BULLETIN No. 93.

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

REPORT

ON THE

WORK AND EXPENDITURES

OF THE

AGRICULTURAL EXPERIMENT STATIONS

FOR

THE YEAR ENDED JUNE 30, 1900.

BY

A. C. TRUE,
Director of the Office of Experiment Stations.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1901.

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

A REPORT

ON THE

WORK AND EXPENDITURES

OF THE

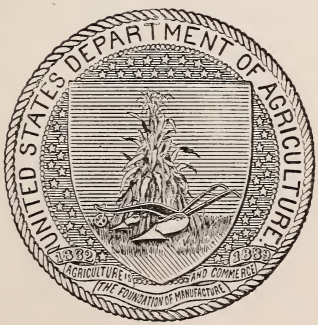
AGRICULTURAL EXPERIMENT STATIONS

FOR

THE YEAR ENDED JUNE 30, 1900.

BY

A. C. TRUE,
Director of the Office of Experiment Stations.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1901.

To the Senate and House of Representatives:

I transmit herewith a report of the Secretary of Agriculture on the work and expenditures of the agricultural experiment stations established under the act of Congress of March 2, 1887, for the fiscal year ended June 30, 1900, in accordance with the act making appropriations for the Department of Agriculture for the said fiscal year.

The attention of Congress is called to the request of the Secretary of Agriculture that 3,000 copies of the report be printed for the use of the Department of Agriculture.

WILLIAM MCKINLEY.

EXECUTIVE MANSION, *January 16, 1901.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of the Secretary,
Washington, D. C., January 4, 1901.

Sir: I have the honor to transmit herewith a report on the work and expenditures of the agricultural experiment stations established under the act of Congress of March 2, 1887, for the fiscal year ended June 30, 1900, in compliance with the following provision of the act making appropriations for this Department for the said fiscal year:

> The Secretary of Agriculture shall prescribe the form of the annual financial statement required by section three of the said act of March second, eighteen hundred and eighty-seven, shall ascertain whether the expenditures under the appropriation hereby made are in accordance with the provisions of the said act, and shall make report thereon to Congress.

If this report is published by Congress it is desirable that 3,000 copies should be provided for the use of this Department.

I have the honor to be, sir, your obedient servant,

James Wilson,
Secretary.

The President.

CONTENTS.

	Page.
Letter of the President	2
Letter of the Secretary of Agriculture	3
Letter of the Director of the Office of Experiment Stations	5
Work and expenditures of the agricultural experiment stations	11
Summary	11
The work of the stations as related to practical agriculture	11
Problems of station organization	12
The original work of the stations	16
The inspection service of the stations	17
State aid to the experiment stations	19
A personal bequest to an experiment station	20
Cooperation of the stations with the Department of Agriculture	20
Experiment stations in Hawaii	21
Experiment stations in Porto Rico	23
The Association of Colleges and Stations	24
Experiment-station exhibit at the Paris Exposition of 1900	24
The Office of Experiment Stations	25
Statistics of the stations	25
Office of Experiment Stations	28
An office in the United States Department of Agriculture	28
Miscellaneous technical bulletins	29
Farmers' bulletins	31
Agricultural experiment stations in Alaska	31
Nutrition investigations	32
Irrigation investigations	34
The Association of American Agricultural Colleges and Experiment Stations	36
The agricultural experiment stations in the several States and Territories.	
Alabama College Station	39
Alabama Tuskegee Station	41
Alaska Stations	42
Arizona Station	44
Arkansas Station	46
California Station	48
Colorado Station	51
Connecticut State Station	53
Connecticut Storrs Station	56
Delaware Station	58
Florida Station	60
Georgia Station	62
Hawaiian Islands Station	63
Idaho Station	64
Illinois Station	67

WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS FOR THE YEAR ENDED JUNE 30, 1900.

SUMMARY.

This is the sixth annual report on the work and expenditures of the agricultural experiment stations in the United States made by the Director of the Office of Experiment Stations, under instructions from the Secretary of Agriculture. As heretofore, the report is based on three sources of information, viz, the annual financial statements of the stations, rendered on the schedules prescribed by the Secretary of Agriculture in accordance with the act of Congress; the printed reports and bulletins of the stations, and the reports of personal examinations of the work and expenditures of the stations made during the past year by the director, assistant director, and one other expert officer of the Office of Experiment Stations. The stations in all the States and Territories have been visited since the previous report was transmitted to Congress.

THE WORK OF THE STATIONS AS RELATED TO PRACTICAL AGRICULTURE.

In making our examination of the work of the experiment stations during the past year we have particularly inquired whether their operations are conducted with special reference to the agricultural needs of their respective States and Territories. The results of this inquiry are embodied in the accounts of the individual stations given in this report. From these it will be seen that by far the largest part of the work of our stations has direct relation to the important agricultural interests of the communities in which they are located. The stations are, in fact, very responsive to the immediate demands of their farmer constituencies. Their greatest danger is not that they will undertake too much work of remote practical bearing, but that in the effort to meet the calls made upon them for immediate assistance they will attempt individually to cover more fields of investigation than the funds at their disposal will permit them to treat thoroughly. This temptation the stations generally are, however, resisting more successfully as their work is becoming better organized and their investigations are more carefully planned and supervised. The nature of their operations is also becoming better understood by the farmers, and the desirability of more thorough and far-reaching investigations

is much more appreciated than formerly. A broader and deeper foundation of scientific inquiry is being laid each year, and there is a constant accumulation of data regarding the general agricultural conditions of the different regions of the United States. The climate, soil, water supply, native and cultivated plants, injurious insects, fungi, and bacteria are being studied in more detail and with greater thoroughness than ever before. The principles of nutrition of animals and the causes of their diseases are being subjected to more elaborate and fundamental scrutiny. Methods of investigation and the improvement of apparatus for research are being given increased attention. Much of this work is done without public observation and in the intervals of other operations. Without doubt it should receive more definite recognition and encouragement. But it is cause for congratulation that so much patient labor of this character is being performed by station officers, who, as a rule, are seeking to advance the boundaries of knowledge for useful ends and are not deterred by a multiplicity of duties from giving attention to the more fundamental concerns of agricultural science. And this work is having its effect on the more practical operations of our stations. These are assuming a more substantial and systematic character and are being conducted with more definite relation to actual conditions. They have, therefore, a greater assurance of successful practical outcome. Questions relating to the introduction of plants or to the improvement of the live-stock industry in any region, for example, are now being investigated with a strict relation to the real requirements of the agriculture of that region which would have been impossible a few years ago. The present activity in plant breeding, as distinguished from the indiscriminate testing of varieties, is a good example of the raising of the level of experiment-station work as applied to directly practical ends. The plant breeder now sets definitely before him the kind of variety needed by the farmer in a given region or for a given purpose and applies all his scientific knowledge and practical skill to the production of such a variety. The notable success of some of the efforts in this direction already made are but a foretaste of much wider practical results as knowledge and experience in this line of endeavor increase. To do such work effectively there must be an almost ideal combination of science and practice. And the more we can learn definitely regarding the underlying principles the more surely will we be able to make successful practical applications. In such investigations science becomes more practical and art more scientific.

PROBLEMS OF STATION ORGANIZATION.

Much attention has been given during the past year to questions relating to the more perfect organization of the stations. As the stations develop, the importance of a clearer definition of the functions

of different officers in administration and investigation becomes more apparent. Conditions which existed when institutions for higher education and research were established in this country have materially changed, and the old forms of organization are now, in many cases, a serious hindrance to their best development. For example, the theory on which the laws relating to the governing boards of many of the State colleges and experiment stations are based is that the board is to have the direct control and management of the institution. For this purpose it is to meet frequently, keep the details of the business of the institution well in hand, consult freely with officers of various grades, and pass rules and regulations governing every operation. This may, perhaps, have been well enough when the institutions were in a formative period and trained executive officers were scarce, but to-day this theory is out of date, and its application to the intricate and specialized business of our colleges and stations is highly injurious to their best interests. It works just as badly when applied to a college or experiment station as it would in the case of a railroad or a bank. The fact is that boards of control are most useful when their functions are confined to a broad, general supervision of the policy, finances, and work of the institution and the choice of its chief officers. For this purpose annual or semiannual meetings would ordinarily be sufficient, since the number of matters requiring the attention of the board should be reduced to a minimum. The best reason for the continuance of such boards is that when composed of broad-minded and successful citizens they represent the best sentiment of the community regarding these institutions, and are able to give the public an adequate guaranty for the wise and liberal management of the great interests involved in the State colleges and universities. Otherwise it would probably be best to do away with the boards and make the heads of the colleges directly responsible to some State officer of high rank. One especially annoying and unjustifiable feature of the present system is the maintenance at many of the colleges of an officer, commonly designated secretary of the board, who acts as a representative of the board in the intervals between their meetings and exercises important functions relating to the business of the institution independently of its president. There is thus divided responsibility in the daily administration, and in case of friction between the president and faculty or students often a convenient center for discontent and disloyalty is ready at hand. All the legitimate functions of a secretary of the board might easily be performed by a registrar or other officer attached to the president's office, and thus an important "rock of offense" might be removed from the administrative system of these institutions.

The successful college president is no longer preeminently a great scholar, but rather a broad-minded and well-trained man of affairs,

understanding the requirements of modern educational and scientific institutions and able to administer the affairs and manage the personnel of such institutions. He will look to his governing board for advice and counsel on the larger matters of general policy, but he ought not to have their intervention in the details of the business. To his hands should be fully committed the administration of the whole institution, and his work should be judged with reference to its successful issue. There should be no doubt in the mind of any officer connected with the institution that he is responsible to the president for his official conduct, and that an appeal to the board can be made only in extreme cases.

The institution will naturally be divided into a limited number of departments, at the head of each of which will be placed an officer competent to plan and manage the business of the department intrusted to his charge. The amount and character of the administrative duties which these officers will be called upon to discharge will vary with the nature of the department. The agricultural experiment station is by law to be organized as a department of the college with which it is connected. It differs from the ordinary college department in being charged with the work of investigation rather than instruction and in having definite relations with a great industry for whose promotion it is especially established. Through its correspondence, publications, inspection service, and association with the farming community it has an increasing amount of business not immediately relating to its investigations, but requiring special knowledge and skill for its successful discharge. To do most effective work the operations of the station must proceed in accordance with a well-matured plan which involves the cooperation of different members of the staff. So extensive and important has the business of the stations become that their proper management requires the time and energy of an executive officer, or director. In some cases it may still be possible for the director to conduct investigations in some special line or do a limited amount of teaching, but as a rule he can do little beyond attending to administrative duties. In a number of institutions prudential reasons of various kinds have led to the combination of the offices of president and director. Whatever justification there may have been for this in the past there is little excuse for it in the present. The duties of a college president are too multifold and onerous to permit his giving much attention to the special needs of an experiment station. His directorship almost necessarily becomes a nominal affair and the general business of the station is actually performed by some one member of the staff or distributed in a desultory way among a number of subordinate officers. This arrangement has not worked well and should be universally abandoned.

As regards the business of the station, the director should be clothed with a large measure of authority and consequent responsibility, should plan and supervise its work and expenditures, and control its staff to such an extent as will bring them together to work as a unit for the promotion of the station's success. The members of the staff should be directly responsible to the director on all matters relating to the station, whatever their position may be in other departments of the college, and should expect to transact station business through the director rather than through the college president or the governing board. A proper independence in the conduct of investigations, or parts of investigation, in their respective specialties and just credit for their share in the station's operations as set forth in publications or otherwise may, it is believed, be amply secured for the expert officers of the stations at the same time that good discipline is maintained and ample provision made for united effort.

No class of men need to readjust their professional code to the modern requirements of the organization of great scientific and educational enterprises more than college professors and scientific specialists. A way must be found by which teaching and research can be conducted on a system which combines liberty with law. The old régime of the entirely independent teacher and investigator has passed away. The specialization which is simply a form of the division of labor well known in industrial pursuits carries with it a necessity for combination of workers in educational and scientific institutions, as well as in manufacturing establishments. In a way hitherto unknown scientific men will be called in the future to work together for common ends. No matter is of more vital importance in the organization of our colleges and experiment stations than the securing of harmonious and concerted action on the part of faculties and staffs for the common good of the institution to which they are attached. One of the greatest difficulties now attending the successful management of these institutions is the fact that while specialization has narrowed the field and outlook of the individual officer, there has not been a corresponding recognition of the necessity of readjusting the form of organization and the spirit of the worker to meet these new conditions. At no time has there been greater need of the cultivation of an earnest and enthusiastic esprit du corps among the rank and file of educational and scientific workers. There are many individual examples of men impressed with this lofty sentiment, but the whole body is not yet animated with it. Obviously it should especially be a virtue characteristic of men connected with public institutions. The officers of our agricultural colleges and experiment stations are public functionaries employed to advance very important public interests. With them the good of the community, as involved in the success of the enterprise

with which they are connected, should be the ruling motive of action. The fame and emoluments of the individual worker should be subordinated to the requirements of concerted action for a common end. And yet in the long run it is believed the individual worker as well as the institution will profit by a loyal and self-sacrificing discharge of common duties, for union of effort will bring greater success; and whenever a college or a station is strong and flourishing, credit is reflected on every worker who has contributed to this issue.

The general considerations affecting the efficient organization of our experiment stations have thus been dwelt upon because a survey of these institutions during the past year has brought additional evidence that the problems of organization are being more generally considered than ever before. The tide is running strongly toward a more compact organization and a greater unification of the work. On the whole, those stations which have a strong organization and administration are meeting with the largest measure of success.

THE ORIGINAL WORK OF THE STATIONS.

There is also unusual interest in the discussion of problems relating to the functions of the stations and the specific duties of station officers. There is quite general agreement that each station should conduct a considerable amount of original investigation; but in what way this should be provided for and what should be its character are variously regarded. There is still great variety in the assignments of teaching and investigation to officers in different stations, and the relative amount of work of research which is left to assistants differs very greatly in different places. Considerations relating to the financial conditions of college and station still affect the assignment of work in a number of institutions. Our observation of the situation leads us to the belief that there is actually going on a widespread differentiation of the investigator from the teacher, and that this is not prevented, though it may be hindered, by the varying arrangements made at the colleges and stations. A certain number of men are more and more devoting themselves to the work of investigation, and succeeding in it. Others are just as certainly losing their interest and activity in such work. Because a man is required to teach many hours he does not thereby become a successful teacher. The research which he is compelled to carry on during vacations and at night may nevertheless be his real mission, and it will be well if his superiors discover this. The leaving of details of research work to assistants often means that the principal has largely lost his interest in it or considers other duties more important. We are getting an increasing body of competent investigators by this process, though in too many cases their training is proceeding under untoward conditions. It will be well if boards and presidents will consider more fully the actual state of things and make

as far as possible such a readjustment that the investigator will be left very largely to investigate and the teacher to teach. It continues to be a weakness of a considerable number of our stations that they are organized on too broad a scale for their resources. Too great a portion of their funds is going into salaries, leaving too little to pay the miscellaneous expenses of important investigations. Here and there only have the authorities had the wisdom and courage to confine the operations of the station within comparatively narrow lines, leaving important departments of work entirely without recognition. It is encouraging, however, to observe that where this has been done success has brought additional funds with which the scope of the station's work could be safely extended.

On the whole, the amount of what may fairly be called original investigation is, in our opinion, steadily increasing. To determine this it is not sufficient to consider simply the bulletins of the stations. These have in various ways been made more popular in form and matter. A larger amount of the more original work is being recorded in the annual reports and the records of more investigations are being withheld from publication until results of value are obtained. While there is still need of urging the advancement of the general standard of investigations, there is every reason to believe that our stations are moving onward and upward as agencies for the original investigation of agricultural problems.

THE INSPECTION SERVICE OF THE STATIONS.

The amount and variety of inspection service required of our experiment stations continue to grow from year to year. Beginning with commercial fertilizers, it now includes feeding stuffs, dairy products and other foods for man, creamery glassware, insecticides, nursery stock for injurious insects, and plant and animal diseases. For a considerable period this matter affected only the stations in the East, where commercial fertilizers were largely used, but it is now a live question in all sections of the country, since there is no region which does not have some evil against which the agricultural public is demanding protection by inspection under State or national auspices. Questions relating to the attitude of the stations toward this work are therefore engaging the attention of station officers throughout the country. Wherever this work has assumed considerable magnitude it is evident that it requires very careful organization in order that it may be conducted so as not to interfere with the work of investigation. Where the same officers are charged with both kinds of work there is constant danger that the severe routine duties of the inspection service will diminish the ability of these officers to conduct

thorough original investigation. It is essential that there should be a distinct differentiation of this service from the other work of the stations as regards both funds and time of performance. Unless this is done and close supervision is exercised, the inspection work is inevitably a drain upon the resources of the station and a hindrance to its more important operations. While our stations have from the beginning been engaged in inspection work, and this has met with increasing popular favor because of its efficient performance, it is still doubtful whether it is the best ultimate arrangement. Almost all our experiment stations are organic parts of educational institutions. As such they are essentially university departments devoted to research and the dissemination of new knowledge. To a certain extent they may naturally and properly engage in the various forms of university extension work through their more popular publications and connection with farmers' institutes, etc. They are organized to conduct investigations on a great variety of subjects, and the scope of their work of investigation can be almost indefinitely extended as their funds increase. They do not need, therefore, to go outside of that work which would be universally considered within their rightful domain as departments of colleges and universities in order to secure a wide field of operation. On the other hand, as the range of inspection service enlarges and its duties become more onerous and complicated it becomes very questionable whether this service should be connected with our educational institutions. It is essentially a part of the police functions of the State and National Governments. It involves many questions on which sooner or later the courts will have to pass. It may even excite public attention to such an extent as to be reckoned worthy of consideration by the people in their choice of administrative and legislative officers. In many ways this kind of business is much more appropriate to bureaus of the State government than to educational institutions.

Thus far the arrangement by which much of it has been connected with the experiment stations has been largely a matter of convenience, and in many States the amount of work to be performed has been so inconsiderable that it has not seemed worth while to create special agencies for its performance. We have now reached a stage in the development of this work when it is believed that this matter should receive careful attention from the managers of our agricultural colleges and experiment stations, in order that a sound policy may be established which will provide for the best future development of these institutions. In our judgment, this would involve efforts to relieve the colleges and stations of the inspection service rather than to increase its scope at these institutions and make it a permanent portion of their work.

STATE AID TO THE EXPERIMENT STATIONS.

A number of the States continue to supplement liberally the national funds, and thus to extend and strengthen the investigations of the stations within their borders. This is done by specific appropriations for substations or special investigations, or by general appropriations for the current expenses of the colleges with which the stations are connected. Often the printing of station publications is provided for by the State. During the past year notable additions have been made to the buildings and equipment of the agricultural colleges, and the experiment stations have received much benefit from these increased facilities. At the University of Illinois a building costing $150,000 has been erected for the use of the agricultural college and experiment station. This will be thoroughly equipped with apparatus and other facilities for instruction, and when completed will form the largest single plant for agricultural instruction and research in this country. At the University of Nebraska a building costing $35,000 has been erected for the special use of the experiment station. At the Washington Agricultural College a science hall costing $60,000 has been erected, which provides greatly improved facilities for the work of the college and station. At the Texas Agricultural College there is a new agricultural and horticultural building costing over $30,000, and at the Kansas Agricultural College an agricultural building of the same value. At the Oklahoma Agricultural College there are new chemistry and library and science buildings, and at the Virginia Agricultural College and the University of Tennessee new and commodious barns have been erected, each costing about $5,000. At the latter institution a dairy building has also been constructed. At the Agricultural College of the University of Minnesota a horticultural-botanical building costing $35,000 has been erected.

It is believed that the successful work of the experiment stations has been a large factor in arousing the attention of the public to the benefits of instruction as well as research in agriculture, and to the importance of equipping the agricultural colleges more amply and giving them increased funds for the extension of their work in both directions. It is well that this fact should be brought to the attention of legislators when appropriations for these institutions are being made. Funds are needed for the extension of investigations as well as for better equipment, and oftentimes a comparatively small sum added to the current revenue of the station will enable it to materially strengthen its work. This is so because the broad organization of our stations requires that a relatively large portion of the national funds must be expended for salaries and wages. This leaves so little for the general expenses of investigations that they can not as a rule be made very extensive. If it is desirable that particular investigations should

be conducted on a somewhat extensive scale or in different localities, the State can often secure this desirable result by providing funds for these specific purposes. As regards the investigations which need to be carried on in different localities, it is, in our judgment, a much wiser policy to give the stations funds for such special investigations than to establish permanent substations, which have universally proved to be relatively expensive and unsatisfactory.

A PERSONAL BEQUEST TO AN EXPERIMENT STATION.

The Connecticut State Station has recently received part of a bequest made by William R. Lockwood, of Norwalk, Conn., amounting to about $80,000, which is to be held as a permanent endowment, the income of which is to be applied "in the promotion of agriculture by scientific investigation and experiment and by diffusion of knowledge of the practical results thereof among the people of the State of Connecticut." This is one of the rare instances in which wealthy citizens have had the wisdom to insure the permanent application of their funds to the public benefit by devoting them to State institutions for education and research. Thus far our wealthy citizens have very largely preferred to endow institutions not directly under State or national control. With the growing change of sentiment regarding the management of our higher educational institutions by the State, and the consequent development of these institutions on a permanent and extensive basis, it is much to be hoped that in the future these institutions will be the recipients of numerous donations from private citizens.

COOPERATION OF THE STATIONS WITH THE DEPARTMENT OF AGRICULTURE.

Much progress has been made during the past year in extending cooperation of the Department and the stations and in maturing plans for the more efficient organization of this work. The stations in all the States and Territories are now cooperating with the Department to a greater or less extent. Among the subjects on which cooperative experiments are being conducted are the following: Tests of varieties of grasses and forage plants in many localities; special experiments with grasses and forage plants for the arid region and the improvement of range lands; breeding experiments with plants; experiments with hybrid orange trees; the culture of dates, tea, sugar beets, and tobacco; the planting of forest trees; the nutrition of farm animals and of man; the effect of feeding stuffs on the chemical composition and physical character of butter; studies of diseases of plants and animals; studies of alkali soils and seepage; the survey and mapping of soils; and irrigation investigations. A representative committee of the

Association of American Agricultural Colleges and Experiment Stations gave very careful consideration to this subject, and made a report to the recent meeting of the association in Connecticut, in which they formulated the principles on which it is desirable from the standpoint of the stations that cooperation should be based. The officers of the Department have also devoted much study to this matter and have thus been able to make plans and contracts for cooperative enterprises in which the actual conditions and requirements of the stations have been much more fully considered. As a result there is a much better understanding on the part of both the stations and the Department regarding the proper scope and limitations of cooperation and the best ways to make it effective. It is now quite evident that by a closer union of effort the work of both the stations and the Department may be made more broadly effective and that the best interests of both these agencies for the promotion of our agriculture demand that they shall be closely affiliated in their operations. With its world-wide association with governments, scientific institutions, and agricultural organizations, and with its trained force of specialists, the Department can bring to the stations advice, information, and materials which will greatly promote their work. The stations, on the other hand, by their intimate knowledge of local conditions of agriculture and their close connections with the practical farmers and horticulturists, can make the work of the Department much more fully felt in the actual business of agriculture throughout the country, and can at the same time provide the Department with that kind of information which will enable it to direct its efforts in the most appropriate lines and with the greatest practical outcome. The expert officers of the stations can also supplement the work of the expert officers of the Department in special lines, so that both the stations and the Department will secure the fruits of much more expert service for a given amount of funds than would be possible under any other arrangement. One very encouraging feature of the development of more intimate relations between the Department and stations is that officers of the stations, as well as graduate students of the agricultural colleges, are coming in larger numbers each year to work and study at the Department, and thus acquire special knowledge, which they will in most cases utilize in special service for the different States and Territories. In this as in other ways the Department is becoming more fully an agency for the benefit of the whole country.

EXPERIMENT STATIONS IN HAWAII.

The first appropriation for the establishment and maintenance of an agricultural experiment station in Hawaii under the direction of the Secretary of Agriculture was made by Congress in May, 1900. This appropriation of $10,000 provides for the erection of buildings and all other expenses essential to the maintenance of an agricultural

experiment station, including the printing (in Hawaii), illustration, and distribution of reports and bulletins.

In order to ascertain definitely the conditions existing in Hawaii with reference to experimental investigations as related to the needs of the agriculture of that Territory, it was deemed desirable to send thither an agent who was thoroughly familiar with the work of the experiment stations in this country. For this purpose the Department was very fortunately able to secure the services of Dr. W. C. Stubbs, who for many years has been the successful director of the three stations in the State of Louisiana, in connection with which extensive experiments have been made in the growing of sugar cane, the manufacture of sugar, and the production of semitropical crops. In the management of his work in Louisiana Dr. Stubbs has found it necessary to familiarize himself with the agriculture of tropical and semitropical regions throughout the world. He was thus eminently fitted to make a rapid survey of the agricultural conditions in Hawaii and to advise this Office with reference to the location and organization of an experiment station there.

In connection with his visit to the Hawaiian Islands, under instructions from the Director of this Office, Dr. Stubbs made a careful investigation of their agricultural conditions and conferred with the managers of educational and scientific institutions already existing in Hawaii and with citizens representing various interests. He also received valuable advice and assistance from the officers of the Territorial government. He was everywhere very cordially received and found that there was much interest in the establishment of an experiment station. Since his return he has submitted a report, in which he recommends that a station be established under the direct control of the Secretary of Agriculture and independent of existing local institutions. As the station already maintained by the Hawaiian Sugar Planters' Association will continue its work in problems relating to the sugar industry, he recommends that the station to be established by this Department give its attention to other agricultural interests. Among the subjects which require especial attention are the culture of fruits and vegetables, coffee growing, stock raising, dairying, irrigation, forestry, and diseases of plants. In a number of these lines the station will require the cooperation of the various divisions of this Department.

As a headquarters for the station it is recommended that the reservation made by the Hawaiian government in 1893 for an experimental and forestry station be secured. This is a tract of 222 acres near Honolulu, with an elevation ranging from 50 to 1,000 feet, thus affording opportunity for a considerable variety of field operations. The buildings needed by the station can conveniently be erected on this tract, and limited areas can be at once cleared for experimental operations. For the proper maintenance of the station, funds equal to those

given to the other stations of the United States should be provided for the current expenses, and in addition provision should be made for buildings and equipment. Following the policy pursued elsewhere, it seems to me that the United States should give to this station the same annual appropriation which is given to other States and Territories under the Hatch Act, and the Hawaiian government and people should be called upon to supplement these funds as far as may be necessary to establish and maintain the station on an efficient basis.

The experiment station at Honolulu, maintained by the Hawaiian Sugar Planters' Association, has continued its work during the past year, and a brief account of its operations is given on page 63.

EXPERIMENT STATIONS IN PORTO RICO.

An appropriation of $5,000 was made by Congress in May, 1900, to determine the agricultural conditions existing in Porto Rico, with special reference to the most desirable localities for agricultural experiment stations, as well as the subjects on which the agricultural people of the island are in most immediate need of practical information, and how this need can be most economically and effectively supplied. The appropriation also provides for the printing (in Porto Rico) and dissemination of circulars of inquiry and bulletins of information in the Spanish and English languages. It will be observed that this appropriation provides only for the preliminary study of questions relating to the establishment of an experiment station in Porto Rico, differing in this respect from the appropriation for Hawaii above referred to. The agent selected for this service is Prof. S. A. Knapp, formerly of the Iowa Agricultural College. In recent years Professor Knapp has successfully engaged in the growing of sugar cane, rice, and other semitropical crops in southern Louisiana, and has lately visited Hawaii and the Philippines in the interests of this Department. He has also had much practical experience in the development of agricultural enterprises in the South on a large scale. He is thus well qualified to judge of the agricultural needs of Porto Rico and to determine what is feasible there in the way of agricultural investigations.

Under instructions from the Director of this Office, Professor Knapp visited Porto Rico, conferred with officers of the government and representative citizens there, and made investigation of the agricultural conditions existing on the island with special reference to the establishment and work of an experiment station. Since his return he has submitted a report, recently transmitted to Congress, in which he points out the urgent need of agricultural education and investigation in the island. He advises that headquarters for an experiment station be established in the vicinity of San Juan, and that this station should be established on a broad basis, special attention being given at the outset to demonstration experiments and the dissemination of information

regarding approved methods of agriculture. Among the subjects to which the station should direct its attention are the improvement of the culture of coffee, sugar, and tobacco; the encouragement of the production of food supplies for home consumption; the improvement of live stock; the making of cheese and butter, and forestry.

As in the case of Hawaii, the appropriation for current expenses for this station should be at least equal to that given to the States and Territories under the Hatch Act. Funds will also be required at the outset for buildings and equipment. If it is possible for the local government to provide the funds for this purpose, as in the case of other States and Territories, it should do so. Otherwise Congress should be asked to make an initial appropriation to provide the station with suitable buildings and equipment.

THE ASSOCIATION OF COLLEGES AND STATIONS.

The Association of American Agricultural Colléges and Experiment Stations held its fourteenth annual convention at New Haven, Conn., in November, 1900. The association went to Connecticut especially to celebrate the twenty-fifth anniversary of the establishment of the first State experiment station in this country, which was organized at Middletown, Conn., in 1875. There was much discussion regarding the relations of this Department with the stations, and their closer affiliation was heartily approved. A brief account of the New Haven meeting is given on page 36 of this report.

EXPERIMENT STATION EXHIBIT AT THE PARIS EXPOSITION OF 1900.

A collective exhibit designed to show the development and present status of the experiment-station enterprise in this country was made at the Paris Exposition of 1900. This exhibit was prepared under the general supervision of a committee of the Association of American Agricultural Colleges and Experiment Stations, consisting of H. P. Armsby, director of the Pennsylvania experiment station, chairman; M. A. Scovell, director of the Kentucky experiment station; A. W. Harris, president of the University of Maine; W. H. Jordan, director of the New York State experiment station, and the Director of this Office.

The exhibit of objects in cases included special devices and apparatus for station work and illustrations, by models and otherwise, of notable results of investigation. At the same time this Office secured from the stations over 800 negatives and photographs illustrating their offices, buildings, and equipment, together with materials for about 100 large charts illustrating different features of their work. This Office also collected a complete set of the office and station publications (some 4,000 documents), and books and monographs by station officers, making in all a library of 750 bound volumes.

To accompany the station exhibit the Director and Mr. V. A. Clark, of this Office, aided by the directors of the stations and members of the Office force, prepared a comprehensive report on the history and present status of the experiment stations in the United States. When printed this made a volume of 636 pages, and was illustrated with 306 figures (arranged in 153 plates), showing buildings, equipment, and features of the work of the individual stations. While this report was prepared primarily to show to foreign nations represented at the Paris Exposition something of the magnitude and success of our experiment-station enterprise, it was also intended to reveal this more clearly to our own countrymen, and to make a permanent record of the condition of the experiment stations in this country at the close of the nineteenth century. This exhibit received much commendation from the foreign officers and experts who examined it, and was given very flattering recognition through the awards conferred by the jury.

THE OFFICE OF EXPERIMENT STATIONS.

Among the matters to which this Office has given special attention during the past year has been the organization of cooperative enterprises between the Department and the stations. By conferences with Department and station officers the Director of this Office has been able to secure and disseminate information regarding the conditions existing in both the Department and the stations and the requirements of cooperative work. Contracts for cooperation have been recorded in this Office and general assistance has been given in the formulating of plans for such work. Much has been accomplished during the past year in strengthening and developing the special investigations in irrigation intrusted to this Office, and it is believed that these are now organized on a substantial and permanent basis. The work on the nutrition investigations has also been somewhat extended, and efforts have been continued to make the results of this work of especial use to educational institutions of different grades, women's organizations, benevolent associations, public institutions, and the Army and Navy. A brief account of the general business of the office will be found on page 28.

STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation, under the act of Congress of March 2, 1887, in all the States and Territories. As stated elsewhere in this report, agricultural investigations in Alaska have been continued with the aid of national funds; an experiment station under private auspices is in operation in Hawaii; and Congress has appropriated $10,000 for the establishment and maintenance of an experiment station under Government auspices in Hawaii, and

$5,000 for a preliminary study of questions relating to the establishment of an experiment station in Porto Rico. In each of the States of Connecticut, New Jersey, and New York a separate station is maintained wholly or in part by State funds; in Louisiana three stations are thus maintained; and in Alabama two—the Canebrake and Tuskegee stations—are maintained wholly by State funds. Excluding the branch stations established in several States, the total number of stations in the United States is 57. Of these, 52 receive appropriations provided for by act of Congress.

The total income of the stations during 1900 was $1,170,857.78, of which $719,999.07 was received from the National Government, the remainder, $450,858.71, coming from the following sources: State governments, $247,281.46; individuals and communities, $2,420.51; fees for analyses of fertilizers, $70,927.31; sales of farm products, $90,088.84; miscellaneous, $40,140.59. In addition to this, the Office of Experiment Stations had an appropriation of $45,000 for the past fiscal year, including $12,000 for the Alaskan investigations. The value of additions to the equipment of the stations in 1900 is estimated as follows: Buildings, $89,416.23; libraries, $10,784.70; apparatus, $19,397.85; farm implements, $17,015.86; live stock, $22,009.10; miscellaneous, $8,850.94; total, $167,474.68.

The stations employ 693 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 71; chemists, 143; agriculturists, 74; experts in animal husbandry, 14; horticulturists, 75; farm foremen, 24; dairymen, 30; botanists, 55; entomologists, 50; veterinarians, 29; meteorologists, 16; biologists, 6; physicists, 7; geologists, 6; mycologists and bacteriologists, 17; irrigation engineers, 7; in charge of substations, 10; secretaries and treasurers, 27; librarians, 10; and clerks, 51. There are also 30 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds, and buildings, apiarists, herdsmen, etc. Three hundred and twenty-seven station officers do more or less teaching in the colleges with which the stations are connected.

The activity and success of the stations in bringing the results of their work before the public continues unabated. During the year they published 386 annual reports and bulletins, which are many more than are required by the Hatch Act. These were supplied to over half a million addresses on the regular mailing lists. A number of stations supplemented their regular publications with more or less frequent issues of press bulletins. These are short popular articles which are prepared at little expense to the station, but which, through the medium of the local agricultural press, reach a wide circle of readers and bring the station and the practical results of its work pointedly before the public.

The stations are being consulted more and more by farmers, and the information given is of the most varied character. This necessitates a voluminous and constantly increasing correspondence. Station officers come into personal contact with farmers at farmers' institutes, where they make addresses and answer questions. Many persons are thus benefited by the stations' work who would not otherwise be reached.

The results of station work are further given wide publicity by the general agricultural press. These papers not only give numerous popular accounts of the work of the stations, but they often employ station officers to answer questions of correspondence and as special contributors. Station officers are also frequent contributors to scientific journals. A number of books by station officers has been published during the year.

OFFICE OF EXPERIMENT STATIONS.

AN OFFICE IN THE UNITED STATES DEPARTMENT OF AGRICULTURE.

