to the Governor of the State, the Secretary of Agriculture, and the Secretary of the U. S. Treasury; statement C being a statement of account with the State Treasury; and statement D showing the receipts from farm produce and other sources and the expenditures from that fund.

The four statements A, B, C, and D, are combined in statement E, which shows the total income and expenditures for the fiscal year.

STATEMENT A.

Hatch Fund.

THE OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION UNDER THE HATCH ACT FOR 1906-1907.

Dr.

To receipts from the Treasurer of the United States, as per appropriation for the fiscal year ending June 30, 1907, as per act of Congress, approved March 2, 1887	$15,000.00

Cr.

By expenditures for:—		
Salaries	$14,490.00	
Labor	207.07	
Postage and stationery	3.09	
Furniture and fixtures	139.50	
Traveling expenses	145.34	
Contingent expenses	15.00	
Total		$15,000.0

STATEMENT B.

Adams Fund.

THE OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION UNDER THE ADAMS ACT FOR 1906-1907

Dr.

To receipts from the Treasurer of the United States, as per appropriation for the fiscal year ending June 30, 1907, as per act of Congress approved March 16, 1906	$7,000.00

Cr.

By expenditures for:—		
Salaries	$ 5,749.61	
Labor	155.00	
Freight and express	5.42	
Chemical supplies	230.59	
Seeds, plants and sundry supplies	138.90	
Furniture and fixtures	400.00	
Scientific apparatus	244.02	
Traveling expenses	76.46	
		$7,000.00

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Ohio Agricultural Experiment Station for the fiscal year ending June 30, 1907; that we have found the same well kept and classified as above; that the receipts for the year from the Treasurer of the United States are shown to have been $15,000.00 under the act of Congress of March 2, 1887 and $7,000.00 under the act of Congress of March 16, 1906, and the corresponding disbursements $15,000.00 and $7,000.00; for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887 and March 16, 1906, and in accordance with the terms of said acts, respectively.

Signed,

T. C. LAYLIN,

JOHN COURTRIGHT,

Auditors of the Board of Control.

STATEMENT C.

State appropriations.

THE OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE STATE TREASURY.

Date of appropriation.	Appropriation for:—	Total amount to Station's credit.	Total amount expended	Balance June 30, 1907.
1907	Expenses Board of Control.....	$ 800 00	$	$ 800 00
	Bulletin publication.....	4,500 00	1,980 85	2,519 15
	Cooperative experiments.....	6,500 00	1,345 11	5,154 89
	Forestry investigations.....	5,000 00	1,410 81	3,589 19
	General construction.....	4,000 00	2,703 47	1,296 53
	General repairs and supplies.....	10,000 00	5,800 85	4,199 15
	Library equipment and care.....	400 00	61 64	338 36
	Special work in animal husbandry	6,000 00	4,858 08	1,141 92
	Special work in entomology, botany, horticulture and chemistry.....	7,000 00	201 59	6,798 41
	Sub-stations for field experiments.	7,000 00	4,361 84	2,638 16
	Total for 1907.....	$51,200 00	$22,724 24	$28,475 76
1906	Expenses Board of Control.....	800 00	505 88	294 12
	Bulletin publication.....	4,331 95	4,331 95	
	Cooperative experiments	2,722 34	2,722 34	
	Forestry investigations..... ...	4,377 65	4,377 65	
	General construction.....	4,000 00	4,000 00	
	General repairs and supplies.....	6,021 89	6,021 89	
	Library equipment and care.....	400 00	400 00	
	Special work in animal husbandry	73	73	
	Special work in entomology, botany chemistry and horticulture.....	9,787 49	9,787 49	
	Sub-stations for field experiments.	4,589 44	4,589 44	
	Southeastern Ohio test-farm.....	1,000 00	1,000 00	
	Totals for 1906.....	$89,231 49	$60,461 61	$28,769 88

STATEMENT D.

Produce Fund.

THE OHIO AGRICULTURAL EXPERIMENT STATION IN ACCOUNT WITH THE PRODUCE FUND.

Dr.

To Receipts.

June 30, 1907.

From Department of Administration	$ 929 66	
" " " Agronomy	2,840 14	
" " " Animal Husbandry	7,375 64	
" " " Horticulture	1,769 20	
" " " Fortestry	6 51	
" Northeastern Test Farm	1 64	
" Southeastern Test Farm	738 06	
" Southwestern Test Farm	815 71	
Total receipts		$14,476 57
To balance brought forward July 1, 1906		348 01
Total		$14,824 56

Cr.

By Expenditures.

June 30, 1907.

For salaries	$ 753 34	
" labor	3,433 84	
" publications	1 50	
" postage and stationery	36 61	
" freight and express	453 90	
" heat, light and power	840 98	
" seeds, plants and sundry supplies	920 10	
" fertilizers	158 97	
" feeding stuffs	2,845 46	
" tools, implements and machinery	147 65	
" furniture and fixtures	479 40	
" livestock	1,073 26	
" traveling expenses	516 99	
" contingent expenses	233 52	
" buildings and repairs	290 24	
Total expenditures		$12,185 76
By balance carried forward		2,638 81
Total		$14,824 57

STATEMENT E.

Totals.

TOTAL RECEIPTS AND EXPENDITURES OF THE OHIO AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING JUNE 30, 1907.

Total Receipts.

From United States appropriations	$22,000 00	
" State appropriations	51,200 00	
" miscellaneous sales	14,476 56	
Total receipts for the year		$ 87,676 56
To balance brought forward, July 1, 1906		38,379 50
Total		126,056 06

Total Expenditures.

For salaries	$32,266 85	
" labor	15,800 27	
" publications	6,314 30	
" postage and stationery	1,167 94	
" freight and express	1,356 03	
" heat, light and power	3,594 78	
" chemical supplies	373 86	
" seeds, plants and sundry supplies	6,368 08	
" fertilizers	800 73	
" feeding stuffs	3,976 81	
" library	687 03	
" tools, implements and machinery	1,818 75	
" furniture and fixtures	1,307 77	
" scientific apparatus	995 25	
" livestock	3,769 25	
" traveling expenses	4,112 67	
" contingent expenses	1,396 87	
" buildings and repairs	8,540 13	
Total expenditures for the year		$94,647 37
By balance carried forward		31,408 69
Total		$126,056 06

Respectfully submitted,

W. H. KRAMER, *Bursar.*

REPORT OF THE DIRECTOR.

MR. T. C. LAYLIN, *President of the Board of Control:*

SIR:—I have the honor to submit the following report of the work of this Station for the year ending June 30, 1907:

THE STATION'S WORK.

AGRONOMY.

The comparison of varieties of cereals and forage crops and the study of cultural methods has been continued, with only such reduction in area as was necessary to provide for the work in plant breeding, which is assuming greater importance each year. In this work the chief stress is being laid upon selection, rather than hybridization or cross-breeding, and the results thus far are most encouraging. It is being discovered that there is as wide a range of individuality in plants as in animals, and as distinct a tendency to hereditary transmission—an old discovery, and yet one the full meaning of which is only just being realized.

In cross-breeding we set out to combine the desirable qualities of two widely different individuals, and as a result we set loose a train of atavic tendencies which produce a mongrel progeny from which the desired type can only be secured after many generations of selection. By starting with the naturally variant types and protecting them from the degenerative influences of cross-breeding we are able to achieve the desired end in a much shorter time.

Working along this line the Agronomist has under observation many thousands of individual plants of corn, oats, wheat, alfalfa and red clover, and while it is much too soon to announce definite results, yet the present outcome is such as to abundantly justify further work along this line.

This part of the work is being conducted under the Adams fund, but if it is to be carried on successfully provision must be made for greater laboratory and storage facilities than the Station now possesses.

Hitherto the work in this field has been chiefly directed to improvement in yield, without regard to quality of product. But the time has now come when quality also must be considered. This is

especially true of the world's great bread plant and Ohio's great cash crop, wheat. The improvement in value of the State's wheat crop by one cent per bushel would add a quarter of a million dollars annually to its wealth. The prize is certainly worth striving for. Before this point can be adequately studied, however, the Station must be equipped with facilities for milling and for thorough chemical and baking investigations of the milled products. Small mills are now made for this purpose and sold at a price which makes it entirely practicable for the Station to possess such an equipment.

ANIMAL HUSBANDRY.

The experiments in steer feeding and manure production, which have been carried on for several years, were continued last winter by the fattening of 41 western steers. The cooperative lamb feeding experiment, reported in Bulletin 179, was repeated on the same premises, and a bulletin reporting it is in preparation. Experiments in feeding for milk have been conducted in a small way for several years, and some of the results of this work are reported in Circular 67, on the value of individual records for dairy cows, a circular showing, by actual records kept for 3 years of two cows in the Station herd, that one cow may barely pay for her feed and care while another may yield a handsome profit.

These feeding experiments are furnishing data respecting the production of meat, milk and manure which add greater definiteness to the farmer's knowledge concerning the profitable outcome of his operations. This is especially true with regard to manure production. The investigations on this point have been conducted on such a scale and under such conditions as to furnish more exact information on this point than has been available hitherto.

BOTANY.

The work in this department includes the identification of weeds and weed seeds; the study of the diseases of plants and of methods for their prevention, and the improvement of varieties of tobacco. Many hundreds of plants or samples of seeds are sent to the Botanist annually for identification, and his advice is being constantly sought in respect to the control of plant diseases. Some of these, such as pear blight, still resist control, but many others, including the various fruit rots, the smuts of grain, the blights of the potato, etc., are kept more or less completely under subjection if the proper means are employed.

In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture, the Botanist is conducting investigations on tobacco, which include the origination of new varieties, and studies of the effect of certain fertilizing materials on the quality of the leaf.

ENTOMOLOGY

In addition to the identification of insect pests and advice by correspondence for their control, which consumes a large part of the time of the Entomologist and his assistant, he has carried on extensive cooperative field experiments in the control of the Codling worm, the Grape-berry worm, the Peach-tree borer and the San Jose scale.

A cooperative experiment on the Codling worm, conducted in a large orchard, resulted in the securing of over 99 percent of fruit not wormy in the season's total crop, including drops, whereas the apples on unsprayed check trees in the same orchard were over 50 percent wormy. Similar results were secured with the Grape-berry worm.

CHEMISTRY.

The work of this department has included (1) an extended study of farm manures, in which analyses were made of manure from cattle, sheep and horses, produced under various conditions of feeding and treatment, both the total and water soluble nitrogen, phosphorus and potassium being determined in many cases, together with total dry substance and ash; (2) nearly 6,000 determinations of nitrogen in samples of grains and forage plants in cooperation with the Agronomist and Botanist; (3) determinations of the lime requirement of 500 samples of soil, and (4) the beginning of a series of complete analyses of soils and produce in the study of the effect of long continued treatment of the soil with various chemical fertilizing materials upon its composition and that of the crops grown upon it.

As stated in my last report, it is proposed to support the chemical investigations of the Station largely from the Adams fund, and in pursuance of this plan the following lines of investigation have been undertaken under that fund:

(1) The role of lime in the soil.

(2) The role of phosphorus in plant nutrition.

(3) The role of mineral elements in animal nutrition.

(4) The role of heredity in the improvement of cereals and legumes as determined by work with pedigreed plants.

COOPERATIVE EXPERIMENTS.

The agricultural experiment station, however thoroughly its work may be done and however great the potential value of its results, cannot accomplish its mission until those results are utilized by the farmer; and while some farmers become convinced of the better method through reading the Station's bulletins, there are many who need to see the physical demonstration of this method. The object lesson is and always will be the most effective one. The chief object of the Department of Cooperative Experiments of this Station is to secure the aid of practical farmers in every township of the state in carrying out some simple demonstrational work on their own farms, that they and their neighbors may see the effect of the treatment suggested by the Station's investigations. To this end the Experimentalist is now cooperating with 795 farmers, scattered over 86 of the 88 counties of the state.

While some 20 lines of work have been taken up, the major part of this work has been confined to experiments with corn, wheat, alfalfa, timothy, potatoes, forestry, fertilizers, lime, plant breeding and farm management. The testing of forage crops and the study of farm management are being conducted in cooperation with the U. S. Department of Agriculture.

Three county infirmary farms are cooperating with this department in certain lines of work, those of Medina, Warren and Clinton counties. It would seem that many such farms might enter into this work with much advantage to their counties.

In the farm management work 30 cooperators are reporting in detail respecting every half hour of time and every cent of money expended on their farms, and thus data of great practical value are being accumulated concerning the cost of different systems of management.

Fifty-three dairymen are also reporting the amount of milk and butter fat produced by 630 cows, together with the approximate amount of feed consumed by each.

HORTICULTURE.

The Station orchards produced this year the smallest crop of apples in 15 years, due to the peculiarly unfavorable winter conditions, which caused a general failure of this fruit.

The experiment in the renewal of old trees by removal of the excess of top, described in Bulletin 180, continues to show very satisfactory results, so far as growth of trees is concerned, but the failure of the fruit crop prevented a continuance of the comparison

of productiveness,and the same may be said of the experiment in mulching the trees instead of keeping the ground cultivated. The mulched trees continue to show a better condition, but the untimely frosts affected all trees alike.

A singular misapprehension respecting this practice has been manifested by some writers on the subject. Mulching, as practiced at this Station, does not consist merely in cutting such grass and weeds as may be found under the trees and letting them lie where they fall. The material is raked up and spread around the trees, under the ends of the branches where the feeding roots are most active, and if the growth on the land is not sufficient to give a thorough mulch more material is brought in. One large orchardist in southern Ohio, who is following this plan with great success, buys many tons of straw each year with which to mulch his trees.

One of the most striking features of the recent work in the Horticultural Department, and one which has been duplicated in the Agronomy Department, is the much greater resistance to disease of some individual potato plants than of others of the same variety. This point has been seized upon in the hope of securing disease-resistant strains and with very encouraging results, the seed from disease-resistant stock producing plants which show the same characteristic and are also more productive.

FORESTRY.

This department of the Station, recently established under authority of a special act of the legislature, has begun the accumulation of data respecting the forest conditions of the state, a report on which is in preparation and will be separately published as a bulletin of the Station

NUTRITION INVESTIGATIONS.

About 98 percent of the substance of the growing plant is composed of carbon, oxygen, hydrogen and nitrogen—all derived from the atmosphere. The remaining 2 percent contains 10 different elements, each of which is indispensable to the existence of the plant. The animal body is composed of the same elements as the plant, and in this case, also, the greater portion consists of the gaseous elements. But with the animal, as with the plant, the deprivation of any of the essential elements is fatal.

The investigations in animal nutrition have hitherto been directed chiefly to the nitrogen supply, and its balance with the carbonanceous constituents of the food. An occasional hint has been

dropped, it is true, that the ash elements have an important part to play, and that we may not always be safe in the assumption that the supply of these elements will take care of itself; but as a rule we have worked on this assumption: we have studied balanced rations, for both animals and men; we have devoted years of exhaustive research to the cheapening of the food supply, but we have paid very little attention to the possible relation which the supply of mineral elements in the food, and the form in which these elements are carried in the food materials, may have to nutrition, and possibly also to health.

In one of the field experiments of this Station fertilizers carrying all the principal elements of plant food except nitrogen have produced a 13-year average increase of 8.8 bushels of wheat to the acre; but when phosphorus was omitted from the fertilizer and nitrogen supplied, the increase was only 2.7 bushels. But phosphorus constitutes less than one part per thousand of the growing wheat plant, whereas it amounts to from 3 to 6 parts per thousand of the total weight of the domestic animals, and to a much larger proportion of the human body. Moreover, the phosphorus absorbed by the plant remains fixed within its organism, but the animal or human body is being constantly torn down and cast away, and rebuilt with new material, so that a constant stream of nutrient material must flow through in order that it be maintained in vigor.

From its first occupation by the white man there has been a constant drain of phosphorus from the soil of Ohio. In the earlier days it left the state in the bones of live stock, driven over the mountains to eastern markets or floated down the rivers to the south in cured meat. With the advent of the canal and railroad wheat became a leading article of export, and with each succeeding decade for nearly a century our production of this grain has increased. Within more recent years corn has been added to the export list, and with the growth of our cities, which take the phosphorus from the farm as effectually as though it were shipped out of the state, the depletion has been increased by the amount carried to them in milk and hay. It is probable that the farms of Ohio have lost not less than 20,000,000 pounds of this element annually for the last 30 years, following an average loss of half as much annually for a similar period preceding.

Within the last 30-year period the use of commercial fertilizers has begun within the state, gradually increasing until the annual importation of phosphorus in this form now reaches about 10,000,000 pounds, or about half that exported, but these figures have only been reached within a very few years.

In the first century of Ohio's agriculture the total loss of phosphorus from the soils of the state has probably amounted to half a million tons. This, it is true, is probably only about 6½ percent of the total phosphorus contained in the upper 7 inches of the 15½ million acres at present under cultivation or in pasture, but experience is showing that that portion of the soil store of phosphorus which is in a form available to our crops is being consumed more rapidly than it is being replenished. It is not the total supply of any element in the soil which counts as plant food, but only that portion of such supply which becomes annually available.

In view of the above facts it would seem that the time has come when the effects of a deficient supply of phosphorus or other soil element on the quality of the produce should be more carefully studied than has yet been done, and also that it is time to endeavor to learn more about the effect on the animal organism of feeding upon the produce of soils thus deficient. To this end a Department of Nutrition has been organized and placed in charge of Prof. E. B. Forbes, formerly of the University of Missouri, whose work will be directed chiefly to a study of the function of the mineral elements in nutrition.

SOIL INVESTIGATIONS.

The present season is the fourteenth at the main station of consecutive study of the effect of certain fertilizing materials upon crops grown continuously on the same land and in rotation; the thirteenth for studies of rotative cropping at the test farm at Strongsville, and the fourth at the test farms at Germantown and Carpenter.

This long continued work under a definite plan is bringing out results of very great value, and which could have been obtained in no other way. These results are showing in a striking manner the wastefulness of continuous culture of the same crop on the same land; for even where large yields are obtained it is done at a much larger expenditure for manure or fertilizers than has been required in rotative cropping. In the rotative cropping data are being obtained concerning the effect of different combinations of fertilizing materials and manures on soils in different natural conditions and in various parts of the state, which furnish a basis of calculation such as has never before been available respecting the practicability of renewing and maintaining the fertility of the soil by the use of chemical fertilizers and manures.

Following are a few illustrations of what these experiments are accomplishing: At the main station, wheat grown with fertilizers in rotation on worn land has made a 14-year average yield of more than

25 bushels per acre, the unfertilized yield on the same land being less than 10 bushels. At Strongsville the same treatment has produced an 11-year average of 17½ bushels, the unfertilized yield being less than 6 bushels. At Germantown similar treatment has given a 3-year average yield of 26 bushels, the unfertilized yield being 11½ bushels. At Carpenter a 3-year average yield of 27 bushels has been attained, the unfertilized yield being 12¾ bushels. These yields are steadily increasing, the fertilized yield for the last 5 years reaching 32 bushels at the main station and 20 bushels at Strongsville. Similar increases have been obtained in corn and oats and in every case the total increase has more than covered the cost of the fertilizer.

The average yield of wheat over the southern third of Ohio is about 12 bushels per acre, or practically that of the unfertilized land on the Station's two southern test farms. Over the middle third the yield averages 14 bushels, and over the northern third about 16 bushels. The yield at the main station has been brought up to a point 50 percent greater than that of the section in which it is located, on land that had been reduced by exhaustive cropping to such a point that its unaided yield is only a little more than half the average yield of its section.

The gains above mentioned have been made with chemical fertilizers on worn land. On land at the main station of the same character as that on which the fertilizer tests are located, barnyard manure has been used for ten years to replace the nitrogen and potassium in the fertilizer, the manure being reenforced with phosphorus and applied to corn, which is followed by wheat and clover without further manuring or fertilizing, and here again a 10-year average yield of more than 25 bushels of wheat has been obtained, following a yield of nearly 65 bushels of corn, the total increase amounting to a net value of more than 4 dollars for each ton of manure.

These results have been attained on soils worn by more than half a century of exhaustive cropping. On land which had not been thus exhausted a 13-year average yield of 37 bushels of wheat to the acre has been obtained in a rotation of potatoes, wheat and clover, the yield averaging more than 40 bushels per acre for the last ten years, or 2½ times the average yield of Wayne county for the same period.

These results are not accidental, for they have been repeated wherever the treatment has been repeated; they are not due to superior tillage nor to drainage, for the unfertilized land receives the same tillage and has had the same drainage as that fertilized,

they are not due, in short, to any large expenditure of money, or to any cause or method which may not be put into operation by any farmer in Ohio.

There can be no reasonable doubt that, over a very large part of Ohio, it is entirely practicable to bring up the average yield of wheat within a very few years to double the present average; to do this with methods within reach of any intelligent farmer, and to do it at a cost which will be reimbursed with each succeeding crop, and with an interest larger than any other investment pays.

One of the very important soil formations of the state is not yet represented in the Station's investigations, namely: the large area overlying the Niagara and Waterline formations in the western part of the state. The black lands which cover a large part of this area are now so rich, that but little concern is being felt for their fertility; but there is good reason to believe that even on such lands as these there is opportunity for a large increase in the average product through a better knowledge of the methods by which fertility may be maintained.

Rich as are the lands in this section, however, the wheat yield here is far below the point of greatest profit, the average production per acre being no greater than in less fertile counties. I am confident that the general use of an active carrier of phosphorus throughout this region would have largely reduced the loss from winter killing which occurred there the past season.

Entirely aside, however, from any possible local benefit which the establishment of a test farm in this region might confer, stands the fact that the study of this type of soil is essential to a thorough understanding of the soil problems of other sections; for no single soil type furnishes sufficient data upon which to formulate conclusions respecting soils in general. It is only by correlating the various types and studying their individual characteristics that any comprehensive knowledge can be obtained.

The Station's lease on the test farm at Strongsville will expire at the close of another season. On this farm there are 370 plots of land which have received various combinations of manure and fertilizer for 12 years past, and of which an exact record has been kept, both as to treatment and produce. All of these plots except 40 are tile drained. The work thus far done on them has been such as to bring them into the best possible condition for successful research in some of the most important soil problems. Their value for this purpose cannot be expressed in dollars because there is no standard for such comparison, there being on this continent only two other field experiments in operation of equal scope in plan and duration

of test. The state holds an option on this land at a very reasonable price. It will be a calamity to the agriculture of Ohio if this option is not closed and the work continued.

PUBLICATIONS.

The investigations of the year are in part reported in the following publications:

Bulletin 177, pp. 1-39. The Hessian Fly; By H. A. Gossard.
Bulletin 178, pp, 41-68. The Strawberry test plot. By F. H. Ballou.
Bulletin 179, pp. 69-88. Fattening range lambs. By B. E. Carmichael.
Bulletin 180, pp. 89-110. Renewal of old orchards. By F. H. Ballou.
Bulletin 181, pp. 111-135. Alfalfa in Ohio. By C. G. Williams and C. H. Kyle.
Bulletin 182, pp. 137-194. The maintenance of fertility. Field experiments with fertilizers on cereal crops and potatoes, 1894-1906. By. C. E. Thorne.
Bulletin 183, pp. 195-228. The maintenance of fertility. Field and laboratory investigations on animal manures, By C. E. Thorne.
Bulletin 184, pp. 229-293. The maintenance of fertility. Statistics of field experiments with fertilizers and manures, 1894-1906. By C. E. Thorne.
Bulletin 185, pp. 295-322 Meteorological summary, press bulletins, and Index.
Circular 59, October 1, 1606, 3 pp. Soil treatment of tobacco plant beds By A. D. Selby.
*Circular 60, November 1, 1906, 4 pp. Soluble oils as destroyers of San Jose scale. By H. A. Gossard.
Circular 61, November 1, 1906, 3 pp. Score card for dent corn. Department of Agronomy.
Circular 62, November 10, 1906, 3 pp. Farmers' institutes. A list of members of the Station staff who are prepared to assist at such institutes, with their topics.
*Circular 63. November 15, 1906, 16 pp. The Grapeberry worm. By H. A. Gossard and J. S. Houser.
Circular 64, February 15, 1907, 6 pp. Dying of bearing grapevines. By A. D. Selby and J. M. Van Hook.
*Circular 65, March 1, 1907, 7 pp. The Spring Canker worm. By H. A. Gossard and J. S- Houser.
*Circular 66, March 23, 1907, 14 pp. Corn breeding and registration. By C. G. Williams.
*Circular 67, March 35, 1907, 10 pp. The value of individual records of dairy cows. By B. E. Carmichael.
Circular 68, March 26, 1907, 4 pp. Treatment of cooperative forestry plots. By W. J. Green.
Circular 69, April 9, 1907, 4 pp. The use of manure as a summer mulch in vegetable forcing houses. By W. J. Green and C. W. Waid.
Circular 70, May 24, 1907, 7 pp. The Paraffined wire basket method of soil investigation of the Bureau of Soils, United States Department of Agriculture. By C. E. Thorne.
The circulars marked * have been sent to the entire mailing list of the Station. The other numbers have been published in small editions and sent only to special lists of names, but a few copies are still available for distribution to those whe may desire them.
Ten press bulletins have issued during the year, numbers 276 to 285 inclusive, which are published with this report.

In addition to the above publications a general circular, descriptive of the Station's work, has been prepared at the request of President James McCrea, of the Pennsylvania Railroad Company, for posting in the passenger stations of that company in Ohio.

Respectfully submitted,

CHAS. E. THORNE, *Director.*

APPENDIX.

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Bulletins

OF THE

Ohio Agricultural Experiment Station.

1906-1907

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CONTENTS.

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	BUL.	PAGE
The Hessian fly	177	1
The strawberry test plot	178	41
Fattening range lambs	179	69
Renewal of old orchards	180	89
Alfalfa in Ohio	181	111
Maintenance of fertility	182	137
Maintenance of fertility	183	195
Maintenance of fertility	184	229
Meteorological summary; press bulletins; index	185	295

BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 185. JUNE, 1907.

METEOROLOGICAL SUMMARY—PRESS BULLETINS—INDEX.

METEOROLOGICAL SUMMARY FOR 1906.

BY C. A PATTON.

EXPLANATION OF TABLES.

The following tables contain statistics of temperature, rainfall, etc., for the year, and are compiled from data obtained from daily observations. T stands for "trace"—less than .01 inch of rainfall. Temperature is given in degrees Fahrenheit.

Table I shows the daily rainfall at the Station during the year in inches and hundredths.

Table II shows the daily mean temperature for each day of 1906 and the monthly mean temperature with the 19 years' average.

Table III gives a comparison of the monthly mean temperature and rainfall at the Station, with the 19 years' average for the same.

Table IV gives a comparison of the monthly mean temperature and rainfall for the state, with the 19 years' average for the same.