The work of the Office of Experiment Stations during the past year, as heretofore, has included the supervision of the expenditures of the stations; conferences and correspondence with station officers regarding the management, equipment, and work of the stations; the collection and dissemination of information regarding the progress of agricultural education and research throughout the world by means of technical and popular bulletins; the management of the agricultural experiment stations in Alaska, and the conduct of preliminary investigations with reference to the establishment of stations in Hawaii and Porto Rico. Special investigations on the nutrition of man and on irrigation assigned to this Office have been prosecuted very thoroughly in cooperation with experiment stations, educational institutions, and other agencies in different States and Territories. The Office also did a large amount of work in connection with the collective experiment station exhibit at the Paris Exposition.

The income of the Office during the past fiscal year, derived wholly from appropriations by Congress, was as follows:

For the general business of the office	$33,000
For the Alaska experiment stations	12,000
For nutrition investigations	15,000
For irrigation investigations	35,000
Total	95,000

During the year the Office issued 58 documents, aggregating 3,367 pages. These include 10 numbers of the Experiment Station Record, with detailed index, 15 bulletins, 7 farmers' bulletins (including 4 numbers of the subseries entitled "Experiment Station Work"), 4 circulars, 4 reports, 4 articles for the Yearbook of the Department, and 14 special articles published as separates.

Experiment Station Record, Vol. XI, pp. 1220.—This contains abstracts of 355 bulletins and 43 annual reports of experiment stations in the United States, 153 publications of the Department of Agriculture, and 1,184 reports of foreign investigations. The total number of pages in these publications is 74,981 (for Vol. VIII it was 38,552). The total number of articles abstracted is 2,225, classified as follows: Chemistry, 146; botany, 175; fermentation and bacteriology, 19; zoology, 18; meteorology, 54; air, water, and soils, 79; fertilizers, 102; field crops, 220; horticulture, 232; forestry, 59; seeds and weeds,

66; diseases of plants, 179; entomology, 221; foods and animal production, 194; dairy farming and dairying, 184; veterinary science, 234; technology, 6; agricultural engineering, 37; statistics, 86. Classified lists of articles, in some cases with brief extracts, are also given in each number. The aggregate number of titles thus reported is 2,247.

Special articles were also published in this volume of the Record as follows: "Selection and its effects on cultivated plants," "Artificial changes of physical properties of soils," and "Adaptation of methods of cultivation and manuring to the physical properties of soils."

There are condensed accounts of the Proceedings of the Sixteenth Annual Convention of the Association of Official Agricultural Chemists, 1899, and of the Thirteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations; and, in addition, editorial discussions of a number of topics.

MISCELLANEOUS TECHNICAL BULLETINS.

Bulletin 72, pp. 36.—Farmers' Reading Courses.—This bulletin shows the scope and methods of work followed in farmers' reading courses in the United States, which, "as an important phase of the general movement among our agricultural colleges to go outside of their class rooms and promote the education of our farmers along the lines of their art, are now attracting widespread attention." It reviews their history and present status, describing reading courses actually in operation in seven States, and contains suggestions regarding the organization of such courses, with an appendix showing representative documents used in the courses in various States.

Bulletin 74, pp. 121.—Organization Lists of the Agricultural Colleges and Experiment Stations in the United States, with a List of Agricultural Experiment Stations in Foreign Countries.—This contains a list of the officers of the Association of Agricultural Colleges and Experiment Stations and of the Association of Official Agricultural Chemists; a list of institutions having courses in agriculture in the United States, with courses of study and boards of instruction; a list of experiment stations in the United States, with governing boards and station staffs; a list of experiment stations in fifty-seven foreign countries, with their location and directors; a list of station publications received by the Office of Experiment Stations during 1899; Federal legislation affecting agricultural colleges and experiment stations, and regulations and rulings of the Federal Departments affecting the stations.

Bulletin 76, pp. 112.—Proceedings of the Thirteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at San Francisco, Cal., July 5–7, 1899.—Contains, in addition to the proceedings of the convention, papers,

addresses, and reports on a number of subjects of interest to students and investigators in agricultural science.

Bulletin 77, pp. 100.—The Digestibility of American Feeding Stuffs.—Summarizes the results of 378 experiments made at the experiment stations in the United States up to the close of 1898 on the digestibility of feeding stuffs by farm animals, and discusses the process of digestion, the significance and practical value of digestion coefficients, the methods, sources of error, and limitations of digestion experiments as at present conducted, and the various factors affecting digestibility.

Bulletin 78, pp. 39.—Statistics of the Land-Grant Colleges and Agricultural Experiment Stations in the United States for the Year Ended June 30, 1899.—Shows the number of officers and students, endowment, equipment, and revenue of the colleges, and the number of officers, revenues, expenditures, lines of work, and number of publications of the stations.

Bulletin 79, pp. 34.—Farmers' Institutes.—Gives the history and present status of farmers' institutes in the United States and Canada.

Bulletin 80, pp. 636.—The Agricultural Experiment Stations in the United States.—Prepared as a part of the exhibit of the agricultural experiment stations in the United States at the Paris Exposition, is an account of the history, work, and present status of the experiment stations in general, and of the fifty-six stations individually, profusely illustrated with half tones, showing buildings, plats, laboratories, herds, etc. It treats of the agricultural conditions in the United States as related to the work of the stations; history of the stations; relation of the Federal Government to the stations; relations of the stations with associations; organization, equipment, lines of work, and general results of the stations: the associations affiliated with the stations; and gives a list of officers, history, organization, equipment, financial support, lines of work, methods of disseminating information, and general results of the work of the individual stations in the several States and Territories. An appendix includes an article on inspection work of the stations; Federal legislation and rulings affecting agricultural colleges and experiment stations; statistics of the agricultural experiment stations in 1899; publications of the Office of Experiment Stations and the several stations, from 1875 to 1899, inclusive; a description of the card index of experiment-station literature; a list of books by experiment-station officers, and a catalogue of the collective experiment station exhibit at the Paris Exposition.

Bulletin 82, pp. 55.—Third Report on the Investigations of the Agricultural Capabilities of Alaska in 1899.—Includes the report of the special agent in charge of the Alaska investigations on the work at Sitka, Kenai, and Kadiak during the open season of 1899.

Bulletin 83, pp. 111.—Report on the Work and Expenditures of the

Agricultural Experiment Stations for the Year Ended June 30, 1899.—Contains the report of the Director of this Office as transmitted to Congress.

U. S. Dept. Agr. Report 63, pp. 48.—The Work of the Agricultural Experiment Stations on Tobacco.—This bulletin contains abstracts of the publications of the stations on this subject, with an introduction and comments by the Chief of the Division of Soils.

Card Index of Experiment Station Literature.—Copy for 1,300 cards was prepared during the past year. The number of index cards distributed has reached 19,200.

FARMERS' BULLETINS.

Farmers' Bulletin 109, pp. 19.—Farmers' Reading Courses.—This is an abridgment of Bulletin No. 72 of the Office of Experiment Stations above referred to (p. 29).

Farmers' Bulletin 112, pp. 39.—Bread and the Principles of Bread Making.—Summarizes recent information on this subject compiled from all available sources, including standard works and the results of investigations conducted under the auspices of this Office. Among the topics treated are grains and flours, yeasts and other leavening agencies; raised bread; special breads; household methods of bread making; imperfections and impurities in bread; and the nutritive value and cost of bread.

Farmers' Bulletin 116, pp. 48.—Irrigation in Fruit Growing.—Discusses "the relations of irrigation to fruit production, and irrigation methods as they have been demonstrated by Pacific coast experience, to the end that recourse to irrigation, wherever it be found desirable, may be facilitated and promoted." The topics treated include the relations of cultivation and irrigation; effects of insufficient moisture; time of application; flowing water *v.* falling water; development and utilization of irrigation water; preparing land for irrigation; methods of applying irrigation water; how much water to apply; after-treatment of irrigated land; cover crops in the irrigated orchard; and minor results of irrigation.

Farmers' Bulletins 103, 105, 107, 114, 119.—Experiment Station Work XI, XII, XIII, XIV, XV.—The five numbers prepared during the past year of the subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries.

AGRICULTURAL EXPERIMENT STATIONS IN ALASKA.

For an account of the work of the Alaska stations during the past year, see page 42.

NUTRITION INVESTIGATIONS.

The investigations on the nutrition of man, in charge of this Office, have been conducted during the past year along the following general lines:

Observations have been made on the nutritive value and cost of different food materials in various localities in the United States. These were less extended than in some previous years and were mostly in connection with dietary studies.

Studies have been made of actual dietaries in order to learn the kinds and amounts of food materials consumed by people in different localities, of different occupations, ages, and sex, and under varying conditions.

The digestibility of certain articles of food, especially cereal products, has been studied, and comparisons have been made between the cheaper and more expensive foods to determine the relative effect on health and comfort by their use.

Studies have been conducted to determine the losses in nutritive value from various modes of cooking and to find out the most economical methods for ultilizing different food materials.

Metabolism experiments have also been continued with the respiration calorimeter. The principal theme has been the transformation of the energy of food materials in the body, and the use which the body makes of the energy so transformed. One important topic has been the relation of muscular work to digestibility and metabolism. The amounts of food consumed and metabolized by men under different conditions of work and rest have been observed. The fuel values of the fats, carbohydrates, and alcohol have been compared.

Determinations of the heats of combustion of food materials have been made with the bomb calorimeter.

Methods of investigation are being studied with reference to their improvement, and constant effort is being made to devise better forms of apparatus.

The current literature of the nutrition of man, which is now quite voluminous, is being regularly followed up, and such abstracts and compilations are being made as will promote the interests of our investigations.

The rapid accumulation of material which must be made ready for publication in both technical and popular form necessitates a large amount of editorial work. The correspondence connected with these investigations has grown to be extensive.

This work was carried on in cooperation with colleges and experiment stations in Connecticut, Massachusetts, Maine, New Jersey, Tennessee, Illinois, Ohio, Minnesota, and California.

Six bulletins and one Yearbook article on subjects relating to the

food and nutrition of man have been issued from this Office during the past year, as follows:

Bulletin 67, pp. 51.—Studies on Bread and Bread Making.—Contains studies on bread and bread making at the University of Minnesota in 1897 and 1898, and on losses in the process of bread making at the New Jersey Agricultural Experiment Station.

Bulletin 68, pp. 48.—A Description of some Chinese Vegetable Food Materials and Their Nutritive and Economic Value.—Describes and discusses the nutritive and economic value of some vegetable food materials (roots and tubers, green vegetables and cucurbits, seeds and grains, fruits, nuts and flowers, fungi and algæ, and miscellaneous substances) which are used to a considerable extent by the Chinese population in San Francisco and other cities of the United States, and which may become generally and favorably known in the United States.

Bulletin 69, pp. 112.—Experiments on the Metabolism of Matter and Energy in the Human Body.—Contains a report of experimental tests of the Atwater-Rosa respiration calorimeter, and a detailed account of six experiments on the metabolism of matter and energy in the human body.

Bulletin 71, pp. 45.—Dietary Studies of Negroes in Eastern Virginia in 1897 and 1898.—Contains accounts of twelve dietary studies conducted in 1897 in families living in the region bordering the Dismal Swamp, where the style of living is very primitive and the income usually quite limited; and of seven dietary studies conducted in 1898 in families living in the neighborhood of Hampton, Va., some of whom had been under the influence of the Hampton Institute, and were quite well to do, while others had received no such training and were believed to be fairly representative of negroes of very limited means and little or no education.

Bulletin 75, pp. 72.—Dietary Studies of University Boat Crews.—This is an account of seven dietary studies made with Harvard and Yale boat crews in the spring of 1898, during the month preceding the annual races of these crews at New London. These studies were undertaken primarily to secure data regarding the food requirements of man performing severe muscular work.

Farmers' Bulletin 112, pp. 38.—Bread and the Principles of Bread Making.—Summarizes the latest knowledge on this subject, as stated on page 31.

Yearbook of the Department of Agriculture, 1899, pp. 403–414.—Development of the Nutrition Investigations of the Department of Agriculture.—Describes the origin, progress, and present status of these investigations.

IRRIGATION INVESTIGATIONS.

Much progress has been made during the past year in the organization and development of irrigation investigations in charge of this Office. In accordance with the terms of the appropriation act two general lines of investigation have been pursued: (1) The study of the laws and institutions relating to irrigation in different regions, and (2) the determination of the actual use made of irrigation waters. Investigations have been made in seventeen States and Territories, largely in cooperation with the agricultural colleges, experiment stations, and State engineers' offices.

The largest single enterprise connected with these investigations has been in the State of California, where a large amount of information has been collected as to how water for irrigation is owned, distributed, and used on eight typical streams in different parts of the State. The California Water and Forest Association has contributed several thousand dollars to aid this work. The University of California and Leland Stanford Junior University have also given efficient aid to this enterprise and have been represented on the staff of agents employed in the prosecution of the work. A comprehensive report on these investigations is now in course of preparation. It is believed that this is the largest and most comprehensive inquiry regarding irrigation laws, customs, and conditions which has been undertaken in this country. Similar investigations, though on a smaller scale, have been made in Utah, Colorado, and other States.

The measurements of the duty of water undertaken last year have been extended this season, regular stations for this purpose having been maintained in eleven States and Territories in the irrigated region. A detailed report on the observations of the previous season is now in press, which includes a larger amount of data on this subject than has ever been brought together before. Studies of the losses from evaporation and seepage and of the amount and character of sediment contained in irrigation waters have also been carried on in a number of localities.

Interest in the use of irrigation to supplement rainfall in the humid regions of the United States is constantly growing. In a number of sections this has been greatly stimulated during the past season by long-continued drought. Interesting and valuable investigations regarding the use of water for irrigation in New Jersey have been made by Professor Voorhees, director of the New Jersey agricultural experiment stations. The results of these investigations have recently been published, and they indicate that the practice of irrigation has been quite profitable in that State as far as it has been tried.

Similar investigations are being undertaken in Missouri and Wisconsin in cooperation with the experiment stations in those States. A

preliminary survey was also made of the conditions of irrigation practice in the rice fields and sugar plantations of the Southern States. This indicated that there is great opportunity for improvement in the methods and use of water in that region, and it is hoped that it may be possible to undertake a study of some of these problems in the near future. A report of the irrigation system of Hawaii is now in press.

During the past year six bulletins and reports on irrigation have been prepared for publication in this Office:

Bulletin 70, pp. 40.— Water-Right Problems of Bear River.—A discussion of the water-right complications and problems of a typical interstate stream.

Bulletin 73, pp. 64.—Irrigation in the Rocky Mountain States.—Explains the agricultural conditions prevailing and the methods of acquiring and using water for irrigation practiced in that portion of the arid region, covering more particularly the States of Colorado, Wyoming, Utah, Idaho, and Montana. This is preliminary to a more thorough investigation on the laws of the water-right problems of these States.

Bulletin 81, pp. 56.—The Use of Water in Irrigation in Wyoming, and its Relation to the Ownership and Distribution of the Natural Supply.—Treats of the application of water to crops, water measurements in Wyoming, duty of water, the irrigating season, and continuous flow as a basis for appropriation.

Bulletin 86, pp. 253.—The Use of Water in Irrigation.—Discusses in detail the results of investigations on the duty of water in eight States of the arid region. It records the results of systematic measurements of the amount of water actually used on a large number of farms in widely separated portions of this region.

Farmers' Bulletin 116, pp. 48.—Irrigation in Fruit Growing.—Is a practical treatise on this subject by a horticulturist of long experience in California.

Yearbook of the Department of Agriculture, 1899, pp. 591–612.—Rise and Future of Irrigation in the United States.—This is a concise presentation of the history, present status, and future prospects of irrigation in this country, with brief statements regarding some of the most important problems affecting further development of our irrigation system.

THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The fourteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations was held at New Haven and Middletown, Conn., November 13–15, 1900, and was attended by delegates representing all sections of the country. The association went to Connecticut this year especially to celebrate the twenty-fifth anniversary of the founding of the Connecticut Agricultural Experiment Station, which was the first station organized under State auspices in this country.

One day was spent at Middletown, where the association was most cordially received and hospitably entertained by Wesleyan University. The delegates also had the opportunity of seeing the Atwater-Rosa respiration calorimeter in operation. At a meeting held in the university chapel, Dr. W. H. Jordan, director of the New York State Experiment Station, gave a historical address on the American agricultural experiment stations. Besides reviewing the rapid growth of this great enterprise from its beginning at Middletown twenty-five years ago, and pointing out the great scientific and practical results which it has already achieved, Dr. Jordan strongly urged that the stations should use every effort to put their work more fully on a high scientific level and devote themselves very largely to original investigations.

He was followed by Prof. W. O. Atwater, who gave a number of interesting details regarding the establishment of the Connecticut Station as the first State station in this country, and showed that the influence of this station had been very great in shaping the organization and work of other stations.

President J. E. Stubbs, of the University of Nevada, presided at the general sessions, and delivered the president's annual address. He took strong ground regarding the fundamental necessity for the direct and indirect teaching of sound moral principles in our public educational institutions of all grades. "It is character and not intelligence that determines the historical development of nations. It is character and not intelligence that distinguishes one individual from another and contributes to social well-being. The morality of the race, together with its strength and vigor, must be the principal object of education; all else is secondary."

A carefully prepared and eloquent address on the career of the late

Senator Justin S. Morrill, of Vermont, was delivered by President G. W. Atherton, of the Pennsylvania State College. President Atherton's close association with Senator Morrill for many years and his intimate familiarity with the history of the movement for the establishment of colleges and agricultural experiment stations under national auspices enabled him to treat this subject in a very thorough and satisfactory manner, so that his address will have a permanent historical value.

Dr. Bernard Dyer, of London, England, as the representative of the Lawes Agricultural Trust, delivered the biennial course of lectures provided for in that trust. In these he gave a résumé of the investigations at the Rothamsted Experiment Station during the past fifty years with different kinds of fertilizers on wheat, pointing out especially the effects of different systems of manuring on the amount and availability of the fertilizing constituents in the soils experimented with. Besides resolutions of thanks to Dr. Dyer, the association adopted a memorial showing its high appreciation of the life and work of Sir John Bennet Lawes and his associates at the Rothamsted Station.

The report of the executive committee pointed out that Congress had recognized the importance of the land-grant colleges to the country in a notable way during the past year, by providing that when the proceeds of the sale of public lands were insufficient to meet the annual appropriations for these institutions the deficiency should be met by direct appropriations from the National Treasury.

In the section on agriculture and chemistry much attention was naturally given to discussions of investigations on tobacco, the Connecticut State Station being engaged in important work in this line in cooperation with the Division of Soils of this Department. Papers were read on methods of experimenting with cigar-wrapper leaf tobacco and on the methods of growing and curing white Burley tobacco. Among other papers read in this section were those on tests in feeding dairy herds, cooperative field experiments, on the raising of sugar beets as a new and profitable industry in this country, and on available energy in foods.

The report of the section on horticulture and botany showed that there had recently been a great growth of interest in the subject of plant breeding and that studies in this direction were being undertaken by both botanists and horticulturists. There is a marked tendency to devote relatively less time to systematic botany and give much more consideration than formerly to problems in plant physiology. The testing of varieties still occupies a large place in the work of the stations, but it is being supplemented by investigations conducted on a more scientific basis. Among the papers read in this section were the following: Plant physiology in its relation to agriculture and

horticulture; grasses and forage plant investigation in experiment stations and the Division of Agrostology; laboratory and field work for students in horticulture; the educational status of horticulture; what our experiment stations have done in originating varieties of plants by crossing and selection; the relation of the Section of Seed and Plant Introduction to experiment stations; and vegetation house arranged for pot experiments.

The section on entomology had a larger attendance than usual, and there was a full programme, which brought out much interesting discussion. Among the papers read were the following: Observations on the banding of trees to prevent injury by the fall canker-worm; suggestions toward greater uniformity in nursery inspection laws and rulings; nursery inspection and orchard insecticide treatment in Illinois; entomology in the Southern States; economic entomology in Florida; experiences in nursery and orchard inspection; some recent results with hydrocyanic acid in large buildings for the destruction of insect pests; danger to American horticulture from the introduction of scale insects; entomological œcology; recent progress in cotton spraying, and new designs for cotton sprayers; some cotton insects and methods for suppressing them; observations on *Artace punctistriga;* a little known asparagus pest; a power sprayer for asparagus; notes on crude petroleum and its effects upon plants and insects; and nursery inspection in a State free from San José scale.

The report of this section showed that much progress is being made in the specialization of the work of the station entomologists, in instruction in entomology in colleges, and in the improvement of facilities for research and instruction in this branch. There is a marked increase in recent years in the amount of inspection work required of station entomologists, and problems relating to the organization and management of this work require very careful thought and attention. Uniformity of inspection laws was advocated. It was shown that inspection had already caused much greater carefulness among nurserymen, thus removing one of the main causes of the dissemination of injurious pests.

One of the most important subjects on which the association took action at this meeting was the report of the committee on cooperative work between the Department of Agriculture and the experiment stations. This was carefully prepared by a thoroughly representative committee after consultation with the directors of the stations, and was unanimously adopted by the association. It commended the attitude of the present Secretary of Agriculture toward closer cooperation between the Department and the stations and pointed out the different ways in which the two institutions might aid each other. It also attempted to define the principles on which the joint work should be arranged and conducted.

THE AGRICULTURAL EXPERIMENT STATIONS IN THE SEVERAL STATES AND TERRITORIES.

ALABAMA.

Agricultural Experiment Station of the Alabama Polytechnic Institute, Auburn.

DEPARTMENT OF THE ALABAMA POLYTECHNIC INSTITUTE.

The work of the Alabama Station during the past year has included experiments in soil improvement; studies of fertilizers and the nutritive value of legumes; experiments with corn; studies of forage plants, especially sorghum, cowpeas, rye, vetch, and crimson clover; investigations on the immediate and residual fertilizer effects of legumes and stable manure; variety, breeding, and fertilizer experiments with cotton; investigations to ascertain the portion of nitrogen obtained by cowpeas from the air; experiments with fodder crops; feeding experiments with pigs and with dairy cows; experiments in butter making; investigations on the availability of phosphoric acid in phosphatic manures; studies of phosphate beds in north Alabama; investigations on the chemical life history of the cotton plant; soil tests with legumes; experiments in sirup making; experiments on the immunity of Northern-bred cattle; studies of animal diseases and the toxic effects of cotton-seed meal and cotton seed when fed to hogs; diseases of plants, particularly of fruit trees; experiments with vegetables, small fruits, and ornamental trees and shrubs, and with hybrid oranges and tea received from this Department, and experiments with grasses, particularly native species.

The station has continued the inspection and analysis of fertilizers under State law, and has aided in the establishment of the inspection of milk, meat, and dairy products in different parts of the State. The officers of the station are assisting in a biological survey of the State. Cooperative experiments with farmers are being continued, with special reference to the improvement of soils and the rational use of commercial and farm fertilizers and green manures. The station is developing an arboretum of native trees, and during the year has issued a comprehensive summary of its investigations on cotton from 1883 to the present time. The horticulturist has given considerable attention to tomato rot, and finds that it is caused by a bacillus and not by the filamentous fungi, as commonly stated. During the

year the horticulturist has begun irrigation experiments with cabbages and other vegetables, and is already getting very favorable results. A new analytical laboratory is being equipped for the chemical department. The farm has recently been enlarged by the purchase of 80 acres, and extensive additions have been made to the live stock.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees for fertilizer analyses	5,628.21
Farm products	931.94
Miscellaneous	1,668.87
Total	23,229.02

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 105–108, Index to Volume 7, and the Annual Reports for 1898 and 1899.

Bulletin 105, pp. 34.— Winter Pasturage, Hay and Fertility Afforded by Hairy Vetch.—This bulletin gives in detail methods of growing, inoculating, and fertilizing hairy vetch, and considers its adaptability for winter pasturage and green manuring in the South.

Bulletin 106, pp. 16.—Orchard Notes.—These notes are largely confined to the effects of the unusual cold of February, 1899, on the apples, cherries, figs, grapes, Japanese persimmons, peaches, pears, and plums growing at the station and in different parts of the State. Notes on injurious insects and diseases are given in some instances.

Bulletin 107, pp. 247, pls. 23, figs. 3.—Results of Experiments on Cotton in Alabama.—A report on cotton prepared for the Paris Exposition, embodying the experience of the station with cotton for sixteen years, and covering the following subjects: Varieties, culture, fertilizers, diseases, list of fungi recorded as growing on cotton, bibliography of cotton diseases, climate of cotton belt, improvement of cotton by hybridization and by selection, and chemistry of cotton.

Bulletin 108, pp. 36, figs. 2.—Tomatoes.—An outline of methods of culture and the results of experiments at the station, including a discussion of the following topics: Soils and fertilizers, plant growing, cultivation and training, pruning, diseases and insects, varieties, and marketing.

Index to Volume 7, pp. 28.—An index to Bulletins 101–107 of the station, issued during the calendar year 1899.

Annual Report, 1898, pp. 38.—The organization list of the station, financial statement for the fiscal year ended June 30, 1898, summary of the bulletins issued during the year, list of the subjects treated in the 100 bulletins issued since the organization of the station, list of

exchanges, and departmental reports reviewing the work of the station along the different lines.

Annual Report, 1899, pp. 32.—The organization list, report of the treasurer for the fiscal year ended June 30, 1899, and reports of the director and botanist, chemist, associate chemist, veterinarian, agriculturist, and biologist and horticulturist, giving a general review of the station work during the year ended December 31, 1899.

The work of the Alabama Station naturally centers about cotton, which is the great staple crop of the State. Its efforts are directed to the improvement of this crop, the maintenance and restoration of fertility of the soil, and the diversification of agriculture through investigations in animal industry and dairying and experiments with forage crops. The recent additions to the farm and live stock of the station were made with a view to developing work along these latter lines. The horticulturist is endeavoring to further the interests of commercial fruit and vegetable growing in the State. The new analytical laboratory will facilitate a greater differentiation of station, college, and State work along chemical lines. The station continues to keep in touch with farmers through its system of farmers' institutes, which are in charge of the veterinarian, and through its system of cooperative experiments. That the station is appreciated by the farmers is shown by the steadily increasing demand for its bulletins. The affairs of the Alabama Station are in good condition, and the prospects for its increased efficiency are bright.

Agricultural Experiment Station of the Tuskegee Normal and Industrial Institute, Tuskegee.

DEPARTMENT OF THE TUSKEGEE NORMAL AND INDUSTRIAL INSTITUTE.

This station was established four year ago by the State, is maintained by a State appropriation of $1,500 a year, and is associated with the agricultural department of the Tuskegee Institute. The land regularly devoted to experimental work consists of 10 acres, but other land is available if necessary. The experimental work thus far has been confined mainly to field and fertilizer work. Such experiments have been made with sweet potatoes, cotton, peas, onions, crimson clover, wheat, corn, teosinte, cabbage, rye, and vetches. Vetches, crimson clover, and velvet beans have given very good results in the locality of the station. Some feeding experiments have also been made. The station staff consists of a director, farm manager and market gardener, floriculturist, manager of dairy herd, superintendent of stock, dairyman, and horticulturist, who are likewise instructors in the institute.

The publications of this station received from the date of organization to the end of the past fiscal year were Bulletins 1–3.

Bulletin 1, pp. 9.—Tuskegee Station.—Feeding Acorns.—Text of the act of the Alabama legislature approved February 15, 1897, establishing the station, brief notes on proposed station work, and a discussion of the composition and feeding value of acorns.

Bulletin 2, pp. 15, figs. 5.—Experiments with Sweet Potatoes.—Results of fertilizer tests with sweet potatoes and general directions for the culture of the crop.

Bulletin 3, pp. 16, figs. 3.—Fertilizer Experiments with Cotton.—Results of experiments in growing cotton with commercial fertilizers on a worn-out soil. Nitrate of soda, acid phosphate, and muriate of potash in different combinations were compared on limed and unlimed plats.

The work of the Tuskegee Station is especially in the interests of the colored farmers of the State, although white farmers also make use of the results obtained. Much of the work done is in the nature of object lessons, and as such is productive of much good. It is especially beneficial to those who come to the institute to examine it either as students or visitors.

ALASKA.

Agricultural Experiment Stations, Sitka and Kenai.

IN CHARGE OF OFFICE OF EXPERIMENT STATIONS.

The work in Alaska during the past year has included experiments in growing wheat, barley, rye, oats, emmer (Russian spelt), millet, buckwheat, corn, and numerous varieties of vegetables; experiments on new land with lime, barnyard manure, guano, and seaweed; drainage experiments; experiments in the making and storage of silage; an investigation of the agricultural possibilities of the interior of Alaska, especially the Yukon Valley; and a preliminary investigation of the Copper River region. Regular stations were maintained at Sitka and Kenai, in Cook Inlet, and in addition to the data collected by officers of these stations considerable additional information regarding the agricultural capabilities of the coast region and the interior has been obtained from residents of Alaska. Meteorological observations have been made at a number of places in cooperation with the Weather Bureau of this Department. Soil temperature records were made at Sitka, Kenai, Eagle, and Fort Yukon.

The fourth report on the investigations in Alaska, giving a detailed account of the operations during the year 1900, has been prepared for transmission to Congress and has been published as House of Representatives Document No. 335, 56th Congress, 2d session (Office of Experiment Stations Bulletin No. 94).

The appropriation for the Alaska investigations for the fiscal year ended June 30, 1900, was $12,000.

In order to gain more complete information regarding the agricultural possibilities of Alaska it was decided to give considerable attention this year to a preliminary survey of the interior. For this purpose two officers made a tour from Skagway via White Horse to Dawson and down the Yukon River, stopping at a number of points, including Eagle, Circle, Fort Yukon, Rampart, Weare, Holy Cross Mission, and St. Michael. Reservations of land for experimental purposes were made at Rampart and Fort Yukon, and headquarters for this work were established at the former place, where an officer of the station will pass the winter with a view to inaugurating experimental work next season.

At Sitka a silo was built entirely of logs, except the roof, which is of common native spruce boards. The logs were fitted together with much exactness and cracks between them were filled with moss. The silo was filled with grass (*Elymus mollis*) found growing on the beach. The silo was opened on November 10, and the silage was found to be in first-class condition.

Wheat, barley, rye, oats, emmer, and buckwheat were successfully matured at Sitka, but millet and corn did not mature. The experiments with lime and fertilizers gave additional evidence that with proper treatment new land in Alaska may be made to produce crops successfully. Of especial interest are the results indicating that seaweed may be used with success as a fertilizer in this region, since this material can be gathered in almost unlimited quantities on the coast in Alaska.

At Kenai a house for the station superintendent has been constructed and 2 additional acres of land have been cleared. The experiments with winter wheat and rye sown in August, 1899, were unsuccessful. Owing to dry weather early in the season the spring grains did not get a good start, though later in the season they grew rapidly. A final report has not been received from this station, but it has been learned that mature barley was harvested September 20 from the seed which matured there last year.

Experience at the stations and in other parts of Alaska during the past season, as heretofore, shows that a considerable variety of vegetables can be grown both in the coast region and in the interior. At Dawson, for example, there are several successful market gardens, and the common hardy vegetables are grown without trouble. Barley and oats were also matured at Dawson in 1899. At Eagle vegetable gardens are successfully maintained, and oats and barley were matured this season. Last winter 19 head of army horses and mules at Fort Egbert were pastured out and successfully maintained in this way on native forage with the addition of only 2 pounds of grain a day per head. The vegetable gardens at Holy Cross Mission have been very successful.

ARIZONA.

Agricultural Experiment Station of the University of Arizona, Tucson.

DEPARTMENT OF THE UNIVERSITY OF ARIZONA.

The lines of work of the Arizona Station during the past year have included irrigation investigations; experiments with green manuring crops; vegetable growing; the improvement of grains, especially wheat and barley; experiments with drought-resistant forage crops; experiments with fruits and varieties of eucalyptus; feeding experiments with steers and sheep; dairying; the improvement of worn-out ranges; the utilization of cacti for forage purposes; chemical studies of irrigation waters, with special reference to the amount and nature of silts and soluble salts contained, and the practical application of the results in problems of drainage.

In cooperation with this Department, experiments in the growing of date palms and sugar beets have been continued; a soil survey of the Salt River Valley, with especial reference to the location of alkali soils, has been undertaken, and irrigation investigations and studies with reference to the maintenance and reclamation of the ranges are being made. By special arrangement, the entomologist of the New Mexico Station has made a special investigation of the insect pests of the Salt River Valley. Experiments have been commenced in the cultivation of opuntias on arid lands as a means of improving worn-out ranges. Variety tests of barley, especially beardless varieties, for hay have resulted in the discovery of a Minnesota variety much superior to any previously grown in Arizona. This discovery is believed to be worth thousands of dollars to the stockmen of the valley. The agriculturist and horticulturist has devised an ingenious arrangement for determining, in the irrigation of orchards, the loss of water by seepage and evaporation and the amount taken up by the trees. Borings are made and samples taken to determine the depth at which the soil is moist. An expert in animal husbandry has been added to the staff. A tract of 28 acres has been acquired and added to the experimental farm at Phœnix for the especial use of the division of animal husbandry.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees	295.23
Farm products	157.76
Miscellaneous, including balance from previous year	782.65
Total	16,235.64

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 31–33 and the Annual Report for 1899.

Bulletin 31, pp. 12, pl. 1.—Sugar Beet Experiments during 1899.—An account of experiments conducted mainly to study the question of irrigation for sugar beets. Incidentally data were secured on the limits of the season, best time to sow and harvest, and on the changes taking place in the beet during ripening.

Bulletin 32, pp. 27.—Some Insect Pests of Salt River Valley and the Remedies for Them.—Notes on the more important insects of Salt River Valley, with a discussion of remedies for each.

Bulletin 33, pp. 64, pl. 1, figs. 31.—An Inquiry Into the Cause and Nature of Crown Gall.—The author reviews previous investigations regarding crown gall, outlines its geographical distribution in the United States, and gives a detailed account of field and inoculation experiments concerning the cause, nature, and treatment of this disease.

Annual Report, 1899, pp. 40, figs. 2.—The organization list of the station; financial statement for the fiscal year ended June 30, 1899; and reports of the director, chemist, botanist, agriculturist and horticulturist, and meteorologist reviewing the work of the station, and including notes on the examination of samples of sugar beets, water, soils, canaigre, etc.; a brief account of investigations concerning crown gall; notes on the establishment of the date industry in Arizona; a report on cultural experiments with sugar beets, plants for green manuring, wheat, barley, potatoes, garden vegetables, melons, forage crops, and eucalypti, and of the effect of winter irrigation on orchards; and a summary account of tests of several dairy herds.

As Arizona is located in the great arid region problems of irrigation and alkali soils are of first and fundamental importance. Along these lines are the station's chemical investigations on irrigation water supply and its soil survey with special reference to alkali. Stock raising is an industry of importance in the Territory, and with the recent addition to the staff of an expert in animal husbandry the station proposes to give special attention to this subject. The most difficult problem of stock raising locally is the production of forage, hence the station's investigation of drought-resistant forage plants, both native kinds, such as cacti, and foreign kinds, such as Opuntia. The conditions in the Territory are very favorable for fruit growing and the station is endeavoring to aid in the development of this industry. The striking results of the station's experiment with the date palm have already attracted much attention, and with the aid of this Department this work is now being conducted on a relatively large scale.

The work of the station has progressed satisfactorily during the past year, and the outlook for the future is very bright. The management of the station has been put on a sound and efficient basis, and the funds are much more economically administered than formerly. The university has adopted a liberal policy toward the station. The present director

has thoroughly reorganized the station business, systematized the office work, and instituted a popular series of leaflets entitled "Timely hints for farmers." These are based upon the work which the station is doing, and, while popular in their nature, are not merely compiled essays. They have been very useful in bringing the station to the attention of the farmers of the Territory and winning their confidence.

Farmers' institute work was taken up last year with promising success. The new work in animal husbandry has already attracted the favorable attention of the stock growers of the Territory, and promises to materially increase the usefulness of the station. The station needs better buildings, and it is hoped the Territory may soon be able to supply its necessities in this direction.

ARKANSAS.

Arkansas Agricultural Experiment Station, Fayetteville.

DEPARTMENT OF ARKANSAS INDUSTRIAL UNIVERSITY.

The work of the Arkansas Station has been along the same lines as heretofore, and has included studies in bacteriology, principally investigations on hog cholera; chemical investigations of cotton seed and its products; tests of methods for keeping first-crop Irish potatoes in marketable condition; variety and curing experiments with tobacco; variety and cultural experiments with melons and strawberries; spraying experiments; variety tests with fruit; experiments in the production of pork, with the use of crops gathered by hogs; tests of proposed methods for hardening pork fat; rotation experiments for increasing the productiveness of worn cotton soils; tests of the manurial value of various legumes; experiments with forage plants, and studies on the effect of latitude on corn. The pomologist has planted experimental orchards at eight different points in the State on land furnished by farmers, selecting typical sections or soils. At Newport experiments have been continued in growing various crops to be harvested by hogs and in the improvement of worn cotton soils. During the year a tobacco barn has been erected for experiments in curing tobacco.

The income of the station during the past fiscal year was as follows:

United States appropriation $15,000

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 57–60 and the Annual Report for 1899.

Bulletin 57, pp. 75.—The Relative Virulence for the Domestic Animals of Human and Bovine Tubercle.—A review of some of the literature on the subject of tuberculosis, with a brief bibliography, and an

account of field and inoculation experiments with calves, pigs, sheep, chickens, guinea pigs, and rabbits to determine certain factors in the question of the transmission of tuberculosis from man to animals and from animals to man.

Bulletin 58, pp. 14.—An Experiment in Grazing a Corn and Cowpea Field with Steers—Experiments with Peanuts, Legume Manuring, Cotton Meal, Whole and Crushed Cotton Seed Manuring, and Varieties of Cotton.—This reports a test with 5 steers to determine the profit of grazing steers on a corn and cowpea field, this being supplemented with as much cotton seed as the animals require; an experiment in planting Spanish peanuts at different distances; a comparison of growing peanuts from shelled, unshelled, and broken seed; trials to determine the relative effects of cotton meal and of whole and crushed seed on the yield of corn, cotton, and potatoes; trials to determine the relative effects on cotton and corn of cowpeas, soy beans, and velvet beans turned under entire and their stubble only turned under, and a test of Allen hybrid cotton.

Bulletin 59, pp. 15.—The Comparative Yield of Corn from Seed of the Same Variety Grown in Different Latitudes.—Data and results of a test covering two years, in which a comparison was made of seed of 11 varieties of corn obtained from 10 Northern, 7 Middle, and 3 Southern States, with tables showing the condition of the weather during the two years.

Bulletin 60, pp. 12, figs. 4.—Second Report on Arkansas Seedling Apples.—Notes on 25 varieties of Arkansas seedling apples, with remarks on their nomenclature and economic value.

Annual Report, 1899, pp. 134, pls. 2.—A financial statement for the fiscal year ended June 30, 1899; a brief report by the director, and reprints of Bulletins 56–60 of the station.

The peculiar problems confronting the Arkansas Station are similar to those of other States in the cotton belt. Long-continued growing of cotton without rotation has impoverished the soil, and at the same time the market value of the product has declined. The physical problem, then, is soil improvement, and the economic problem, the introduction of more profitable money crops. Both requirements are met at once by hog raising, using leguminous plants as far as possible as soil renovators and forage crops. Rotation experiments are also being used as a further aid to soil improvement. The diversification of agriculture is being promoted by encouraging the trucking and fruit-growing industries of the State, which are already of considerable importance. With this end in view, the pomologist is carrying on cooperative experiments in fruit growing with farmers, with the triple object of testing the adaptability of varieties, of introducing the industry, and of educating the people in advanced methods of orchard culture. The station has profited to a considerable extent by

recent special appropriations by the State legislature for the agricultural department of the college. The farm has been put in very much better condition, and an additional piece of land has been cleared. The pomologist continues to conduct the farmers' institute work. He forms farmers' clubs in every county and is meeting with success in this work. He has also succeeded in arousing much interest in advanced methods of fruit culture, especially in spraying.

Considering the varied agricultural conditions of this great State, the station needs enlarged funds, which will enable it to carry on investigations in different regions and to bring its work more thoroughly to the attention of farmers throughout the State. Greater attention to agricultural education, through farmers' institutes and otherwise, is also much to be desired, and the recent action of the legislature toward the development of the agricultural department of the university is very commendable.

CALIFORNIA.

Agricultural Experiment Station of the University of California, Berkeley.

DEPARTMENT OF THE UNIVERSITY OF CALIFORNIA.

The work of the California Station during the past year has been for the most part along the same lines as heretofore, and has included investigations on the application of heat in the extraction of color and tannin from grapes for wine making; sterilization and use of pure yeast; methods of preservation of unfermented grape juice; experiments in pickling ripe and green olives; investigations on plant diseases, especially those of the vine, sugar beet, onion, etc.; studies in agricultural and horticultural chemistry, especially analyses of soils, waters, sugar beets, fruits, dairy products, human and cattle foods, insecticides, fertilizers, fruit-preserving liquids, etc.; chemical studies of humus and the availability of plant food in soils; investigations of the various crude petroleums of the State with reference to the insecticidal value of the different distillates; studies of the effect of sugar-beet pulp on the hardness of butter; investigations of the nutritive value of different varieties of edible mushrooms; investigations of soils, soil moisture, and alkali; experiments with resistant roots and stocks, and tests of methods of propagation and grafting.

The work on liquid bleaches for nuts has been continued and has resulted in the recommendation of a formula now popularly known as the "instantaneous bleach." In practice, on a large scale, 1 ton of nuts is put in the best marketable condition at a cost of only 8 to 10 cents. As a result of its examinations of the Paris green in the markets, the station has set the limit of tolerance of white arsenic at 4 per cent. The feeding value and salt content of the Australian saltbush in different localities has been determined, and it has been shown that

the latter is the same on alkali and nonalkali land. The station has published the results of a careful inquiry into the condition of olive culture in California, explaining many causes of failure and disappointment with this fruit.

In cooperation with this Department, the study of grasses and forage plants adapted to semiarid conditions is being continued, together with its corollary, seed and plant distribution. Nutrition investigations have also been continued in cooperation with this Department. The university is cooperating with this Department in irrigation investigations. During the year a dairy husbandman has been added to the staff. The 4 culture and 2 forestry substations have been continued with the aid of State funds, and a wide range of field experiments of a great variety of forage plants, cereals, vegetables, fruits, and forest trees is thus being carried on in different parts of the State.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	11,560.00
Farm products	817.61
Total	27,377.61

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 124–128; Circular, September, 1898; and Seed Bulletin, 1899–1900.

Bulletin 124, pp. 31, pls. 5.—Lupines for Green Manuring.—Botanical descriptions and notes on the history, culture, and food and manurial value of 13 species or varieties of lupines, grown as agricultural crops in the United States and foreign countries, together with the results of culture experiments with 7 of the more important of these varieties grown at the station and substations, a test of the relative rates of rotting of the same varieties when turned under for green manures, and a bibliography of 20 works bearing on this subject.

Bulletin 125, pp. 30, pls. 7.—Australian Saltbushes: Results of 18 Years' Tests—Characteristics, Propagation, and Field Experiments; Composition and Food Value.—An account of the introduction and increasing culture throughout the State of the different species of saltbushes brought into California from Australia; of the tolerance of these plants for dry alkali soils, and of their growth on nonalkali uplands; of their vegetation characteristics, and of the cultural methods practiced in California; together with notes on saltbushes in other countries, descriptions of some 15 species of Atriplex and of the Pacific coast Salsolaceæ, results of seed germination tests, and data as to the composition and fodder value of saltbushes.

Bulletin 126, pp. 40, figs. 2.—Paris Green for the Codling Moth.—This contains notes and replies to a circular letter sent to entomologists and editors of agricultural newspapers regarding the purity of Paris green, discussions of the forms of impurities in Paris green, danger from arsenical adulterations, causes of injury to foliage, tests for purity, requirements for spraying purposes, laws concerning Paris green, standards of purity and quality, substitutes for Paris green and other methods of fighting the codling moth; directions for the use of Paris green in fighting the codling moth, and a brief discussion of other methods; and the results of chemical examination of Paris green and several other arsenical spraying materials.

Bulletin 127, pp. 38, figs. 10.—Bench-grafting Resistant Vines.—An account of extensive investigations as to the most suitable varieties of grapes for the reestablishment of California vineyards necessitated by the spread of the phylloxera, the best methods of grafting the same, and the grafting of vinifera varieties upon various resistant stocks.

Bulletin 128, pp. 46, figs. 16.—Nature, Value, and Utilization of Alkali Lands.—A general summary of the results of investigations at the station on this subject during the past twenty years, the details of which have been previously reported.

Bulletin 129, pp. 34, pls. 5.—Report on the Condition of Olive Culture in California.—An account of an investigation concerning the cultural and commercial conditions depressing the olive industry in the State, together with a discussion of pickling olives and preserving the product from bacterial growth.

Circular, September, 1898, pp. 3.—The Extermination of Weeds.—Brief notes are given regarding the principles of weed extermination.

Seed Bulletin, 1899–1900, pp. 4.—Distribution of Seeds and Plants.—A descriptive list of the plants and seeds available for distribution through the station in 1899–1900.

The California Station is aiding in the development of the great horticultural and forestry interests of the State, the diversification of its agriculture, and the reclamation of its arid lands. In the investigation of the problems due to natural conditions consequent on aridity, the station has been a pioneer and its work has attained to world-wide reputation. The most extensive investigations have been on alkali soils—their nature, origin, and reclamation.

The California Station continues to have considerable financial aid from the State through the university. This enables it to maintain substations in different localities, with a view to meeting the varied requirements of the vast agricultural and forest regions of the State. The university also aids in the diffusion of useful agricultural information through its system of farmers' institutes. The great success of the station in different lines of work has led to a demand for the investigation of numerous problems the thorough study of which

would require many years and much greater funds than are now at the disposal of the station. Without doubt many of these problems should be studied in different localities, and arrangements should be made for the thorough coordination of the work and its close supervision by the expert officers of the station. This will involve considerable expenditures for traveling, transportation of materials to the central laboratories, and other items necessarily connected with investigations covering wide areas. It is believed that the importance of the thorough organization of this great enterprise with reference to the needs of the entire State has not yet been sufficiently appreciated by the people and their representatives in the State legislature and government. Much has already been done, but more is urgently needed and only awaits financial support for its accomplishment.

COLORADO.

Agricultural Experiment Station, Fort Collins.

DEPARTMENT OF THE STATE AGRICULTURAL COLLEGE OF COLORADO.

The work of the Colorado Station for the past year has included studies of irrigation problems, especially seepage of streams and the duty of water on the Big Thompson and in other parts of the State; meteorology, including observations on the effect of forests in preserving snow; soils, especially the effect of irrigation on the motion and character of soils, and studies on feldspar; experiments with orchard and small fruits, especially phenological observations; investigations on cantaloupe blight; investigation of sugar beets, especially with reference to the elaboration of sugar, and experiments in breeding; bee keeping, especially the determination of glucose in honey, and experiments with comb foundation and in the prevention of foul brood; entomology, especially investigations on grasshoppers, the codling moth, and insects injurious to sugar beets; breeding experiments with wheat; feeding experiments, and digestion experiments. The test of varieties of apples has been abandoned. An experiment in soaking sugar beets showed that an irrigation late in the season increases the sugar, provided the temperature is low. The changes in ammonia, nitrates, and nitrites as irrigation water flows on and off the soil have been much studied.

The substations at Cheyenne Wells and Rockyford have been continued. At the former substation all of the farm of 160 acres, except about 20 acres, has been rented in order to reduce expenses. On the small tract retained the tests of the various crops that have been tried will be continued. At Rockyford the area of the station has been reduced to 40 acres, the rest of the land being leased. From this time on the principal lines of work will be the investigation of cantaloupe blight and experiments in sugar-beet culture.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	1,013.22
Miscellaneous, including balance from previous year	511.69
Total	16,524.91

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletin 53 and the Annual Report for 1899.

Bulletin 53, pp. 27.—Strawberries.—Detailed popular directions for the culture, fertilizing, irrigation, selection, and pollination of strawberries, with notes on seventy-four varieties tested.

Annual Report, 1899, pp. 113, pls. 8, dgms. 6.—The organization list of the station; a financial statement for the fiscal year ended June 30, 1899; a report of the director discussing at some length the organization and work of the station and substations; an inventory of station equipment; detailed outlines of station work for 1899, and reports of the heads of departments and superintendents of substations, giving, in addition to a general review of the different lines of station work during the year, notes on various insects, measurements of seepage and river flow, monthly and annual summaries of meteorological observations during 1898 and 1899, observations during thirteen years on the evaporation from a water surface, and results of culture and variety tests with a large number of field and garden crops.

As Colorado lies in the arid region, the station's natural lines of investigation relate to irrigation farming. Among these are the determination of methods of procuring and distributing water with the attendant problems of duty of water and determination of seepage. In applying water to the soil, it should be done in such a way as to bring the least alkali to the surface; hence it is necessary to know the effect of irrigation on the motion and character of the salts in the soils, and this point is being investigated. At the same time the loss of fertilizer elements in irrigation water must be guarded against, and to this end numerous determinations of those elements have been made in irrigation waters flowing on and off of land and in the seepage. Feldspar forms the basis of Colorado soil, and the relation of this substance to productiveness is being studied. Since forests are so important an agency in conserving water, the extent of their agency in this State is being investigated. The station has established the adaptability of the State for the production of sugar beets, and is now studying the growing of sugar-beet seed. Colorado wheat is low in protein content and that of the San Luis Valley unusually so. The station is trying to remedy this by endeavoring to find or produce a

variety giving a better yield and a better flour. For the latter place an earlier variety is also being selected, as the crop is frequently frosted. Alfalfa is an important fodder crop in Colorado. The station has made feeding tests with cows to determine how much protein can be used to advantage in the ration, and a variety of feeding experiments and some digestion experiments with alfalfa have been carried on. On account of the danger to fruit trees from late frosts in this State, the observations on blossoming period, etc., being made by the station are important. The important cantaloupe-growing industry of Rockyford suffers much from blight. The station is trying to find a method of dealing with this disease. Grasshoppers and the codling moth are among the serious insect pests of the State, and methods of fighting them are being investigated. The experiments in the prevention of foul brood, the preparation of comb foundation, and the determination of glucose in honey are of immediate importance to the bee-keeping industry, and the last-named line of work was undertaken at the instance of the Beekeepers' Association. The station continues to aid in the farmers' institutes of the State.

The separation of the office of director from that of president of the college has resulted in the more thorough organization of the station's work and the coordination of the investigations of the different divisions in accordance with a well-matured plan. On the basis of investigations relating directly to irrigation, the effort is being made to make the work of the station a joint enterprise along a few of the lines of most importance to the agriculture and horticulture of the State. In the interests of economy and effective work the areas of land used by the substations have been materially reduced, and their operations have been limited and brought into organic relation with those of the main station. For these outside enterprises the financial aid of the State is urgently needed, and it is hoped Colorado will soon follow the example of other States in this regard.

CONNECTICUT.

The Connecticut Agricultural Experiment Station, New Haven.

The Connecticut State Station has continued its work during the past year along the same lines as heretofore. The study of the vegetable proteids continues to be a prominent line of investigation. Experiments in the fertilization of orchards, especially peach orchards, have been continued. The botanist is cooperating with fruit growers in experiments in spraying peach orchards, and at the same time is making investigations on the causes of injury to peach foliage by fungicides. Experiments have been begun on a somewhat large scale in grafting the native chestnut on wild stump land with improved varieties. Forestry experiments have also been inaugurated with a view

to the utilization of waste land. Investigations on the fertilization, curing, and fermentation of tobacco have been continued with the cooperation with this Department and the tobacco growers of the State. The botanist is studying the rot of tomatoes, and the horticulturist is carrying on breeding experiments with the same vegetable. Pot experiments with fertilizers have been continued, and the grass garden at South Manchester is still being maintained. The station still carries on, under State law, the inspection of fertilizers, human foods, and commercial cattle feeding stuffs. It also inspects orchards and nurseries at the expense of the owners. During the year the director, S. W. Johnson, resigned and was succeeded by the vice-director, E. H. Jenkins. The former director was retained on the staff, however, in the capacity of advising and consulting chemist. The station has recently received part of a bequest by William R. Lockwood, esq., deceased, late of Norwich, Conn. Besides some accrued income, $79,970.31 are legated to be held as permanent endowment, the income of which is to be applied "in the promotion of agriculture by scientific investigation and experiment and by diffusing a knowledge of the practical results thereof among the people of the State of Connecticut."

The income of the station during the past fiscal year was as follows:

United States appropriation	$7,500.00
State appropriation	12,500.00
Fees, including balance from previous year	8,471.03
Farm products	1,103.42
Miscellaneous	271.31
Total	29,845.76

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The publications of this station received during the past fiscal year were Bulletin 130 and the Annual Reports for 1898, Part III, and 1899, Parts I and II.

Bulletin 130, pp. 40.—Commercial Feeding Stuffs in the Connecticut Market.—A brief discussion of commercial feeding stuffs and their uses, with tabulated analyses of a large number of samples.

Annual Report, 1898, Part III, pp. 132, pls. 2, figs. 4.—This contains a descriptive account of several diseases of melons with the results of experiments for controlling them; results of experiments testing the difference between thick and thin planting and upright and slanting poles as regards the prevalence of mildew of Lima beans; extended notes on two diseases of tobacco known as "calico" or "mottled top" and "spotting;" notes on *Monilia fructigena* on the peach, bacterial blight of Lima beans, damping off of peas, relation between plant diseases and weather, preparation or Bordeaux mixture, and on

spraying apparatus; an account of an experiment in growing roses in the greenhouse in compost and in coal ashes and peat moss to which commercial fertilizers had been added; brief notes on a number of insects; results of grafting chestnuts at the station on different dates and by different methods and the experience of three prominent Connecticut horticulturists in chestnut grafting, with notes on the technique of grafting and characteristics of American, European, and Japanese chestnut scions; results of experiments to determine the availability to grass of nitrogen in the form of nitrate of soda, cottonseed meal, and fine hard bone; results of experiments in curing and fermenting tobacco during 1898; a discussion of the nature of fermentation of tobacco, and an account of efforts to ferment Connecticut tobacco in bulk by the methods practiced in the South; tabulated analyses of 5 feeding stuffs; results in tabular form of tests of the vitality of a large number of samples of vegetable seeds and of experiments to test the vitality of onion seed as affected by age, crop, and variety; an account of the preparation, composition, and properties of crystallized egg albumin; an index to the complete report; a brief review of station work during the year, and a financial statement for the fiscal year ended June 30, 1898.

Annual Report, 1899, Parts I and II, pp. 196.—An abstract of the State laws relating to fertilizers; explanations concerning the analysis and valuation of fertilizers; analyses and valuation of 459 samples of fertilizing materials; State laws relating to food and feeding stuffs, and detailed results of the examination of a large number of samples of foods, condiments, and feeding stuffs, with notes concerning methods of examination.

Connecticut is a thickly peopled State where agriculture has become highly diversified and intensive. Important products are fruit, tobacco, and greenhouse crops, it being estimated that the fruit crop brings $1,000,000 annually into the State and the tobacco crop $2,000,000. Under intensive agriculture, fertilization is one of the most important problems, and this has been for many years a leading feature of the station's work. The recent work of the station on the curing and fermentation of tobacco and the growing of Sumatra tobacco has been very successful and is being further developed in lines of great economic importance with the aid of the Division of Soils of this Department.

Station officers continue to keep in touch with the farmers of the State by taking part frequently in farmers' institutes. The inspection work of the station is of much value to the State and is highly appreciated by the farmers. Dr. S. W. Johnson, the eminent agricultural chemist, was director of this station for nearly a quarter of a century, and under his management it achieved great success in both scientific and practical lines. His recent retirement from the active

direction of its operations has been attended with no change in the policy on which it has been so long conducted, and there is every reason to expect that its work will be developed with increasing thoroughness and efficiency.

Storrs Agricultural Experiment Station, Storrs.

DEPARTMENT OF CONNECTICUT AGRICULTURAL COLLEGE.

The work of the Connecticut Storrs Station during the past year has been along the same lines as heretofore, including field experiments with fertilizers, especially to study their effects upon the growth and composition of plants; studies in dairy bacteriology and on bovine tuberculosis, and investigations upon the food and nutrition of man. Experiments in cooperation with farmers throughout the State in feeding dairy cows have been continued, and an interesting bulletin showing the results obtained has recently been issued. The investigations on the food and nutrition of man have continued to be the most important line of work carried on by this station, and, as heretofore, have been aided by Wesleyan University and by a special State appropriation, and have been carried on in cooperation with this Department. The work includes the study of the composition of foods and food materials by chemical analyses; dietary studies showing the kinds and amounts of foods consumed by individuals, families, boarding houses, institutions, etc.; digestion experiments furnishing information concerning the digestibility or availability of different classes of food materials; determinations of potential energy (heats of combustion) of different foods by the use of the bomb calorimeter; metabolism experiments with and without the respiration calorimeter, furnishing data concerning the conservation of matter in the human body, the physiological requirements of the body for nutriment, the nutritive values of different food materials, and the fundamental laws of nutrition. In connection with these lines of work considerable attention is also paid to the improvement of methods of analysis and manipulation and to devising and improving apparatus. A new dairy building is to be erected for the college at a cost of $6,000 or $7,000. The present building will be used by the experiment station as a working dairy.

The income of the station during the past fiscal year was as follows:

United States appropriation	$7,500.00
State appropriation	1,800.00
Miscellaneous	1,684.75
Total	10,984.75

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 20 and 21 and the Annual Report for 1898.

Bulletin 20, pp. 40, figs. 16.—A Study of Dairy Cows.—Data as to the production of dairy cows in Connecticut; a discussion of variation in the production of individual cows, and of the anatomical and physiological features of the dairy cow; and a comparative study of individual cows as regards type and economy of production.

Bulletin 21, pp. 24.—The Ripening of Cream.—This is a general discussion of the purposes, cause, and control of cream ripening; the effect of different species of bacteria; the use of pure cultures in the United States and Europe; results of the use of pure cultures; and the use of starters with and without pasteurization.

Annual Report, 1898, pp. 248.—This includes the organization list, financial statement for the fiscal year ended June 30, 1898; a brief review of station work by the director; a general discussion of the opinions of European veterinarians and agriculturists upon the various problems connected with tuberculosis in cattle; an account of some practical applications of bacteriology in European dairying as observed by the author as the result of an examination of various institutions in England, Holland, Denmark, Germany, and Switzerland; a report of an experiment to study the effect of feeding the milk of tuberculous cows to healthy calves; an extended report on investigations which have been in progress at the station since 1888 to determine the effect on the yield and composition of certain farm crops when fertilized with different kinds and quantities of nitrogenous fertilizers used with uniform quantities of potash and phosphoric acid, and also to study the relative economy of using the different nitrogenous fertilizers; data for a number of digestion experiments with sheep, with a summary of the results of the present and earlier experiments; an account of feeding experiments in the winter fattening of lambs; tabulated analyses of a number of samples of fodders and feeding stuffs; and a summary of meteorological observations during 1898.

Among the more important needs of agriculture in the State is a clearer knowledge of the principles of nutrition of both plants and animals. Intensive cultivation of crops and expert management of herds are more and more indispensable to successful farming. It is the effort of the station, therefore, to furnish information concerning these matters. The field experiments are made for the special purpose of studying the particular needs of different soils and crops and the best methods of supplying them with fertilizers. Experiments are also being made to learn the best method of restoring fertility to soils that have long been under cultivation and are lacking in some of the ingredients of plant food. The experiments with nitrogenous fertilizers indicate that these fertilizers increase not only the yield of various

crops, but also the percentage of protein in them, thus improving their feeding value.

The officers of the station participate in farmers' institutes and other meetings for farmers as far as possible, and through the cooperative feeding experiments keep in touch with the needs of the practical farmer. Arrangements have recently been made which will render possible the issue of bulletins more frequently than heretofore.

The investigations on human nutrition carried on by this station, in cooperation with this Department, are of general value to all our people, and their results already form the basis of a considerable share of the instruction on this subject in many public and private schools throughout the country. Locally considered, they are of especial importance to communities like that of Connecticut, where a large population engaged in many different kinds of highly developed industries are living under conditions that make problems of food supply of vital importance to their physiological and economic welfare. It is very encouraging to have the State recognize this by a special appropriation for this work, thus enabling the station to more efficiently cooperate with this Department in this line of investigation.

DELAWARE.

The Delaware College Agricultural Experiment Station, Newark.

DEPARTMENT OF DELAWARE COLLEGE.

The work of the Delaware Station during the past year has been along the same general lines as heretofore, and has included investigations looking to the introduction of leguminous plants, especially cowpeas; varietal studies of cowpeas and tests of the crop in rotations; field and chemical studies of sorghum as a sugar producer; tests of silage for summer feeding on the dairy farm; comparisons of methods of handling dairy cows; studies of certain diseases of apples and pears; investigations on certain diseases of poultry; studies of bovine pneumonia; bacteriology of water; investigations looking to the establishment of milk standards for dairy farming; chemical analyses of feeding stuffs, etc.; studies of the sour cherry groups and their classification; top working of young fruit trees; investigations in the pollination of apples; experiments in thinning fruit; general studies of the fruit industries of the State; entomological studies, especially of the strawberry root louse, the pea louse, and of insects affecting young apple trees; experiments with hydrocyanic-acid gas as an insecticide, studies in the classification of the immature stages of the Coleoptera, and the formation of an economic collection of the injurious insects of the State.

Cowpeas have been successfully grown with corn as a silage crop, the crop being cut with a corn harvester, and easily handled in this way. The chemist has studied the diffusion of hydrocyanic-acid gas

as used in treating nursery stock, and has demonstrated that it does not mix evenly with the air in the compartment, but rises to such an extent that a rabbit at the bottom of the compartment is not harmed by it. This in practice may lead to overtreatment of some of the stock to an injurious extent and failure of other portions to come under the influence of the gas. To correct this, a simple fan within the compartment has been found very advantageous for mixing the gas with the air, and so bringing the gas into contact with all parts of the stock. The chemist has also devised an ingenious apparatus for making fat determinations in milk on a large scale, with a view to securing better results in preserved samples than by the Babcock method. The station has made an examination of a certain proprietary remedy used in veterinary practice, which resulted in the discovery that the so-called black antimony of commerce is almost invariably an absolute falsification. The director is making experiments in feeding animals at his own expense on his own farm, for lack of facilities at the station. In its different lines the station is doing a good deal of cooperative work with farmers. During the year an entomologist has been added to the station staff.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 45 and 46.

Bulletin 45, pp. 16, figs. 7.—The Pruning of Young Fruit Trees.—A discussion of the Stringfellow method of root pruning; the results of root-pruning experiments carried out on heavy clay land and light sandy loam with different sorts of fruit trees, and some general considerations based on the experiments relative to the formation of root systems of newly planted trees.

Bulletin 46, pp. 24.—The Southern or Cowpea in Delaware.—Notes on the relative merits of crimson clover and cowpeas for culture in Delaware; an account of culture, fertilizer, and variety tests with cowpeas, with notes on the history, botany, etc., of the cowpea, and the results of an experiment to compare pea-vine silage and June pasture for dairy cows.

The underlying thought in the management of the Delaware Station is the increase of soil fertility by the use of leguminious plants and the use of this increased fertility in general agriculture. Through the efforts of the station crimson clover has been quite generally introduced throughout the State, and attention is now being concentrated on the cowpea. The general advantage of growing this crop in

the State has already been demonstrated, and the station is now endeavoring to ascertain the best varieties and the best methods of managing the crop. Much attention has been given to the study of the bacteria of soils, a matter of general and fundamental importance in scientific agriculture, and the subject of denitrification of soils is now being taken up. The pea louse, which is of great injury to the growing of peas for canneries, is a subject of special investigation. The large horticultural interests of the State are being actively promoted by the investigations of the station.

Farmers' institute work is in a flourishing condition, and the station takes an active part in it. Several of the station staff have also done considerable lecturing on nature-study subjects, which, however, was so managed as not to interfere to any extent with the station work. The Delaware Station enjoys the confidence of the farmers of the State to a large extent, and is cooperating with them in various ways. Its work seems to be meeting the most pressing needs of the farmers and horticulturists, and there are evidences of its increasing usefulness.

FLORIDA.

Agricultural Experiment Station of Florida, Lake City.

DEPARTMENT OF FLORIDA STATE AGRICULTURAL COLLEGE.

The work of the Florida Station during the past year has included fertilizer experiments, especially studies on the effects of different elements on the quality of tobacco, and on methods of influencing the starch content of cassava and the sugar content of cane; experiments in the utilization of cassava; feeding experiments; determination of digestion coefficients of important Florida feeding stuffs; experiments with legumes as soil renovators; tests of forage plants; investigations of diseases of celery, cucumbers, and citrus fruits; fertilizer and variety experiments with citrus fruits and tests of stocks; experiments with pecans; investigations of the cottony cushion scale; colonization experiments with the Australian ladybird; investigations of white fly; spraying experiments with crude petroleum and kerosene mixtures against scale insects; investigations of various common scales; collection and systematic study of various insects; chemical studies of food products on sale in the State; investigations of the composition and digestibility of the velvet bean; fertilizer tests with pineapples; and miscellaneous analyses. The pineapple experiments at Jensen have been abandoned. The station has recently been given 20 acres of land and $1,000 for special experiments with citrus fruits at Bocaraton, in the southeastern part of the State, under the supervision of the horticulturist of the station. About 80 acres of land in the vicinity of the station have been obtained for experimental purposes. During

the year a dormitory building has been erected by the college, a part of which will be used by the director as a residence.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	1,132.55
Total	16,132.55

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 50–53.

Bulletin 50, pp. 104, pls. 8, figs. 8.—Pineapple Fertilizers.—The general plan, details, and results of extensive fertilizer experiments with different forms of potash, nitrogen, and phosphoric acid used alone and in various combinations on pineapples, with an extended discussion of the data as regards the effect of the different fertilizers on the general development of the plants, abundance and earliness of fruit, blooms, the frost-resisting properties, etc.; analyses of pineapples, and descriptive and remedial notes on the more important diseases and insect enemies.

Bulletin 51, pp. 24, figs. 8.—Some Common Florida Scales.—Notes on the appearance, habits, life history, natural enemies, remedies, and host plants of 8 insects, with general observations on spraying.

Bulletin 52, pp. 13.—Baking Powders.—A description of the different classes of baking powders, with the results of an examination of a number of samples.

Bulletin 53, pp. 27, pls. 6, figs. 5.—Some Citrus Troubles.—Notes on diseases of citrus fruits, including foot rot, scab, dieback, sooty mold, blight, melanose, and leaf spot, and on the injuries caused by the presence of lichens and moss upon the trees, with suggestions for the prevention of these diseases.

The staple crops of the State, especially tobacco, sugar cane, citrus fruits, and pineapples are being studied with respect to fertilizer requirements and utilization. The pecan is a native nut of importance in commerce. Its culture has, however, not yet been developed, and this the station is endeavoring to bring about. The work with cassava has been of considerable value. Florida offers excellent opportunities for the development of cattle raising; hence the station's experiments with forage crops, especially velvet beans and cassava. The station is getting into closer relations with the general agricultural interests of the State through a system of farmers' institutes which have been conducted under the direction of the agriculturist.

GEORGIA.

Georgia Experiment Station, Experiment.

DEPARTMENT OF GEORGIA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

The work of the Georgia Station during the past year has been for the most part along the same lines as heretofore, including variety, fertilizer, and culture experiments with corn and cotton; horticultural investigations, especially with strawberries, plums, peaches, grapes, and onions; and feeding experiments and work in dairying.

As already reported, the biologist and horticulturist is developing his work principally along horticultural and entomological lines, giving incidental attention to the study of diseases of plants. The dairyman has undertaken some incidental work in the breeding of hogs, and is making observations, in cooperation with this Department, on the infection of cattle with Texas fever by means of ticks.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	700.00
Farm products	1,608.89
Balance on hand July 1, 1899	2,400.36
Total	19,709.25

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 44–48 and the Annual Report for 1899.

Bulletin 44, pp. 19.—Wheat and Oats, Rye and Barley.—Popular directions for the culture and manuring of wheat and oats for grain and for the culture of barley and rye for pasture, with the results of several fertilizer and variety tests.

Bulletin 45, pp. 30, figs. 17.—Some Important Insect Enemies of Cucurbits.—A general discussion of the habits, life history, distribution, natural enemies, and remedial and preventive measures of the striped cucumber beetle, melon aphis, pickle worm, melon worm, squash-vine borer, and the squash bug.

Bulletin 46, pp. 23.—Corn Culture.—A report on cultural, variety, and fertilizer tests with corn; detailed directions for corn culture based on the results of ten years' experience at the station; and a brief summary of rainfall and temperature at the station during the corn-growing season each year from 1890 to 1899.

Bulletin 47, pp. 32.—Fertilizer, Culture, and Variety Experiments on Cotton.—Results of tests of 25 varieties of cotton, with notes on some of the varieties tested; tests to determine if the ripening season of cotton could be lengthened and thus the capacity of the soil more fully utilized by mixing and planting together seed of an early and a late

variety of cotton; experiments in planting at different distances; and fertilizer tests, together with directions for cotton culture based on the results of ten years' experience in growing cotton at the station, and a reprint of meteorological data from Bulletin 46 of the station noted above.

Bulletin 48, pp. 27, pls. 6, figs. 5.—Strawberry Notes for 1899.—Results of tests of 60 varieties of strawberries, with descriptive notes on 17 varieties not previously tested at the station; details and results of several culture and fertilizer experiments; and cultural directions reprinted from an earlier bulletin of the station.