Table V gives the monthly mean temperature and rainfall for the Station and State for 1906 with the 19 years' average for the same.

Table VI contains the mean temperature, the highest and lowest temperatures, with the range of temperature for each month; the number of clear, fair and cloudy days; the rainfall, snowfall and and prevailing direction of the wind, at the Station for 1906.

Table VII contains the principal points of interest on temperature, state of weather and rainfall at the Station during the year and a grand summary for 19 years.

Table VIII contains the principal points of interest on temperature, state of weather and rainfall for the State during the year and a grand summary for 24 years.

Table IX gives the monthly maximum and minimum temperatures for both the Station and State for 19 years.

The statistics for the State, and for this Station previous to 1893, are compiled from the publications of the Ohio Meteorological Bureau and the State Weather Service, the 18 years' average being computed from the observations of the Wooster Station of the Meteorological Bureau, now located on the grounds of the Experiment Station, one mile south of Wooster.

NOTES ON THE WEATHER AT THE STATION 1906—SUMMARY BY MONTHS.

LATITUDE 40°47′01″, LONGITUDE 81°55′48″. ELEVATION ABOVE THE SEA, 1030 FEET.

JANUARY.

The mean temperature for January was 35.9°, which is 7.5° above the Station average for January. The highest 72°, occurred on the 21st; the lowest 6°, on the 9th. Cloudy weather prevailed. Rain or snow fell on eleven days. The total precipitation was 1.93 inches, which is 1.10 inches below the Station average for January. The prevailing wind was southwest.

FEBRUARY.

The mean temperature for February was 25.8°, which is 0.4° below the Station average for February. The highest 65° occurred on the 23rd and 24th; the lowest —14° on the 7th. Cloudy weather prevailed. Rain or snow fell on seven days. The total precipitation was 1.06 inches, which is 1.72 inches below the Station average for February. The prevailing wind was northwest.

MARCH.

The mean temperature for March was 30.2°, which is 6.3° below the Station average for March. The highest 61°, occurred on the 2nd; the lowest —5° on the 23rd. Cloudy weather prevailed. Rain or snow fell on thirteen days. The total precipitation was 3.57 inches, which is 0.20 inch above the Station average for March. The prevailing wind was southwest.

APRIL.

The mean temperature for April was 51.9°, which is 3.7° above the Station average for April. The highest 80°, occurred on the 13th; the lowest 21°, on the 1st. Cloudy weather prevailed. Rain or snow fell on eleven days. The total precipitation was 2.27 inches, which was 0.46 inch below the Station average for April. The prevailing wind was southwest.

MAY.

The mean temperature for May was 59.9°, which is 1.4° above the Station average for May. The highest 86°, occurred on the 17th and 18th; the lowest 29°, on the 10th. Clear weather prevailed. Rain fell on twelve days. The total precipitation was 2.98 inches; which is 1.04 inches below the Station average for May. The prevailing wind was north.

JUNE.

The mean temperature for June was 68.8°, which is 1.1° above the Station average for June. The highest 92°, occurred on the 29th; the lowest 47° on the 3rd. Rainy weather prevailed. Rain fell on fourteen days. The total precipitation was 3.81 inches, which is 0.35 inch below the Station average for June. The prevailing wind was south.

JULY.

The mean temperature for July was 71.0°, which is 0.3° below the Station average for July. The highest 88°, occurred on the 12th, 13th and 28th; the lowest 46° on the 25th. Clear weather prevailed, Rain fell on fourteen days. The total precipitation was 4.93 inches which is 0.55 inch above the Station average for July. The prevailing wind was south.

AUGUST.

The mean temperature for August was 74.2°, which is 4.9° above the Station average for August. The highest 91°, occurred on the 4th and 5th; the lowest 48° on the 29th. Clear weather prevailed. Rain fell on thirteen days. The total precipitation was 7.38 inches, which is 4.02 inches above the Station average for August. The prevailing wind was south.

SEPTEMBER.

The mean temperature for September was 67.7°, which is 4.0° above the Station average for September. The highest 90°, occurred on the 9th; the lowest 44°, on the 15th. Clear weather prevailed. Rain fell on seven days. The total precipitation was 5.16 inches, which is 1.78 inches above the Station average for September. The prevailing wind was south.

OCTOBER.

The mean temperature for October was 51.4°, which is 0.3° degrees above the Station average for October. The highest 74° occurred on the 24th; the lowest 22°, on the 12th.. Cloudy weather prevailed. Rain or snow fell on twelve days. The total precipitation was 3.55 inches, which is 1.21 inches above the Station average for October. The prevailing wind was northeast.

NOVEMBER.

The mean temperature for November was 40.4°, which is 0.5° above the Station average for November. The highest 72°, occurred on the 21st; the lowest 23°, on the 2nd. Cloudy weather prevailed. Rain or snow fell on ten days. The total precipitation was 2.39 inches, which is .60 inch below the Station average for November. The prevailing wind was northeast.

DECEMBER.

The mean temperature for December was 31.2°, which is 0.6° above the Station average for December. The highest 58.°, occurred on the 6th; the lowest 6°, on the 26th. Cloudy weather prevailed. Rain or snow fell on eighteen days. The total precipitation was 3.77 inches, which is 1 20 inches above the Station average for December. The prevailing wind was northwest.

METEOROLOGY—TABLE I—RAINFALL.

Daily rainfall, and melted snow for 1906, at Experiment Station.

DATE	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Date.
1	.....	.10	.....	.....	.....	.25	.....	.....	.....	T	.....	.03	1
2	.....	.....	.....	.....	.13	.06	.....	.....	.88	.....	.....	.....	2
3	.51	.....	.62	.....	.....	.....	T	.....	2.00	T	.....	.....	3
4	02	.05	.02	T	T	.....	.95	.....	.....	.11	.....	.....	4
5	.02	.25	.02	.16	.32	.07	.....	.....	.....	.....	.....	.27	5
6	T	.....	.....	.10	.02	.59	.21	2.30	.....	.89	.....	.87	6
7	.....	.....	.07	.....	.....	T	.....	1.13	.....	.16	.....	.02	7
8	.11	.....	.....	T	.43	.....	T	.33	.....	.....	.....	.03	8
9	.....	.....	T	.38	.02	T	.01	.14	.....	63	.....	T	9
10	.....	.....	.07	.02	.....	.02	.01	.15	.....	.13	T	.27	10
11	T	.....	.50	.....	.....	.....	.....	.15	.....	.....	.27	.....	11
12	.05	.....	.20	.....	.47	T	.....	.....	.....	.....	.10	.....	12
13	.05	.....	.20	.....	T	.06	.42	.....	.05	.....	.....	T	13
14	.32	.27	.....	.40	T	.....	.....	.....	.....	.....	.....	.32	14
15	T	.....	.....	.03	T	.....	1.56	.....	.....	.....	.07	.72	15
16	.30	.....	.....	.....	T	.....	.80	.....	.....	.....	.....	.....	16
17	.....	.....	.....	.....	.....	.68	.18	.11	.....	.....	.30	T	17
18	.23	07	.....	.....	1.02	.07	.20	1.22	.....	.42	.37	T	18
19	.....	.....	.60	.....	.....	.....	.....	T	T	.46	.....	.....	19
20	.....	.....	.10	.08	.....	.58	.19	T	.96	.....	.65	.05	20
21	.....	.25	.....	T	.....	.46	.06	.15	.....	.....	.45	.35	21
22	22	...	.....	.17	.05	.31	T	1.01	.....	.....	.....	.20	22
23	10	.....	.....	.....	.....	.42	.04	.23	T	.....	.....	.10	23
24	.....	T	.....	.....	.....	.....	.....	.....	.....	.31	.....	.05	24
25	.....	.07	.....	.23	.....	.....	.....	.....	.....	.02	.....	T	25
26	.....	.....	T	.56	.05	.....	.....	.....	T	.....	.09	.....	26
27	.....	....	.55	.....	.....	.....	.....	.41	.34	.25	.....	.20	27
28	.....	.....	.....	.....	.16	.08	.15	.....	.....	.11	07	.08	28
29	.....	.....	T	.14	.....	....	.15	.....	.29	.....	.....	.....	29
30	T	.....	.50	.....	.07	.16	.....	.....	.64	.06	.02	.04	30
31	T	.....	06	.....	.24	.....	.....	.05	.....	.....	.....	.17	31
Totals	1.93	1.06	3.57	2.27	2.98	3 81	4.93	7 38	5.16	3.55	2.39	3.77	42.80
Averages	.062	.038	.115	.076	.096	.127	.159	.238	.172	115	.080	1.22	.117

METEOROLOGY—TABLE II—TEMPERATURE.

Mean temperature for each day of 1906, at the Station.

DATE	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Date
1	28.5	24.5	34.0	34.0	59.6	65.0	71.0	72.0	64.5	50.5	36.5	38 0	1
2	29.5	11.5	47.0	42.5	68.0	62.5	75.5	72 0	67.0	59 0	39.5	26.5	2
3	44.0	13.5	51.0	45.5	59.0	62.5	72.0	72.0	72.0	62.5	40.0	28.5	3
4	43.5	29.5	35.5	56.0	60.5	67.0	69.5	77.5	62.0	66.0	46.0	25.5	4
5	33.5	14.5	27.0	47.0	56.0	74.5	66.5	78.0	64.0	65 0	44.5	30.5	5
6	27.5	0.5	25.5	41.5	51.5	73.5	66 5	78 0	69.5	56 5	44.5	46.5	6
7	36 5	4.5	31.0	49.5	41.5	77.0	72.0	76.5	68.0	48.0	42.0	25.0	7
8	24.5	11.5	38.0	50.0	41 0	79.5	73.0	75.5	68.0	55.5	46.0	26.5	8
9	17 0	14.5	37.0	57.0	40.5	74.5	70.0	76.5	73.0	53.0	46.0	42.5	9
10	24.5	11.0	31.5	46 0	41.5	71.0	73.5	76.0	73 5	38.0	44.0	43.5	10
11	31.5	16.0	30.0	46.0	53.0	61.5	71.5	75.0	73.5	33.0	36.5	30 5	11
12	33.0	33.5	22.0	49.0	65 0	57.5	72.0	70.5	75 5	36.0	30.5	33.0	12
13	32.0	39.0	22.5	63.0	63.5	67.0	75.5	67.5	75 5	52.0	31.0	43.5	13
14	36.5	29.5	25.0	66.0	65.5	66.5	74 5	65 0	62 5	51.0	31.0	51.0	14
15	45.0	12.0	25.5	66.0	69.5	72.0	76 0	68 5	59.0	56.0	33.0	46.0	15
16	38.0	12.5	25.0	49 0	71.5	66.0	73.5	71.5	64.5	59.5	35.0	33.5	16
17	30.5	26.5	18.5	45.0	71.0	65.0	71.5	77.5	68.0	60.5	45.0	29.5	17
18	33.0	40.0	22.0	53.0	71.5	65.0	70.5	76.5	72.0	56.5	47.0	23.0	18
19	33 0	37.0	26.0	59.0	70.5	68.5	70.0	78.0	77.5	56.0	42.0	21.0	19
20	50.0	42.0	24.5	59.0	51.0	68.5	75.0	79.0	76.5	51.5	43.0	21.0	20
21	63.5	45.5	24.0	54.0	54.5	67.0	75.0	79.5	71.5	53.0	57.5	31.5	21
22	65.0	37.5	24.5	42.0	66.0	61 5	73.5	78.0	70.5	58.5	41.5	26.5	22
23	43.5	45 5	10.5	39.0	72.5	64.0	67.0	78.5	64.0	57.0	37.5	18.5	23
24	31.0	50.0	19.0	43.0	69.5	64.5	60.0	75.5	56.5	60.0	34.5	13.5	24
25	28.5	43.0	31.5	56.0	68.5	68.0	62.0	79.0	62.5	49.5	37.0	14.5	25
26	31.0	31.5	42.0	60 5	66.0	69.5	68.0	79.5	62.5	50.0	48.5	18.0	26
27	33.5	22.5	43.5	57.0	66.5	73.0	69.5	72.0	63.0	49.5	46.0	20.5	27
28	30.0	18.0	35.0	54.5	51.5	75 5	73.5	73.0	63.5	39.5	36.5	32.0	28
29	39 0	.....	33.0	66.0	50.5	79.5	72.5	64.5	71.0	37.0	33.0	35 0	29
30	41.0	.....	43.5	62.0	55.0	78.5	71.0	70.5	60.0	39.5	35.5	42.5	30
31	35.0	.....	33.0	.....	65.0	.....	70.0	66.0	.....	34.0	.....	49.5	31
Monthly mean..	35.9	25.8	30.2	51.9	59.9	68.8	71.0	74.2	67.7	51.4	40.4	31.2	
19 year averages.	28.4	26.2	36.5	48.2	58.5	67.7	71.3	69.3	63.7	51.1	39.9	30.6	

METEOROLOGY—TABLE III.

Monthly mean temperature and rainfall for nineteen years at Wooster.

Temperature in degrees Fahrenheit.