Annual Report, 1899, pp. 35.—This includes a brief account of the organization and work of the station during the year; a financial statement for the fiscal year ended June 30, 1899; and a report of the biologist and horticulturist, giving tables showing the results of a severe frost on 45 varieties of plums and the effect of ringing on 195 varieties of grapes; brief notes on experiments with onions, sweet corn, celery, and asparagus; and notes on various plant diseases and injurious insects, with the results of experiments for their control.

Cotton and corn are the field crops most extensively cultivated in Georgia, and to these the station has continued to devote the larger part of its attention as heretofore. In recent years the horticultural interests of the State have also become prominent, and these are also being aided. The station has demonstrated the suitability of the State for dairying, and its studies of Texas fever and experiments in the breeding of hogs are matters of immediate importance to the agriculture of the State.

HAWAIIAN ISLANDS.

Hawaiian Experiment Station, Honolulu.

MAINTAINED BY THE HAWAIIAN SUGAR PLANTERS' ASSOCIATION.

The work of this station has included the physical and chemical examination of the soils of the Hawaiian Islands, and a study of the lavas from which these soils have been derived; investigations regarding the fertilizer requirements of different soils; studies of soil evaporation and plant transpiration as related to irrigation; variety, fertilizer, and culture experiments with sugar cane; investigations on the manufacture of sugar; studies of the economic plants of the islands; experiments with reference to the introduction of new plants; investigations on certain diseases and insect pests of sugar cane; and miscellaneous chemical analyses, including soils, waters, sugars, molasses, etc.

The studies of varieties of sugar cane have been very comprehensive and have approached the subject from many standpoints. Determinations have been made of the mineral matter in the canes and in

various parts of plants of numerous varieties, as also of the solid matter, the yield of sugar, and the consumption of nitrogen and the other fertilizer elements. During the past year, as during previous years of the station's existence, it has maintained an unofficial fertilizer control in the interests of its patrons. The director has recently resigned to accept a position under the Government of Queensland, Australia, and has been succeeded by R. E. Blouin, previously assistant director of the Louisiana Sugar Experiment Station.

The publication of this station received during the past fiscal year was the Annual Report for 1900.

Annual Report for 1900, pp. 51.—This is an account of experimental work with sugar cane during the year and includes results of tests to compare planting seed at different rates and of tests of 4 native and 9 introduced varieties; analyses of different parts of the plant in connection with a discussion of the elements removed from the soil by the 13 different varieties studied; notes on insects affecting sugar cane during the year; a monthly record of rainfall and of irrigation water used during the growth of the crop (July, 1898, to November, 1899); and a statement of new work.

The work of this station continues to be of much value to the sugar industry of Hawaii, and it will be maintained as heretofore by the Sugar Planters' Association. The station to be established by this Department (see p. 21) will supplement this work by investigations in other directions.

IDAHO.

Agricultural Experiment Station of the University of Idaho, Moscow.

DEPARTMENT OF THE UNIVERSITY OF IDAHO.

The work of the Idaho Station during the past year has included investigations of the apple scab; experiments to determine the kinds of grasses best adapted for local culture without irrigation; work on the powdery mildew and on edible fungi; studies of the native grasses of the State; investigation of a scale insect resembling San José scale; experiments with crude petroleum as an insecticide; studies of the life history of the elm louse, with experiments in repression; studies of the effects of climate on the codling moth; experiments in the repression of onion thrips and the clover louse; continuation of systematic study of the insect fauna of the State; meteorological observations; observations of soil temperatures; experiments with an apparatus for the detection of frost; experiments with an automatic electrical apparatus for detecting and recording in irrigation to prevent excessive irrigation; culture experiments with fruit trees; experiments in pruning orchard and forest trees; observations on root sys-

FIG. 1.—ILLINOIS COLLEGE AND STATION—AGRICULTURAL BUILDING.

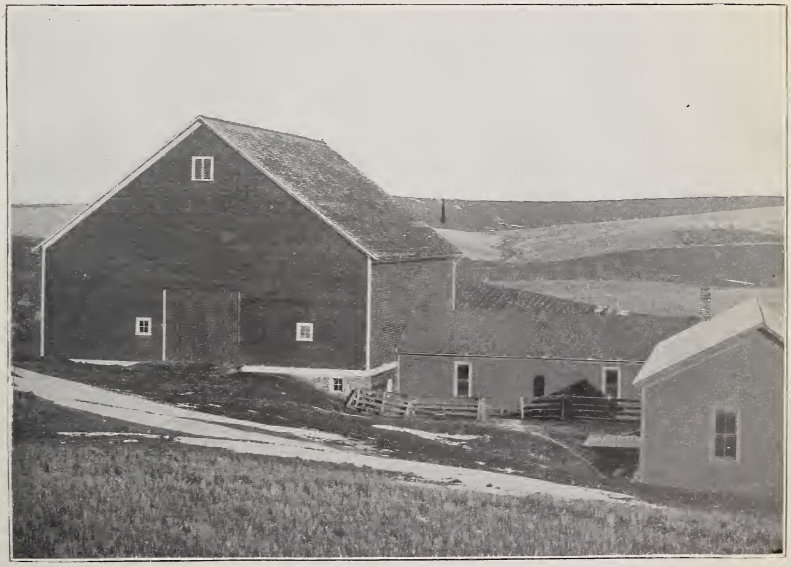


FIG. 2.—IDAHO STATION—BARN.

tems in subsoil; tests to determine forest trees best adapted to local conditions; experiments in root-pruning certain vegetables with a view to hastening ripening; experiments in forcing lettuce; culture experiments with nut trees; feeding experiments with steers and with lambs; experiments with various forage crops; chemical comparisons of Idaho wheat with that of other States; examination of various forms of commercial Paris green; analyses of prune soils, irrigation water, sugar beets, and green and cured fruits; and comparisons of different methods of curing fruits.

Cooperative experiments have been carried on with farmers in testing potatoes, alfalfa, millets, *Bromus inermis*, etc. The agriculturist is paying special attention to animal industry. He proposes to introduce cattle of a type for both beef and milk production, with a view to meeting the conditions of the region in which the station is located, where the raising of cattle is beginning to supplement grain growing. The entomologist continues to act as adviser of the district horticultural inspectors appointed under a State law. The quarters of the station staff have been greatly improved by the finishing off of new rooms in the upper story of the main building of the university. The farm has been much improved and a farmhouse and a good-sized barn (Pl. I, fig. 2) have been erected. The president and director resigned at the end of the fiscal year and was succeeded by Prof. J. A. McLean, of the Colorado State University. The irrigation engineer also resigned.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000
Farm products	612
Total	15,612

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 17–23.

Bulletin 17, pp. 12, figs. 4.—Construction and Management of Hotbeds.—Popular notes on the construction and management of hotbeds, especially for the home garden.

Bulletin 18, pp. 22.—Sugar Beet Investigation in 1898.—A report on culture experiments carried on at the station and in various sections of the State, with directions for the culture of sugar beets and the destruction of insect pests; instructions for taking samples for analysis; summary of analyses of 472 samples; a discussion of the cost of producing beets; and a comparison of the profits in beet and wheat raising.

Bulletin 19, pp. 22.—Miscellaneous Analyses.—Analyses of 36 varieties of strawberries, 65 varieties of peas, 6 samples of wines, 7 samples of Paris green, 7 samples of ashes, 21 samples of water, and 20 miscellaneous samples, with a brief discussion of the importance of pure water, directions for taking samples of water for analysis, and notes on the interpretation of the results of water analysis.

Bulletin 20, pp. 18, pls. 3.—Apple Scab in the Potlatch.—A description of this disease and of remedial treatment, such as spraying with copper sulphate solution, Bordeaux mixture, and ammoniacal copper carbonate, with the results of spraying experiments.

Bulletin 21, pp. 16, figs. 6.—The Codling Moth.—A description of this insect; observations on its life history, habits, etc.; and a discussion of remedial measures, including the results of experiments at the station.

Bulletin 22, pp. 13, figs. 8.—Onion Growing.—This gives methods of onion culture adapted to Idaho soils and climate based on three years' experience in growing onions at the station; descriptive notes on 6 varieties and the comparative results obtained in growing these by transplanting and from seed sown in the open field; and directions for irrigating onions.

Bulletin 23, pp. 15, figs. 3.—Meteorological Records.—Prediction of Frost.—Meteorological summary of observations at the station and tabular record of soil temperatures at different depths during the growing seasons of 1898 and 1899; a brief discussion of protection against frosts by means of smudges, and a description of a piece of electrical apparatus devised by the author to give warning of a fall in temperature.

This station is investigating a number of the most serious difficulties confronting Idaho farmers. Stock raising is just beginning to be developed in a regular way in this region, and the station is doing all it can to encourage it. The botanist is determining the grasses, both native and introduced, that can be grown most profitably. He is also investigating a few fungus diseases which are especially troublesome to fruit growers. The chemist is also helping fruit growers through his determinations of soils best adapted for prune growing and his studies of methods of curing prunes. The entomologist is trying to lessen the ravages of those widely distributed and highly troublesome insects, the San José scale and codling moth. The latter presents certain peculiar local problems. Farmers' institutes have been hopefully begun, but a scattered population and lack of transportation facilities make this work difficult and expensive. Nevertheless, the farmers are becoming better acquainted with the station, as is attested by a greatly increased correspondence. The affairs of this station are on a sounder basis than formerly, and if a vigorous and consistent policy is hereafter pursued, much useful work will be accomplished. The station is

doing what it can to promote the general agricultural interests of the State. It needs to develop its work relating to irrigation, and it is hoped that it may soon be put in a position to cooperate effectively with this Office in irrigation investigations.

ILLINOIS.

Agricultural Experiment Station of the University of Illinois, Urbana.

DEPARTMENT OF THE UNIVERSITY OF ILLINOIS.

The work of the Illinois Station during the past year has been along the same lines as heretofore, and has included studies on the comparative value of corn silage and corn stover in beef production; experiments to determine the effect of small additions of gluten meal to corn rations for fattening steers; observations on the comparative efficiency of individual cows in capacity to make milk and butter fat from given amounts of feed; chemical selection of corn; experiments in inbreeding corn; experiments in the conservation of soil moisture by tillage; culture experiments with sugar beets; experiments in improving white clay lands, especially by drainage; experiments in the cultivation and spraying of orchards; and studies on the winterkilling of fruit trees.

Cooperative work in horticulture and along other lines is being undertaken in different localities. The university continues to cooperate with this Office in nutrition investigations, especially on the nutritive value of meats and their place in the diet. A department of domestic science has recently been established. The State legislature has recently made an appropriation of $150.000 for a building for the college of agriculture and the experiment station. This building is now in process of erection, and besides rooms for college purposes it will contain laboratories and offices for the station. (See Plate I, fig. 1.)

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees	260.00
Farm products	747.04
Balance on hand July 1, 1899	196.15
Total	16,203.19

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 55–59 and the Annual Report for 1899.

Bulletin 55, pp. 36, figs. 5.—Improvement in the Chemical Composition of the Corn Kernel.—Details and results of extensive experiments made to determine the influence of selection in increasing or diminishing the content of protein and fat, respectively, of the corn

kernel, together with other data on the selection of corn with reference to protein and fat content on the basis of mechanical analysis, and on the proportion of corn germ to kernel.

Bulletin 56, pp. 47, pls. 4.—Recent Work on the San José Scale in Illinois.—A detailed account of the work of the entomological department, especially of the field assistants, in locating new areas of infection, inspection of nurseries, insecticide treatment, and distribution of fungus diseases for destroying the San José scale.

Bulletin 57, pp. 72, pls. 10.—The Smuts of Illinois Agricultural Plants.—The results of studies made during the past five years to ascertain the kind of smuts infesting cultivated plants, the injuries inflicted by them, their life histories, the most practical methods of preventing their ravages, with a description of the general structure of smuts, and directions for their prevention.

Bulletin 58, pp. 10.—Composition and Digestibility of Corn Fodder and Corn Stover.—A report of a digestion experiment with 4 lots of 4 steers each, to test the digestibility of corn fodder and corn-and-cob meal.

Bulletin 59, pp. 26, pls. 9.—Orchard Management.—Popular directions for the cultivation, pruning, fertilizing, and spraying of orchards, with notes on fungicides and spraying machinery.

Annual Report, 1899, pp. 16.—A brief statement of the principal lines of station work, subject list of bulletins published since 1888, a detailed financial statement for the fiscal year ended June 30, 1899, and the organization list of the station.

Corn, beef, dairy products, and apples are the important agricultural products of Illinois, which the station is studying. The investigations on corn and in animal husbandry converge in the work on silage and stover. While corn is of great importance as a feeding stuff, it is deficient in protein as compared with other grains. This deficiency the station is trying to supply by artificially increasing its protein content by chemical selection. In this State, as in the West generally, problems of conservation of soil moisture are of great importance and are receiving attention.

The status of the Illinois Station as a part of the University of Illinois has been materially changed during the past year, as the result of the increased income of the college of agriculture. This has made it possible to make a much clearer differentiation of the station equipment and work. The station has been relieved from the general expenses of the farm and from the management of the dairy. The completion of the magnificent building now in process of erection for the use of the college of agriculture and the experiment station will give very much better facilities for station work. The station is also perfecting its organization so as to put direct management of its operations more fully in the hands of its chief expert officers, and to concentrate its efforts on a few important lines of work.

The recent awakening of the agricultural people of the State, especially as represented in their organizations, to the importance of the work of the agricultural college and experiment station is very encouraging. Already the number of students in the agricultural courses offered by the university has been materially increased, and with the further privileges which each student will enjoy after the completion of the new agricultural building, there is every reason to expect they will come in still larger numbers. The vast agricultural interests of Illinois, including the production not only of crops and animals but also of dairy and meat products valued at many millions of dollars, will, it is believed, from this time on increasingly aid the university to extend its teaching and experimenting along lines of the greatest economic importance.

INDIANA.

Agricultural Experiment Station of Indiana, Lafayette.

DEPARTMENT OF PURDUE UNIVERSITY.

The work of the Indiana Station during the past year has been mainly along the same lines as heretofore, including chemical investigations on sugar beets, tomatoes, soils, fertilizers, etc.; investigations on animal diseases and regarding sex and fecundity of domestic animals; bacteriological studies of milk; feeding experiments with pigs, sheep, and poultry; field experiments with wheat, corn, oats, soy beans, Kafir corn, and other forage plants, with fertilizers, and on rotation of crops and methods of tillage; studies on corn smut and rusts; greenhouse experiments with fertilizers for lettuce, tomatoes, chrysanthemums, and roses, and on surface *v.* subwatering for tomatoes, and the culture of mushrooms, and horticultural investigations, including the testing and crossing of varieties, grafting, and fertilizer experiments. Experiments on different methods of grafting apples are being made in cooperation with the Division of Pomology, and seedling forest trees are being tested in cooperation with the Division of Forestry of this Department. The chemist of the station continues to act as State chemist and to make fertilizer analyses with funds furnished by the State.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	2,251.21
Total	17,251.21

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 78–81, Circular 1, and the Annual Report for 1899.

Bulletin 78, pp. 8, figs. 3.—The San José Scale and Other Scale Insects, and the Indiana Nursery-Inspection Law.—Brief notes on the San José scale, the oyster-shell bark louse, the scurfy bark louse, and the Putnam scale, with suggestions for their treatment, and the full text of the nursery-inspection law of Indiana.

Bulletin 79, pp. 10.—Roots as Food for Pigs.—A detailed report of an experiment made with 12 pigs and lasting from February 1 to June 7 to test the feeding value of mangel-wurzels.

Bulletin 80, pp. 14, figs. 8.—Sheep Scab.—A general account of the nature of sheep scab and a description of the parasitic mite which causes the disease; brief notes on the dips to be used for the destruction of the scab mite and on the method of applying such dips, together with a description of dipping tanks; a summary of reports from sheep owners concerning the prevalence of the disease in the State; the live-stock law of Indiana affecting the spread of sheep scab; and the regulations of this Department concerning the dipping of sheep which are affected with scab.

Bulletin 81, pp. 16.—Field Tests with Fertilizers on Heavy Clay Lands.—An account of fertilizer experiments on tenth and twentieth acre plats on three farms in the State, in which a number of fertilizing materials in different combinations were applied to corn and wheat, with a discussion of the results as illustrating how field tests may be conducted.

Circular 1, pp. 8.—List of Reports and Bulletins Published up to December 31, 1898.—Subject list of publications of the school of agriculture from 1885 to 1887 and of the station since 1888.

Annual Report, 1899, pp. 150, pls. 14, figs. 3.—This includes the organization list of the station; a report by the director on the station work, staff, publications, and mailing list; a detailed report of extensive pot experiments, covering a period of three years, made to study the relative effects of different forms of phosphoric acid alone and conjointly with nitrate of soda and muriate of potash on roses; an account of the anatomy and physiology of the mammary gland and its development in different types of mammalia, particular attention being paid to the form, structure, and vascular supply of the cow's udder; notes on pseudo-scabies of sheep due to the awns of *Stipa spartea;* results of a study of the effects on horses of the organisms found in moldy corn; yields of corn grown continuously since 1880 on plats fertilized with either horse manure, gas lime, or ammoniated phosphate to study the residual effects of these fertilizers; conclusions as to the relative value of a number of different makes of cultivators for corn tested at the station continuously for eleven seasons; data showing the average yield and the characteristics of the grain and straw of 189 varieties of wheat tested at the station during nineteen years; notes on the culture and yield of a number of forage plants

grown at the station and by farmers in different parts of the State; analyses of a number of feeding stuffs; composition of a substance used for packing horses' hoofs; composition of the bones of a normal horse and of the bones of a horse suffering with osteoporosis; analyses of several samples of maple sugar; notes on the results of tests of several methods for determining the strength of solutions of formaldehyde; a determination of the reducing power of taka diastase; notes on 43 varieties of Russian apples which fruited at the station during the season; data for subwatering *v.* surface-watering experiments with tomatoes and lettuce and of fertilizing experiments with lettuce and peas; a detailed report on corn smut, including an historical résumé of the subject, results of original investigations, a description of the life history of the smut fungus, a discussion of the influence of weather and maturity on infection, means of infection, and on prevention by spraying and destroying smut masses, notes on the effect of smut on animals, and an extensive bibliography of the subject; a list of trees and shrubs on the grounds of the university; description and plan of a piggery at the station; a list of acknowledgments; and a financial statement for the fiscal year ended June 30, 1899.

The work of the Indiana Station is in a number of ways directly related to the pressing needs of the agriculture of the State. By its studies of soils and staple crops it has done much to improve general farm practice in the State, as regards especially the culture and rotation of crops and the use of farm and commercial fertilizers. Recently it has shown in a comprehensive way the relative adaptability of different parts of the State to the successful growing of beets for sugar. It has paid much attention to physiological and pathological investigations of immediate economic application. Among these may be mentioned investigations on hog cholera and those regarding sex and fecundity of domestic animals. The forcing-house industry is coming into considerable prominence, and much capital is already invested in the commercial growing of flowers, as chrysanthemums and roses. This fact has led the station to emphasize fertilizer experiments with these classes of crops. The station's systematic investigations into methods of watering tomatoes have yielded original and practical results. Its thorough studies of corn smut have shown that the disease may be in a great measure prevented by the use of Bordeaux mixture.

The operations of the station as related to the great agricultural interests of the State are of necessity comparatively limited in extent, owing to lack of State funds to supplement those received from the United States. The station needs better equipment and larger resources to enable it to extend its work in animal industry and other lines.

IOWA.

Agricultural Experiment Station, Ames.

DEPARTMENT OF IOWA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

The work of the Iowa Station during the past year has been along the same lines as heretofore, and has included studies in the application of the Babcock test in measuring the fat in cream where the "gathered cream" or farm separator system is used; horticulture, especially investigations on the cause of the winterkilling of fruit trees and remedies for the same, studies of plums growing in the State, and experiments with garden vegetables; experiments with cereals, grasses, forage crops, and sugar beets; entomological investigations; botanical investigations, especially along lines of plant pathology; investigations in veterinary science, and chemical analyses of sugar beets, feeding stuffs, and forage crops and grasses.

The station has recently published a bulletin which contains the results of three years' investigation with various breeds of hogs, especially with reference to determining the merits of the British bacon breeds as compared with the popular American breeds of the agricultural States. This investigation covered all the various points in pork production from the selection and breeding of the sows to the curing of the product for the home and foreign markets, and in cooperation with this Department about 1,200 analyses of the different parts of the carcasses were made. Another investigation completed during the year was one in growing and maturing skim-milk calves, which were put on the market and their final value determined in competition with other beef cattle. It was clearly demonstrated that properly raised skim-milk calves can be finished and put on the market at an early age and command a price well up to the highest quotations in its class. At present the station is paying much attention to a series of investigations now in progress in the selection and development of Western horses bred on the great ranges. Results already obtained demonstrate the desirability of good blood on the range as well as on higher-priced farming lands. The station has now carried on investigations for nearly four years to determine the cost of producing butter from dairy cows of five breeds and to make comparisons in other respects.

The college has recently purchased imported stock of different kinds and breeds to the amount of about $10,000. A new horse barn and stock-judging lecture room, which will accommodate 500 students, has recently been erected. The entomologist continues to conduct the inspection of nurseries for San José scale under State laws.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees	7.00
Farm products	2,678.35
Miscellaneous	144.70
Total	17,830.05

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 41–47 and the biennial report for 1898 and 1899.

Bulletin 41, pp. 65.—Some Reports from Trial Stations on New Orchard Fruits and Shrubs.—A report in the form of replies to a circular of inquiry sent out by the station on the value of a number of varieties of fruits, ornamental trees, and shrubs which were obtained from Central Asia, Northwest China, and Mongolia, and the steppes of Eastern Europe and planted at the station and distributed for trial.

Bulletin 42, pp. 12, figs. 3, maps 2.—Horse Nettle as a Troublesome Weed in Iowa.—Two Other Troublesome Weeds—Potato Scab.—Notes are given on the horse nettle, which is rapidly spreading throughout the State and becoming one of the most troublesome perennial weeds, and on the European bind weed or morning-glory and *Tribulus terrestris*, with a discussion of means for the extermination of these weeds. A brief report is also given on some experiments with corrosive sublimate, formalin, and potassium sulphide for the prevention of potato scab.

Bulletin 43, pp. 32, figs. 21.—Some Injurious Scale Insects.—Brief descriptions and an account of the life history, habits, and economic importance of about 20 species of scale insects, with formulas and suggestions concerning the making and application of the more commonly used insecticides against scale insects.

Bulletin 44, pp. 35, figs. 9.—Observations and Suggestions on the Root Killing of Fruit Trees.—A review of the root killing of fruit trees in the State and the work of the station thereon, supplemented with notes from nurserymen and others, and including a table of information from 60 leading fruit growers of the State on the subject of root killing by cold.

Bulletin 45, pp. 16, pls. 2, figs. 2.—Field Experiments.—A preliminary report on a series of experiments with corn, oats, barley, wheat, brome grass, rape, sorghum, soy beans, cowpeas, and sugar beets, devoted largely to testing methods of culture and varieties, together with an experiment to determine the shrinkage of ear corn.

Bulletin 46, pp. 74, figs. 31, map 1.—Facts and Opinions About Plums and Plum Growing in Iowa.—This includes a classification of plums, with the characteristics of different types; notes on self-sterility; blossoming record for 1899; table showing relative hardiness of varieties; data obtained from correspondents concerning varieties best adapted to the State; descriptive notes on 122 varieties; and cultural notes on soil, planting, cultivation, pruning, spraying, thinning, stocks, and top grafting.

Bulletin 47, pp. 30, figs. 18.—Notes on Vegetables.—Notes on the results of variety tests of cucumbers, eggplants, peppers, Lima beans,

sweet potatoes, and tomatoes; directions for the culture of each of these vegetables, and methods employed in combating injurious insects and diseases.

Biennial Report, 1898 and 1899, pp. 7.—Notes on the work of the station, abstracts of Bulletins 37–43 of the station, and a financial statement for the fiscal year ended June 30, 1899.

The Iowa Station is making investigations in animal industry, including dairying, the most prominent feature of its work, and continues to develop lines of investigation already started in preference to beginning new lines. The results of its comparative study of the various breeds of hogs have yielded a large amount of data of scientific interest and practical value to the pork producers of America. The results are especially of interest in indicating that the British bacon breeds may be grown successfully and profitably under the agricultural conditions of the Mississippi Valley States. In a State where dairying is well developed, an incidental question of importance is the most profitable methods of rearing calves for veal. The station has studied methods of rearing calves on separator skim milk, and has shown just what results can be obtained with calves handled in this manner. This investigation has excited much popular interest, and inquiries for the bulletins have come from many States.

In the station's investigations of grains and forage plants some varieties introduced by the station have been almost universally adopted by the farmers of the State. The work of the horticultural division has been materially extended and strengthened, especially along the lines of breeding varieties of fruits suited to the Northwest and investigations on the prevention of winterkilling of fruit trees. Both of these problems are of the most fundamental importance to local horticulture. Substantial progress has been made along all lines, but the station is seriously hampered by reason of insufficient funds—the result of increasing popular interest in the station's work, of a rapidly growing bulletin list, and of the extension of investigations to new and important lines of work. The State has dealt liberally with its agricultural college, and now that the need of special funds for the further development of the station is clearly demonstrated will doubtless make suitable provision to meet its requirements in the near future.

KANSAS.

Kansas Agricultural Experiment Station, Manhattan.

DEPARTMENT OF KANSAS STATE AGRICULTURAL COLLEGE.

The work of the Kansas Station during the past year has included field and feeding experiments with drought-resisting crops, especially soy beans, Kafir corn, and cowpeas; feeding experiments with calves; trials of soiling dairy cows; investigations on diseases of animals, especially swine plague and blackleg; experiments in plant breeding,

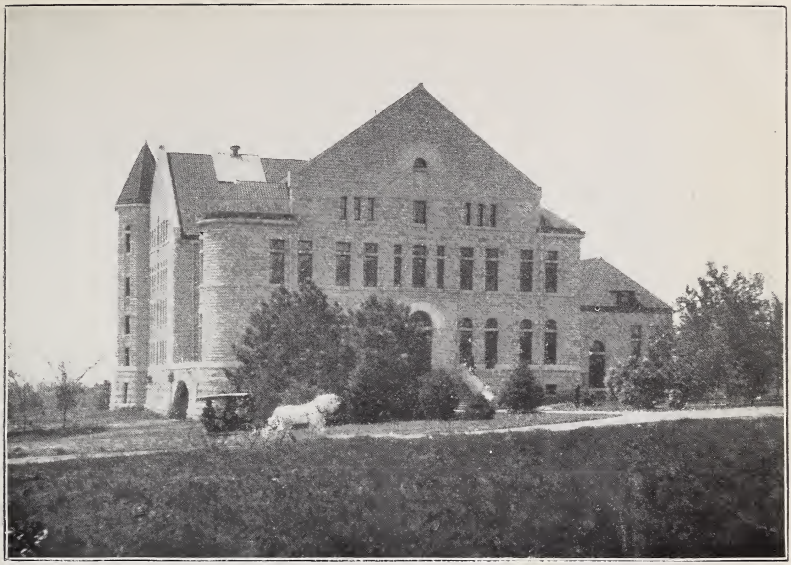


FIG. 1.—KANSAS COLLEGE AND STATION—AGRICULTURAL HALL.

FIG. 2.—LOUISIANA STATE STATION—LABORATORY.

especially with wheat, corn, soy beans, Kafir corn, and alfalfa; seed selection of soy beans, Kafir corn, and alfalfa; variety tests with wheat, barley, emmer, rye, broom-corn millet, and timothy; tests of a large number of kinds of native and cultivated grasses and other forage plants; chemical studies of the effect of continuous cropping with wheat on soil exhaustion; chemical selection of corn; digestion experiments; variety tests of orchard fruits, especially plums, and of several hundred selected seedlings of the sand plum (*Prunus watsoni*) on sandy lands and on clay loam; experiments in the improvement of other native fruits; experiments with foreign vegetables; experiments in the improvement of esculent roots by selection; cultural tests; experiments in foresty; studies of the scale insects affecting grasses, together with extended collections of specimens from various localities; investigations on the life history of the grain aphis; tests of various proprietary insecticides; and experiments in the destruction of the codling moth and in the protection of cabbage from insects.

The botanical division has continued and much extended its grass garden. Experiments in the culture of sugar beets are being carried on by the chemical division in cooperation with this Department. The station suffered the loss by fire, May 31, 1900, of its chemical laboratory. A new agricultural building for the college and station has been completed during the past year at a cost of $31,000. (Pl. II, fig. 1.)

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	7,002.05
Total	22,002.05

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 86–98 and the Annual Reports for 1898 and 1899.

Bulletin 86, pp. 62.—Press Bulletins.—This is made up of reprints of weekly Press Bulletins Nos. 1–34 on miscellaneous subjects, issued by the station from August 2, 1898, to April 7, 1899, and based largely on the results of experiments at the station.

Bulletin 87, pp. 29, figs. 21, maps 29.—Native Agricultural Grasses of Kansas.—Notes on the grass regions of Kansas and illustrated descriptions of 29 species of the more important grasses, with notes on their relative economic value, and maps showing their distribution throughout the State.

Bulletin 88, pp. 7, figs. 7.—Keeping Milk in Summer.—An account of a method of handling milk employed at the station during the summer for keeping milk in good condition for forty to fifty-two hours without the use of ice and at a very small cost.

Bulletin 89, pp. 22, charts 5.—Soil Moisture.—An account of box and field experiments to test the effect of various fertilizers and of field experiments to test the influence of different methods of tillage on soil moisture.

Bulletin 90, pp. 4.—Alfalfa in Eastern Kansas.—A popular bulletin calling the attention of farmers in the eastern part of the State to the value of alfalfa as a farm crop and giving brief directions for its culture.

Bulletin 91, pp. 18, figs. 5.—Swine Plague.—An account of experiments in protective inoculation against swine plague made at the station with 434 pigs; a discussion of the possibility of the virus used for protective inoculation against swine plague being the cause of an outbreak of the disease, and notes on the results obtained in protective inoculation by farmers in the State.

Bulletin 92, pp. 10, figs. 3.—A New Drought-resisting Crop.—Soy Beans.—A description of the soy bean, with directions for planting, cultivating, and harvesting; a discussion of the feeding value of the plant, and the results of 5 tests comparing soy beans and Kafir corn for pigs.

Bulletin 93, pp. 32, figs. 4, maps 2.—Kafir Corn.—A popular bulletin summarizing the results of cultural and feeding experiments with this crop at the station.

Bulletin 94, pp. 22.—Sugar Beets, 1899.—Station Publications.—Analyses of samples of sugar beets sent to the station by 40 growers throughout the State; plans for growing sugar beets in 1900 in given localities; directions for growing sugar beets, and a complete list of station publications with an index of the principal subjects treated.

Bulletin 95, pp. 29, figs. 10.—Fattening Hogs with Drought-resisting Crops.—A detailed report of 8 series of feeding experiments to determine the value of Kafir corn, soy beans, and alfalfa for fattening hogs.

Bulletin 96, pp. 20, pls. 6, dgms. 2.—Soil Inoculation for Soy Beans.—Reprint from a previous publication of the station of a report of preliminary experiments on root tubercles and their production by inoculation, and a report of a series of experiments in inoculating soy beans under field conditions.

Bulletin 97, pp. 16, figs. 7.—Skim Milk Calves.—A discussion of the possibility of raising calves on skim milk suitably supplemented by other foods, and a report of such a test with 13 calves.

Bulletin 98, pp. 16, pls. 6.—Some Scale Insects upon Kansas Grasses.—Descriptions and brief notes on 8 species of Coccidæ occurring upon the native grasses of Kansas, with a table for the determination of the different genera.

Annual Report, 1898, pp. XVII.—Financial reports of the treasurer and secretary for the fiscal year ended June 30, 1898; a summary of

Bulletins 76–80 of the station; a brief review of station work in progress; the organization list of the station, and a subject list of previous publications.

Annual Report, 1899, pp. XX.—The organization list of the station, reports of the treasurer and secretary on the receipts and expenditures of the station for the fiscal year ended June 30, 1899; summaries of Bulletins 81–89 of the station, with an index to the bulletins; subject lists of regular and press bulletins issued by the station, and a general review of work in the different departments.

The great need of Kansas farmers is plants that will withstand the semiarid conditions of large portions of the State. To supply this need the larger part of the station's effort is being directed, especially that of the agricultural, botanical, and chemical divisions. The work is naturally taking the form of tests of introduced plants, experiments in breeding or selection, and the improvement of native species. Scale insects inhabiting grasses, the grain aphis, and the codling moth work a large amount of destruction in the State, and these insects have been investigated by the division of entomology. The station's demonstration of the practicability of soil inoculation to promote the growth of soy beans and the introduction of this method among the farmers of the State is a notable feature of the station's recent work.

Following the resignation of the president of the college in June, 1899, the station has been reorganized. The chemist was made director and charged with general executive duties relating to the station. This is a movement in the right direction, and has already led to improvements in the business management of the station. The State makes an appropriation for farmers' institutes, the work being in charge of the agriculturist. A large number of meetings has been held throughout the State, in which station officers have largely engaged. This work is proving to be too heavy a drain on the energies of the station force. The work in which the Kansas Station is engaged is so important to the agricultural interests of the State that it is not a wise or economical policy to divert the energies of station officers in any large measure to duties in the class room or lecture hall. The State can well afford to support the farmers' institutes in such a manner that the investigations of the station may proceed without interruption and be most thoroughly and efficiently conducted. The State should also fully provide for the distribution of vaccines or other remedies for animal diseases as far as sound public policy makes such distribution under State auspices desirable.

KENTUCKY.

Kentucky Agricultural Experiment Station, Lexington.

DEPARTMENT OF THE AGRICULTURAL AND MECHANICAL COLLEGE OF KENTUCKY.

The work of the Kentucky Station during the past year has been in the same lines as heretofore, including field experiments with tobacco, hemp, potatoes, cereals, etc.; variety tests of grasses and other forage plants; horticultural investigations; studies of plant diseases; entomological and botanical investigations; dairying, especially studies in the variation in butter fat in the milk of cows; meteorological observations; inspection of fertilizers, foods, and nursery stock.

During the year the station has reported on the composition of a number of native grasses and on diseases of elms and methods of treatment. Especial attention is being given to experiments in the culture and curing of tobacco and the growing of hemp, and the station has recently erected a barn for curing tobacco.

The income of the station for the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation, including balance from previous year	2,455.26
Fees, including balance from previous year	20,866.29
Farm products, including balance from previous year	3,334.34
Miscellaneous, including balance from previous year	105.30
Total	41,761.19

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 82–85.

Bulletin 82, pp. 32.—Commercial Fertilizers.—A summary of the provisions of the fertilizer law, notes on the selections of fertilizers, and a list of all the fertilizers entered for sale in the State up to the time of the publication of the bulletin, July, 1899, with guaranteed analyses.

Bulletin 83, pp. 16, pls. 2.—Wheat.—Results of cooperative fertilizer experiments with wheat and of tests of 33 varieties grown in 1899, with descriptive notes on 13 varieties.

Bulletin 84, pp. 25, pls. 13.—The Elms and Their Diseases.—Brief notes on the appearance and distribution throughout the State of 6 species of elms and descriptions of different injurious insects, including the imported elm-leaf beetle, elm-leaf skeletonizer, and the elm-bark beetle, with a discussion of remedial measures.

Bulletin 85, pp. 51.—Commercial Fertilizers.—A brief account of the inspection of fertilizers in Kentucky during 1899, with a list of fertilizer dealers complying with the law; and analyses and valuations of 406 samples of fertilizers.

The important agricultural products of Kentucky are tobacco and hemp, investigations in the culture of which the station has recently undertaken with renewed energy. At the same time the other staple crops of the State, as potatoes, cereals, and grasses, are not being neglected. In recent years dairying has received increased attention, and the station is doing much to popularize this business and establish it on a scientific basis. Inspection service continues to hold a large place in the work of this station and has the cordial support of its constituency. The facilities for investigations in curing tobacco have been materially improved, and in view of the large tobacco interests of the State, this line of work is especially appropriate for this station.

LOUISIANA.

No. 1. Sugar Experiment Station, Audubon Park, New Orleans.
No. 2. State Experiment Station, Baton Rouge.
No. 3. North Louisiana Experiment Station, Calhoun.

DEPARTMENT OF LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE.

The work of the three Louisiana stations during the past year has been mainly along the same lines as heretofore, some of the principal subjects of investigation being as follows:

Sugar Station.—Studies have been made with a view to describing scientifically the effect of severe frost on cane and stubbles, and valuable information of a physiological character has been obtained. Experiments with fertilizers to determine the most desirable form and quantity of each fertilizer element for the growing of cane have been continued, as also cultural and variety tests, the latter of which especially have yielded results of great practical value. Studies have been continued on the ferments of the sugarhouse and on special processes by which sterilization of juices, sirups, and molasses can be obtained. A considerable number of field crops is under observation and experiment, such as ramie, jute, grasses, clovers, alfalfa, and other forage crops, Egyptian and Indian varieties of cotton, and sea-island cotton. Experiments in hybridizing cotton have been continued, and tests are being made of the tensile strength of a large number of varieties as ginned on the roller gin and by the saw gin. In cooperation with this Department experiments have been undertaken in tea culture. The fertilizer and Paris-green inspection has been continued as heretofore.

State Station.—The geological survey which is carried on by this station with a special State appropriation has been actively prosecuted, and at the same time the soil survey in cooperation with this Department has also been continued. Culture experiments with a considerable variety of field crops have been continued. Tobacco has been a prominent subject of investigation, especially with reference to high-grade Sumatra and Habana wrappers. The seed of many varieties

was obtained and various cultural tests were made, as, for instance, the use of shade and the amount of it, and fermentation experiments were carried on from the standpoints of common practice, of bacteriology, and of chemistry. The experiments in the immunization of imported cattle to Texas fever have been continued as heretofore. Experiments have been made with various ticks and investigations are being made into their life histories and on the power of different ticks to produce the fever. Considerable attention has been given to investigations of outbreaks of anthrax. Investigations have been made on methods of eradicating red rice and other weeds from rice fields. A new station building (Pl. II, fig. 2) has been erected.

North Louisiana Station.—A wide range of field crops has been experimented with, as heretofore. Much attention has been given to methods of harvesting and utilizing the corn crop. Feeding experiments with beef cattle and the work in dairying are being continued. In cooperation with this Department a model road, three-fourths of a mile in length, has been built through the station grounds. The work was in progress while the annual fair was being held in the town and thus many had an opportunity to observe the methods used. The barn, tool shed, carriage house, and horse stable were destroyed by fire. The loss was partly covered by insurance. Since then a large barn and a combined stable and tool house, both 40 by 60 feet, two stories high, and covered with galvanized iron, have been erected.

The income of the stations during the past fiscal year was as follows:

United States appropriation	$15,000.00
State	18,000.00
Individuals and communities	2,005.00
Fees	5,514.25
Farm products	1,669.90
Miscellaneous, including balance from previous year	12,974.84
Total	55,163.99

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 56–59; Report on Geology and Agriculture, Part V, and the Annual Report for 1899.

Bulletin 56, pp. 15, pls. 9.—Ticks and Texas Fever.—This bulletin discusses from an anatomical and biological standpoint the cattle tick, the lone star tick, the wood tick, and *Ixodes ricinus*, and gives the results of a number of experiments to determine whether the different species of ticks transmit the germs of Texas fever.

Bulletin 57, pp. 43, figs. 6.—Immunization Against Texas Fever by Blood Inoculation.—A detailed account of experiments in blood inoculation made with 9 heifers; a description of the method to be used in

securing the blood for inoculation, and in making the inoculation in animals to be immunized; and a report on experiments conducted for the purpose of determining whether the blood in ticks could be used for inoculation purposes, and on an experiment in preserving blood for inoculation purposes.

Bulletin 58, pp. 86.—Analyses of Commercial Fertilizers and Paris Green.—This contains the text of the State fertilizer law, a discussion of the various commercial sources of nitrogen, phosphoric acid, and potash, and the valuation of fertilizers, analyses of 528 samples of fertilizing materials, text of the State law providing for the inspection of Paris green, and analyses of 38 samples of Paris green.

Bulletin 59, pp. 54.—Sugar Cane.—This gives cultural directions, including preparation of land, drainage, planting, and selection of varieties; report of a test comparing different methods of propagation; results of trials to determine the influence of planting large, medium, and small canes selected continuously from plantings of large, medium, and small canes, respectively; a report of an investigation of the composition of roots, stalks, leaves, and tips of Louisiana sugar cane, with a brief review of the reported composition of cane grown in different countries; a discussion of the fertilizer requirements of sugar cane; detailed results of extended nitrogen, potash, and phosphoric-acid experiments with sugar cane; results of a comparison of deep and shallow cultivation; and a summary of meteorological observations during 1897, 1898, and 1899.

Geology and Agriculture, Part V, pp. 354, pls. 53, figs. 3, maps 12.—A Preliminary Report on the Geology of Louisiana.—This report summarizes previous work and gives an account of additional investigations on the geology of Louisiana. The report is divided into three parts. Part I is an historical review of investigations from the earliest times up to and including those of the Louisiana Experiment Stations. Part II deals with the general geology of the State, including stratigraphic and economic geology. Part III contains reports of investigations of the topography and geology of the Shreveport and Natchitoches areas and of the Five Islands, and reports on Louisiana clay samples, a collection of fossil plants from northwestern Louisiana, Cretaceous and Lower Eocene faunas of Louisiana, establishment of meridian lines, road making, and on some wood-destroying fungi.

Annual Report, 1899, pp. 16.—A report of the director on the work of the Sugar Station, State Station, and the North Louisiana Station; an outline of the report on the geological survey of Louisiana; notes on the soil survey of the State; the staff of each station; and a financial statement for the fiscal year ended June 30, 1899.

The most important agricultural product of southern Louisiana is sugar, and the sugar industry is receiving most valuable assistance from the sugar experiment station. The work of this station is widely

known both in this country and abroad. At the same time other crops of possible value locally are not being neglected. Especial mention may be made of ramie, jute, and foreign and sea-island cottons. With respect to the last named, the station is endeavoring to show that it may be successfully cultivated all along the Gulf coast, whereas the region in which it is now grown is very restricted. The work of the State experiment station on Sumatra and Habana tobaccos gives promise of valuable practical results. Several boxes of cigars made from tobacco grown by the station were rated by New Orleans manufacturers with good imported Habana stock. The station has met with success in inoculating cattle for Texas fever. The North Louisiana Station is endeavoring to introduce among the farmers better methods of general farming, and is meeting with much success.

The work of the Louisiana stations is very actively prosecuted, and has cordial support in the State. Station officers continue to take an active part in farmers' institute work.

MAINE.

Maine Agricultural Experiment Station, Orono.

DEPARTMENT OF THE UNIVERSITY OF MAINE.

The work of the Maine Station during the past year has been along the same lines as heretofore, including investigations on the food and nutrition of man and domestic animals, poultry experiments, breeding experiments with sheep, box and field experiments with fertilizers, horticultural investigations, botanical and entomological investigations, and work in veterinary science and practice. Digestion experiments with sheep have been continued. The poultry work is being developed. Experiments in sheep breeding have been undertaken, the work consisting specifically of crossing Dorsets to get earliness of lambing combined with other qualities. The experiments in crossing blueberries and huckleberries are proceeding hopefully.

The station has made studies of the nutritive value of nuts and of breakfast foods offered for sale in Maine, and in cooperation with this Department is continuing studies on the nutritive value and digestibility of cereals and bread, with special attention to methods of digestion experiments. Chemical analyses have been made of certain other foods, particularly concentrated army rations, and investigations on the effect of climate on varieties of wheat and potatoes have been carried on as heretofore. The station continues to cooperate with farmers in Aroostook County in experiments in apple growing. To these have been added cooperative experiments in manuring and spraying potatoes. The inspection of fertilizers, creamery glassware, feeding stuffs, and seed has been continued under State laws.

During the year a two-story brick addition, 22 by 26 feet, with basement, has been made to the office and laboratory building at a cost of

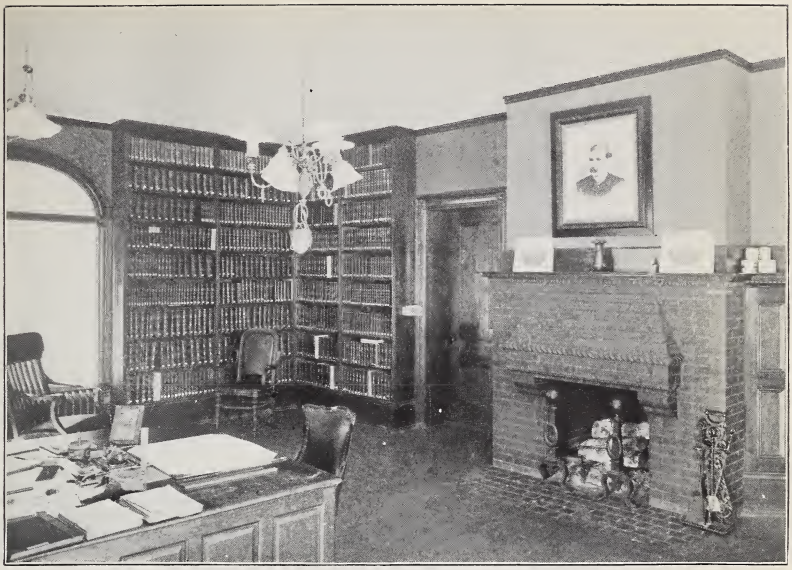


FIG. 1.—MAINE STATION—DIRECTOR'S OFFICE.

FIG. 2.—MINNESOTA COLLEGE AND STATION—HORTICULTURAL BUILDING.

$3,500. The new laboratory is used as a food laboratory, the basement being used for work with the bomb calorimeter and for feeding experiments with men, and the second story as the director's office. (Pl. III, fig. 1.)

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees for inspection service[1]	4,970.53
Farm products	3,950.10
Balance from previous year	177.74
Total	24,098.37

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 53–65 and the Annual Reports for 1898 and 1899.

Bulletin 53, pp. 14.—Fertilizer Inspection.—Analyses of 163 samples of fertilizers collected by representatives of the station, notes on the valuation of fertilizers, and a discussion of the quality of fertilizers offered for sale in Maine.

Bulletin 54, pp. 22.—Nuts as Food.—Statistics of the amount of nuts imported into the United States, composition of a number of nuts analyzed at the station, analyses of nuts made by other investigators, and a discussion of the characteristics of the different nuts and their preparation and use as articles of diet.

Bulletin 55, pp. 14.—Cereal Breakfast Foods.—Analyses of a considerable number of commercial cereal breakfast foods, with a discussion of their nutritive value and cost.

Bulletin 56, pp. 40, pls. 8.—Apple Insects of Maine.—Notes on the appearance, life history, etc., of 21 insects injurious to the apple, with a discussion of remedial measures.

Bulletin 57, pp. 14.—Experiments with Potatoes.—An account of an investigation undertaken to determine the effect on the starch content of the tubers of spraying potato vines with Bordeaux mixture, including analyses of samples of potatoes from sprayed and unsprayed fields; estimates based on ash analyses at the station of the amount of fertilizing constituents removed by a crop of potatoes, and a summary of considerable literature on fertilizing potatoes.

Bulletin 58, pp. 23.—Finances, Meteorology, Index.—A list of acknowledgments, summary of meteorological observations during the year, financial statement for the fiscal year ended June 30, 1899, index to the annual report, the organization list of the station, and notes on the work and publications of the station.

Bulletin 59, pp. 16.—Feeding Stuff Inspection.—Notes on the Maine

[1] For the year ended December 31, 1899.

law regarding the sale of feeding stuffs, and analyses of a large number of samples.

Bulletin 60, pp. 8.—Fertilizer Inspection.—A statement of the chief provisions of the State fertilizer law, and analyses of 131 samples of fertilizing materials.

Bulletin 61, pp. 16, figs. 2—Notes on Insects and Plants.—Brief biologic and economic notes on the more important species of injurious insects observed during the year, and notes on 12 weeds and other plants sent to the station for identification.

Bulletin 62, pp. 30.—The Maine Experiment Station.—A brief historical and descriptive account of the station from its establishment in 1885, a summary of the more important experimental work undertaken, and lists of the subjects treated in the 15 annual reports and 61 bulletins issued by the station since its organization.

Bulletin 63, pp. 14.—Feeding Stuff Inspection.—Analyses of a large number of samples of feeding stuffs made in accordance with the State law, with a statement of the chief requirements of the law and notes on its violation.

Bulletin 64, pp. 16.—Poultry Experiments in 1899.—An account of experiments in fattening chickens for market undertaken to compare the rapidity of growth of chickens confined in small coops and chickens kept in sheds or yards, to compare the gains made by chickens of different ages, and to test the value of green food for fattening chickens; a discussion of breeding hens for egg production, and a tabulated record of the egg production of 238 hens during fourteen months.

Bulletin 65, pp. 16.—Coffee Substitutes, Nut Oils, Testing Seeds, Potato Pomace.—Analyses of 8 sorts of cereal coffee, with a discussion of their food value; analyses of the oils of a large number of nuts; notes on the examination of 103 samples of clover and grass seed, and 2 analyses of the residue from the manufacture of starch from potatoes.

Annual Report, 1898, pp. 242, pls. 17, fig. 1.—This contains the organization list of the station; a brief report by the director; list of acknowledgments, abstracts or reprints of Bulletins 41–47 of the station; a summary of the results of the inspection of feeding stuffs during 1898 and analyses of a number of fodders and feeding stuffs analyzed in connection with station work; tabulated results of the examination with regard to the purity of 134 samples of clover and grass seeds; a summary account of box experiments extending over a number of years to determine the relative value of acid Florida rock, crude finely ground Florida rock, and a phosphate of iron and alumina; data and summarized results of a number of digestion experiments with sheep; a study of the composition of oat hay harvested at different stages of maturity; a report of experiments carried on during three winters to study the effect of gluten meals varying greatly in fat content on the texture of butter and the composition of butter fat; the results of an

experiment conducted to study the effect of food on the fat content of milk; brief descriptions of a number of species of millipeds; brief notes on an injurious caddice fly; brief notes on a number of insects reported as injurious during the year; notes on some 30 species of weeds sent to the station for identification; a review of the history of tuberculosis in the station herd; description of a nest box for keeping individual egg records; data for a test to determine the number of hens that can profitably be kept in one pen; a monthly record of 24 cows for 1898; the comparative yields of radishes grown from large and small seeds; an account of experiments in comparing subwatering and surface watering for radishes; an account of the blueberry industry in Maine, with botanical descriptions of several species of blueberries and notes on cultural experiments with blueberries; a detailed tabular report on a number of experiments with men to determine the digestibility of different kinds of bread; results of experiments with different kinds of Nitragin cultures; a discussion of the use of skim milk in making bread and other articles of diet; a technical discussion of the more salient points concerning fertilization in plants; a summary of meteorological observations during 1898; and a financial statement for the fiscal year ended June 30, 1898.

Annual Report, 1899, pp. 171, pls. 8, figs. 2.—The organization list of the station, brief announcements concerning the work and publications of the station, summary of meteorological observations during the year, acknowledgments, a financial statement for the fiscal year ended June 30, 1899, and reprints of Bulletins 48–57 of the station.

While in selecting lines of work the station has regard at all times for the needs of the agriculture of the State, much of the work, notably the nutrition investigations, is of general importance. The requirements of the intensive and diversified agriculture of the State make problems of the nutrition and breeding of animals and plants of immediate importance, and along these lines lies much of the work of the station. In horticulture the work has mostly to do with fruit culture. The blueberry industry is a large one, and much attention is being given to it, both along lines of management of the blueberry barrens as well as those of culture under domestication. Apple growing in the central portions of the State and the growing of small fruits in the neighborhood of the summer resorts are industries of importance, and the station is making investigations along these lines.

The cooperative experiments with farmers and fruit growers, especially in Kennebec and Aroostook counties, have been carefully planned and are thoroughly supervised by the station officers. They have increased the influence of the station among practical men and led to the introduction of improved agricultural practices. The inspection service maintained by the station is growing in extent and

importance. It is fully supported by State funds and is conducted as far as practicable during such definite and limited periods as not to interfere with the experimental work. Farmers' institutes, in which some members of the station staff participate, are held under the direction of the State Board of Agriculture. A four-day institute was held at the college during the past summer.

MARYLAND.

Maryland Agricultural Experiment Station, College Park.

DEPARTMENT OF MARYLAND AGRICULTURAL COLLEGE.

The work of the Maryland Station during the past year has included chemical investigations, feeding and digestion experiments with cows and pigs, breeding experiments with dairy cattle, field experiments with staple crops, experiments in curing tobacco, horticultural investigations, studies in vegetable pathology, entomological investigations, studies of animal diseases, work in dairying, investigations in plant breeding, experiments with forcing crops with special reference to soil preparation and manuring, and bacteriological work in connection with the preservation of milk and butter, and on diseases of horses.

During the year the station has published the results of its investigations in cooperation with the State geological survey on the occurrence and composition of lime in Maryland, together with a report on experiments on its agricultural uses. Investigations on the cause of mottled butter have also been reported in which this condition is shown to be due to the uneven distribution of salt.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	2,830.94
Miscellaneous	5.69
Total	17,836.63

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 61–64 and the Annual Report for 1899.

Bulletin 61, pp. 18.—The Sugar Beet in Maryland.—A detailed historical account of the sugar beet in Maryland, notes on the possibility of its successful culture in some portions of the State, and tabulated analyses showing the sugar content and percentage of purity of the crop grown in the State in cooperative tests during 1898.

Bulletin 62, pp. 19.—Experiments with Wheat, Corn, and Potatoes.—Results of a test of 30 varieties of wheat in 1898, and the maximum, minimum, and average yields of 80 varieties tested since 1889; results of culture experiments with corn from 1883 to 1898, to determine the

relative value of deep and shallow cultivation, different number of cultivations, wide and narrow rows, and planting in drills and checks; results of tests of about 50 varieties of potatoes in 1897 and 1898; notes on the effect of spraying potatoes with Bordeaux mixture for the prevention of blight; and the results of comparative tests of early *v.* late cultivation of potatoes, deep *v.* shallow cultivation, ridge *v.* flat culture, and planting in wide *v.* narrow rows.

Bulletin 63, pp. 41, pls. 10, dgms. 2.—Experiments in Feeding Pigs for the Production of Pork.—A detailed report of experiments with pigs, conducted to compare separator skim milk with a quantity of green clover furnishing approximately the same amount of protein; to compare separator skim milk with gluten and linseed meal for balancing a grain ration; to test the value of ground corn shives fed as a partial substitute for hominy chop, as a substitute for part of a mixed-grain ration, as an addition to grain and skim milk, and as a partial substitute for hominy chop with linseed meal and gluten meal; and to test the value of cowpea pasture, artichoke pasture, and sweet potatoes, in addition to a ration of grain and skim milk, with and without corn shives.

Bulletin 64, pp. 12.—A Study of the Cause of Mottled Butter.—An account of experiments conducted to test various theories as to the cause of mottled butter, including tests of the effect of using cold wash water, and of the effect of the uneven distribution of salt on the appearance of the butter, together with a discussion on the prevention of mottles based on the results of the experiments.

Annual Report, 1899, pp. 221, pls. 9, figs. 51.—Brief notes on the work of the station, a meteorological summary for 1898, a financial statement for the fiscal year ended June 30, 1899, and reprints of Bulletins 57–62 of the station.

In the early years of the State, tobacco was one of the most important money crops, but in more recent years the production has greatly declined. It is natural that the station should be endeavoring to reestablish this industry as far as possible. One cause of the decline has been shown by the physicist to be due to a change in the mechanical condition of the soil. Starting out from this point, a comparative study was made of the adaptability of the soils of the State for tobacco growing, and this work has later, in cooperation with various other institutions, including this Department, been broadened in its scope to include a comprehensive and systematic survey of all soils of the State from both scientific and economic standpoints. Other branches of agriculture of much importance locally are fruit growing and truck gardening, and these are receiving increased and systematic attention. The station is also doing what it can to promote the dairy interests of the State and to aid in the development of animal industry. The business of the station farm has been put on a more efficient basis, and is

made to directly promote the work of investigation. The inspection of commercial fertilizers and nursery stock has been continued under the direction of the college, as well as the system of farmers' institutes. Through these agencies, as well as through the publications of the station, the farmers of the State are being aroused to the importance of the work of the college and station, and are more fully appreciating its direct relation to their practical affairs.

MASSACHUSETTS.

Hatch Experiment Station of the Massachusetts Agricultural College, Amherst.

DEPARTMENT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

The work of the Massachusetts Hatch Station during the past year has been along the same lines as heretofore, and has included investigations on the clover-leaf beetle, grass thrips, chrysanthemum fly, the common scale insects of Massachusetts, the Pyralidæ of North America, and cranberry insects, variety tests and fertilizer experiments in horticulture; tests of seedling strawberries, raspberries, currants, plums, and weeping silver maple; tests of stocks for fruit trees; comparisons of methods of grafting and of varieties of grafting wax; experiments with cover and green-manuring crops for orchards; experiments in pruning, protection of fruit and vegetable crops from insect and fungus pests, together with practical tests of insecticides and fungicides; investigations on drop of lettuce and on diseases of violets and cucumbers, the investigations in the last case including tests of the susceptibility of the principal varieties to disease, and to methods of pruning; investigations to determine why certain varieties of roses can be grown in New Jersey and New York but not in Massachusetts; investigations on soils and their water-retaining properties as related to greenhouse crops and asparagus rust; experiments in breeding asters and studies of aster diseases; seed testing; field experiments with fertilizers on different crops; soil tests; comparisons of winter and spring applications of barnyard manure for corn; experiments in growing alfalfa; Nitragin experiments; experiments with forage plants, including the cowpea; pot experiments; feeding experiments with milch cows and poultry; investigations in dairying; meteorology, and studies of soil moisture.

The card catalogue of literature of all described species of scale insects has been continued. Exhaustive investigations on butter fat have been carried on in conjunction with the feeding experiments to ascertain the effect on butter of feeding ground flaxseed meal containing 36 per cent of oil as compared with a normal linseed ration. In the work on cucumbers the botanist is investigating the use of different kinds of glass and their effects on the foliage, etc. The discovery of the botanist and his assistant that sterilizing the surface soil is a complete preventive for the drop and Rhizoctonia of lettuce is now being applied

by large lettuce growers. The investigations on the effect of electricity on lettuce out of doors have been continued, and the botanist has ascertained the amount of current which will give a maximum yield. The entomologist has worked out a remedy for the leaf miner of the Marguerite flower and chrysanthemum. The station continues the inspection of fertilizers and feeding stuffs under State law, and to these has been added during the past year, the inspection of nurseries for San José scale, which was taken up voluntarily as a college matter.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriations	11,200.00
Fees from inspection service	3,600.00
Farm products	1,720.86
Miscellaneous	1,979.82
Total	33,500.68

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 62–67; Special Bulletin, August 10, 1899; Meteorological Bulletins 126–137; and the Annual Report for 1899.

Bulletin 62, pp. 20, and 63, pp. 26.—Analyses of Fertilizers.—Tabulated analyses of 467 samples of fertilizing materials.

Bulletin 64, pp. 31.—Concentrated Feed Stuffs.—A detailed report on the examination of a large number of samples of concentrated feeding stuffs in accordance with the law in Massachusetts, with a classification of feeding stuffs and notes on their comparative value.

Bulletin 65, pp. 14.—Analyses of Fertilizers.—Tabulated analyses of 59 samples of fertilizing materials, directions for taking and shipping samples for analysis, and trade values of fertilizing ingredients in 1900.

Bulletin 66, pp. 19.—Summary of the Work of the Horticultural Division for the Year 1899.—Summarized results of variety and fertilizer tests with orchard and small fruits and grapes, together with suggestions on thinning fruits and the pruning of fruit trees and plants, and a spraying calendar.

Bulletin 67, pp. 12, pl. 1.—The Grass Thrips.—Treatment for Thrips in Greenhouses.—A brief account of the life history, feeding habits, food plants, etc., of the grass thrips, with the results of experiments on the destruction of this insect in greenhouses.

Special Bulletin, August 10, 1899, pp. 57, pls. 9.—The Coccid Genera Chionaspis and Hemichionaspis.—A monographic account of these genera with synoptic tables for the identification of species, and brief biological notes and bibliographies in connection with the species.

Meteorological Bulletins 126–137, pp. 4 each.—Notes on the weather and monthly summaries of meterological observations for the year ended May 31, 1900, with an annual summary for 1899 in Meterological Bulletin 132.

Annual Report, 1899, pp. 125, map 1.—A brief summary of the work during the year, including a list of officers of the station and a list of station publications now available for distribution; a financial statement for the fiscal year ended June 30, 1899; and reports of the heads of departments reviewing in detail the different lines of station work during the year and giving in addition an account of soil tests with corn and onions, a comparison of barnyard manure alone and barnyard manure and sulphate of potash for corn, a comparison of a special fertilizer and a fertilizer containing a larger amount of potash for corn, a comparison of sulphate and muriate of potash for a number of crops, a test of seven different forms of potash for soy beans, experiments with leguminous crops as nitrogen gatherers, a test of 94 varieties of potatoes, experiments in manuring grass lands, a test of the value for egg production of rations with wide and narrow nutritive ratios, investigations on a number of plant diseases, experiments in growing violets in sterilized soil, a study of the relationship existing between the asparagus rust and the physical properties of the soil, a general summary of meteorological observations from 1889 to 1898, notes on various injurious insects, and a summary of the results of fertilizer inspection during the year.

Massachusetts being a thickly populated State, with an intensive and diversified agriculture, the economical feeding of plants and animals is a problem of prime importance. Dairying, market gardening, the growing of crops under glass, fruit growing, and poultry raising are important industries, and along these lines the station has concentrated most of its energies. The station continues to carry on a large amount of scientific investigation, and results of great practical value have been obtained. The inspection service performed by the station is an important part of its work. The farmers' institutes are under the direction of the State Board of Agriculture and the demand on station officers for this kind of service is not excessive.

MICHIGAN.

Experiment Station of Michigan Agricultural College, Agricultural College.

DEPARTMENT OF MICHIGAN AGRICULTURAL COLLEGE.

The work of the Michigan Station during the past year has been along much the same lines as heretofore, and has included experiments in reclaiming muck lands, with tests of the effects of different fertilizers, lime, barnyard manure, etc., on various crops on such land; fertilizer experiments with sugar beets; experiments with sand lucern and other forage crops; rotation and fertilizer experiments; studies of

tuberculosis; investigations on the production of sanitary milk; studies of gassy curd; variety tests of strawberries, fruits, and potatoes; fertilizer experiments with potatoes; spraying experiments with apples; comparisons of different methods of trellising tomatoes; tests of cover crops for orchards; experiments in improving very light worn land; fertilizer experiments with greenhouse crops; studies of strongylus in sheep and of a new sheep disease; entomological investigations; the distribution of San José scale in the State; investigations on plant diseases; forestry; tests of clover seed, and chemical studies of sugar beets, especially to ascertain the relation of weather conditions to the development of sugar.

The station is giving considerable attention to testing varieties of legumes new to the State, and some of them are coming into considerable prominence locally. The station continues to conduct the fertilizer inspection under State laws. During the year a large general barn and a dairy building have been erected, the latter with a State appropriation of $15,000. The dairy building will afford offices for the director and the agriculturist. There have been several changes in the station during the year. The director has been relieved of all experimenting, and his duties are now confined to the executive work connected with the station, farmers' institute and extension work, and to special courses in agriculture. The horticulturist has been relieved of all teaching duties, and will confine his attention almost exclusively to station work. The bacteriologist has been made a member of the station council.

Work at the substation at Grayling has been abandoned. Another substation has been established by the State on 160 acres of timber land at Chatham in the Upper Peninsula, and work was begun with a special appropriation of $2,500 a year. About 25 or 30 acres have been cleared and experiments begun to determine what crops can be profitably grown in that section. Work at South Haven substation has been continued much as in previous years. Heretofore this work has been carried on by the late Mr. T. T. Lyon, but after his death, which occurred recently, an assistant was placed in charge.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation for substation	2,500.00
Fees for fertilizer inspection	1,620.00
Farm products	438.43
Miscellaneous	405.73
Balance	895.66
Total	20,859.82

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 174–178, Special Bulletins 9, 10, and 13, and the Annual Reports for 1898 and 1899.

Bulletin 174, pp. 13.—Fertilizer Analyses.—This bulletin gives the text of the State fertilizer law; a discussion of the objects and results of inspection and the composition and character of different classes of fertilizers; a schedule of commercial prices, with notes on the valuation of fertilizers; explanation of terms used in fertilizer analysis; and tabulated analyses of 68 samples of commercial fertilizers inspected during 1899.

Bulletin 175, pp. 33, figs. 20.—Some Insects of the Year 1898.—Brief economic notes on 19 species of insects, and formulas and directions for the use of various insecticides.

Bulletin 176, pp. 14.—Strawberry Notes for 1899.—Tabulated data as to the blooming period, productiveness, yield, quality of fruit, etc., for 160 varieties of strawberries grown at the station in 1899, with descriptive notes on 103 of these varieties.

Bulletin 177, pp. 40.—South Haven Report for 1899.—Results of tests of a large number of varieties of small and orchard fruits, with descriptions of a number of varieties, and brief notes on a number of varieties of nuts; and a brief account of experiments in pruning back peach trees which had been injured by frost, and on spraying experiments.

Bulletin 178, pp. 32, figs. 8.—The Production and Marketing of Wool.—This bulletin deals with the production of wool in Michigan and the best methods of improving this industry, the discussion being based in part on replies received to questions addressed to a number of wool dealers in different parts of the United States.

Special Bulletin 9, pp. 12.—Suggestions on Farm Accounts.—Practical methods of keeping farm accounts are described and examples given.

Special Bulletin 10, pp. 4.—Sugar Beets.—Brief cultural directions for the growing of sugar beets.

Special Bulletin 13, pp. 8.—Review of Professor Bang's Work with Contagious Abortion.—An abstract of the work of Professor Bang bearing on this subject.

Annual Report, 1898, pp. 492, figs. 40, dgms. 2.—This includes the organization list of the station; a financial statement for the fiscal year ended June 30, 1898; a report of the director on the publications, personnel, and work of the station; a report of the agriculturist reviewing the work of the year with wheat, oats, corn, and certain forage crops, and giving a plan of some fertilizer experiments under way on muck land; a report of the horticulturist giving notes on the different lines of experiments undertaken and the progress made, and an account of a series of spraying experiments undertaken for the prevention of the

curl leaf of the peach; a brief report of the chemist; a report of the bacteriologist covering the subjects of tuberculosis, crown-gall in peaches, gassy cheese, hog cholera, and cleanliness in milking; a report of the apiarist on a number of experiments, including wintering bees, testing kinds of foundations, etc.; a tabulated summary of meteorological observations during 1897, and reprints of Bulletins 145–160 of the station.

Annual Report, 1899, pp. 312, figs. 14, maps 2.—Contains the organization list of the station; a report of the secretary and treasurer for the fiscal year ended June 30, 1899; a report of the director, and departmental reports reviewing the different lines of station work during the year; daily and monthly summaries of meteorological observations during 1898, and reprints of Bulletins 161–174 of the station.

The Michigan Station has work in progress on a variety of questions of immediate importance to the agriculture of the State. Its experiments in reclaiming muck lands, of which there are large tracts, have demonstrated the great value of barnyard manure for this purpose. The entomologist has studied the various injurious insects of the year, has worked out the life history of certain new insects, and has suggested methods of repression. The work of this station on sugar beets has been instrumental in leading to the establishment of nine sugar factories in the State, besides three others in course of erection. Forage plants new to the State, such as cowpeas and soy beans, are being brought into considerable prominence by the work of the station. Station officers continue to take part actively in farmers' institutes, which are carried on under the supervision of the director with the aid of a State appropriation of $5,500. In this way the work of the station is brought prominently before the farmers and is gaining much support.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota, St. Anthony Park.

DEPARTMENT OF THE UNIVERSITY OF MINNESOTA.

The work of the Minnesota Station during the past year has been along the same lines as heretofore, including field experiments with grain and forage crops, flax grown for fiber and for seed, sugar beets, rotation of crops, etc.; horticultural and forestry investigations; entomological investigations, especially with reference to the repression of grasshoppers; chemical studies of soils, foods, etc.; investigations in dairy farming and dairying; studies in veterinary science and practice; feeding experiments with cattle, sheep, and pigs; pasturage experiments with sheep, and breeding experiments with sheep and

pigs. A large amount of work is being done in the breeding of important varieties of cereals, grasses, millet, field peas, etc. Along this line, wheat has received especial attention, and the investigations have already resulted in the origination of superior varieties. Similar experiments with soy beans and cowpeas are engaging some attention, the object being to secure early maturing varieties. Improved records of plant-breeding experiments are being kept on slips with printed headings, which are ultimately bound together. In the experiments with forage plants for sheep, pigs, etc., especial attention has been given to cowpeas and soy beans. Breeding experiments with sheep and with pigs have already yielded promising results. The chemist is continuing nutrition investigations with cereals in cooperation with this Department. His work on soils has been enlarged by an arrangement with the State geological survey, by which he will have $1,200 a year for four years for work in this line. The entomologist continues to act as State entomologist, and the veterinarian continues to be a member of the State board of health, but has been relieved of details hitherto imposed on him.

A new horticultural building (Pl. III, fig. 2) for the use of the college and station has recently been completed at a cost of $35,000. The substations at Crookston and Grand Rapids are being maintained as heretofore with State funds. During the year an extensive report of the work of these substations for several years, as also of the work of Coteau Farm, has been published.

The income of the station (including substations) during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	32,033.09
Farm products	9,333.31
Total	56,366.40

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 62–67 and the Annual Report for 1899.