DATE	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Date.
1888	23.0	28.8	31.7	46.3	57.7	68 9	70.1	67 8	57.1	44.9	40.7	31.4	47.4	1888
1889	31 1	22.9	38 7	47.1	57 8	64.5	70 0	66 0	60.8	45 3	39 3	40.7	48 7	1889
1890	36 0	36.6	30.9	48 4	56 0	69.8	70 5	65 8	59.6	50.0	41 3	28.8	49.5	1890
1891	30.0	34 0	32.0	49.0	52.0	68 0	68.0	71 0	68.0	49 0	38.0	37.0	49.7	1891
1892	22.0	33 0	33.0	47.0	57.0	70.0	70.0	69 0	61.0	49 0	38.0	28 0	48 1	1892
1893	18.0	28.0	38.0	50.1	57 6	69.3	72.0	67.9	63 2	52.3	37.7	30 9	48.7	1893
1894	32.8	26 7	43.5	50 5	57 5	67.9	71.4	69.2	66.1	52.3	36.5	32.9	50.6	1894
1895	21.9	17.9	32.4	49.5	59.4	69.9	68 6	70 9	66 5	44.2	40.4	32.8	47 9	1895
1896	27.9	29 2	29.8	54 6	64.5	65.6	70.2	68 5	60.6	45.8	44.4	30.6	49 3	1896
1897	24.0	30.0	39 3	47.2	53 4	64 3	73 2	67.0	66.7	55 9	40.7	31.8	49 5	1897
1898	31.6	27.4	43.3	45 3	58 2	68 7	74.5	71.1	66.2	52.6	38 4	27.9	50.4	1898
1899	26 6	21.3	35.0	52.1	60 0	69.4	70.0	71.0	61.6	55.0	43.2	29 0	49 5	1899
1900	30.2	25.0	31.8	47.8	61 5	68.5	72 6	74.0	67 1	58.9	40.6	30.7	50 7	1900
1901	28.3	20.0	39.1	45.2	57.9	69 1	75 9	71.6	63 3	51.7	36 6	26.1	48.7	1901
1902	26.3	21.4	41 2	46.2	61.2	65.6	73.0	66 4	62.7	53.9	47.3	28.7	49 5	1902
1903	24.4	29 0	45.7	48.0	62 2	63 0	71 8	68.8	64.4	58.2	36 8	21.7	49.1	1903
1904	18.6	20.5	37.6	42.8	59.4	67.0	69.8	66.7	64.2	50.4	39 6	28.1	47 1	1904
1905	22 6	19.8	41.2	46 8	59.2	68.0	71.6	70.0	63.8	51.0	38.3	33.1	48.8	1905
1906	35.9	25.8	30.2	51.9	59.9	68 8	71.0	74.2	67.7	51.4	40.4	31.2	50.7	1906
Averages	28.4	26.2	36 5	48.2	58.5	67.7	71.3	69.3	63.7	51.1	39.9	30.6	49 2	

TABLE III—*Concluded. Rainfall—Inches.*

1888	3.52	2.43	3.34	2.48	3.82	2.31	4.54	4.35	1.92	3.18	4.95	1.39	3.18	1888
1889	4.33	2 42	2.13	1.58	2.97	4.86	6.73	1.98	4.05	1.36	3.53	3.93	3.32	1889
1890	4 71	6.20	4 37	3.10	6.01	5 57	2 67	4.66	5.12	7.45	2.61	1.74	4.51	1890
1891	2.74	4.83	3.71	1.66	2.24	7.13	3.28	1.85	0.94	1.33	5.73	2.92	3 20	1891
1892	2.67	2.67	3.38	2.44	7.69	7.89	4.73	2.69	3.20	0.37	2.06	1.74	3.46	1892
1893	4 01	6 33	1.89	5.66	6.28	2 51	1.38	1.53	1.85	5.18	2 49	1.50	3.38	1893
1894	2 19	3.37	2.36	1.74	4 41	2.23	1.38	0 76	4.07	2 53	2.41	3.15	2.55	1894
1895	3.92	1.00	1.98	1 69	1 38	4.20	2.19	2.30	3.92	1.15	4.21	3.51	2.62	1895
1896	1.73	2.27	3.67	3.34	3.41	3 98	8.05	1.96	5.16	0.71	1 78	2.41	3.21	1896
1897	2.82	2.64	2 81	2.75	4.97	2.98	3.89	3.86	0 29	0.89	5.76	2 50	3.01	1897
1898	4.10	2.27	6.44	2.56	4.60	2.70	6.79	5.53	2.15	4 28	4.14	2.29	3.99	1898
1899	3.29	1.64	3.95	1.28	4.42	1.95	3.73	0.53	5.56	2.21	1.59	2.78	2.74	1899
1900	2.78	2.74	2.25	1.70	2 23	3.71	5.65	5.97	2.19	2.10	4 30	0.99	3.05	1900
1901	1.58	1.20	3.09	2.46	4.32	4.82	3.32	3.58	5.64	0.81	1.62	3 47	2.99	1901
1902	0.63	0.83	2 99	1.46	2.57	5.55	5.26	1.87	3 49	1 52	2.62	4.07	2.74	1902
1903	3.54	3.69	3.29	4 55	1.59	3.69	4.61	6.58	2 07	2.63	2.25	1.95	3.37	1903
1904	5.27	3.90	6 22	6.59	4.45	1.67	4 93	2.03	2.27	0.87	0 40	2.68	3.44	1904
1905	1.83	1.36	2.61	2.51	5.97	7.50	5.14	4.47	5.10	2.32	2.04	2.08	3.58	1905
1906	1.93	1.06	3.57	2.27	2.98	3.81	4.93	7.38	5.16	3.55	2.39	3.77	3.57	1906
Averages	3.03	2.78	3.37	2.73	4.02	4.16	4.38	3.36	3.38	2.34	2.99	2.57	3.26	

METEOROLOGY—TABLE IV.

Monthly mean temperature and rainfall for nineteen years for the State.

Temperature in degrees Fahrenheit.

DATE	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Date.
1888	24.3	30.5	34.2	49.2	59.1	70.4	72.1	70.4	60.3	47.9	42.9	33 3	49.5	1888
1889	33 3	25.8	40 2	49.9	60.2	66.7	72 5	69 1	62.9	47 9	41 0	43 8	51 1	1889
1890	38.8	39.4	34.5	51 3	59.2	73.3	73.1	68 8	62 1	52.7	43.9	31.2	52 3	1890
1891	33.0	36.0	35.0	52.0	58.0	71 0	69.0	70.0	67.0	51 0	40 0	39.0	51.7	1891
1892	24.0	35.0	35.0	49.0	59.0	73.0	73 0	71.0	64 0	52.0	38.0	29 0	50 1	1892
1893	18.0	29.0	38 0	50.2	58 3	70.6	74.5	70.7	65.2	53.7	39.3	32 7	51.6	1893
1894	37.7	28.9	45.1	50 6	60 0	71 3	74.3	71.2	67.8	53.9	37.5	33.9	52.3	1894
1895	23.4	19.6	35 5	51.7	61 1	70.2	71.6	73.5	69.0	46.9	41 3	33 9	49 9	1895
1896	29.4	30.5	32.4	56.7	67.9	69.5	73.2	71 8	62 7	49.0	45 1	32 9	51.7	1896
1897	25.5	32.4	41.5	49.3	46.3	68.1	75 5	69 4	66.9	58 1	42 2	32 8	50 6	1897
1898	32.4	30.0	45.0	47 2	61.0	71.9	76.0	73 5	67 8	53.1	38 8	28 8	52 1	1898
1899	27 8	21.6	36.9	53.3	63 3	71.5	74.1	73.7	64.1	57.4	43 9	30 2	51 5	1899
1900	31.1	26.0	32.9	50.1	62.9	69.8	74.1	76.3	69 3	60.5	41 6	31.6	52.3	1900
1901	29.2	21.1	39.5	46.7	59.0	70.9	78.1	73.1	64 8	53 8	37.7	27 9	50 2	1901
1902	27.3	22.3	41.9	48.2	62.6	66.9	74.0	67 4	63.6	54.6	48 5	29.4	50 5	1902
1903	27.1	29.9	46.7	49.9	63 9	64.4	72.9	70.7	65.6	54.0	37 2	23.4	50.5	1903
1904	20.7	22.9	39.7	44.4	60.7	68.4	71.4	68.8	65 5	52.2	40 5	28.6	48 6	1904
1905	22.7	20.8	42.7	48.5	60.7	69.2	73.0	71.7	65.3	52 6	39 6	32 9	50 0	1905
1906	35.7	27.3	31.3	52.1	61.3	69.8	72.1	74.6	68.9	52.7	41.1	32.3	51.6	1906
Averages	28.5	27 8	38.3	50.0	60 2	69 8	73.4	71 4	65.4	52.8	41.1	32.0	50 9	

TABLE IV—*Concluded. Rainfall—Inches.*

1888	3.65	1.74	3.55	1.99	3.77	3.41	4.40	5.16	2.27	3.98	4.25	1.47	3.30	1888
1889	3.13	1 35	1.50	1.79	3.71	4.13	4.25	1.50	3.62	1.78	4 02	2.81	2 79	1889
1890	4 94	5.25	5 29	3.15	5.52	4 50	1 99	4.70	5.56	4.27	2.53	2.37	4.17	1890
1891	2.82	4.91	4.19	2.13	2.20	4.82	3.82	3.07	1.50	1.76	5.00	2.39	3 21	1891
1892	2.05	3.27	2.16	2.63	4.63	6.73	5.13	6.15	1.27	0 67	2.62	1 85	3 09	1892
1893	2.56	5.13	2.09	6.37	4.97	3.34	2.49	2.17	1.57	4.24	2 09	2 61	3 30	1893
1894	2.14	2.79	2.16	2 31	4.00	2.65	1.56	1 67	3.31	2.01	2.17	2 98	2.47	1894
1895	4.00	0.69	1.59	2.11	1.80	2.44	2.00	2.96	1.66	1.22	4.11	3.85	2.37	1895
1896	1.67	2.25	3.34	2.78	2.67	4 81	8.11	3 38	5.13	1.20	2 63	1.65	3 29	1896
1897	1.93	3.64	5 17	3.27	3 93	2.85	4.65	2.72	0.78	0 64	6.62	2 39	3 21	1897
1898	5.25	2.32	6.23	2.38	4 10	2.86	3.98	4.50	2.56	3 72	3.17	2 71	3.65	1898
1899	3 01	2.11	4.66	1.68	4.32	2.96	4.18	1.82	2.69	2.14	1.72	3.16	2 87	1899
1900	2.37	3.53	2.35	1 89	2 40	2.99	4.62	3.68	1.76	1 89	4.15	1.24	2.74	1900
1901	1.70	1.24	2.66	3 40	3 96	4.38	2.73	3.32	2.86	0.73	1.54	3 79	2.69	1901
1902	1.42	0 88	2.76	2.21	3.09	7.48	4.69	1.67	4 55	2.28	2.60	3 95	3.13	1902
1903	2 36	4.95	3 51	4 01	2.82	3.97	3.67	3.20	1.52	2.62	2.10	2.07	3.07	1903
1904	3.85	2.69	5.73	2 64	3.79	2.88	4.13	2.74	1.95	1.50	0 37	3.09	2 95	1904
1905	1.73	1.58	2.50	3.10	5 63	4.72	3.93	4.46	2.86	3.63	2 63	2.25	3 25	1905
1906	1.98	1.16	3.97	1.89	2 17	3.41	5.14	4.77	2.92	3.19	2.59	3 68	3.07	1906
Averages	2.77	2.71	3.44	2.72	3.66	3.96	3.87	3.35	2.65	2.29	3.00	2 65	3 09	

METEOROLOGY—TABLE V.

Mean temperature and rainfall for the Station and State for 1906 and for nineteen years.

Temperature in degrees Fahrenheit. Rainfall in inches.

	January	February	March	April	May	June	July	August	September	October	November	December	Year
Mean temperature at the Station, 1906	35 9	25 8	30 2	51 9	59 9	68 8	71 0	74 2	67,7	51 4	40 4	31 2	50 7
Nineteen years average temperature at the Station	28 4	26.2	36 5	48 2	58 5	67 7	71 3	69 3	63.7	51 1	39 9	30 6	49 2
Mean temperature for the State, 1906	35 7	27 3	31 3	52 1	61 3	69 8	72 1	74 6	68 9	52 7	41 1	32 3	51 6
Nineteen years average temperature for the State	28 5	27 8	38 3	50 0	60 2	69 8	73 4	71.4	65 4	52 8	41 1	32 0	50 9
Rainfall at the Station, 1906	1.93	1 06	3 57	2 27	2 98	3 81	4 93	7 38	5 16	3 55	2 39	3.77	3.57
Nineteen years average rainfall at the Station	3 03	2.78	3 37	2 73	4 02	4.16	4 38	3 36	3 38	2 34	2 99	2 57	3 26
Rainfall for the State, 1906	1 98	1.13	3 97	1 89	2 17	3.41	5 14	4 77	2 92	3 19	2 59	3 68	3 07
Nineteen years average rainfall for the State	2 77	2.71	3 44	2 72	3 66	3 96	3 87	3 35	2 65	2 29	3.00	2.65	3 09

METEOROLOGY—TABLE VI.

Summary by months.

AT THE STATION	Temperature											Number of days				Precipitation in inches			Prevailing wind
	Mean	Highest	Date	Lowest	Date	Range	Mean daily range	Greatest daily range	Date	Least daily range	Date	Clear	Fair	Cloudy	Rainfall .01 or more	Monthly rainfall	Average daily rainfall	Monthly snowfall	
January	35.9	72	21	6	9	66	16.9	35	23	2	18	5	3	23	11	1.93	.062	4.25	S. W.
February	25.8	65	*23	—14	7	79	24.6	44	11	9	26	9	3	16	7	1 06	.038	7 00	N. W.
March	30.2	61	2	—5	23	66	14.8	31	23	5	15	3	2	26	13	3.57	.115	18 50	S. W.
April	51.9	80	13	21	1	59	25 4	40	18	10	10	13	4	13	11	2.27	.076	.25	S. W.
May	59.9	86	*17	29	10	57	23.4	39	21	11	9	14	8	9	12	2.98	.096	T	N.
June	68.8	92	29	47	3	45	23.3	38	4	14	16	12	10	8	14	3.81	.127	.....	S.
July	71.0	88	*12	46	25	42	22.9	32	*12	10	23	15	10	6	14	4.93	.159	.....	S.
August	74.2	91	*4	48	29	43	21.2	33	29	4	28	20	6	5	13	7.38	.238	.....	S.
September	67.7	90	9	44	15	46	23.8	38	7	11	26	18	7	5	7	5.16	.172	.....	S.
October	51.4	74	24	22	12	52	19.3	38	14	5	28	7	5	20	12	3.55	.115	1.00	N. E.
November	40.4	72	21	23	*2	49	17.3	33	2	6	*13	13	2	15	10	2.39	.080	1.75	N. E.
December	31.2	58	6	6	26	52	14.3	27	27	3	21	1	1	29	18	3.77	.122	7.83	N. W.
Sums and averages	50.7	77	.....	26	.....	55	20.6	36	.....	7	....	130	60	175	142	3.57	.117	40.58	S.
FOR THE STATE																			
January	35.7	79	21	—14	9	93	.....	50	10	.....	.....	9	7	15	9	1.98	.064	.....	S. W.
February	27.3	72	*23	—23	6	95	.....	53	6	.....	.....	12	7	9	7	1.16	.041	.....	N. W.
March	31.3	74	26	—12	23	86	.....	46	23	.....	.....	5	7	19	14	3 97	.128	.....	N. E.
April	52.1	91	13	18	1	73	.....	51	13	.....	.....	14	8	8	9	1.89	.063	.....	S. W.
May	61.3	94	17	24	10	70	.....	50	22	.....	.....	13	10	8	9	2 17	.070	.....	S. W.
June	69.8	100	29	34	12	66	.....	47	4	.....	.....	12	12	6	11	3.41	.114	.....	S. W.
July	72.1	98	19	43	25	55	.....	46	19	.....	.....	14	11	6	12	5 14	.166	.....	S. W.
August	74.6	101	21	43	28	58	.....	44	28	.....	.....	13	13	5	12	4 77	.154	.....	S. W.
September	68.9	98	18	36	15	62	.....	49	15	.....	.....	15	9	6	8	2.92	.097	.....	S. W.
October	52.7	91	25	18	12	73	.....	54	13	....	.....	10	7	14	11	3 19	.103	.....	S. W.
November	41.1	82	20	14	16	68	.....	45	4	.....	.....	10	6	14	8	2 59	.086	.....	S. W.
December	32.3	68	14	—15	24	83	.....	40	5	.....	.....	4	5	22	14	3 68	.119	.....	S. W.
Sums and averages	51 6	87	.....	14	.....	73	.....	48	.....	.....	.....	131	102	132	124	3.07	.100	.....	S. W.

*On other dates also.

METEOROLOGY—TABLE VII.

Summary by years and grand summary for nineteen years at Wooster.

	1888	1889	1890	1891	1892	1893	1894
At	Wooster	Wooster	Wooster	Wooster	Wooster	Experiment Station	Experiment Station
Mean temperature	47.3°	48.6°	49.5°	49.6°	48.°	48.7°	50.6°
Highest temperature		91.5° *1	94.5° Aug. 3	99.° Aug. 8	98.° July 25	95.° *5	98.° July 19
Lowest temperature	—5.° Feb. 9	—5.° *2	1.° Mch. 2	0.° Mch. 1	—20.° Jan. 20	—9.° Jan. 11	—7.° Dec. 28
Range of temperature		96.5°	93.5°	99.°	118.°	104.°	105.°
Mean daily range of temperature		18.7°	18.9°	21.°	19.°	20.2°	22.9°
Greatest daily range of temperature		42.° April 23	41.° Jan. 13	42.° Sept. 23	46.° July 17	45.° Aug. 9	45.° July 31
Least daily range of temperature		2.° Jan. 6	4.5° *3	4.° Feb. 8	4.° *4	3.° *6	4.° *7
Number of clear days		125	109	116	116	96	127
Number of fair days		103	119	110	123	164	154
Number of cloudy days		137	137	125	98	105	84
Number of days rain fell		119	149	119	119	129	130
Total rainfall	38 23 inches	39.87 inches	54.21 inches	38.36 inches	41.46 inches	40.61 inches	30.60 inches
Greatest monthly rainfall	4 51 inches	6.73 in. July	7.45 in. Oct.	4.26 in. June	7.89 in. June	6.33 in. Feb.	4.41 in. May
Least monthly rainfall	1.39 inch	1.36 in. Oct.	1.74 in. Dec.	1.95 in. April	1.37 in. Oct.	1.38 in. July	0.76 in. Aug.
Prevailing direction of wind	S.	S.	S.	S.	S. W.	S. W.	S. W.

*1 July 10 and Sept. 1. *2 Feb. 23 and 24. *3 Jan 8 and Sept. 10. *4 March 5, Nov. 1, 3 and 25, Dec. 1 and 18. *5 July 7, 25 and Sept. 7 *6 Jan. 24, Feb. 11 and May 26. *7 Dec. 1 and 21.

METEOROLOGY TABLE VII—Continued.

Summary by years and grand summary for nineteen years at Wooster

At...	1895 Experiment Station	1896 Experiment Station	1897 Experiment Station	1898 Experiment Station	1899 Experiment Station	1900 Experiment Station	1901 Experiment Station
Mean temperature	47.8°	49.6°	49 4°	50 4°	49.5°	50.7°	48 7°
Highest temperature	98.° June 4	93.° Aug. 9	96 ° *10	96.° July 3	95.° Aug. 20	95.° July 4	95 ° *12
Lowest temperature	—6.° *8	—6.° Feb. 19	—18 ° Jan. 26	—9.° Feb. 2	—21.° Feb. 10	—10.° Feb. 27	—11.° Dec. 21
Range of temperature	104.°	99.°	114.°	105.°	116 °	105.°	106.°
Mean daily range of temperature	21.8°	19.°	21.5°	20 3°	22.9°	20 6°	20.1°
Greatest daily range of temperature	55.° Oct. 6	43.° May 8	49.° Oct. 5	50.° Nov. 14	52.° Oct. 24	43.° May 6	43.° April 30
Least daily range of temperature	1.° Nov. 22	3.° *9	0.° Feb. 6	5.° *11	3.° Feb. 18	2.° Nov. 20	2.° April 20
Number of clear days	125	130	124	133	126	149	152
Number of fair days	117	106	123	104	114	68	66
Number of cloudy days	123	130	115	128	125	118	147
Number of days rain fell	102	134	128	134	116	132	142
Total rainfall	34.45 inches	38.47 inches	36.16 inches	47 85 inches	32.93 inches	36.61 inches	35.91 inches
Greatest monthly rainfall	4.21 in. Nov.	8.05 in. July	5.76 in. Nov.	6 79 in. July	5.56 in. Nov.	5.97 in Nov.	5.64 in. Sept.
Least monthly rainfall	1.00 in. Feb.	0.71 in. Oct.	0.29 in. Sept.	2.15 in. Sept.	0.53 in. Aug.	0 99 in. Dec.	0.81 in. Oct.
Prevailing direction of wind	W....	S. W.....	S. W.....	N. W	N., S. W....	S. W.....	S. W.....

*8 Jan. 12, 13 and Feb. 5. *9 Jan. 10 and March 8. *10 July 5 and 6. *11 Jan. 21, March 2 and Dec. 18. *12 July 1, 22 and 28.

METEOROLOGY—TABLE VII—Concluded.

Summary by years and grand summary for nineteen years at Wooster.

At	1902 Experiment Station	1903 Experiment Station	1904 Experiment Station	1905 Experiment Station	1906 Experiment Station	Summary for nineteen years
Mean temperature	49 5°	49 1°	47.1°	49.0°	50 7	49 1°
Highest temperature	97.° May 4	94.° *14	92.° July 17	92.° July 17	92 ° June 29	99.0° Aug. 8, 1891
Lowest temperature	—9 ° Feb. 5	—9.° Feb. 19	—21 ° Jan. 5	—12.° Feb. 14	—14.° Feb. 7	-21 ° *17
Range of temperature	106.°	103.°	113.°	104.°	106.°	120.°
Mean daily range of temperature	21.3°	21.6°	21.5°	20 8°	20.6.	20.7°
Greatest daily range of temperature	45.° May 4	48.° Nov. 8	48.° Dec. 28	42.° *16	40 ° April 18	55.° Oct. 6, 1895
Least daily range of temperature	4.° *13	3.° *15	0 ° Dec. 25	2.° Dec. 18	2.° Jan. 18	0.° *18
Number of clear days	183	148	149	144	130	132
Number of fair days	49	58	47	44	60	96
Number of cloudy days	133	159	170	177	175	132
Number of days rain fell	140	121	136	118	142	128
Total rainfall	32.86 inches	40.44 inches	41.28 inches	42.93 inches	42.80 inches	39.21 inches
Greatest monthly rainfall	5.55 in. June	6.58 in. Aug.	6.59 in. April	7.50 in. June	7 38 in. Aug.	8.05 in. July, 1896
Least monthly rainfall	0.63 in. Jan.	1.59 in. May	0 40 in. Nov.	1.36 in. Feb.	1.06 in. Feb.	0 29 in. Sept. 1897
Prevailing direction of wind	S. W.....	S. W.....	S. W.....	S.....	S.....	S. W.....

*13 Jan. 22 and April 28. *14 July 4 and 9. *15 Jan 4, Nov. 27 and Dec. 6. *16 April 9 and May 2. *17 Feb. 10, 1899 and Jan. 5, 1904.
*18 Feb. 6, 1897 and Dec. 25, 1904.

METEOROLOGY—TABLE VIII.

Summary by years and grand summary for twenty-four years for the State.

FOR THE STATE.	1883	1884	1885	1886	1887	1888	1889
Mean temperature	49.4°	50.6°	48.0°	49.6°	51.4°	49 5°	51 1°
Highest temperature	98 ° Aug. 22	98.° *1	101.° July 21	98.6° July 7	108.° July 18	102.° Aug. 3	99.5° Aug. 31
Lowest temperature	—17.2° Jan. 22	—34.° Jan. 25	—31.° Jan. 29	—21.5° Jan 12	—21.° Jan. 7	—15.° Jan. 27	—13.5° Feb. 24
Range of temperature	115.5°	133.°	132.°	120.1°	129.°	117.°	113.°
Greatest daily range of temperature	55.2° Mar. 18	50.° *2	58.5° Jan. 30	57.° Dec. 11	57 ° Dec. 11	50.°	53.° Mar. 30
Average number of days rain fell	146	145	148	131	121	125	118
Mean yearly rainfall	44.98 inches	40.19 inches	30.08 inches	36.71 inches	33.63 inches	39.64 inches	33.53 inches
Mean daily rainfall	.123 inch	.110 inch	.104 inch	.100 inch	.092 inch	.108 inch	.092 inch
Prevailing direction of wind	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.
	1890	1891	1892	1893	1894	1895	1896
Mean temperature	52.4°	52.0°	50 0°	50.1°	52.4°	49.9°	51 8°
Highest temperature	103.1° Aug. 3	101.° Aug. 10	103.° July 25	102 ° July 19	105° *4	106.° July 20	103.° Apr. 17
Lowest temperature	—4.° Mar. 7	—8.° Mar. 2	—25.° Jan. 20	—24.° Jan 11	—27.° Dec. 29	—24 ° Feb. 6	—18.° *6
Range of temperature	107.1°	109.°	128.°	126.°	132.°	130.°	121.°
Greatest daily range of temperature	48.5° Apr. 11	50.° *3	51.° Sept. 25	54.6°	60.° Oct. 19	59.° *5	53.° Mar. 25
Average number of days rain fell	149	120	121	113	100	89	124
Mean yearly rainfall	50.33 inches	38.61 inches	37.16 inches	39.63 inches	29.75 inches	28.46 inches	39.58 inches
Mean daily rainfall	.138 inch	060 inch	.102 inch	.108 inch	.081 inch	.070 inch	.108 inch
Prevailing direction of wind	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.

*1 Sept. 28 and Oct. 1. *2 Sept. 5 and Dec. 4. *3 April 27 and 30. *4 July 18 and 19. *5 Jan. 15 and Mar. 29. *6 Feb. 20 and 21.

METEOROLOGY—TABLE VIII—Concluded.

Summary by years and grand summary for twenty-four years for the State.

FOR THE STATE.	1897	1898	1899	1900	1901	1902
Mean temperature	50.6°	52.0°	51 5°	52.0°	50 2°	50.6°
Highest temperature	113.° July 4	105.° Sept. 6	105.° Sept. 6	103.° *8	102.° July 22	100.° July 8
Lowest temperature	—27.° Jan. 26	—20.° Feb. 3	—39.° Feb. 10	—20.° *9	—20.° Feb. 23	—17.° Feb. 14
Range of temperature	140.°	125.°	144.°	123.°	129.°	117.°
Greatest daily range of temperature	67.° *7	.....	.....	57.° Feb. 9	61.° Dec. 14	56.° May 4
Average number of days rain fell	110	121	107	107	107	114
Mean yearly rainfall	38.54 inches	43.78 inches	34.51 inches	32.87 inches	32.98 inches	37 58 inches
Mean daily rainfall	.105 inch	.119 inch	.094 inch	.090 inch	.090 inch	.103 inch
Prevailing direction of wind	S. W.....	S. W.....	S. W.	S. W.....	S. W.....	S. W.....