Bulletin 62, pp. 174, figs. 51, charts 4.—Wheat—Varieties, Breeding, Cultivation.—This bulletin contains a history, with detailed records, of variety, selection, and breeding experiments carried on by the station and substations through a series of years; a discussion of the botanical characteristics of wheat and of the methods employed by the station in breeding wheat; and suggestions regarding field management of wheat in rotations.

Bulletin 63, pp. 41, fig. 1.—Miscellaneous Analyses.—Composition of Tomatoes.—Proteids of Wheat Flour.—Analyses of various foods,

food preservatives, feeding stuffs, fertilizing materials, and miscellaneous substances; a report on an investigation of the composition and food value of tomatoes; and a somewhat exhaustive review of the subject of the chemistry of wheat proteids and a report on a study of the proteids of a number of samples of wheat flour and other milling products.

Bulletin 64, pp. 35, pls. 2, figs. 26.—The Black Rust or Summer Rust.—The Hessian Fly.—Migratory Locusts or Grasshoppers.—A descriptive account of the fungus causing the black or summer rust of wheat, a summary of the present knowledge concerning the life history and habits of the Hessian fly, with suggestions as to remedies; and a popular account of the habits and of the devastation caused by migratory locusts, with recommendations as to remedial measures.

Bulletin 65, pp. 84, figs. 8.—Soil Investigations.—Chemical analyses of 124 samples of soil from 64 different localities in Minnesota, with descriptions of samples, explanations of terms, and interpretation of results, mechanical analyses of 28 samples, with a discussion (with illustrations) of the mineralogical character of the soil particles, and the influence of lime, humus, and alkali on the texture of soils; an account of determinations of the sap acidity of a few agricultural plants; a comparison of the Dyer and Goss methods for determining available plant food in soils, and experiments in growing wheat in soils extracted with acids; and a discussion on the average composition of Minnesota soils, the influence of continuous grain cropping and summer fallowing on the nitrogen of soils, the reaction of soils, the amount of plant food in soils, the adaptability of soils to a variety of crops, reserve fertility of soils, and the importance of farm rotations and the use of farm manures.

Bulletin 66, pp. 250, figs. 249.—Beetles Injurious to Fruit-producing Plants.—A brief classification of the various families of beetles and a general account of a large number of species known to be injurious to fruit trees and small fruits, with suggestions as to remedies.

Bulletin 67, pp. 226, figs. 30, charts 3.—Investigation in Milk Production.—Feeding Dairy Cows.—Illustrations of the system of keeping dairy records employed at the station; tabulated records of the dairy herd for 1894, 1895, and 1896, with a discussion of the data; an account of experiments with dairy cows, comparing wheat with barley and corn, and prairie hay with timothy; a discussion based on records of the station herd of the production of cows during one period of lactation, the variation in productive capacity of cows, the comparative cost of butter and meat production, and variations in the yield and quality of milk; and a consideration with reference to dairy cows of principles of feeding and the composition and use of feeding stuffs.

Annual Report, 1899, pp. 630, pls. 42, figs. 207, charts 4.—The organization list of the station, financial statement for the fiscal year

ended June 30, 1899, a detailed review of station work during the year, reprints of Bulletins 60–64 of the station, and a summary of meteorological observations during 1898 and six months of 1899.

Cereals, especially wheat and flax, live stock, and dairy products are the leading agricultural products of the State. The station's work with cereals and forage crops has taken the form of breeding experiments, which have been carried on for a series of years on an extensive scale and with results of great practical value. The live-stock interests of the State have received helpful attention in the station's feeding and breeding experiments with sheep and with hogs. The work in dairying, horticulture, and entomology has also been of much practical importance. Many of the soil investigations have yielded results of more than local value, and the same may be said of the nutrition investigations on cereals and bread. The newly erected horticultural building will give the horticulturist greatly increased facilities for his work. Farmers' institutes are being continued, as heretofore, under the auspices of the university with the aid of a special State appropriation, but other demands on the station officers are so great that they can give only a limited amount of assistance. The university is doing a large work for the practical education of farmers' children in its very successful secondary school of agriculture. With the liberal financial aid of the State and the university, the Minnesota Station continues active operations on a relatively large scale.

MISSISSIPPI.

Mississippi Agricultural Experiment Station, Agricultural College.

DEPARTMENT OF MISSISSIPPI AGRICULTURAL AND MECHANICAL COLLEGE.

The work of the Mississippi Station during the past year has been mainly along the lines of soil studies; investigations in beef and mutton production; dairying; variety tests of orchards and small fruits, cotton, and wheat, and investigations on Texas fever. The soil studies have comprised investigations on the chemical and physical composition of the various types and formations in the State; investigations of the water conditions and water-holding power of the several typical soils; comparisons of the productive power of the different soils and fertilizer tests on a number of them; experiments in the improvement of contrary soils, and analyses of artesian and other deep well waters. The experiments in beef and mutton production have included in part breeding experiments with cattle and sheep; studies of the value of these products as money crops for the State; investigations and demonstrations of the advantages of stock raising for maintaining soil fertility; experiments in the utilization of corn fodder, and experiments with sorghum for hay and for soiling crops.

The fertilizer inspection continues to be carried on by the State at the college with which the station is connected. During the year a

FIG. 1.—MISSISSIPPI COLLEGE AND STATION—DAIRY BUILDING.

FIG. 2.—NEBRASKA STATION—LABORATORY.

new dairy building (Pl. IV, fig. 1) has been completed and equipped, mostly at the expense of the college. This building will be used in part for experimental work in dairying. The vacancy in the presidency of the college, caused by the death of President J. M. Stone, has been filled by the election of J. C. Hardy.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	1,780.06
Miscellaneous, including balance from previous year	33.43
Total	16,813.49

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 58–61 and the Annual Reports for 1898 and 1899.

Bulletin 58, pp. 14.—Soils of Mississippi: Texture and Water Conditions.—A general discussion of this subject.

Bulletin 59, pp. 29.—Analyses of Commercial Fertilizers.—This bulletin contains brief notes on the fertilizer trade in the State, terms used in analysis, and the provisions of the fertilizer law, with tabulated analyses and valuations of 166 samples of fertilizers collected during the season of 1897–98.

Bulletin 60, pp. 32.—Value of Cotton Seed to the Farmer.—Notes on the feeding and fertilizer value of cotton seed; an account of tests conducted during two winters to determine the relative feeding value for dairy cows of cotton seed, cotton-seed meal, and corn-and-cob meal, with the results of a study of the influence of these feeds on the quality of milk and butter; an account of feeding experiments with steers, comparing cotton seed, cotton-seed meal, and corn-and-cob meal; data as to the cost of wintering a herd of 25 cows; a brief report of tests of the value of raw and cooked cotton-seed meal for hogs, and analytical data and discussion concerning the fertilizing constituents of feeds recovered in the manure.

Bulletin 61, pp. 15.—Analyses of Commercial Fertilizers.—Reports analyses and valuations of 48 samples of fertilizers collected during December, 1899, with some incidental explanation.

Annual Report, 1898, pp. 70.—Contains the organization list of the station; a brief review of station work by the director; a summary and discussion of meteorological observations during 1897 and 1898; a financial statement for the fiscal year ended June 30, 1898, and reprints of Bulletins 43, 44, 49, and 50 of the station.

Annual Report, 1899, pp. 47.—This includes the organization list of the station; reports of the director and treasurer for the fiscal year

ended June 30, 1899; a report of the agriculturist giving results of tests of varieties of cotton and wheat; an account of fertilizer tests with cotton, and culture experiments with hairy vetch; the results of feeding tests to determine the relative value of corn and cotton seed for beef production, and data as to the cost of wintering a herd of 25 cows; a report of the horticulturist describing briefly the station irrigation plant and giving notes on varieties of small and orchard fruits recently planted at the station; a brief report on dairy work during the year, including a summary of the results of feeding experiments with cotton seed, cotton-seed meal, and corn-and-cob meal; a herd record for 1898, and the results of tests of 7 cows; brief notes on forage crops; a report of the chemists giving the results of chemical and mechanical analyses of soils from different parts of the State, analyses of samples of manure, forage plants, and artesian-well water, and a brief description of pot and field experiments on soils in progress at the station; a brief report of the botanist and entomologist, giving notes on inoculation of soils and on a study of tomato blight and the chinch bug; a meteorological summary for the year, and reprints of Bulletins 53–59 of the station, with the exception of Bulletins 55 and 57.

Among the important problems which confront the Mississippi farmer, that of the maintenance of soil fertility is one of the most vital. The station is therefore studying the important matters of tillage, fertilizers, functions, and proper use of restorative crops, soil erosion, and the control of soil water. As live stock is an important agent in maintaining the productiveness of land, the station is endeavoring to make practical demonstration of the desirability of paying more attention to this industry. The wisdom of this course is emphasized by the fact that there is a ready local market for meat and dairy products. The work in animal husbandry has involved extended studies of forage crops, feeding experiments, and experimental and demonstration work in dairying. The station has been quite successful in the holding of farmers' institutes. The last State legislature appropriated $1,000 for this purpose, which will relieve the station of the expense attending them. The station is still wisely maintaining a policy of concentration of effort on a few main lines. Its affairs are in good condition, and its work is steadily increasing in value and in the appreciation of the farmers of the State.

MISSOURI.

Missouri Agricultural College Experiment Station, Columbia.

DEPARTMENT OF THE COLLEGE OF AGRICULTURE AND MECHANIC ARTS OF THE UNIVERSITY OF THE STATE OF MISSOURI.

The work of the Missouri Station during the past year has been chiefly in the same lines as heretofore, including field experiments with cereals, forage crops, fertilizers, rotation of crops, etc.; feeding experiments with beef cattle and pigs; field, greenhouse, and laboratory experiments in horticulture; chemical studies in connection with feeding and digestion experiments, and on the influence of iron salts on the composition of the leaves and fruit of apples; investigations of animal diseases, especially Texas fever; entomological studies, especially on insects affecting fruit; studies on the effect of different crop rotations on the productiveness of land; experiments on the reclamation of naturally poor land on which corn has been grown without fertilizers for fifty years; experiments in the utilization of corn stover as fodder; tests of the feeding value of timothy hay at different stages of growth as regards yield, palatability, and digestibility; fertilizer experiments in apple orchards on typical soils in different parts of the State; experiments with commercial fertilizers for forcing winter vegetables; variety and breeding experiments with fruits, especially apples, grapes, strawberries, and persimmons; an experiment in reforesting, without cultivation, waste bluff land with valuable nut trees; experiments with spraying mixtures; and special studies of the ticks causing Texas fever, together with experiments in immunizing Northern cattle intended for the Southern market.

During the year the station has added irrigation to its lines of work, and has undertaken grass work in the southern part of the State with a view to finding suitable pasture grasses for the Ozark Mountain region and the swamp region of southeast Missouri. The work in veterinary science, which has heretofore been confined to Texas fever, has now been extended to include the intestinal parasites of sheep, with especial reference to the life history of the tapeworm, and to suitable preventives and remedies. Considerable cooperative work is now in progress about the State, notably in orchard management, fertilizer experiments, spraying, and trials of various pasture grasses, mostly on the farms of graduates of the college. The station has recently collected data from about a thousand of the most successful feeders of steers as to the methods followed. During the year the station has issued a noteworthy bulletin on orchard management, one reporting a very systematic and thorough test of spray nozzles, and a comprehensive report of the investigations on Texas fever made by this station in cooperation with the State department of agriculture and the Texas Station. The inspection of commercial fertilizers has been continued

under State laws. The station has assisted the State Board of Agriculture in regulating the sale of artificial butter and in the enforcement of State laws against infectious diseases of live stock. It has also cooperated with the State Horticultural Society in the inspection of nursery stock.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees for fertilizer inspection	1,129.95
Farm products	2,520.00
Miscellaneous	62.64
Balance on hand July 1, 1899	1,133.19
Total	19,845.78

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletin 48, Circular of Information 9, and the Annual Report for 1898.

Bulletin 48, pp. 66, figs. 11.—Texas Fever.—A detailed report on investigations on Texas fever carried out under the cooperation of the Missouri and Texas experiment stations and the Missouri State Board of Agriculture, involving experiments to determine whether the sterile blood serum of immune cattle would produce immunity in other cattle, experiments in immunizing cattle by tick infestation, and experiments in immunizing cattle by blood inoculation.

Circular of Information 9, pp. 5.—Practical Value of the Work of the Experiment Station.—Brief mention of results obtained in some of the more important lines of work carried on at the station.

Annual Report, 1898, pp. 178, figs. 23, map 1.—This includes the organization list of the station; a financial statement for the fiscal year ended June 30, 1898; a report of the director reviewing in detail the different lines of station work during the year; reprints of Bulletins 40–44 of the station; an itemized statement of receipts and expenditures of the station on account of the fertilizer control and analyses of 23 samples of fertilizing materials; a report on miscellaneous chemical work, including ash analyses of twigs and leaves from apple trees and of apple peelings and leaves from trees fertilized and not fertilized with iron sulphate, ash analyses of some common plants, analyses of cowpeas and millet, some observations on common purslane, examination of commercial vinegars sold in the State at retail, analyses of ash of excrements insoluble in hydrochloric acid, an investigation of the loss of nitrogen in the drying of feces and urine, differences in the composition and properties of ether extracts from feed and from feces, differences in the ultimate composition and the experimental and calculated thermal values of feed and feces, proxi-

mate composition and calculated thermal values of feed and feces, the determination of fiber in feeding stuffs, and analyses of new dairy foods; a record of the amount of food consumed by a cow producing a large quantity of milk and butter; a preliminary report on an ecological study of the native and introduced plants of the vicinity of Columbia, Mo.; and a list of bulletins issued by the agricultural college and station.

The Missouri Station has given its chief attention to two of the more important lines of agriculture in the State. These are beef production and fruit growing. The investigations on the production of beef are many sided and approach the subject from various standpoints. Mention may be made especially of its experiments in the utilization of corn stover and in the renovation and development of pastures on different kinds of land. Somewhat less closely related to this work, though in the interest of the same industry, are the station's well-known investigations on Texas fever and its prevention. This work has now been in progress for a number of years and has been brought down to an entirely practical basis, enabling valuable breeding cattle to be inoculated and then taken into the Texas fever belt with almost entire safety. Station officers inoculated over 500 animals during the past winter. The work has already had a noticeable effect on the business of breeders, as evidenced by letters which they have written the station. The work done by the Missouri and Texas stations in combating Texas fever furnishes an excellent illustration of the practical value of experiment station work. The discovery of a means by which cattle can be moved from the North to the South will mean millions of dollars to cattle breeders and owners, and will result in a much needed improvement of the cattle fed in the South and in the stock kept for dairy purposes. The station is now endeavoring to breed up an immune herd by natural methods, keeping inoculated heifers in a tick-infested pasture and allowing the calves to contract the disease and become immune to it as they do in the South.

In the work in fruit growing a specialty is made of apples, which are a very important commercial crop, especially in the southwestern part of the State. That the work of the station is meeting with popular approval is shown by the fact that it receives considerable assistance from the State Board of Agriculture and the Horticultural Society. The latter has printed several bulletins for the station. The last legislature directed that the station bulletins should be printed by the State printer, but funds were not appropriated for the purpose, so no benefit has thus far been derived from this provision. Station officers continue to render as much assistance as possible in farmers' institute work. The college conducts a summer teachers' course in horticulture to assist in the nature-study work in public schools. This has aroused much interest in this subject in the State.

MONTANA.

Montana Agricultural Experiment Station, Bozeman.

DEPARTMENT OF MONTANA AGRICULTURAL COLLEGE.

The lines of work of the Montana Station during the past year have included various irrigation problems, especially the introduction of improved devices for measuring water; experiments to determine the proper time to irrigate and the proper quantity of water to use on the staple crops of the State; problems of alkali soils; experiments to determine the limits of tolerance of economic plants for alkali; tests to determine the plants best adapted to various soils, the alkali content of which is known; analyses of irrigation waters with respect to manurial value and alkali content; experiments with sugar beets; analyses of food products; analyses of native forage plants to be accompanied by digestion experiments; rotation experiments; variety tests with cereals, potatoes, and grasses and forage plants; pasturage experiments on clover; feeding experiments with lambs, steers, and poultry; investigations in entomology, with especial reference to the prevention of the introduction of injurious insects not now found in the State; studies of insects injurious to the shade and ornamental trees of the State, and those affecting cruciferous plants; observations on shade trees and ornamental vines suited to Montana, the native forest trees, forage plants, plants poisonous to stock, parasitic fungi, weeds, alkali plants, economic plants of various Indian tribes, and the aquatics which obstruct the irrigation canals and ditches. The station is cooperating with the United States Geological Survey in the measurements of the streams used for irrigation purposes and in the survey and construction of storage reservoirs. In cooperation with this Office, important data have been collected on the duty of water. The State gives the station a special appropriation for studies of the water resources of Montana. The experiments with sugar beets in cooperation with this Department have been continued. The station is already carrying on a considerable amount of work in cooperation with individuals in different parts of the State and proposes to further extend and systematize this work. The station's investigations on the tolerance of alkali by economic plants have brought out the important fact that while with a high alkali content (up to 0.6 per cent in surface foot) the plant does poorly at first, after passing a certain stage of growth, the subsequent development is at least as rapid as in soil containing little of the alkali salts. The poultry department which was discontinued in 1895 has been reestablished and two poultry houses have been built. The entomologist continues to act as inspector at large to the State board of horticulture, and in this capacity has direct charge of various local inspectors whose duties are to inspect orchards and nurseries, as well as fruit shipped into the State.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	1,500.00
Farm products	3,128.89
Total	19,628.89

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 19–21.

Bulletin 19, pp. 38.—The Sugar Beet in Montana.—This bulletin contains considerable data on the production and consumption of sugar in the United States and in foreign countries; on the climate, culture, and soil requirements of sugar beets; cost of growing in Montana, etc.; analytical data for sugar beets in Montana for each year from 1895 to 1898, with notes on the samples; and analyses of experiment station farm soil, and one sample of limestone.

Bulletin 20, pp. 34.—Annual Report, 1898.—The organization list of the station; financial statement for the fiscal year ended June 30, 1898; and reports of the director and heads of departments, including, in addition to summaries of results obtained during the year, a brief description of the greenhouse and method of heating, notes on a test of a number of species of forest trees, observations on the hardiness of a large number of varieties of orchard fruits, notes on pollination and cultural experiments with strawberries, and results obtained the first year in a six-year rotation test.

Bulletin 21, pp. 13.—Sheep Feeding.—A discussion of the possibility of profitably fattening lambs in Montana instead of shipping them for this purpose to other regions, and the results of a test with 3 lots of 16 lambs each to compare the value of alfalfa, red clover, and alsike hay.

The problems confronting the Montana Station are those of pioneer agriculture in an arid country. Among them are the introduction and improvement of methods of irrigation; the study of soils, especially with reference to alkali; the measurement and determination of the suitability of the waters of the State for irrigation purposes; the introduction and testing of economic plants able to withstand alkali and a severe climate; the encouragement of lines of agriculture already introduced, and the introduction of others new to the State—and these are the lines of work occupying the station's attention. The efforts of the station in these directions have already been productive of valuable practical results. More attention is being given to careful methods of irrigation; rotation of crops is encouraged by the growth of leguminous plants, especially red clover. Improved varieties of wheat, oats, barley, and potatoes are now available to the farmers of

the State, and ways in which a profitable live-stock industry may be combined with irrigation farming are being pointed out. A change in the directorship at the end of the past fiscal year has resulted in a concentration of the work of the station more fully on problems based on irrigation as the fundamental factor in the agriculture of the State.

NEBRASKA.

Agricultural Experiment Station of Nebraska, Lincoln.

DEPARTMENT OF THE UNIVERSITY OF NEBRASKA.

The work of the Nebraska Station during the past year has included investigations in the treatment of hog cholera, on the geographical distribution and possible eradication of blackleg, and on a new disease among cattle, of recent appearance locally; feeding experiments with steers and sheep; experiments in the repression of grasshoppers with a fungus disease imported from South Africa; comparisons of different methods of conserving or providing soil moisture for growing vegetables; tests of varieties of beans and melons; experiments with cover crops; soil-tillage experiments; tests of grasses, particularly native species, and of varieties of winter wheat, and forestry experiments. Experiments with sugar beets and tests of a considerable number of new plants have been continued in cooperation with this Department. The station is also cooperating with this Office in irrigation investigations. A new building has been erected, at a cost of about $35,000, especially for the use of the experiment station (Pl. IV, fig. 2). Various sheds and yards have been provided for cattle-feeding experiments, and considerable apparatus for soil investigations has been purchased during the past year. A new chancellor of the university has recently assumed office and will act as director of the station.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	1,806.12
Balance on hand July 1, 1899	949.78
Total	17,755.90

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 59–64 and the Annual Report for 1899.

Bulletin 59, pp. 79, figs. 79.—The Homemade Windmills of Nebraska.—This bulletin gives sketches of typical windmills built by farmers in Nebraska, accompanied by brief descriptions, and also a discussion of the uses of shopmade windmills and other water lifters, storage of windmill energy, and transmission of windmill power.

Bulletin 60, pp. 34, figs. 6, dgm. 1.—Experiments in the Culture of the Sugar Beet in Nebraska.—Results of cultural and fertilizer experiments and of variety and seed tests with sugar beets during 1898.

Bulletin 61, pp. 39.—Hungarian Brome Grass (Bromus inermis).—A botanical description of this plant, with an account of culture and pasture experiments at the station and cooperative culture tests throughout the State, and directions for growing the crop, based upon experiments at the station and elsewhere.

Bulletin 62, pp. 10.—The Feeding Value of Sorghum as Shown by Chemical Analysis.—Analyses of samples of sorghum cut at various stages of growth, explanation of terms used in stating the results of analysis, and a discussion of the variations in the composition of sorghum during growth and of the feeding value of sorghum pasturage and sorghum fodder.

Bulletin 63, pp. 14.—The Fatal Effect of Green Sorghum.—An account of an investigation to determine the nature and cause of the poisoning of animals due to the feeding of sorghum, especially to determine if the sorghum plant under certain conditions develops a poisonous principle.

Bulletin 64, pp. 21.—Proceedings of Agricultural Students' Association, 1899–1900.—The proceedings of the association at its February meeting, including reports on home-reading courses and on cultural experiments with corn, and suggestions for carrying on experimental work under the supervision of the heads of different departments of the college.

Annual Report, 1899, pp. 171, pls. 3.—This contains the organization list of the station; a report of the acting director on the staff, equipment, publications, and work of the station; a financial statement for the fiscal year ended June 30, 1899; a report of the agriculturist, summarizing the results obtained in soil tillage, cultivation experiments, and fertilizer and variety tests; a report of the animal pathologist on the different diseases studied during the year; a report of the botanist, containing notes on various plant diseases, poisonous plants, weeds, grasses, forage crops, and the trees of Nebraska; a report of the chemist, giving a brief account of a study of methods of determining the moisture content of soils, analyses of feeding stuffs and forage crops, and analyses of a number of patent remedies which have been proposed for hog cholera; a report of the entomologist, giving notes on various insects; a report of the horticulturist, giving an account of a series of experiments which have been discontinued, of experiments with the codling moth, tree planting, and irrigation, which have been continued with some modifications, and of new experiments with native ornamentals, cover crops for orchards, orchard cultivation, and plant breeding; a report on cooperative experiments in the treatment of hog cholera; a classification of the literature of

agriculture enlarged from the decimal classification of Melvil Dewey, and the results of a two years' test of 128 varieties of grasses and forage plants.

The immediate needs of Nebraska agriculture are those common to the great Northwest. They include better methods of conserving soil moisture, and the introduction of hardy varieties of forage and other economic plants suited to these semiarid conditions. A corollary of the introduction of new varieties of forage plants is experiments with those plants to determine their feeding value, which have been carried on. Investigations of hog cholera and certain other diseases of domestic animals which cause great and widespread losses to live-stock men in the Northwest continue to receive a large measure of attention from the station as in the past. The station's assistance in the development of the beet-sugar industry of the State is worthy of special mention. Enlarged attention is being given to the development of work in animal husbandry, especially along the more practical lines. The officer in charge of this work also has charge of the farmers' institute work for the university. The location of the agricultural buildings at the farm in recent years has helped to develop the agricultural work of the university, and coincidentally the station work is assuming more importance.

The liberality of the State in providing a handsome and well-arranged building for the special use of the station is a very encouraging indication that the work of the station is being locally appreciated. There has also been a large and gratifying increase in the demand for station publications during the past year. Considerable progress has been made in the more thorough organization of the station and the differentiation of its work and equipment from those of the college of agriculture. It has thus become more truly a well-defined department of the university, and as such should have an executive officer, distinct from the chancellor, who can devote himself to the special interests of the station and its growing administrative business as related to the great agricultural interests of the State.

NEVADA.

Nevada Agricultural Experiment Station, Reno.

DEPARTMENT OF NEVADA STATE UNIVERSITY.

The work of the Nevada Station during the past year has been in the same lines as heretofore, including field experiments with cereals, sugar beets, alfalfa, and other crops; feeding experiments with steers; horticultural investigations; studies in botany and entomology; chemical analyses and studies of soils and of native grasses; and investigations of animal diseases. Experiments with sugar beets in cooperation with this Department have been continued. The chemist is continuing his work on the soil survey and is obtaining some quite interesting results

on peculiar soils. The university is cooperating with this Department in irrigation investigations. The house from the old farm has been moved to the new tract, the purchase of which was reported last year, and has been enlarged so as to make a superintendent's dwelling.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	110.15
Miscellaneous	135.63
Total	15,245.78

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 40–45 and the Annual Report for 1897.

Bulletin 40, pp. 16.—Pig Feeding.—The results of a test with 4 pigs of the value of alfalfa hay when fed alone and when fed with roots, corn, and peas, and an appendix to the bulletin containing answers received from farmers to a number of questions regarding the feeding of alfalfa to pigs.

Bulletin 41, pp. 6, pls. 6.—Steer Feeding.—A report of an experiment with 4 steers to learn the amount of alfalfa hay required for a pound of gain.

Bulletin 42, pp. 13, dgm. 1.—Nevada Butters.—Brief notes on butter and its composition, and analyses of 16 samples of butter from different parts of the State.

Bulletin 43, pp. 30, pls. 5, figs. 2, map 1.—Sugar Beets in 1898.—Results of cultural experiments during 1898, analyses of 25 samples of sugar beets, and information on miscellaneous topics connected with the beet-sugar industry.

Bulletin 44, pp. 21, figs. 2.—Sugar Beets in 1899.—Results of cultural experiments during 1899 directed mainly to the production of beets of a high sugar content on a commercial scale in different sections of the State; analyses of 183 samples of sugar beets; and remarks on the factory conditions of a number of localities and on water and limestone for factory use.

Bulletin 45, pp. 16, figs. 18.—Twigs of Common Trees and Shrubs.—This is the first of a proposed series of bulletins on nature studies, and describes the twigs and buds of poplars, elms, maples, and willows.

Annual Report, 1897, pp. 29.—Outlines of the station work during the year by the director and heads of departments, and a financial statement for the fiscal year ended June 30, 1897.

Irrigation is of necessity a matter of foremost importance in Nevada agriculture, and the station has recently made arrangements, in cooperation with this Department, for greatly increased work along this line. Stock raising is the most important branch of agriculture and

is receiving attention at the hands of the station along various lines, especially that of forage crops adapted for local cultivation. It is hoped that work relating to animal industry will be materially extended in the near future. The station's work with sugar beets has given very promising results in one section of the State, the beets being rich and the yield large.

NEW HAMPSHIRE.

New Hampshire College Agricultural Experiment Station, Durham.

DEPARTMENT OF NEW HAMPSHIRE COLLEGE OF AGRICULTURE AND THE MECHANIC ARTS.

The work of the New Hampshire Station during the past year has been mainly along lines of chemistry, especially the study of silage and ripening fruits; field experiments, including forage crops, rotations, tillage, and methods of using stable manure; feeding experiments; horticultural investigations, including tests of corn, potatoes, strawberries, tomatoes, and muskmelons; plant diseases and the bacteria and fungi of silage and decaying fruits; entomology, including experiments in the suppression of insect pests and studies of the life zones of the principal insects of the State; roads, especially the comparison of different grades of gravel for road surfaces; and experiments in forcing greenhouse crops. The station is studying the storage of apples and making chemical and bacteriological studies with reference to the keeping qualities of different varieties, causes of decay, etc., in cooperation with a storage company. The station has undertaken experiments in the improvement of old pasture lands by breaking them up and introducing rotation. This line of work is important for New Hampshire and other parts of New England where old run-out pastures abound. The station has continued to cooperate with the State Board of Agriculture in the inspection of fertilizers and the enforcement of laws relating to oleomargarine.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees for inspection service, including balance	1,222.38
Total	16,222.38

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 66–75.

Bulletin 66, pp. 12, dgms. 3.—Experiments in Pig Feeding.—A report of three series of tests of the comparative value for pigs of the following feeding stuffs fed in combination with skim milk: (1) pumpkins, cooked and uncooked, apples and pumpkins, corn meal and bran,

and corn meal; (2) bran, fermented and unfermented, bran and corn meal, and corn meal; and (3) corn-and-cob meal and ear corn.

Bulletin 67, pp. 19, figs. 13.—The Spiny Elm Caterpillar.—A popular account of the habits, life history, and natural enemies of this insect, with suggestions as to remedies.

Bulletin 68, pp. 52, figs. 2.—Annual Report, 1899.—This contains the organization list of the station; a financial statement for the fiscal year ended June 30, 1899; a report of the vice-director and chemist giving results of analyses of several samples of city stable manure, spring water, and wood washes; a report of the horticulturist giving notes on fruits at the station during the year; a report of the agriculturist containing a summary of the record of the college dairy herd for the year; a report of the bacteriologist containing a statement of the lines of work followed during the year, and a popular account of bacteria, their morphology, physiology, and relations to agriculture; and a summary of meteorological observations from July, 1898, to June, 1899.

Bulletin 69, pp. 14.—The Inspection of Fertilizers in 1899.—Trade values of fertilizing ingredients in 1899, a review of fertilizer inspection, tabulated analyses of 97 samples of fertilizing materials, and the guaranteed composition of 31 brands of fertilizers sampled, but not analyzed.

Bulletin 70, pp. 28, figs. 7.—Experiments with Muskmelons.—This reports a study of the flowers of the muskmelon; an experiment to determine the comparative yield and profitableness of sowing seeds out of doors and of transplanting plants early; an experiment to test pinching or heading in vines; and tests of varieties, including descriptions of varieties not previously noted.

Bulletin 71, pp. 10, figs. 3.—Corn Culture.—A report of tests of methods of cultivating corn, a study of the effect of witch grass on corn production, and experiments to determine the effect of plowing to different depths on the yield of corn.

Bulletin 72, pp. 16, figs. 11.—Insect Record for 1899.—Brief popular notes on the life history, habits, and means of combating the tent caterpillar, *Cacœcia cerasivorana*, plum curculio, fall webworm, white grubs, oyster-shell bark louse, scurfy bark louse, apple aphis, and the red-legged locust.

Bulletin 73, pp. 11, figs. 4.—Experiments with Tomatoes and Potatoes.—Results of tests of 15 varieties of tomatoes grown in 1899 and 48 varieties grown in 1898, with descriptive notes on 20 of the newer varieties, and the results of tests of 47 varieties of potatoes.

Bulletin 74, pp. 19, figs. 6.—Growing Strawberries in New England.—Brief notes on the culture of strawberries, results of tests of 86 varieties, and descriptive notes on 10 of the more popular varieties and on 29 of the later introductions.

Bulletin 75, pp. 26, figs. 14.—The Forest Tent Caterpillar.—A revision of a popular bulletin on this insect previously issued by the station, with additional notes concerning outbreaks of the insect in 1899, and notes on the bird enemies of this insect.

Milk, hay, potatoes, apples, and strawberries are the principal market crops of New Hampshire, and all the station's lines of work, excepting roads and forcing crops, are in the interests of these products. Great interest in roads has been aroused in the State by the board of agriculture, and the station is endeavoring to assist the movement by showing how the abundant drift deposits of the State should be an important factor in road economy. An increasing city population and the annual presence of large numbers of summer visitors in the State make better and better markets for all kinds of garden truck. The station cooperates with the State Board of Agriculture in farmers' institute work. It is making progress in the concentration of its work on a few main lines in which different divisions cooperate. State aid is needed to enable the station to extend its cooperative work with farmers in different localities.

NEW JERSEY.

New Jersey State and College Agricultural Experiment Stations, New Brunswick.

CONNECTED WITH RUTGERS COLLEGE.

The New Jersey State and College stations continue to be under the supervision of the same director and to issue their publications in one series. The work of these stations during the past year has been along the same lines as heretofore, including chemical studies of fertilizers and soils, feeding stuffs, and dairy products; meteorological observations; cultural experiments with asparagus, blackberries, raspberries, currants and gooseberries, strawberries, tree fruits, lettuce and radishes under glass, and tomatoes; an extended investigation of pear growing in the State; experiments with various forage crops, including soiling crops for dairy cows; inoculation experiments with soy beans; experiments in feeding for milk and for fat; milking experiments; rotation experiments with soiling crops; studies of abortion of dairy cows; observations on tuberculosis with especial reference to detection, contagiousness, rapidity of development, and curative action of repeated injections of tuberculin; biological studies of an intestinal disease of ducks; experiments with soil fungicides for potato and turnip diseases, including tests of susceptibility of different varieties; experiments with soil rot of sweet potatoes and club rot of turnips; experiments with germ fertilizers, especially Nitragin and Alinit; experiments and investigations in shading; cultural experiments with

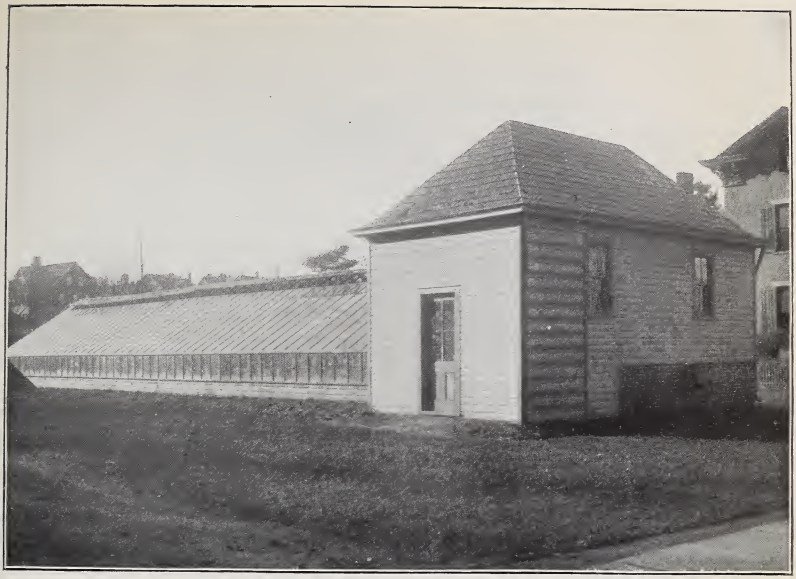


FIG. 1.—NEW JERSEY STATION—PLANT HOUSE.