	1903	1904	1905	1906	Summary for twenty-four years	
Mean temperature	50.5°	48.6°	50 0°	51.6°	50.7°	
Highest temperature	104.° July 25	99.0° *10	100.° July 10	101.° Aug. 21	113 ° July 4, 1897	
Lowest temperature	—20.° Feb. 19	—30.° Jan 4	—20.° Feb. 3	—23.° Feb. 6	—39° Feb. 10, 1899	
Range of temperature	124.°	129.°	120 °	124.°	152.°	
Greatest daily range of temperature	60.° Sept. 25	54.° Jan. 5	57.° May 24	54.° Oct. 13	67.° Sept. 25, 1897	
Average number of days rain fell	111	117	118	124	120	
Mean yearly rainfall	39.87 inches	35.36 inches	39 02 inches	36.87 inches	37.24 inches	
Mean daily rainfall	.109 inch	.096 inch	.107 inch	.101 inch	.100 inch	
Prevailing direction of wind	S. W.....	S. W.....	S. W.....	S. W.....	S. W.....	

*7 Sept. 25 and 26. *8 July 4, Aug. 6 and 10. *9 Jan. 20 and Feb. 27. *10 July 17 and Sept. 29.

METEOROLOGY—TABLE IX.

Monthly maximum and minimum temperature for nineteen years.

Date	January		February		March		April		May		June		July		August		September		October		November		December	
	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest
1888.....		—5		—1		8		19		31		42		43		41		31		27		21		9
1889.....	54	12	54	—5	71	16	80	21	90	30	87	38	92	49	90	45	92	37	76	23	65	16	65	18
1890.....	66	5	65	14	60	1	74	23	83	30	88	46	94	45	95	40	88	38	81	30	66	24	48	15
1891.....	51	12	60	3	61	0	83	21	82	28	89	44	89	49	99	53	98	42	88	25	71	10	58	16
1892.....	54	—20	54	6	65	10	76	28	86	38	90	56	98	48	92	49	88	36	81	25	67	16	61	—2
1893.....	51	—9	47	—2	75	10	83	24	84	36	92	45	95	47	93	37	95	28	85	24	66	15	62	6
1894.....	56	1	64	—1	75	14	92	24	83	35	93	37	98	41	96	41	93	36	80	28	65	31	57	—7
1895.....	54	—6	60	—6	59	9	80	21	94	27	98	35	92	42	94	42	93	34	73	19	72	18	61	—2
1896.....	53	—2	58	—6	65	4	89	19	86	44	87	39	92	45	93	41	92	34	71	21	69	13	56	1
1897.....	61	—18	54	0	69	11	79	21	78	31	88	37	96	50	92	42	96	28	86	25	65	12	60	2
1898.....	64	—1	64	—9	71	12	77	16	81	32	90	40	96	45	90	46	90	38	86	24	66	13	56	1
1899.....	55	—6	57	—21	67	9	86	21	86	30	92	40	94	45	95	39	94	32	92	22	66	22	63	—2
1900.....	54	—5	65	—10	57	—4	78	20	89	25	90	44	95	44	94	49	89	41	86	30	69	6	55	11
1901.....	53	—4	40	0	69	—1	82	22	82	33	91	38	95	50	94	47	86	34	79	26	67	18	64	11
1902.....	47	2	59	—9	69	9	83	24	97	29	89	39	93	46	88	40	85	32	77	27	72	24	60	—5
1903.....	60	—8	63	—9	76	21	74	19	89	27	88	41	94	42	92	43	89	32	79	26	71	9	49	—2
1904.....	60	—21	57	—10	74	13	72	12	88	33	88	44	92	46	90	42	89	31	83	19	68	15	63	—1
1905.....	59	—8	43	—12	79	10	77	23	82	31	89	38	92	50	90	46	87	36	80	23	61	16	52	13
1906.....	72	6	65	—14	61	—5	80	21	86	29	92	47	88	46	91	48	90	44	74	22	72	23	58	6
Extremes	72	—21	65	—21	79	—5	92	12	97	25	98	35	98	41	99	37	98	28	92	19	72	6	65	—11
FOR THE STATE																								
1888.....	68	—15	69	—10	77	—6	92	19	91	23	102	34	97	42	102	35	92	26	80	22	81	17	63	1
1889.....	61	1	70	—14	82	10	88	15	96	26	92	38	98	47	100	40	99	28	83	17	77	9	73	10
1890.....	75	1	73	1	69	—4	86	20	92	28	101	39	101	43	103	40	92	33	85	29	77	17	65	3
1891.....	65	3	80	—2	74	—5	95	15	93	25	98	40	95	41	101	39	99	36	93	20	76	0	66	9
1892.....	61	—25	74	1	80	6	90	14	99	28	101	47	103	40	99	45	96	34	89	20	76	8	70	—12
1893.....	63	—24	68	—14	87	—8	93	20	94	23	102	40	101	42	101	37	100	24	95	15	76	2	72	—5
1894.....	66	—16	76	—15	91	3	97	16	98	31	102	29	105	36	104	36	103	27	90	15	79	4	70	—27
1895.....	62	—19	70	—24	86	—7	90	16	102	19	105	29	106	34	103	31	105	25	84	8	85	5	79	—13
1896.....	70	—4	78	—18	73	—7	103	15	99	36	98	33	102	39	102	35	100	25	85	17	79	7	67	—15
1897.....	71	—27	72	—9	82	5	92	11	91	25	102	31	113	44	101	38	105	25	97	20	76	8	71	—18
1898.....	71	—18	72	—20	84	5	87	10	92	29	99	39	105	38	100	40	102	38	96	20	76	2	67	—7
1899.....	66	—15	67	—39	76	0	94	6	96	28	102	36	105	41	104	39	107	26	94	20	79	18	69	—7
1900.....	67	—20	80	—20	70	—9	87	15	97	20	96	38	103	38	103	40	100	33	93	23	80		65	—2
1901.....	67	—10	60	—20	84	—8	91	18	90	26	103	30	109	48	101	42	98	29	88	20	79	10	73	—19
1902.....	63	—11	66	—17	82	—4	90	17	98	24	98	33	100	43	97	37	94	24	88	21	87	17	63	—11
1903.....	73	—13	69	—20	85	11	88	10	93	22	95	35	104	42	101	38	98	26	93	15	88	2	57	—11
1904.....	70	—30	75	—18	86	—1	81	7	95	27	98	37	99	41	97	38	99	23	92	15	75	0	69	—16
1905.....	65	—17	54	—20	85	—5	89	12	93	26	99	34	100	44	96	41	95	30	89	20	71	10	58	2
1906.....	79	—14	72	—23	74	—12	91	18	94	24	100	34	98	43	101	43	98	36	91	18	82	14	68	—15
Extremes	79	—30	80	—39	91	—12	103	6	102	19	105	29	113	34	104	31	107	23	97	8	88	0	79	—19

PRESS BULLETINS.

The following press bulletins have been issued during the year:

No. 276. July 2, 1906. SPRAYING POTATOES FOR LATE BLIGHT ADVISABLE IN 1906. THE TIME TO BEGIN IS NEAR.

The late blight and rot fungus of potatoes may be expected to prove destructive over the northern half of Ohio during the late summer of 1906 This disease prevailed in both 1904 and 1905, being very destructive last year, when it appeared July 20 to 25; the maximum danger is reached during August. All except very early potatoes are liable to attack.

The late blight and rot of potatoes may be prevented by spraying frequently with Bordeaux mixture, made of 4 lbs. blue vitriol and 4 to 5 lbs. of lime to 50 gallons of water, beginning the treatment July 15 to 20, and repeating the spray at 7 to 10 day intervals till crop is mature. The more frequent spraying is necessary later in the season. The increase in 1906, from spraying only 3 times, was from 35 percent to 50 percent in marketable potatoes; upon the late crop 5 to 7 sprayings may be required.

The results at Wooster are published in Circular No. 58, and the instructions for making and applying the spray are contained in the Spray Calendar; (Bulletin 147); both these publications will be sent free upon application. For earlier treatments, when plants are smaller, about 50 gallons of mixture will be needed per acre, but when ground is nearly covered by plants about 100 gallons per acre or even more will be required for efficient treatment.

Specimens may be submitted to the Station Botanist to determine the appearance of late blight. Applications for bulletins, etc., may be made to the Experiment Station, Wooster, Ohio.

No. 277. July 9, 1906. FORESTRY INVESTIGATIONS BY THE OHIO AGRICULTURAL EXPERIMENT STATION.

The farm woodlot is an important factor in timber production in Ohio. Are these woodlots held at a profit or loss? Undoubtedly there are some second growth timber tracts where the stand of trees of the best kinds is good enough so that the annual increase is yielding profitable returns. There are many other woodlots where the stand is poor or the trees are of inferior species which are not paying a fair rate of interest. It is important that every one who is interested in forestry should know to which class his woodlot belongs. Measurements and calculations will disclose at what rate a tract of timber is growing into money and a careful study of the conditions will show how it should be managed so as to make it more profitable. The investigations referred to have in view the determination of the kinds of trees, or mixture of trees, which are yielding the greatest profits, as they are found growing in natural second growth forests. The Ohio Experiment Station has already found, as outlined in Bulletin 158, that planted groves of catalpa and locust may give returns exceeding ten dollars per acre annually. While the natural forests may fall short of this it will doubtless prove true that they are growing into value much faster than is commonly supposed. How to make them still more profitable, especially those which are in bad condition, is a problem which the Station is willing to try to

help the owners to solve. but at the out set it should be understood that numerous factors enter in which may make experimentation necessary. The Station is ready to determine the prospective increase in value of tracts of timber, but it may not be able, in all cases, to unreservedly recommend a course of treatment which will insure satisfactory results with neglected woodlots. So far as means will permit it is willing to co-operate in such work, especially in representative cases. The owner is to provide land and labor, while the Station will furnish plans and, in some cases trees, in order to put into operation and test certain methods which promise good results.

Windbreaks; their utility in relation to woodlots, orchards, crops, buildings, the kind of trees best adapted to the purpose, location, etc., will receive attention.

The amount of work outlined is, ot course, limited by the means at hand and consideration must also be given to the availability of particular tracts to the carrying on of work the results of which will have a general value. Applications for examination of timber tracts which are received soon will have attention this season if possible. Those received later than November 1st cannot be acted upon this season. Co-operative planting with catalpa, locust and mulberry trees is to be continued.

In all cases, as in 1905, the premises of those wishing to plant trees are to be visited, and an experimental planting planned. To insure attention, applications for trees should be sent in at once, as the supply of trees may be exhausted early. This part of the work will be closed after January 1, 1907, and applications received after that date must be held over until another year.

No. 278. July 30, 1906. FERTILIZERS FOR WHEAT IN SOUTHEASTERN OHIO.

The Ohio Experiment Station has established a test farm near the northern line of Meigs county, the object of which is to study the agricultural problems of the hilly counties of southeastern Ohio.

One of the experiments now in progress at this test farm is the use of fertilizers on corn, wheat and clover grown in a three-year rotation, the fertilizers being applied to the corn and wheat crops. Three tracts of land are devoted to this test, in order that each crop may be represented each season. These tracts are subdivided into plots of one-tenth acre each, and every third plot is left continuously unfertilized The experiment was begun in 1904, and following are some of the results for the average of the two wheat crops, harvested in 1905 and 1906:

Plot No.	Fertilizers per acre		Yield per acre bushels	Increase per acre bushels
	Kind	Pounds		
2	Acid phosphate	120	19 1	5.4
3	Acid phosphate	120	21 4	8.2
	Potassium chloride	20		
6	Acid phosphate	120	21 9	9 6
	Sodium nitrate	20		
8	Acid phosphate	120	23 2	11.5
	Potassium chloride	20		
	Sodium nitrate	80		
12	Acid phosphate	240	24.9	12.9
	Potassium chloride	20		
	Sodium nitrate	80		
14	Acid phosphate	240	27.4	14.6
	Potassium chloride	40		
	Sodium nitrate	160		

The average yield of the unfertilized plots was 12½ bushels per acre, but there was some variation in this yield, owing to natural differences in the soil in different parts of the field, so that in calculating the increase the yield of each fertilized plot has been compared with those of the two unfertilized plots between which it lies, not with the general average of all.

The average retail cost of acid phosphate, 14 percent grade, is about fifteen dollars per ton. That of sodium nitrate and potassium chloride is about two and one-half cents per pound, delivered to Ohio points in ton lots. If we value wheat at eighty cents per bushel, the cost of fertilizer, value of increase, and net profit per acre from the various applications, over and above the cost of the fertilizer, would be as follows:

Plot	Value of increase	Cost of fertilizer	Net profit
2	$ 4 32	$0.90	$3.42
3	6 56	1.40	5.16
6	7 68	2.90	4 78
8	9 20	3 40	5.80
12	10 32	4.30	6 02
14	11.68	6.80	4.88

While it is evident that phosphorus, as carried in acid phosphate, is the fertilizing element most urgently needed on this soil, it is equally evident that phosphorus alone is not sufficient to produce a maximum yield of wheat. Either potassium or nitrogen, when added to phosphorus in the carriers and quantities used, produces a marked additional increase, not only in the total yield but also in the net gain, notwithstanding the relatively high cost of these materials, and when all three substances are combined, a still further increase is found, both total and net.

It will be observed that the largest net gain, although not quite the largest total yield, is found on Plot 12, on which the dressing of acid phosphate is doubled, while that of the other two constituents remains unchanged. As ordinarily expressed in the fertilizer trade, the combination used on this plot would analyze four percent "ammonia" seven percent "phosphoric acid" and three percent "potash." This combination is used at the rate of 340 pounds per acre on wheat, following a like application on the preceding corn crop.

While it is very evident, therefore, that the soil under consideration requires a complete fertilizer, containing nitrogen, phosphorus and potassium, all three, it does not follow that the purchase of commercial nitrogen and potassium is necessary. Stable manure is rich in these elements and experiments which have been carried on for nine years at the main Station at Wooster have shown conclusively that manure to which some carrier of phosphorus has been added, such as acid phosphate or the finely ground rock from which acid phosphate is made, will produce an effect quite equal to that from a fertilizer made up from the most effective fertilizing chemicals.

Our advice, therefore, to the farmers in southeastern Ohio, is to purchase phosphorus only, in one of the carriers named, incorporate that with stable manure and apply this directly to the field. If the manure is allowed to lie in the barnyard any length of time its nitrogen and potassium will be leached out —the potassium of manure being even more easily washed away than that of wood ashes—but when spread at once upon the land there is little or no loss.

If it is not possible at once to provide manure enough for this purpose, then as a temporary expedient purchase sodium nitrate and potassium chloride (commercially known as nitrate of soda and muriate of potash) and combine

these with acid phosphate or steamed bonemeal, in about the proportions used on Plot 12 of this experiment, thus making a complete fertilizer. This, however, should be regarded as a temporary expedient only; for even in the absence of manure it is possible to secure the nitrogen supply without cost through the growth of clover, soy beans or cowpeas, and such crops should be systematically grown on every farm in Ohio. Such crops not only secure nitrogen from the limitless supply in the atmosphere, but they also render available more or less of the potassium of the soil, making the purchase of this element less necessary.

No Ohio farmer can afford to purchase nitrogen in commercial fertilizers as a regular operation, but no Ohio farmer can afford to neglect, for even a single season, the maintenance of the nitrogen supply in his soil.

No. 279. August 11, 1906. LATE BLIGHT OR ROT OF POTATOES HAS APPEARED. SECOND WARNING TO POTATO GROWERS.

The late blight or rot fungus of potatoes, *Phytophthora*, has appeared about Wooster, Ohio, following the rainy weather. This same fungus appeared at Wooster, August 15, 1904, and July 25, 1905; the fungus has just been collected by the Botanist of the Ohio Experiment Station, in abundance, in fields near the Station, August 9, 1906. This late blight is liable to be followed by rot.

The late blight and rot may be prevented by thorough spraying with Bordeaux mixture, made of 4 lbs blue vitriol and 4 to 5 lbs. of lime in 50 gallons of water, if treatment is prompt Such spraying should be repeated at 7 to 8 day intervals till crop is mature. Some growers gained one-third to one-half increase of crop by spraying from this time forward, in 1905. Such treatment is now again recommended.

Inquiries and applications for bulletins, spray calendar, etc., may be addressed to the Ohio Experiment Station, Wooster, Ohio.

No. 280. August 20, 1906. FERTILIZING WHEAT IN THE MIAMI VALLEY.

The Southwestern Test-farm of the Ohio Experiment Station is located at Germantown, abut 12 miles southwest of Dayton. The soil is upland clay, classified by the Bureau of Soils, U. S, Department of Agriculture, as "Miami Clay Loam," a type of soil covering a large area in this region.

An experiment is in progress on this farm in which corn, wheat and clover are grown in rotation, each crop being grown every year, fertilizers of varying composition being applied to the two cereal crops. Wheat has been harvested in this experiment in 1904 and 1906, the average unfertilized yield for the two crops being ten bushels per acre.

120 pounds of acid phosphate per acre, applied to the wheat crop, and following a similar application to corn, increased the yield of wheat by 6 bushels per acre. With acid phosphate at $15.00 per ton and wheat at 70 cents per bushel, this increase would pay for the fertilizer with $3.30 to spare.

When 20 pounds of muriate of potash and 80 pounds of nitrate of soda were added to the 120 lbs of acid phosphate, increasing the cost of the fertilizer to $3.40 per acre, the increase in the wheat yield rose to 8 bushels, leaving a margin of $2.20.

When this application was doubled, making a total dressing of 440 pounds per acre, costing $6.80, the increase in yield rose to 15¾ bushels, giving a net profit of $4 20.

Doubling the acid phosphate only, leaving the muriate of potash at 20 pounds and the nitrate of soda at 80 pounds, thus increasing the fertilizer to 340 pounds, costing $4 30, produced an increase in yield of 12¼ bushels, leaving a net balance of $4.27.

The combination last mentioned would analyze about 4½ percent "ammonia," 10 percent "phosphoric acid" and 3 percent "potash," and this formula may be confidently recommended for practically all the clay soils of Ohio which have been reduced by exhaustive cropping to an average yield of less than 20 bushels of wheat per acre.

Nitrate of soda and muriate of potash are the cheapest commercial carriers of fertilizer "ammonia" and "potash," when effectiveness is considered; but no Ohio farmer can afford to buy nitrogen and potash in commercial fertilizers except as a temporary expedient, for they can be secured without cost by the growth of clover, soy beans, etc., the feeding of these crops to live stock and the reenforcement of the manure thus obtained with some carrier of phosphorus, such as bone meal, acid phosphate or the rock dust from which acid phosphate is made. commercially known as "floats."

No. 281. August 27, 1906. FERTILIZING WHEAT ON A RUN DOWN FARM.

For thirteen years the Ohio Experiment Station has been conducting experiments with fertilizers on a farm which had been reduced to a very low state of productiveness by exhaustive cropping. In these experiments corn, oats, wheat, clover and timothy have been grown in a 5-year rotation, each crop being grown every year, and the fertilizers have been applied to the corn, oats and wheat.

When acid phosphate has been used alone, 80 pounds per acre on corn and oats and 160 pounds on wheat, the increase yield on the five crops of the rotation has reached an average value of more than $18.50 per acre, leaving a net profit of sixteen dollars per acre over and above the cost of the fertilizer.

When to this quantity of acid phosphate were added 480 pounds of nitrate of soda and 260 pounds of muriate of potash, these being distributed over the three cereal crops and raising the total cost of the fertilizer to twenty-one dollars for each five-year period, the total increase has risen to a value of forty-three dollars leaving a net gain of twenty-two dollars, or more than four dollars annually.

One-third of this land has been left continuously unfertilized, an unfertilized plot adjoining every one that has received fertilizers. For the last eight years of the test the yield of wheat on this unfertilized land has been nine and one-half bushels per acre; a yield which has been increased by acid phosphate alone to an eight-year average of twenty bushels per acre, and by the complete fertilizer to twenty-nine bushels.

It has thus been possible to raise the yield of this worn land from less than ten bushels of wheat per acre to an average of twenty-nine bushels, and to accomplish this result by a method which has not only paid its way, but has paid in addition an annual rental for the land of more than four dollars per acre.

It will be seen that while the first cost of the acid phosphate used alone has been much smaller than that of the fertilizer carrying nitrogen and potassium also, yet the net gain is much greater from the complete fertilizer than from the acid phosphate alone.

Other experiments on the same farm have shown that farm manure, taken directly from the stable to the field after being reenforced with some carrier of phosphorus, such as acid phosphate or the powdered rock from which acid phosphate is made, may completely replace the nitrate of soda and muriate of potash used in the test above described, thus reducing the necessary expenditure for the fertilizer to that for phosphorus alone.

In these experiments the manure has been applied to the corn crop in a three-year rotation of corn, wheat and clover, at the rate of eight tons per acre, and has increased the yield to a nine-year average of sixty-two bushels of shelled

corn per acre, followed by twenty-five bushels of wheat without any further manuring, the total increase on the three crops of the rotation reaching an average net value, after paying for the phosphate, of thirty-five dollars per acre, or nine dollars per acre annually after paying one dollar per ton for handling the manure.

No. 282. Sept. 3, 1906. FORTY BUSHELS OF WHEAT TO THE ACRE A POSSIBLE AVERAGE ON MANY OHIO FARMS.

For twelve years the Ohio Experiment Station has grown potatoes, wheat and clover in a three-year rotation on one of its farms in Wayne county, a farm no better in natural fertility than thousands of others which may be found in this region of the state.

The land under experiment is divided into three sections and each crop is grown every season. Each section is subdivided into plots of one-tenth acre each, every third plot being left continuously without ferti izer or manure, while the intervening plots have received different combinations of fertilizing materials the fertilizers being divided between the potato and wheat crops.

The average yield of wheat in this test for the last ten years has been twenty-five bushels per acre on the unfertilized land. The application of 160 pounds of acid phosphate per acre to wheat, following a like application to potatoes, has increased the wheat yield by five bushels. When to this application, 100 pounds of muriate of potash was added for each crop, the yield of wheat was increased by seven bushels, while the use of a complete fertilizer, made up of 160 pounds of acid phosphate, 100 pounds of muriate of potash and the equivalent of 160 pounds of nitrate of soda for each crop, has increased the total yield of wheat to more than forty bushels per acre for the ten-year average.

The increase in the potato crop in each of these cases has more than paid for the fertilizer, leaving the increase in wheat as net gain, a gain which has been further augmented by a considerable increase in the yield of clover.

Not only has the yield been maintained at a high point, but it seems to be steadily increasing; the average yield for the three plots which receive the combination given, and which are located in different parts of the field, being 38¼ bushels per acre for the first half of the ten-year period, and 42½ bushels per acre for the second half.

It has therefore been possible to produce forty bushels of wheat per acre in Ohio as a ten-year average, and to accomplish this result by a method which has much more than paid the cost.

It is the general observation of farmers that wheat does exceptionally well when it follows potatoes, and this fact in part accounts for the large yields obtained in this experiment. The fact that the land was in good condition to start with—part of it having been cleared from the forest for purposes of this test, must also be borne in mind. But on another of the Station's Wayne county farms, one which had been reduced to a very low state of fertility by long continued exhaustive cropping, an average yield of 28½ bushels of wheat per acre has been maintained for the same period in a rotation of corn, oats, wheat, clover and timothy.

In this test the unfertilized yield has been nine and one-half bushels of wheat per acre. This yield has been increased to 28½ bushels by a fertilizer of the same composition as that above mentioned, namely: 160 pounds acid phosphate, 100 pounds muriate of potash and the equivalent of 160 pounds of nitrate of soda, per acre.

In this case as in the potato rotation, the increase in the other crops of the rotation has more than paid all the cost of the fertilizers, leaving the increase of wheat as clear gain.

In this case also the rate of gain is increasing, the average yield for the first five years of the period being 25 bushels per acre, as against 32 bushels for the last five years, and there seems to be no good reason to doubt that after the wasted fertility of this land has been restored it will be possible to still further increase the yield to a point equaling that in the experiment first mentioned.

No. 283. September 17, 1906. HESSIAN FLY. (By H. A. Gossard.)

If the conditions that exist at the Station prevail over the whole state of Ohio, no one need fear to disregard the Hessian Fly as a factor in determining the date of sowing wheat this fall. So far as our information goes, conditions over most of the state resemble those at Wooster, and even in those localities where the fly is quite menancing we are by no means sure that sowing should be delayed on its account. The best wheat obtained among the Station's date plots in 1905 was from wheat sown September 1st, 1904, and the best obtained in 1906 was from wheat sown September 15. The flies were sufficiently numerous in both years to constitute a menace and, while later sowing seemed advisable the crop yields proved that sowing early enough to give the plants a chance to stool and make a good growth before cold weather set in was more important than trying to dodge the fly, Therefore, in such a year as the present one, we think reasonably early sowing is quite safe. For northern Ohio from the 15th to the 22d of September has proved a good sowing period in ordinary years, in central Ohio from the 18th to 25th of September, and in southern Ohio from the 22d of September to October 1st.

The following paragraph from a bulletin now in the hands of the printer, but which cannot be distributed to the entire mailing list in time for use, sums up our conclusions based on three seasons of careful study:

"To reduce to a minimum the effects of Hessian fly attack, choose for seed the screened product of a variety possessing a large or medium straw, but above all with excellent stooling qualities. Pulverize the ground thoroughly by cultivating, harrowing and rolling until the mechanical condition of the soil is as good as possible Do not sow too late, for the damage can sometimes be better overcome by early sowing than avoided by late. In case of severe attack, either early sown or late sown grain is best secured against insect injury and winter killing by a liberal use of fertilizer. The farther the newly sown field is away from old stubble the better. Burn badly infested stubble whenever possible.

No. 284. March 4, 1907. WHAT IS THE CONDITION OF YOUR SEED CORN?

The time is at hand when each farmer should look well to the condition of his seed corn before the rush of spring work begins. A few hours spent now in testing the germination of individual seed ears may mean the prevention of the loss of many dollars and much time. Testing a sample of bulk seed after shelling and mixing is of little value, for one is then powerless to improve the quality of his seed by the rejection of the ears of low germination. He simply has to discard all or none, and generally does the latter. By testing each ear in such a way that one knows exactly how each ear behaves, the worthless ears can be rejected and the quality of the seed greatly improved. While the germination test is not a substitute for the ear-row corn test, since ears which show equally good germination frequently vary widely in their ability to yield, yet it is of great value in that it will weed out ears more or less injured as a result either of too late gathering of seed, or of lack of proper care in drying out, or moth, and this will pay any corn grower many times over for the labor involved.