FIG. 2.—PENNSYLVANIA STATION—CALORIMETER BUILDING.

a considerable number of truck crops, lawn grasses, and ornamental plants; observations on the growth habits of weeds; experiments with asparagus rust and pear blight; the forcing of peaches; entomological investigations on plant lice, the pea plant louse, peach thrips, and a number of insects injurious to orchard trees, small fruits, field crops, truck crops, and shade trees, respectively; experiments with insecticides, especially crude petroleum; extended investigations of the San José scale with especial reference to distribution, remedies, and methods of application.

A new plant house (Pl. V, fig. 1) has recently been erected for the use of the botanical division. Experiments have been made with fertilizers for peaches and other fruits, and the irrigation of small fruits has been continued with variety and fertilizer experiments with small fruits. Experiments in crossing tomatoes and corn have given interesting and promising results. Experiments are in progress in methods of handling barnyard manure. Experiments in pruning back pears to dwarf them, in order to make them produce earlier, have been very successful. In dairy farming an intensive system is being followed, in which a wide range of forage crops is being tested, often securing two or three crops from the same area. The effect of this work on milk production has become very apparent in the community and gradually outside. The biologist has of late given considerable attention to the improvement of laboratory apparatus and methods, and has suggested a number of improvements. The inspection of fertilizers and of nurseries for San José scale has been continued under State law. A State law was also passed last year providing for the inspection of feeding stuffs. Irrigation experiments are still being carried on in cooperation with this Department.

The income of the stations during the past fiscal year was as follows:

State station:	
State appropriation (fiscal year ended October 31, 1900)	$16,600
College station:	
United States appropriation	15,000

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of these stations received during the past fiscal year were Bulletins 137–143, Special Bulletin S, and the Annual Report for 1899.

Bulletin 137, pp. 24.—Dairy Experiments.—A discussion on the yield, composition, and cost of milk and on maintaining a standard of quality in herd milk, the discussion being based on a record of a grade dairy herd of about 25 cows for three years and a report on experiments comparing balanced and unbalanced rations and different quantities of feed for dairy cows.

Bulletin 138, pp. 22, pls. 4.—Crude Petroleum as an Insecticide.—A detailed account of cooperative experiments in which crude petroleum was applied at different seasons of the year to various orchard and small fruits for the destruction of the San José scale.

Bulletin 139, pp. 59.—Analyses and Valuations of Fertilizers.—This bulletin gives trade values of fertilizing constituents in 1899; the results of examination of the standard commercial materials supplying them, as well as of home mixtures, factory-mixed fertilizers, and miscellaneous fertilizing materials; and tabulated analyses and valuations of 472 samples of fertilizing materials.

Bulletin 140, pp. 16, figs. 9.—Three Common Orchard Scales.—A popular account of the life history, habits, and means of controlling the oyster-shell bark-louse, scurfy scale, and San José scale.

Bulletin 141, pp. 18.—Forcing Tomatoes.—A description of methods generally observed in New Jersey in growing tomatoes under glass and of financial considerations involved in forcing tomatoes, and detailed results of investigations of problems connected with forcing tomatoes, including thickness of setting, fertilizers with surface *v.* subwatering, the effect of varying amounts of nitrogen on different soils, boxes and pots *v.* benches for forcing tomatoes, and single stem *v.* three-stem training.

Bulletin 142, pp. 14.—Pear Growing in New Jersey.—A discussion of pear growing in New Jersey, based largely on data obtained from the fruit survey of the State made in 1895, and including a consideration of soils, varieties, planting, cultivating, manuring, insects and diseases, etc.

Bulletin 143, pp. 23, pls. 2, figs. 30.—The Apple Plant Louse.—Observations on the appearance, life history, habits, food plants, natural enemies, etc., of the apple plant louse, with a discussion of remedial measures.

Special Bulletin S, pp. 43, pls. 8.—Soil Fungicides for Potato and Turnip Diseases.—A summary account of miscellaneous experiments extending over a number of years in an investigation of remedies for the scab of potatoes, soil rot of sweet potatoes, and club root of turnips.

Annual Report, 1899, pp. 532, pls. 37, figs. 24, dgm. 1.—This includes the organization lists of the stations; a report of the treasurer for the year; a report of the director reviewing the work of the different departments; a reprint of Bulletin 139 of the stations, with the addition of statistics of the fertilizer trade in New Jersey during 1898 and thirteen preceding years, the market prices of fertilizers, text of the fertilizer law, and lists of inspectors and of manufacturers whose goods were examined in 1899; an account of a study of the changes in the nitrogen of a mixture of barnyard manure with nitrate of soda, sulphate of ammonia, and with dried blood with and without the addition of gypsum, acid phosphate, kainit, sulphur, and carbon bisulphid;

a review of literature relating to denitrification and the changes which may occur in the nitrogen of barnyard manure and a report of investigations relating to the composition and the availability of the nitrogen of solid and liquid manure; tabulated analyses of fodders and feeding stuffs; statistics as to the average market price of feeding stuffs in the State for a number of years; results of a number of experiments with vegetables and small fruits conducted to test methods of fertilizing and treatment and to study the effects of irrigation; reprints with minor changes of Bulletins 141 and 142 of the stations; deductions from the results of dairy experiments reported in earlier publications of the stations; results of a test of a number of forage plants; an account of an experiment in inoculating soy beans by means of soil or dust; notes on tubercles in the third successive crop of cowpeas; results of a comparison of three varieties of corn as regards yield and adaptability to the soil and climate of New Jersey; details and results of 9 tests, each made with 2 cows, to study the influence of rations varying widely in character upon the yield and composition of milk and the economic production of milk and butter; a study of the yield and composition of milk when the intervals between milkings are equal and unequal; data regarding the cost of milk production; yield and amount of nutrients obtained per acre from the various combinations of soiling crops grown for the dairy herd; a discussion of dairying in relation to soil exhaustion; a record of the dairy herd of 12 cows for one year; observations with reference to abortion and tuberculosis in the college herd, with a brief consideration of the present aspects of the tuberculosis problem; results of a bacteriological study of an intestinal disease of ducks; notes on new methods and apparatus for bacteriological investigations; detailed results of extended experiments with fungicides on various field, garden, and orchard crops and ornamental plants, including a reprint of Special Bulletin S and notes on various plant diseases; results of a series of experiments with Nitragin and other germ fertilizers on different crops; notes on experiments with weeds and lawn grasses; a discussion of fungi as related to weather; and an extended account of entomological work during the year, including studies of the life histories, habits, etc., of a large number of insects and tests of various remedial measures.

The agriculture of New Jersey is intensive, and hence fertilizer problems are of primary importance. For many years the investigations of the State station along this line have been well known, and its management of the fertilizer control has been very successful. The work in horticulture and dairy husbandry is noteworthy for the systematic way in which it is conducted and for the practical value of the results obtained. To a high degree the station has been successful in meeting the requirements of the farmer in the field and in obtaining

his approval and cordial support for the station. The investigations in biology—those of the botanist, entomologist, and biologist—likewise have their starting point in practice and follow the same systematic methods, but with the addition of the strict analytical methods of science. The results obtained are in many cases of scientific importance, while their practical value, and the popular approval with which they have been received, show that the original purpose of the investigations has not been lost sight of.

The stations continue to keep in touch with the farmers of the State by the frequent attendance of their officers at farmers' institutes. The success of the New Jersey stations in gaining the confidence of the farmer, and in modifying his practice by getting him to make application of the results of their work is very noteworthy.

NEW MEXICO.

Agricultural Experiment Station of New Mexico, Mesilla Park.

DEPARTMENT OF NEW MEXICO COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

The work of the New Mexico Station during the past year has included irrigation investigations, studies of soil moisture, investigations on alkali and drainage, meteorology, observations on the rate of evaporation from exposed water surfaces, variety tests of grasses, field experiments with fodder and soiling crops, observations on the blooming and ripening periods of fruits, experiments in pruning fruit trees and in thinning fruits, experiments in sugar-beet culture, chemical studies of the waters of various streams of the Territory, miscellaneous analyses, experiments with native grasses for pasture, a systematic study of the flora of the Territory, and entomology, especially spraying experiments for the codling moth.

In cooperation with this Department, investigations have been made of the waters of the Rio Grande and Pecos rivers. A part of the months of November and December, 1899, was spent by the soil physicist in special work in the Division of Soils of this Department, and the entomologist has made special investigations along his line in Arizona for the Arizona Station. During the year the agriculturist has been changed, and an irrigation engineer has been added to the staff, and the station is extending its lines of work to include investigations in animal husbandry. A vineyard has also been set out. Work has been continued at the three substations with Territorial funds. At Roswell experiments have been made in draining out alkali. At the Las Vegas substation, experiments are being made in growing root and forage crops. At the Aztec substation a nursery is about to be established, with a view to making investigations of fruits the principal line of work.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	153.58
Miscellaneous	661.80
Total	15,815.38

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 28–31.

Bulletin 28, pp. 45.—Life Zones in New Mexico. II. The Zonal Distribution of Coleoptera.—Data showing the distribution of the different families of Coleoptera, with the exception of two families.

Bulletin 29, pp. 31, dgm. 1.—New Mexico Sugar Beets.—Brief cultural directions, analyses of 66 samples of sugar beets, notes on the sugar-beet zone of the United States, results of tests of varieties and of methods of culture, and a discussion of factory conditions, with analyses of water and limestone from different sections of New Mexico.

Bulletin 30, pp. 37.—The Effect of Spring Frosts on the Peach Crop; with Cultural Notes on the Peach in New Mexico.—This reports a a study of the effect of frosts on the different varieties of peaches, and gives notes relative to the culture of peaches in New Mexico. The bulletin contains tables showing the daily temperature of the winter and spring months for each season from 1895 to 1898, and a record for the four seasons of the date of blooming, fruiting habits, and ripening period of 147 different varieties of peaches, arranged in groups according to the fruiting habits of each.

Bulletin 31, pp. 16.—A Study of Soil Moisture.—Results of determinations of soil moisture from April to October, 1899, in a series of plats upon which corn was grown under different methods of culture.

The fact that New Mexico is in the arid region makes problems of irrigation, alkali soils, and methods of preserving soil moisture of fundamental importance, and these the station is investigating. With the addition of an irrigation engineer to the staff, irrigation will hereafter receive increased attention. Important agricultural industries of the Territory are stock raising and fruit growing; hence the station's investigations of forage plants for that arid climate, and its variety and irrigation experiments with fruits. The San José scale and codling moth are very troublesome, and the entomologist has made experiments in repressing them. During the year the president of the college has succeeded in obtaining from the principal railroads of the Territory a concession of free transportation to members of the station staff engaged in experimental work. This will enable the station to

serve the public interests more perfectly than has been possible in the past.

The work of the New Mexico Station during the past year has suffered from changes of officers, the lack of a consistent and settled policy, and the limited funds of the college with which it is connected. Progress has been made in the development of the work of the station along the lines of animal husbandry and irrigation. The station needs, however, to concentrate its work more fully on a few of the most important lines, and should have the direct and vigorous management of a separate executive officer trained along the lines of agricultural investigations.

NEW YORK.

New York Agricultural Experiment Station, Geneva.

The lines of work carried on by the New York State Station during the past year have been in the main of a similar character as heretofore, and have included studies of diseases of plants, especially preventive treatment of body blight of pear, root rot of pear, New York apple-tree canker, carnation stem rot and damping-off, cauliflower and cabbage black rot, onion smut, asparagus rust, Rhizoctonia root rot of various plants, cauliflower blight, peach leaf curl and fruit rot, and downy mildew of muskmelons; a fruit-disease survey of western New York; entomology, especially studies upon life histories and remedies for San José scale, destructive pea louse, Palmer worm, wheat sawfly, cherry fruit fly, and woolly aphis, with biological studies upon parthenogenesis of plant lice. Tests have been made of commercial fertilizers for potatoes and onions; potash and soda in crop growing; systems of maintaining fertility, including use of legumes, necessity of supply of ingredients in commercial fertilizers, and comparison of commercial fertilizers and barnyard manure; foraging power of plants for phosphoric acid; nitrogen-gathering power of legumes in ordinary conditions in good soil; influence of different forms of plant food upon the quality of fruit; thick and thin seeding on yield of fodder corn; and feeding value and yield of some of the newer forage plants. Studies have been made on food sources of milk fat; metabolism in milch cows; influence of temperature and moisture upon loss of weight in curing cheese; influence of size of cheese upon loss of weight in curing; proteolytic changes taking place in cheese ripening under different conditions of temperature and moisture; separation and identification of proteid bodies formed in curing cheese; proteids in whey; proteolytic changes in milk inoculated with various microorganisms; changes taking place in the production of cider vinegar; bacteriological studies and tests relating especially to cheese ripening, sweet flavor, musty spot, and bitter flavor in cheese, and fishy flavor

in milk and to pasteurization for butter making; and study of enzym action of bacteria and galactose in cheese ripening.

Experiments have been conducted in poultry feeding with special reference to the study of the effect of mineral ingredients in the food, and in poultry breeding to study the effect of selection and inbreeding. Investigations have been conducted upon the self-fertility of cultivated varieties of the grape; productivity of stock from scions from vigorously growing plants and from mature plants; value of certain commercial fertilizers and stable manure on lettuce in the forcing house and on apple trees in the orchard; economical use of irrigation for strawberries; practice of spraying fruit trees in full bloom; and methods of propagation and culture of chestnuts. Studies of numerous varieties of orchard and small fruits have been continued. The station has continued to cooperate with this Department in experiments with sugar beets and foreign varieties of melons, and in investigations on the spread of peach yellows and cucumber downy mildew. Much work is done by the station on rented land in different parts of the State, the work including fertilizer, spraying, and irrigation experiments; investigations on body blight of pear and diseases of cabbage, onion, and cauliflower; experiments in chestnut culture; and experiments in the treatment of San José scale. The inspection of fertilizers and concentrated feeding stuffs and the analysis of Paris green and other insecticides have been continued. During the year an act has been passed by the State legislature, charging the station with the inspection of all Babcock test glassware used in butter and cheese factories which pay by test. An appropriation of $11,500 has also been made for a house for the director.

The income of the station for the past fiscal year was as follows:

United States appropriation	$1,500.00
State appropriation	69,489.80
Total	70,989.80

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 159–175 and the Annual Report for 1898.

Bulletin 159, pp. 28, pls. 6 (Popular edition, pp. 6, figs. 3).—The Forest Tent Caterpillar.—An account of the systematic position, history, food plants, appearance, life history, natural checks, and methods of combating this insect, with a bibliography.

Bulletin 160, pp. 89.—Report of Analyses of Commercial Fertilizers for the Spring of 1899.—Trade values of fertilizing ingredients, text of the State fertilizer law, and tabulated analyses of samples of 646 different brands of fertilizers.

Bulletin 161, pp. 12, pls. 2, dgm. 1 (Popular edition, pp. 2, fig. 1).—Treatment for Gooseberry Mildew.—Results of spraying experiments during three seasons with Bordeaux mixture, lysol, formalin, and potassium sulphid for the prevention of gooseberry mildew.

Bulletin 162, pp. 14, pls. 6 (Popular edition, pp. 6, pl. 1, figs. 2).—Leaf Scorch of the Sugar Beet, Cherry, Cauliflower, and Maple.—An account of a physiological trouble of the sugar beet, cherry, cauliflower, and maple due to the "transpiration of more water from the leaves than the roots are able to supply."

Bulletin 163, pp. 28, pls. 6 (Popular edition, pp. 6, pls. 2).—The New York Apple-tree Canker.—An account of investigations of this disease due to *Sphæropsis malorum*, with a discussion of the history and distribution of the disease, characteristics, time and manner of infection, preventive measures, etc.

Bulletin 164, pp. 15, pls. 4 (Popular edition, pp. 5).—Notes on Various Plant Diseases.—Notes on a bacterial rot of onions, powdery mildew on field-grown cucumbers, dodder on cucumbers under glass, on the possible cause of the Baldwin fruit spot, a fusarium leaf spot of carnations, and *Chætomium contortum* on barley seedlings.

Bulletin 165, pp. 12.—Report of Analyses of Paris Green and other Insecticides.—Composition of chemically pure Paris green, tabulated analyses of 24 samples of commercial Paris green, brief notes on the results of examination of 7 miscellaneous insecticides, and the text of the New York law to prevent fraud in the sale of Paris green.

Bulletin 166, pp. 41 (Popular edition, pp. 6).—Commercial Feeding Stuffs in New York.—A classification of feeding stuffs; analyses of a large number of samples collected in 1898 and 1899, with a discussion of the feeding value of the different classes; results of a digestion experiment with sheep to study the effect of introducing oat feeds into grain rations; analyses of a number of condimental foods; and the text of the New York law regulating the sale and analysis of concentrated feeding stuffs.

Bulletin 167, pp. 34, pls. 4 (Popular edition, pp. 6).—A Fruit Disease Survey of the Hudson Valley in 1899.—Economic and in some cases descriptive notes on the different fruit diseases occurring in the Hudson Valley in 1899, the data being obtained from personal observations made by the authors of the bulletin and from replies to letters of inquiry sent to fruit growers.

Bulletin 168, pp. 24.—Director's Report for 1899.—A review of the different lines of station work with the results obtained, notes on the station staff, student assistants, needed changes and additions, inspection of fertilizers and feeding stuffs, and the publications of the station; and lists of bulletins published in 1899, and periodicals received by the station library.

Bulletin 169, pp. 41, pls. 2 (Popular edition, pp. 5).—Fertilizing

Self-sterile Grapes.—A detailed statement and a summary of results of pollination experiments made to compare different varieties of grapes for fertilizing self-sterile kinds, and a list of self-fertile and self-sterile grapes classified according to their blooming season.

Bulletin 170, pp. 65.—Common Diseases and Insects Injurious to Fruits.—An account of the common diseases and insects most injurious to cultivated fruits in New York, with directions for controlling them.

Bulletin 171, pp. 48, pl. 1 (Popular edition, pp. 6, pl. 1).—Animal Food for Poultry.—A detailed report of two series of tests made to compare vegetable and animal food for chickens, hens, and ducks.

Bulletin 172, pp. 24, figs. 2 (Popular edition, pp. 6).—The Efficiency of a Continuous Pasteurizer at Different Temperatures.—This contains introductory statements concerning dairying in Denmark and in the United States, an explanation of the terms pasteurization and sterilization, a discussion of the discontinuous or household system of pasteurization for sanitary purposes and the continuous or Danish system adapted to butter making, and the details and results of experiments to determine the effect upon the germ life of passing milk through a continuous pasteurizer at temperatures of 70°, 80°, and 85° C.

Bulletin 173, pp. 22.—Report of Analyses of Commercial Fertilizers for the Fall of 1899.—Results of analyses of 130 different brands of fertilizers.

Bulletin 174, pp. 8, figs. 2.—Fumigation of Nursery Stock.—A general account of the necessary apparatus and chemicals and the method to be adapted in applying fumigation by hydrocyanic-acid gas to infested plants, and a description of a fumigation house suitable for this purpose.

Bulletin 175, pp. 13, pls. 3.—A Parasite Upon Carnation Rust.—A brief descriptive account of carnation rust and of *Darluca filum*, a fungus observed as a natural check of this disease.

Annual Report, 1898, pp. 598, pls. 53, figs. 10.—The organization list of the station; a report of the treasurer for the year ended September 30, 1898; a summary of meteorological observations and readings of soil thermometers; reprint of a station circular on the name of a new variety of cherry; and reprints of Bulletins 143–157 of the station.

All of the station's lines of work have been undertaken after careful study of conditions existing in the State, in the hope and expectation of aiding the most important agricultural interests. As dairying is of preeminent importance in the State, the station gives investigation of its problems a leading place. It is at present studying cheese production and curing, as this phase of dairying is scientifically least

understood. New York leads the Union, if not the world, in the production of table grapes; so special study is placed upon viticultural topics, without, however, neglecting the other great fruit interests of the State. Poultry raising in New York is a most important source of revenue, and the station regards the scientific study of poultry feeding as well worth attention. Plant diseases and insect pests annually cause great loss to market gardeners, fruit growers, and grain raisers; so the attention of botanist and entomologist has been given to the prevalent and destructive foes of the field and orchard. The station officers keep in touch with the farmers of the State by taking part in farmers' institute work, by the system of experiments carried on on private farms in different parts of the State, by means of the fruit survey, by visits to cheese and butter factories, by trips for the study of insect distribution and other purposes, and by visits of granges and similar organizations to the station. The farmers' institute work is under the direction of the State commissioner of agriculture, and by agreement no station officer is to be called upon for more than two weeks' work in the institutes during any year. The organization and work of this station have been put upon a very efficient basis. Effort is concentrated mainly on a few important lines of investigation, and the different divisions unite in work along these lines on a well-matured plan and under such supervision as gives the individual investigator credit for his part of the work, but holds him to persistent endeavor within the limits fixed for the station's operations.

Cornell University Agricultural Experiment Station, Ithaca.

DEPARTMENT OF CORNELL UNIVERSITY.

The work of the New York Cornell Station during the past year has been for the most part along the same lines as heretofore, and has included variety experiments with wheat, field beans, and sugar beets; comparisons of different legumes as soil renovators; experiments with commercial fertilizers on pastures; tillage experiments with potatoes; studies of the manurial value of straw and sawdust as stable litter; tests of various plants as forage crops; plat experiments with grasses; feeding experiments with steers and pigs; studies of the relation of food to milk fat; investigations on butter and cheese making; breeding and feeding experiments with poultry; studies of the higher fungi, especially those of use as food plants; investigations on the diseases and decay of forest trees and timber and on the diseases of shade trees; spraying experiments for leaf curl; investigations on crown blight of apple trees, on root rot and damping-off diseases, and on certain effects of cold on fruit trees; chemical studies of soils, fertilizers, beets and their by-products in beet-sugar manufacture, silage, insecticides, and feeding stuffs with especial reference to pentosans; investigations on the life history of the Palmer worm, cankerworm, tent caterpillar,

three strawberry pests, and one grape pest new to the State, and on the effect of crude petroleum as an insecticide.

The horticulturist continues to pay much attention to the forcing of various garden crops, those receiving especial attention at the present time being fruits and rhubarb. The station continues to carry on an extensive system of cooperative experiments throughout the State with the aid of State funds. In this way sugar beets, field beans, the tillage of potatoes, and soil renovation are receiving attention among other lines at the present time. During the year a professor of university extension work has been appointed in the college of agriculture, the first position of the kind in this country. He is to employ the larger part of his time in giving instruction and help to farmers away from the university.

The income of the station during the past fiscal year was as follows:

United States appropriation	$13,500.00
State appropriation	[1] 17,500.00
Farm products, including balance from previous year	867.68
Miscellaneous	517.02
Total	32,384.70

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 168–182, and the Annual Report for 1899.

Bulletin 168, pp. 26, figs. 15.—Studies and Illustrations of Mushrooms: II.—A descriptive account of three edible species of Coprinus, namely, the shaggy mane, ink cap, and the glistening Coprinus.

Bulletin 169, pp. 34, pls. 4, dgms. 3.—Studies in Milk Secretion.—A record of the university herd of about 20 grade cows from 1891 to 1898, with a discussion of the data, especially as regards production as influenced by age, variation in the yield and quality of milk during lactation, effect of change from barn to pasture, and the cost of milk production.

Bulletin 170, pp. 12, figs 4.—Emergency Report on Tent Caterpillars.—A brief account of the appearance, life history, habits, etc., of the apple tent caterpillar and the forest tent caterpillar, with a discussion of remedial measures.

Bulletin 171, pp. 18, figs. 8.—Concerning Patents on Gravity or Dilution Separators.—Descriptions, mainly in the form of extracts from the specifications and claims under which patents were granted, of 8 gravity cream separators or creaming cans, with a discussion of the ground covered by the patents.

[1] This is approximately the amount spent for experimental purposes out of an appropriation of $35,000 by the State for cooperative experiments and university extension work in agriculture.

Bulletin 172, pp. 20, figs. 7.—The Cherry Fruit Fly—A New Cherry Pest.—An account of the appearance, habits, distribution, life history, etc., of *Rhagoletis cingulata*, with a discussion of remedial measures.

Bulletin 173, pp. 43, dgms. 6.—The Relation of Food to Milk Fat.—A summary of 44 experiments by various investigators concerning the relation of food to the fat content of milk, and a report of 2 experiments with rations having different nutritive ratios, and 1 with rations containing varying quantities of palm-nut meal.

Bulletin 174, pp. 34, figs. 2.—The Problem of Impoverished Lands.—A popular summary of information on this subject based on investigations at the station, including a discussion of the nature of soils, the principles of tillage and underdrainage, and the causes of impoverishment and the means of reclamation of soils, a series of questions and answers on the general subjects of soils and plant growth, and brief directions for conducting fertilizer experiments.

Bulletin 175, pp. 32, figs. 18.—Fourth Report on Japanese Plums.—Descriptive notes on varieties of Japanese plums fruiting on the station grounds in 1899.

Bulletin 176, pp. 79, figs. 16 (abridged edition, pp. 16, figs. 12).—The Peach-tree Borer.—An account of the history, distribution, characteristics, food plants, habits, life history, and natural enemies of the peach-tree borer; results of an extended series of experiments of various remedies for the destruction of this insect, and a bibliography from 1749 to the present time.

Bulletin 177, pp. 19.—Spraying Notes.—This includes general advice on spraying, results of experiments in fighting the San José scale, results of tests of new insecticides as regards injury to foliage, brief notes on the composition of various arsenical poisons, and the results of experiments to determine the effect of copper carbonate and potassium sulphid on the foliage of Japanese plums.

Bulletin 178, pp. 21, pl. 1, figs. 2, dgm. 1.—The Invasion of the Udder by Bacteria.—The views of several investigators regarding the presence or absence of bacteria in the normal udder are noted, and investigations on this subject, including the bacteriological examination of the udders of 19 cows slaughtered on account of tuberculosis, are reported in detail.

Bulletin 179, pp. 34, figs. 8.—Introduction to Field Experiments with Fertilizers.—The plan and object of cooperative field experiments with fertilizers commenced under State appropriation in 1897, with a brief discussion of the general results so far obtained.

Bulletin 180, pp. 14, dgms. 6.—The Prevention of Peach-leaf Curl.—Results of experiments conducted during two years to test different methods of treatment for the prevention of the leaf curl of the peach.

Bulletin 181, pp. 25, figs. 23.—Pollination in Orchards.—A popular discussion of various reasons why flowers of orchard trees often fail

to set fruit and the general subject of self-sterility of orchard fruits, giving results obtained at the station in self and cross pollination experiments with a number of varieties of different fruits and suggestions as to the planting of mixed orchards.

Bulletin 182, pp. 21.—Sugar-beet Investigations for 1899.—Results of cooperative cultural and variety tests, with tabulated analyses of 121 samples of sugar beets, and a summary account of experiments conducted at the station, including cultural tests during 1899 and fertilizer tests for three years.

Annual Report, 1899, pp. 732, pls. 4, figs. 152, dgms. 3.—The report proper contains the organization list of the station and brief reports by the director, treasurer, and heads of departments. Appendix I is made up of reprints of Bulletins 150–170 of the station. Appendix II gives a detailed statement of receipts and expenditures of the station for the fiscal year ended June 30, 1899. Appendix III contains reprints of publications on nature study.

Many of the important crops of the State are being studied by this station, especially from the point of view of field practice as best suited to different sections of the State, and special attention is being given to bringing the results of experimental work home to the farmer through the extensive system of cooperative experiments rendered possible by the State appropriation.

The college with which the station is connected continues to be active in university-extension work in agriculture, and in the effort to introduce nature study in the rural schools. One noteworthy result of the university extension work and cooperative experiments carried on by the college and station is the bringing of both instruction and research in agriculture favorably to the attention of a great number of farmers, and a further result is a largely increased attendance in the agricultural college. Many problems have arisen regarding the best organization of the outside work as related to the regular college courses in agriculture and the proper differentiation of the station operations with a view to their maintenance on a thorough and scientific basis. It is recognized that university-extension work in agriculture is still in its formative stages and that various plans must be tried before the one best suited to local conditions will be discovered. This station has in recent years been very successful in bringing its work before the farmer. The problem now before it is how to best direct the popular interest it has aroused and to conduct its investigations so as constantly to have fresh and original information for the farmers it is educating.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station, Raleigh.

DEPARTMENT OF NORTH CAROLINA COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

The work of the North Carolina Station during the past year has included experiments in bulb culture; experiments with tomatoes with special reference to the "Southern blight;" experiments in forcing tomatoes; variety tests of lettuce in cold frames; breeding experiments with various vegetables and ornamental annuals, especially sugar corn, golden cosmos, and scarlet sage; systematic studies of the flora and entomological fauna of the State; feeding experiments with dairy cows, beef cattle, and pigs; studies of tuberculosis; experiments in the management of poultry and in incubation; variety and fertilizer experiments with the principal farm crops of the State; experiments in the renovation of soils, especially with cover crops and rotations; experiments with forage crops; fertilizer experiments with peanuts and experiments in the selection of seed; experiments in growing broom corn; studies in plant nutrition and on the digestibility of various feeding stuffs; investigations on the digestibility of proximate constituents of feeding stuffs and on the purification of phloroglucinol; comparison of methods for determining proteid nitrogen in vegetable materials, and miscellaneous analyses. Cooperative work in connection with the Association of Official Agricultural Chemists has been continued. Experiments with sugar beets have been continued in cooperation with this Department.

During the year the farm formerly occupied by the agricultural department has been assigned to the horticultural department, and much of the time of the horticulturist has been occupied in getting the land into suitable condition. A considerable number of varieties of fruit trees and grapes has been planted. To the agricultural department has been assigned about 50 acres of land from the college farm, together with all of the equipment necessary for working it. A 75-acre pasture has been fenced in and put in shape. The poultry yards have been moved and improved, and a brooder house erected and incubator purchased.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	420.87
Miscellaneous	1,438.04
Total	16,858.91

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 163–170, Special Bulletins 51–53, Biennial Report for 1897 and 1898, and the Annual Report for 1899.

Bulletin 163, pp. 26—Rational Stock Feeding.—This includes definitions of terms; a discussion of the functions of nutrients, composition and digestibility of feeding stuffs, feeding standards, and the method of calculating rations; and a table showing the coefficients of digestibility of a large number of feeding stuffs and mixed rations.

Bulletin 164, pp. 76.—The Flora of North Carolina.—A list of 2,685 species of the flowering plants and higher cryptogams known to occur within the State.

Bulletin 165, pp. 6.—Preservatives in Canned Goods Offered for Sale in North Carolina.—Results of the examination of a number of samples of canned goods.

Bulletin 166, pp. 10.—Butter.—A statement concerning the number and value of cows in the State and a popular discussion of the chemical composition of animal fats, manufacture of oleomargarine, adulterants of butter and their detection, and adulteration of butter in North Carolina.

Bulletin 167, pp. 26.—Poultry Experiments During the Year 1898–99.—A summary of the work of the poultry department for one year, including results of tests of the comparative value of the different crosses and breeds, a discussion of the advisability of selling eggs by weight, and the results of tests to determine the effect of feeding onions on the flavor of the eggs.

Bulletin 168, pp. 14, fig. 1.—Experiments with Field and Forage Crops.—This bulletin gives the results of some work in seeding pastures, testing varieties of cotton and wheat, seeding timothy, improving peanuts, and certain notes on the growth at the station of sachaline and prickly comfrey, and on miscellaneous permanent station improvements.

Bulletin 169, pp. 20.—Feeding Experiments and Milk Records.—Tabulated data showing the amount of food consumed and the yield of milk and fat for 8 feeding experiments conducted to compare various feeding stuffs alone and in different combinations, and a review of the record of the station herd from 1891 to 1899.

Bulletin 170, pp. 24.—Gardening Under Glass.—Results of tests of a number of varieties of tomatoes for winter forcing, with descriptive notes, and a general discussion on the use of glass for market gardening in North Carolina.

Special Bulletin 51, pp. 48.—Catalogue of Herbarium Specimens for Exchange.—A list of duplicate specimens offered for exchange.

Special Bulletin 52, pp. 28.—Cattle Quarantine Line.—This contains a copy of Order No. 24 of the Bureau of Animal Industry of this Department regarding cattle transportation, a statement of the North

Carolina State laws regarding traffic in cattle, a proclamation of quarantine by the governor of North Carolina, a special order of the Secretary of Agriculture modifying quarantine line for the State, quotations from newspapers regarding cattle quarantine, a copy of the Virginia State law concerning cattle transportation, and a copy of an act to prevent the spread of cattle distemper or tick fever and other contagious or infectious diseases of live stock, which latter has been brought before the general assembly of North Carolina.

Special Bulletin 53, pp. 19.—Food Adulteration.—A popular summary of bulletins of the station on the adulteration of foods, with notes on State legislation.

Biennial Report, 1897 and 1898, pp. 78.—This covers the work of the station for the two years ended December 31, 1898, and includes a discussion of the relation of the station to the State and National Government, an outline of the history and the organization list of the station, a summary of the publications issued during 1897 and 1898, a brief review of the different lines of station work, and a list of acknowledgements. Departmental reports giving a more detailed account of work in agriculture, chemistry, horticulture, botany, entomology, veterinary science, and fertilizer control are appended.

Annual Report, 1899, pp. 514, figs. 30.—This is in part reprinted with changes from the Biennial Report of the Station for 1897 and 1898, noted above. It includes in addition the text of the Hatch Act, a summary of publications issued during the year, a financial statement for the fiscal year ended June 30, 1899, and reprints of Bulletins 152–169 of the station.

The station is paying much attention to the culture of the common farm crops of the State—cotton, corn, tobacco, potatoes, etc., and to the renovation of soils, a problem of widespread importance in the South. Efforts are at the same time being made to introduce a more diversified agriculture. One of the lines along which this work is being prosecuted is that of stock raising and dairying. Other lines are the growing of peanuts and broom corn, the latter, especially, in a very experimental way at present. Earlier investigations of the station have established the fact that many flowering bulbs can be grown in North Carolina, and the station is now endeavoring to demonstrate the advantage of introducing this industry. As an object lesson in what may be done, the station has shipped about 6,000 Bermuda lilies to Northern dealers the present season, and now has an order from one firm for 35,000 for next year. The growing of early vegetables for the Northern market is another industry of some importance, and the station is encouraging it as much as possible.

That the farmers of the State are interested in the station and turn to it for advice is demonstrated by the station's extensive correspondence. The station is now planning a system of cooperative experi-

ments with farmers throughout the State, and continues to take a leading part in farmers' institute work. As a consequence of the separation of the station from the State department of agriculture at the close of the fiscal year in 1899, the past year has been to some extent one of transition and reorganization. The efforts to concentrate its work on a few important lines are much to be commended. If a consistent policy is maintained in its management and thorough investigations are conducted within the limits of its funds, this station's work may be put on a more efficient footing, and results of substantial value to the agriculture of the State may be obtained. Progress in this direction has been made during the past year.

NORTH DAKOTA.