The Experiment Station does not believe in doing for the farmer what he can do for himself as well, or perhaps better, and hence it does not contemplate making an individual ear germination test for him, but will be glad to send full instructions for making the germination box and test, to such as apply.

In addition to this, the Station would like to study, both in the germination box and in the field, as many samples as possible of the seed corn that is to be planted in Ohio this spring. To all who care to assist in this matter full instructions for sampling and shipping seed samples will be sent.

No. 285. March 25, 1907. A WORD OF CAUTION REGARDING ALFALFA.

As a result of the great interest which has been awakened in alfalfa during the past year or two it is probable that more alfalfa will be sown in Ohio during the coming season than the total of all that has been sown in the state since its reclamation from the wilderness. In view of this probability the Experiment Station, which has been growing this plant for years in various sections of the state, would offer the following words of caution: In the first place,

ALFALFA MUST HAVE LIME.

Over the western half of Ohio, which is underlaid with limestones, this poin need give the prospective alfalfa grower no concern, except in a few old fields where the failure of red clover and the appearance of sorrel indicates acidity of soil; but over the broad belt of shales and sandstones stretching across the state from north to south, east of a line drawn from Sandusky through Columbus to the west line of Scioto county, there are many old upland fields in which the lime has been reduced to so low a point by exhaustive cropping that neither clover nor alfalfa can be successfully grown until lime is added.

ALFALFA MUST HAVE PHOSPHORUS AND POTASSIUM.

What is true of lime over the territory indicated, is true of phosphorus and potassium throughout the state. Where upland soils have been so long in cultivation without manure or fertilizer that they will no longer produce fair crops of corn they will not produce satisfactory alfalfa, and the farmer who is deluded into sowing his seed upon such land, without manuring or fertilizing, will reap disappointment as his harvest.

ALFALFA LOVES A RICH SOIL.

The successful alfalfa fields in Ohio are to be found on river bottoms, or on uplands which have been kept in good condition by careful husbandry. It is true that alfalfa, like red clover, is a crop which adds fertility to the soil, but every practical farmer knows the difficulty of growing clover on a worn out soil, and the difficulty is still greater with alfalfa.

DO NOT BE MISLED BY EXTRAVAGANT STATEMENTS.

Alfalfa promises to be one of the most useful crops ever grown in Ohio; but the Brobdignagian stories which have been circulated regarding it are calculated to disgust the well informed and to lead the ignorant into error. The truth about alfalfa is good enough abundantly to justify the patient care which in most cases will be found necessary to start it successfully.

A bulletin on alfalfa is now in preparation by the Experiment Station at Wooster, which will summarize the experience of some hundreds of successful alfalfa growers. scattered throughout Ohio. This bulletin will be sent to those regularly on the Station's mailing list and to any others who may apply for it. It will be ready for distribution about the tenth of April. It will advise that the land intended for alfalfa be prepared early in the season, but that the seeding be delayed until July or August.

INDEX.

Acid phosphate as reenforcement of manure 206
Adams Fund, balance sheet of xii
" " proposed work under xviii
Agronomy, work of department of xvi
Alfalfa in Ohio, Bulletin 181 111
" at the Experiment Station 111
" a word of caution regarding 318
" amount of seed to use 126
" causes of failure of 128
" clipping while young 133
" comparison of lime and inoculation for 134
" drainage for 120
" effect of lime on 114
" experience of farmers with 116
" fertilizers on 113
" for ensilage 133
" for soiling 134
" importance of humus for 122
" influence of underlying water on 121
" " " flood water on 121
" " " limestone strata on 123
" inoculation of 123
" influence on, of a preceding crop 126
" injury of by cutting 133
" manuring 122
" methods of seeding 127
" nurse crops for 129
" pasturing 133
" soil requirements of 127
" soils for 119
Animal Husbandry, work of department of xvii
Announcement iii
Apple trees, old, renewal of 92
Appropriations, state, balance sheet of xiii
" " for 1907 v
Arrangement of plots in fertility experiments 142, 143
Barnyard manure, see manure .....
Board of control, names of iv
" " " report of v
Botany, work of department of xviii
Bursar, report of xi
Chemistry, work of department of xviii
Clover, residual effect of fertilizers on 156, 171, 179
Corn, fertilizers on at southern test farms 179
" " " in 5-year rotation 147
Comparison of different carriers of nitrogen 175
" " " " " phosphorus 173
Cooperative experiments, work of department of xix
Cows, production of manure by 201

Dairy Association, Ohio, resolutions by vi
Director, report of..... xvi
Elements removed per acre by average crops 146
Entomology, work of department of..... xviii
Fattening range lambs, Bulletin 179..... .....69, 88
Fertilizers for wheat in the Miami valley 314
" " " " southeastern Ohio 312
" " " on a run down farm..... 315
Fertilizing elements recovered in manure..... 200
" " effect of combining 160
" plan of, in 5-year rotation 145
Fertility, investigations on, in progress..... 140
" the maintenance of, Bulletins 182, 183, 184.....
Fertilizers and manure, comparative increase from 214
" experiments with at southern test farm..... 177
" effect of reducing number of applications..... 161
" " " increasing applications of..... 217
" in potatoes-wheat-clover rotation, financial results..... 172
" in 5-year rotation, summary table 159
" on potatoes grown in rotation..... 165
" on crops grown in 3-year rotation..... 164
" " " " " 5-year " 142
" on corn in 5-year rotation..... 147
" " oats " " " 152
" " wheat" " " 154
" " " following potatoes 168
" on crops at southern test farms... 179
" on crops grown in continuous culture 184
" on sandy land 187
" on crops grown in rotation, summary of results..... 190
" residual effect of on hay crops 156
" value of total produce from..... 163
Fertility maintenance, statistics of experiments on, Bulletin 184:—
Clover in barnyard manure test, Wooster..... ... 264
" " cereal (3-year) rotation, Carpenter..... 301
" " " " " Germantown..... 283
" " " (5-year) rotation, Wooster..... 242
" " " " " Strongsville..... 258
" " potato (3-year) rotation, Wooster..... 271
" " tobacco (3-year) rotation, Germantown 294
Corn in barnyard manure test, Wooster... 260
" " cereal (3-year) rotation, Carpenter..... 299
" " " " " Germantown 279
" " " (5-year) rotation, Wooster..... 230
" " " " " Strongsville..... 246
" " continuous culture, Wooster. 273
Manure test, statistics of..... 260
Manures, analyses of..... 302
Oats in 5-year rotation, Wooster..... 234
" " " " Strongsville..... 250
" " continuous culture, Wooster..... 275
Potatoes in 3-year rotation, Wooster..... 265

Fertility, maintenance of, statistics of experiments on, contintinued:—
Timothy in 5-year rotation, Wooster 244
Tobacco in 3-year rotation, Germantown 284
" " continuous culture, Germantown 295
Wheat in barnyard manure test, Wooster 262
" " continuous culture, Wooster 277
" " cereal (3-year) rotation, Carpenter 300
" " " " " Germantown 281
" " " (5-year) " Wooster 238
" " " " " Strongsville 254
" " potato rotation, Wooster 267
" " tobacco " Germantown 292
Fertilizer requirement, factors influencing 194
Financial statement xi
Floats as reenforcement of manure 206
Forestry, work of, department of ..... ix, xx
Forestry investigations, notice concerning 311
Grain Dealers' Association, resolutions by vi
Gypsum as reenforcement of manure 206
Hatch Fund, balance sheet of xi
Hessian fly, the, Bulletin 177 ..... 1, 40, 317
" " amount and character of damage by 13
" " breeding record in insectary 22
" " burning stubble for 33
" " dates of egg laying 16
" " date of sowing for 35
" " description of 2
" " effect of cold on eggs of 30
" " " " fertilizers on 12, 31
" " food plants of 8
" " history of 1
" " larva of 4
" " life history and habits of 3
" " parasities of 31
" " plowing under stubble for 34
" " rotation of crops for 35
" " record of plant infestation 25
" " strength of straw as affecting 12
" " the spring brood 28
" " treatment of crop to prevent attack 38
" " varieties of wheat resistant to 10
" " volunteer wheat and decoy strips 38
" " weather conditions affecting 16
Horticultural test farm needed vii
Horticulture, work of department of xix
Kainit as reenforcement of manure 206
Lambs, comparison of rations for 69
" fattening as affected by market conditions 85
" fat, shrinkage in shipment 77
" " expense of marketing 78
" " dressed percentages 78
" food consumed while fattening 76

Lambs, losses of, in fattening 80
" manure produced by 81
" weekly gains while fattening 74
Maintenance of fertility, the Station's work on vii
Manure and fertilizers, comparative increase from 214
" composition of fresh and exposed 204
" comparison of yard with fresh 206
" effect of increasing applications of 217
" experiments, summary of 222
" fertilizing elements recovered in 200
" field and laboratory investigations on, Bulletin 183 .....
" from fattening cattle, quantity of 199
" " " " composition of 198
" " lambs, feed and bedding per ton of 83
" " " composition of 81
" losses of from exposure 204
" on potatoes, value of 218
" produced on cement, or earth floors 197
" production of 196
" " " by fattening steers 196, 224
" " " " sheep 201
" " " " dairy cows 201
" " " " fattening lambs 81
" reenforcement of 206
" test, plan of 207
" the value of 213
" the waste of 203
Meteorologist, report of, Bulletin 185 295
Meteorological summary for 1908 295
Millers' Association, Ohio, resolutions by vi
Milling and baking tests, resolutions concerning vi
Nitrogen, comparison of carriers of 181
" removed per acre by average crops 149
Nitrate of soda as a carrier of nitrogen 181
Northeastern test farm, soil of 138
Nutrition, establishment of department of ..... x, xx
Oats, fertilizers on in 5-year rotation 152
Organization of the Station ..... iv, ix
Orchards, old, renewal of, Bulletin 180 89
Peach trees, old, renewal of 104
Personnel x
Phosphorus removed per acre by average crops 146
Plan of fertilizing in 5-year rotation 144
" " " at southern test farms 178
Potassium removed per acre by average crops 146
Potatoes, fertilizers on, on sandy land 189
" fertilizers on 165
" spraying for late blight of 311, 314
" value of manure on 218
Potatoes-wheat-clover rotation, plan of 164
Press bulletins, reprint of 311

Publications of the year, list of xxv
Rainfall for the State for 19 years 302, 303
" at the Station, daily, for 1906 299
" " " " monthly mean, for 1906 301
" " " " for 19 years 301, 303
Rations for fattening lambs 70
Strawberries, variety tests of 41
Strawberry, the Abington 45
" " Arkansas Black 62
" " Armstrong 46
" " Arnout 46
" " Bennett 42
" " B. W. No. 6 63
" " Cardinal 63
" " Carrie Silvers 47
" " Catherine 48
" " Desert 48
" " Fremont Williams 65
" " Great Scott 49
" " King Edward 49
" " Kitty Rice 65
" " La Belle 50
" " Lady Garrison 65
" " Late Prolific 51
" " Latest 66
" " Laxton 67
" " Malinda 51
" " Mead 66
" " Mexican 67
" " Millets No. 7 66
" " Mrs. Miller 52
" " Morning Star 52
" " New Home 53
" " Nimrod 54
" " North Shore 54
" " No. 267 (Reasoner) 55
" " No. 324 (Reasoner) 55
" " No. 325 (Reasoner) 55
" " No. 2 (Thompson) 56
" " No. 300 (Thompson) 56
" " No. 400 (Thompson) 57
" " No. 611 (Thompson) 57
" " No. 700 (Thompson) 58
" " Peck's No. 99 58
" " Peerless 66
" " President 66
" " Repeater 66
" " Reynolds 59
" " Robinson 59
" " Sibert 59
" " Twentieth Century 66

Strawberry, the, Stevens 60
" " Wonder 60
" " Wyoga 61
Strawberry test plot, the, Bulletin 178 ..... 41, 68
Strawberries, outfit for photographing 42
Seed corn, what is the condition of 317
Sheep, production of manure by 201
Soil investigations, some results of xxii
Soils under experiment, description of 137
Southwestern test farm, soil of 139
Spraying potatoes for late blight 311, 314
Steers, fattening, production of manure by 196, 224
Strongsville test farm, expiration of lease ..... viii, xxiv
Substations, importance of viii
Tankage as a carrier of nitrogen 181
Temperature for the state for 19 years 302, 303
" at the station for 19 years 301, 303
" " " " daily, for 1906 300
" " " " monthly mean, for 1906 301
Test farms, importance of viii
Timothy, residual effect of fertilizers on 156
Variety-testing at experiment station 41
Weather conditions in 1906, summary by months 296, 304
" " for 19 years, general summary 305
" " " 24 " " " 308
What the Station can do iii
" " " cannot do iii
Wheat, 40 bushels to the acre a possible average 316
" date of seeding as affecting Hessian fly 16
" date of sowing as affecting Hessian fly 35
" strength of straw and Hessian fly 12
" varieties resistant to Hessian fly 10
" management of to prevent Hessian fly attack 38
" following potatoes, fertilizers on 168
" yields from early and late seeding 36
" fertilizers on in 5-year rotation 154
" " on on sandy land 189
" " for in the Miami valley 314
" " " on a run down farm 315
" " " in Southeastern Ohio 312
" " on at Southern test farm 179