North Dakota Agricultural Experiment Station, Fargo.

DEPARTMENT OF NORTH DAKOTA AGRICULTURAL COLLEGE.

The work of the North Dakota Station during the past year has been along the same lines as heretofore, and has included tests of cereals; experiments with wheat and corn; tillage and soil studies; investigations on the formation and movement of nitrates in the soil; studies of the relation of available fertility to plant transpiration and growth; field and feeding experiments with brome grass, accompanied by chemical analyses; plant diseases, especially "flax sickness," and studies of soil humus; the availability of plant food, and the conservation of soil moisture and fertility.

Cooperative experiments in sugar-beet culture have been continued as heretofore. The experiments in breeding corn have resulted in the development of a variety which is much more promising than any heretofore had in the State. The botanist believes that he has shown that the so-called "flax sickness" is a fungus disease. During the year the station has reported considerable studies of the rooting habits of a number of field crops. A new sheep and hog barn affords much improved facilities for feeding experiments.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees	3.00
Farm products	2,271.99
Miscellaneous	571.18
Total	17,846.17

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 41–43 and the Annual Reports for 1898 and 1899.

Bulletin 41, pp. 21, figs. 3.—Some Hints on Ornamental Planting.—Popular suggestions to the farmers of the Northwest on the planting of ornamental and economic trees and shrubs, with notes on some of the more essential principles of landscape gardening, an article on planting shrubs, and a table showing the hardiness of deciduous trees and ornamental shrubs and vines.

Bulletin 42, pp. 41.—Field Notes of Horticultural Department.—Results in tabular form of fertilizer tests with vegetables in the Red River Valley during 1898 and 1899.

Bulletin 43, pp. 18, pls. 11.—A Study of the Root Systems of Cultivated Plants Grown as Farm Crops.—A brief review of a study of the root systems of wheat, oats, and corn reported in an earlier publication of the station and the results obtained in studying the root systems of flax, *Bromus inermis*, potatoes, and sugar beets, with notes on the effect of subsoiling on the root growth of sugar beets.

Annual Report, 1898, pp. 36.—Includes the organization list of the station; brief reports of the director and heads of the departments of agriculture, horticulture, and dairying; a report of the chemist reviewing the work of the department on drinking waters, wool scouring, soil, humus, feeding stuffs, vinegars, poisoning of cattle by water hemlock, a glucosid of millet hay, sugar beets, preserving eggs, chicory, marl, and ripening of cream, and giving a record of observations on soil temperature and moisture and meteorological observations; a brief report of the botanist on the different lines of botanical investigation under progress at the station; a report of the veterinarian containing an account of experiments made for the purpose of testing the value of mallein and creolin in the treatment of glanders, and a financial statement for the fiscal year ended June 30, 1898.

Annual Report, 1899, pp. 56, figs. 4.—Contains the organization list; a financial statement for the fiscal year ended June 30, 1899; a brief general report on station work during the year; and more detailed reports on the work of the different departments, including analyses of food products and miscellaneous substances, analyses of clay deposits, a summary of meteorological observations, analyses of 82 samples of sugar beets, observations on the growth and products of wheat plants of known selected pedigree, results of an investigation of conditions favoring the growth of smuts, results of tests of formalin and chlorid of lime for the prevention of smuts, notes on spraying for the destruction of weeds, observations on the life of weed seeds planted at different depths, brief notes on wild oats, results of tests of large and small potatoes from the same vine for seed purposes, a description of two forms of apparatus suited to use on the kitchen stove for distilling water for drinking purposes, a report on a study of the development of the buds of the wild plum, conclusions from experiments with field crops reprinted from earlier publications of the station, results of fertilizer tests with vegetables, and brief notes on injurious insects.

The study of soils, with special reference to the conservation of soil moisture, and the origination and introduction of hardy and drought-resistant varieties of economic plants are matters of prime importance in this State. The diversification of agriculture through rotation of crops, animal industry, and dairying is receiving increased attention. Its demonstration of how rotation of crops will materially increase the yield of wheat, especially in a dry season like that just past, has received much favorable notice from the farmers of this region. The station is gaining rapidly in the sympathies of the farmers of the State, as is shown by the fact that its correspondence has increased fully 100 per cent during the last eighteen months. One of the great railroads of the State continues to run free excursions to the station for the benefit of farmers along its line, and by this means, during the month of July alone, 1,200 farmers visited the station. At such visits a short farmers' institute is held, and the work of the station explained. Farmers' institutes were largely held throughout the State during the year and attended by members of the station staff. The demand for station men to attend these meetings has now become so great that some special provision should be made for carrying on the institutes without drawing so largely on the time of the station officers. The college is pursuing a more liberal policy toward the station, and the differentiation of college and station work is much more complete and satisfactory. The outlook for both college and station is quite promising.

OHIO.

Ohio Agricultural Experiment Station, Wooster.

The work of the Ohio Station during the past year has been along the same lines as heretofore, and has included investigations on the physical and chemical composition of soils and the conservation of moisture and fertility; variety and cultural experiments with field and garden crops of the State, together with observations on the growth habits of different species; diseases of plants; entomology; comparison of different breeds of cattle and sheep; feeding experiments, with some investigations on the nutrition of animals; and diseases of animals. The station continues to cooperate with this Department in work on sugar beets, sorghum, and tuberculosis. Different divisions of the station are cooperating with one another, and through the Agricultural Students' Union considerable cooperative work is done with farmers in different parts of the State. The inspection of nursery stock is now being carried on with the aid of a State appropriation. The entomologist is chief inspector and has two assistants. New work on tuberculosis is about to be undertaken with a special State appropriation. The investigations on the maintenance of soil fertility have been continued, and during the year a bulletin showing the results

obtained up to the present time has been issued. The two substations have been continued, being maintained by a special State appropriation.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation, including balance from previous year	25,879.15
Fees	377.07
Farm products, including balance	5,851.57
Miscellaneous	1,568.24
Total	48,676.03

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 105–111, Special Bulletin 4, and the Annual Report for 1899.

Bulletin 105, pp. 20, figs. 2.—Further Studies of Cucumber, Melon, and Tomato Diseases.—Notes on the prevalence of diseases of cucurbits and tomatoes in 1898, and the results of investigations conducted for their prevention.

Bulletin 106, pp. 20, figs. 6.—The Chinch Bug.—Experiments with Insecticides.—An account of the chinch bug and a report on experiments conducted to determine the insecticidal value of kainit, tobacco, and carbon bisulphid.

Bulletin 107, pp. 32, figs. 11.—The Hessian Fly.—An extended discussion of this insect.

Bulletin 108, pp. 86, figs. 9.—Bovine Tuberculosis.—This bulletin contains a general account of the nature of tuberculosis, of the properties of the tuberculin test, and of the method of making the test; detailed records of tuberculin tests of a large number of animals at the station, with the results of post-mortem examinations in those cases where the animals were slaughtered; a discussion of the disposal of the meat and other products of tuberculous animals; results of an experiment in infecting swine with tuberculosis; a review of the literature bearing upon the prevalence of tuberculosis in different States and in foreign countries; extracts from replies to circulars of inquiry sent to health officers and veterinarians regarding the prevalence of tuberculosis in dairy cattle, the extent of the application of the tuberculin test, and meat and milk inspection; a discussion of bovine tuberculosis in relation to the public health, and of the identity of the bacillus in the human and bovine forms of the disease; extracts from replies to circulars of inquiry sent to physicians concerning the transmission of tuberculosis through milk, with a discussion of the data; statistics as to the number of deaths from tuberculosis in Ohio; a discussion of the hereditary transmission of tuberculosis; and a review of State control and the literature of bovine tuberculosis.

Bulletin 109, pp. 14.—Meteorological Summary for 1898.—A summary of meteorological observations during 1898, and for comparison, similar data for previous years.

Bulletin 110, pp. 91, pls. 11, dgms. 8.—The Maintenance of Fertility.—A detailed account of field experiments with a large number of fertilizers on a variety of crops carried on by the station from 1888 to 1899 at five different points in Ohio. These experiments have been reported upon from time to time in earlier publications of the station.

Bulletin 111, pp. 52, pls. 8, fig. 1.—Investigations of Plant Diseases.—A summary account of the work of the station from 1891 to 1899 in the control of apple scab, raspberry anthracnose, shot-hole fungus, leaf curl, spot and scab of the peach, downy mildew and anthracnose of the cucumber, and tomato leaf blight.

Special Bulletin 4, pp. 4, pls. 2.—Clover Seed.—Notes on the vitality, purity, and manner of testing clover seed, results of the examination of 15 samples of commercial clover seed, and illustrations of seeds of 31 weeds found as impurities in clover seed.

Annual Report, 1899, pp. 34, map 1.—Contains an announcement relative to the character of the work undertaken at the station, the organization list of the station, a report of the treasurer for the fiscal year ended June 30, 1899, a report of the director reviewing the different lines of station work, an index to the publications issued during the year, and a subject list of station publications.

One of the leading lines of investigation at this station relates to the fundamental problem of soils, their physical and chemical composition, amelioration, and special treatment for conserving moisture and fertility. The principal grain, forage, fruit, and vegetable crops of the State have been studied to determine the varieties and cultural methods best adapted to local conditions. Observations have also been made on their growth habits—investigations of less immediate but more fundamental importance, since without such knowledge rational cultural methods can not be prescribed. The obstacles to the production of these crops most common in the State have also been investigated. This has necessitated studies on the life history and distribution of injurious insects and fungi, preliminary to discussing methods of repression. Along these lines the station's investigations of cucumber mildew, peach curl, and chinch bug have especially been of great practical value to the farmers of the State. Comparative studies have been made on the merits and demerits of different breeds of cattle and sheep. Investigations have been made on the economic feeding of cattle as especially suited to local conditions. Certain diseases of animals, especially tuberculosis and sheep worm, which cause great losses to the stock raisers of the State, have been studied.

The station continues to keep in touch with farmers through an extensive correspondence, frequent bulletins, and the attendance of its

officers at farmers' institutes. The State continues to supplement the national fund liberally. The assumption by the State of the financial burden of the inspection of nursery stock is a recent evidence of its just appreciation of the proper relations of the State government to such work.

OKLAHOMA.

Oklahoma Agricultural Experiment Station, Stillwater.

DEPARTMENT OF OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE.

The work of the Oklahoma Station during the past year included tests of the digestibility of Kafir corn and its products; determinations of the yield of digestible nutrients by a number of fodder crops; digestion trials with chickens; feeding experiments with steers and pigs; cultural and variety experiments with wheat; experiments in the continuous cropping of wheat and Kafir corn; rotation experiments; fertilizer and cultural experiments with alfalfa; studies of the flora of the Territory; fertilizer experiments with hops; studies of the crown knot of the apple; water culture experiments; experiments with hyacinths; apiculture; diseases of animals, especially blackleg, Texas fever, and animal parasites; horticulture, especially orchard and small fruits and the culture of grapes, and variety and cultural experiments with potatoes.

A building has been completed for the joint use of the departments of chemistry in the college and station (Pl. VI, fig. 1). The building formerly occupied as a chemical laboratory is now occupied by the agricultural department. A new library building (Pl. VI, fig. 2) has also been completed, which will furnish accommodations for the station veterinarian, and various sheds and a small piggery have been added to the station's equipment. During the year the station staff was increased by the appointment of an assistant agriculturist.

The income of the station during the past fiscal year was as follows:

United States appropriation	$14,999.07
Farm products, including balance from previous year	3,895.91
Total	18,894.98

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 42–45 and the Annual Report for 1899.

Bulletin 42, pp. 26, figs. 8.—Oklahoma Soil Studies.—An account of experiments during three years on the influence on soil moisture of plowing, subsoiling, cultivation, rolling, and manuring; data on the moisture content of upland and bottom lands, mechanical analyses,

FIG. 1.—OKLAHOMA COLLEGE AND STATION—CHEMISTRY BUILDING.

FIG. 2.—OKLAHOMA COLLEGE AND STATION—LIBRARY.

specific gravity, water-holding capacity, and rate of evaporation of different kinds of soil; and observations on humidity and rainfall during 1898.

Bulletin 43, pp. 12.—Fruits for Oklahoma.—An account, based on the reports of 37 growers, of the different varieties of orchard and small fruits most successfully grown in different parts of the Territory, and suggestions regarding desirable shade trees and methods of planting them.

Bulletin 44, pp. 12.—Field Crops, 1899.—A summary of the results of variety tests with oats and culture experiments as regards time of seeding, thickness of planting, and methods of plowing and cultivation with Kafir corn, Indian corn, castor beans, and cotton, and notes on the experience of farmers in cotton culture, and on the growth of cowpeas at the station.

Bulletin 45, pp. 48 (Popular edition, pp. 12).—An Annotated Catalogue of the Ferns and Flowering Plants of Oklahoma.—A list with notes of about 750 plants growing without cultivation in the Territory, a summary of this information being given in the popular edition.

Annual Report, 1899, pp. 90, pls. 3, figs. 3, dgms. 2.—A report of the director, reviewing the different lines of station work during the year; a financial statement for the fiscal year ended June 30, 1898; a summary account of feeding experiments made from 1896 to 1899 with steers, pigs, mules, horses, sheep, and lambs, the principal object being to test feeding stuffs which can be readily grown under local conditions and which may be prepared with small cost; results of variety and culture experiments with wheat; notes on the destruction of insects and on a disease prevalent among horses in the western part of the Territory; summaries of meteorological observations; an extended summary of the results of the more important work done since the establishment of the station; subject list of station bulletins, and a list of the native and introduced grasses found near Stillwater, Okla.

The work of the station is closely confined to the study of questions bearing upon animal husbandry and the production of orchard and small fruits, topics in which there is much popular interest and which the station believes to be of most immediate importance to the agriculture of the Territory. At the same time a strong effort is being made to introduce diversified farming, for which there are great possibilities. The station continues to keep in close touch with the farmers through its extensive correspondence and frequent publications, especially press bulletins, which are widely copied by the newspapers of the Territory. The mailing list has increased considerably during the past year. The station is further strengthening its relations with the farmers by paying special attention to studies of the conditions of farming as they actually obtain among the practical farmers of the Territory. The equipment of the station has been improved, its work

concentrated along the more important lines, and its business placed on a systematic basis. Much interest in the station has been aroused, and the feeling toward it among the people is good, and the outlook for the future has never been better.

OREGON.

Oregon Experiment Station, Corvallis.

DEPARTMENT OF OREGON STATE AGRICULTURAL COLLEGE.

The work of the Oregon Station during the past year has included field experiments with wheat, oats, potatoes, grasses, and forage plants; feeding experiments with sheep and dairy cows; horticultural investigations, especially with peaches, apples, and other orchard fruits; entomological investigations; chemical studies, especially on soils, sugar beets, prunes, cherries, strawberries, and the native clovers; bacteriological studies of tuberculosis and other diseases of poultry, and on a method for making vinegar rapidly; and work in dairying.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products, including balance from previous year	2,884.24
Total	17,884.24

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 56–62.

Bulletin 56, pp. 8.—Chemical Studies of Oregon Fruits.—Points on Prune Dipping.—Results of experiments in dipping prunes into boiling solutions of lye of different strengths, and analyses with reference to alkalinity of 27 samples of concentrated lyes found in Oregon markets.

Bulletin 57, pp. 15, figs. 7.—Brown Rot of Prunes.—An account of this disease caused by *Monilia fructigena* with suggestions as to remedies.

Bulletin 58, pp. 11, pls. 7.—Rose Culture in Oregon.—Popular directions for propagating, planting, and pruning roses, with brief notes on the more common insects and diseases affecting roses.

Bulletin 59, pp. 21, pls. 3.—Sugar Beet Experiments of 1898.—Results of cooperative variety and cultural tests with sugar beets in 1898, analyses of beet pulp and notes on its use as a food for cattle, and conclusions reached after five years of investigation on the production of beet sugar in the State.

Bulletin 60, pp. 8, pls. 3.—Apple-tree Anthracnose.—This is described

as a new disease of the apple and the name *Glœosporium malicorticis* is given tothe fungus which causes it. Remedies are suggested.

Bulletin 61, pp. 18.—The Oregon Prune.—Tabulated food analyses of fresh and cured prunes, with an explanation of the terms used, a statement of the method of analysis employed, and a discussion of the results: a discussion of the food value of fresh prunes; and ash analyses of prunes with a discussion of the fertilizer elements removed from the soil by prunes and a fertilizer formula recommended for fruits in general and prunes in particular.

Bulletin 62, pp. 20.—Miscellaneous Investigations.—Analyses of samples of sorghum grown in 28 different localities in the State; original and compiled analyses of strawberries and other fruits; a discussion of the cost and composition of bread in Oregon based on an examination of 25 samples; tabulated analyses of a number of feeding stuffs; descriptions and analyses of 12 samples of gypsum and 19 samples of limestone; and a report of a dietary study made with a family of 2 men and 3 women and covering one week.

Oregon is well adapted for fruit growing, prunes being a product of especial importance, and this industry is receiving attention at the hands of the station. At the same time the staple field crops of the State are not being neglected, and experiments in feeding cattle and sheep are being made. The station is endeavoring to develop the dairy interests of the State and to secure the introduction of grasses and forage crops better adapted to different regions. The college with which the station is connected is growing in public favor, as is shown by an increased attendance of students. This makes more difficult the problem of keeping the amount of teaching required of members of the faculty, who are also on the station staff, within such limits as will permit the carrying on of thorough investigations. At the same time the importance of the station's work is better appreciated in the State, and there is more demand for the services of its officers at farmers' institutes. Here, as elsewhere, it is evident that the State must take into account the growing needs of its agricultural college and experiment station and provide for their further endowment if they are to meet most successfully the demand made upon them by the public.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station, State College.

DEPARTMENT OF THE PENNSYLVANIA STATE COLLEGE.

The work of the Pennsylvania Station during the past year has been along the same lines as heretofore, including studies in the composition of bench soils for roses, dried distillery waste, the humus content of certain soils, and methods of cattle food analysis; fertilizer, variety,

rotation, and cultural experiments with field crops; fertilizer experiments on tobacco; comparisons of soiling crops; investigations in dairying; and horticulture, especially variety tests, experiments in root grafting and ginseng culture, and studies of crown gall. As heretofore, the station continued to cooperate with the State department of agriculture in the inspection of fertilizers, feeding stuffs, and seeds. In cooperation with that department the station has also carried on experiments in watering and handling fattening steers. In the same way studies have been made of the effects of lime upon typical soils of the State, and investigations have been made on the chemical composition of the apple and its products, together with studies of the changes which cider undergoes in its conversion into vinegar. A respiration calorimeter is being constructed for investigations on the nutrition of the larger domestic animals, modeled after the Atwater-Rosa calorimeter constructed by the Connecticut Storrs Station, in cooperation with this Office, for investigations on the nutrition of man. A special building (Pl. V, fig. 2) has been erected for the housing of the calorimeter. This work is being conducted in cooperation with the Bureau of Animal Industry of this Department.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees from inspection service	8,217.00
Farm products	1,446.94
Miscellaneous	5,946.84
Total	30,610.78

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 46–51.

Bulletin 46, pp. 7.—Variety Tests of Wheat.—Results of tests of 32 varieties of wheat in 1898, 22 varieties in 1899, and several varieties for periods ranging from two to ten years, with a brief discussion of the question as to whether wheat will run out.

Bulletin 47, pp. 8.—Tests of the Sugar Beet in Pennsylvania.—Results of a test of 11 varieties of sugar beets, a brief report on a study of the best time of harvesting, and a summary, by counties, of the weight and composition of samples received from different sections of the State.

Bulletin 48, pp. 8.—Winter v. *Spring Bran.*—Analyses of 10 samples of bran from winter wheat and 10 from spring wheat, with a discussion of the comparative value of the two sorts of bran.

Bulletin 49, pp. 8.—Field Fertilizer Experiments on Tobacco.—Results of a cooperative test of the comparative value of a number of fertilizer mixtures for tobacco.

Bulletin 50, pp. 12, fig. 1.—Distillery Waste.—Miscellaneous Cattle Food Analyses.—A report on the composition of distillery waste obtained in the manufacture of vinegar from fermented grain, and analyses of miscellaneous feeding stuffs.

Bulletin 51, pp. 6.—Small Fruits in 1899.—Brief notes on tests of varieties of strawberries, raspberries, and blackberries.

The energies of the Pennsylvania Station have been directed mainly to developing the dairy industry, in the belief that the attention of the farmers of the State should be called more specifically to its advantages, as the large population not engaged in agriculture affords a ready home market for the products. Much of the work has been on the nutrition of animals, problems of most fundamental and general importance. The completion of the respiration calorimeter now under construction will give added impetus to these investigations. The college and station have continued to aid largely in the farmers' institutes of the State, to conduct correspondence courses, and to promote the introduction of nature study in the public schools. This work has been a heavy tax on the time and energies of the officers engaged in it and should be more fully supported by the State. Considering the great and manifold agricultural interests of the State and the success which has attended the work of this station, Pennsylvania could, without doubt, well afford to give it additional funds which would enable it to extend its investigations along lines of great importance.

RHODE ISLAND.

Rhode Island Agricultural Experiment Station, Kingston.

DEPARTMENT OF RHODE ISLAND COLLEGE OF AGRICULTURE AND MECHANIC ARTS.

The work of the Rhode Island Station during the past year has included plat and pot experiments with lime, fertilizers, and rotations, and on the availability of fertilizer ingredients in soil and manures as affected by lime, magnesia, etc., with related chemical investigations; poultry experiments, including breeding and feeding experiments with hens, geese, and pigeons; studies of methods of heating and ventilating brooders and poultry houses; investigations on factors determining sex in poultry, and poultry diseases; and horticultural experiments with varieties, methods of planting, pruning, etc., of bush fruits. Breeding experiments with Belgian hares have been continued and a black variety has been produced. The station has continued to cooperate with this Department in the testing of various seeds and plants. Cooperative experiments with farmers are carried on to a limited extent. The marine work which had been in progress for several years has been closed. The fertilizer and feeding-stuffs inspection has been continued by the chemist and his assistants with State funds.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	615.41
Miscellaneous, including balance from previous year	186.30
Total	15,801.71

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 53–65, and the Annual Report for 1898.

Bulletin 53, pp. 13.—The Practical Bearing of Some of the Field and Pot Experiments Conducted at the Rhode Island Station.—A summary of the results of direct practical value obtained in investigations on potato scab; the poisonous or unsatisfactory action of ammonium sulphate as a fertilizer; the effect of acid soils on the growth of plants; the distribution of acid soils in Rhode Island; the assimilability of the nitrogen in nitrate of soda, sulphate of ammonia, and dried blood on an acid soil before and after liming; and the fertilizer requirements of different kinds of soil.

Bulletin 54, pp. 19.—Commercial Fertilizers.—This bulletin discusses fertilizer inspection in Rhode Island, makes suggestions regarding the purchase and sale of fertilizers, gives a schedule of trade values of fertilizing materials, explains the terms used in fertilizer analysis, and reports analyses and valuations of 13 samples of fertilizers.

Bulletin 55, pp. 9, figs. 4.—Forcing Rhubarb.—An account of an experiment conducted in the greenhouse and in the cellar in forcing rhubarb in light and in darkness before and after freezing, with the results of a test of the cooking qualities of the plants grown.

Bulletin 56, pp. 9.—Analyses of Commercial Fertilizers.—Tabulated analyses and valuations of 46 samples of fertilizers.

Bulletin 57, pp. 7.—Quantities of Nitrogen for Grass.—Data showing the yield and cost for fertilizers of hay from 3 plats which had received annually for a number of years no nitrogen and 150 and 450 pounds of nitrate of soda, respectively, with a discussion of different phases of the experiment.

Bulletin 58, pp. 8, fig. 1.—Financial Gain from Liming Grass Land.—Data for the yields of grass grown for four years in succession on limed and unlimed plats which had received the same amounts each year of nitrate of soda and muriate of potash.

Bulletins 59, pp. 9; 60, pp. 10.—Analyses of Commercial Fertilizers.—Tabulated analyses and valuations of 93 samples of commercial fertilizers and 6 samples of wood ashes.

Bulletin 61, pp. 12.—On the Mortality of Incubator Chicks.—Observations relative to the mortality among incubator chicks; a discussion of the results of post-mortem examinations ascribing the causes of

death to diseases due to heredity or environment, to mechanical causes, to imperfect sanitation, and to improperly balanced rations; and the results of an experiment conducted to determine the hygienic effect of different rations.

Bulletin 62, pp. 24.—Chemical Methods for Ascertaining the Lime Requirements of Soils.—A discussion of various methods proposed for the determination of the acidity of soils, with the results of tests of a number of them.

Bulletin 63, pp. 10.—Feeding-stuff Inspection.—Text of the Rhode Island law regulating the sale of concentrated commercial feeding stuffs and tabulated analyses of a number of samples of feeding stuffs made in accordance with the act.

Bulletin 64, pp. 24.—Feeding and Feeding Stuffs.—A discussion of principles of feeding, including a table of feeding standards, directions for calculating rations, and the digestibility of different feeding stuffs, and a report on feeding-stuff inspection, including tabulated analyses of 16 samples of feeding stuffs.

Bulletin 65, pp. 10.—Fertilizer Experiment with Potatoes.—Details and results of two series of fertilizer experiments with potatoes: (1) A comparison of like quantities of nitrogen in the form of nitrate of soda, sulphate of ammonia, and dried blood alone and in different combinations, and (2) a comparison of like quantities of potash in the form of muriate and high-grade sulphate alone and in combination.

Annual Report, 1898, pp. 172, figs. 58.—This includes the organization list of the station; reports of the director and heads of departments reviewing at some length the different lines of station work during the year; a discussion of the cause, symptoms, and treatment of roup in fowls; notes on several experiments in horticulture, including the root and top pruning of apple trees at the time of planting; miscellaneous chemical analyses; a discussion based on the results of experiments at the station on the possibility of drawing erroneous conclusions from plant soil tests designed as guides to the economical manurial treatment of soils, and to serve as a basis for the development of reliable chemical methods for ascertaining their requirements; results of experiments to determine the effectiveness of nitrate of potash as compared with like amounts of nitrogen and potash in form of muriate of potash and nitrate of soda; observations on the substitution of soda for, and its value in connection with, potash; observations on the growth of a large number of different kinds of plants upon an acid upland soil, limed and unlimed; an account of cooperative experiments in eight different localities conducted to study the lime requirements of Rhode Island soils; results of tests of 22 varieties of potatoes, with descriptive notes on 11 of the varieties tested; a report on soil inoculation experiments with Nitragin; results of a comparative test with 13 varieties of oats of Ceres Pulver and the Jensen hot-water treatment for the

prevention of smut; notes on a possible error in the determination of nitrogen in nitrates due to impurities in reduced iron; a brief discussion on some of the requirements for successful poultry raising which are often neglected, and on ventilation of poultry houses; a summary of meteorological observations during 1898; and lists of donations, exchanges, and station publications.

The station is limiting its efforts to problems of crop production, both general and special, under the peculiar conditions arising from the widespread acidity of the soil in Rhode Island, the existence of which has been demonstrated by the station; to poultry culture, which has been and is still an industry of importance locally, though suffering from the inroads of disease and from inattention to the principles of breeding; and to horticulture, more especially the production of the perishable crops for which the proximity of markets affords exceptionally favorable opportunities.

The college and station are giving considerable attention to nature-study work, correspondence courses, and farmers' institutes. The college is making a specialty of instruction in aviculture through its poultry school. Progress has been made in the concentration of the work of the station on a few important lines. Its field and laboratory investigations on the use of lime as a soil amendment have attained a much more than local importance. The poultry work is especially appropriate to this State and should be strongly developed.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station, Clemson College.

DEPARTMENT OF CLEMSON AGRICULTURAL COLLEGE.

The work of the South Carolina Station during the past year included investigations of the sweet potato as a starch producer; studies on the chemical composition of various rice products; variety, fertilizer, rotation, and cultural experiments; plant breeding, especially cotton and corn; studies of forage plants for hay and for pasturage; plant diseases, especially cotton-boll rot; diseases of animals, especially tuberculosis, Texas fever, glanders, and hog cholera; comparisons of soiling and pasturage; feeding experiments with pigs; experiments in pasteurizing milk; entomology, especially insects injurious to the cotton plant; and horticulture, especially experiments in the repression of injurious insects and fungi, studies of frost-resisting varieties of fruits, methods of training and pruning grape vines, and forcing fruits and vegetables. The inspection of fertilizers continues to be carried on by the college under State law.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	776.25
Total	15,776.25

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 41–53 and the Annual Reports for 1898 and 1899.

Bulletin 41, pp. 31, figs 5.—Rice Blast and a New Smut on the Rice Plant.—A Preliminary Report on Treatment for Rice Smut.—An account of blast or blight of rice which appeared seemingly in two forms, and of a smut considered due to *Tilletia corona*, and a report on a number of experiments made to test the effect on rice seed of various treatments for the prevention of rice smut.

Bulletin 42, pp. 8.—Varieties of Cotton.—Results of tests of 30 varieties of cotton in cooperative experiments.

Bulletin 43, pp. 30.—Analyses of Commercial Fertilizers.—This includes statements regarding the composition and valuation of fertilizers, directions for taking samples, the law and regulations governing the sale of fertilizers in South Carolina, and analyses and valuations of 327 samples of fertilizers inspected during the season of 1898–99.

Bulletin 44, pp. 6.—Corn.—Tabulated results, with comments, on experiments with corn, involving planting, tillage, distance, and fertilizer tests; comparison of kernels from different parts of the ear for seed; and on excessive manuring, tillage, and irrigation.

Bulletin 45, pp. 23.—Analyses of Commercial Fertilizers.—Analyses and valuations of 149 fertilizers, together with notes on valuation, directions for sampling, and regulations for governing the sale of commercial fertilizers in South Carolina.

Bulletin 46, pp. 4.—Cotton.—Results of a test to determine the time of application, kind, quantity, and combination of fertilizers most suited for the production of lint cotton on sandy upland soil with red clay subsoil.

Bulletin 47, pp, 102, fig. 1.—A Chemical Study of the Sea-island Cotton Plant.—A general discussion of the origin, history, culture, etc., of sea-island cotton; analytical data showing the food and fertilizing constituents of the whole plant and of each individual part, with a comparison of the data with analyses of upland cotton; actual and calculated analyses of the whole plant; percentages of the different parts of the sea-island cotton plant; estimated amounts of fertilizing constituents removed by a crop of sea-island cotton; a critical discussion based on the analytical data of methods of fertilizing sea-island cotton; a consideration of the exhaustive effect of growing sea-island cotton when both lint and seed are entirely removed from the land; a discussion of the feeding value of different parts of the plant; and a comparison of the analyses with analyses of sea-island and upland cotton made by other investigators.

Bulletin 48, pp. 16.—Broad and Narrow Tires.—An account of

two dynamometer tests on wet and dry sandy roads of wagons having tires 6 inches and 1½ inches wide, with a summary of similar tests at other stations.

Bulletin 49, pp. 27, pls. 7.—Strawberries.—A popular bulletin on growing strawberries, with notes on the results of tests of 95 varieties at the station.

Bulletin 50, pp. 41, figs. 10.—Tuberculosis of Cattle.—A general account of the nature and cause of tuberculosis and a description of the method of applying the tuberculin test, a report on the application of the tuberculin test to 200 cows, and suggestions regarding legislation concerning tuberculosis.

Bulletin 51, pp. 15, figs. 6.—Silo Construction and Silage.—A brief discussion of the value of the silo to the Southern dairymen; detailed directions, with illustrations, for the construction of a round silo; and suggestions as to the location, size, and method of filling a silo, and crops to be grown for silage.

Bulletin 52, pp. 12, figs. 4.—Pig Feeding.—Results of a comparative test of peanuts, sweet potatoes, field peas, and corn for pigs; notes on the shrinkage of hams in curing; and analyses of peanuts.

Bulletin 53, pp. 24.—Analysis of Commercial Fertilizers.—This bulletin reports analyses of 176 samples of fertilizers collected during the season of 1899–1900, discusses the composition and valuation of commercial fertilizers, and gives regulations governing the sale of fertilizers in South Carolina and the text of the law providing for the free analysis of purchasers' samples of fertilizers recently passed by the State legislature.

Annual Report, 1898, pp. 37.—This includes a financial statement for the fiscal year ended June 30, 1898, and reports of the vice-director and heads of departments reviewing the different lines of station work and giving results in some cases, including notes on tests of varieties of different field and garden crops.

Annual Report, 1899, pp. 37.—A general report on the work of the station by the vice-director, and more detailed reports by the heads of departments, including in some cases brief statements of the results obtained during the year; a financial statement for the fiscal year ended June 30, 1899; and a subject list of station publications.

The staple money crop of South Carolina is cotton. Considerable amounts of garden vegetables are also raised for shipment to northern markets. In recent years the development locally of industries other than agriculture has created a larger home market not only for garden truck but also for dairy products. These are the principal interests which the South Carolina Station is endeavoring to promote. The chemist of the station has published a detailed account of a thorough study of the chemistry of the sea-island cotton plant. The station is endeavoring to develop farmers' institute work and has succeeded in

FIG. 1.—TENNESSEE STATION—DAIRY HALL.

FIG. 2.—TENNESSEE STATION—EXPERIMENTAL PLATS.

awakening considerable enthusiasm on the subject throughout the State. The station is doing considerable useful work but still lacks in concentration of effort and the maintenance of a consistent and vigorous policy. It should be given an expert director as a separate officer, under whose supervision the work of the station should be conducted without the interference of the governing board in the details of its operations.

SOUTH DAKOTA.

South Dakota Agricultural Experiment Station, Brookings.

DEPARTMENT OF SOUTH DAKOTA AGRICULTURAL COLLEGE.

The lines of work of the South Dakota Station during the past year have included soil analyses; analyses of native and introduced forage plants and grains, including new forage grains introduced by this Department; studies of plant diseases; plant-breeding experiments, especially with wheat, oats, barley, spelt, and corn; studies of the effects of various methods of tillage on soil moisture; studies of the effects of farm manure on the physical condition of the soil; rotation experiments; variety and breeding experiments with grains; variety tests of farm crops with special reference to drought-resistant qualities; feeding experiments; digestion experiments; breeding experiments with apples, plums, native fruits, and tomatoes; studies of hardy stocks for orchard fruits; cultural and variety tests of vegetables and fruits; tests of hardy hedge and ornamental plants; forestry experiments; studies on blackleg, calf cholera, tapeworms and stomach worms of sheep, and on the means of dissemination of weeds. *Bromus inermis* has proved so successful as a forage plant for this region that the station can not meet the demand for seed. Tests of grasses and forage plants at Highmore in cooperation with this Department have been continued, but irrigation work at Mellette has been stopped, owing to lack of funds for its successful prosecution.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	400.00
Farm products	464.01
Total	15,864.01

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 63–65.

Bulletin 63, pp. 14.—Pig Feeding in South Dakota.—A report of two tests with about 30 pigs each, conducted to compare some of the common feeding stuffs and to collect data regarding the cost of pork production from common grains under favorable conditions.

Bulletin 64, pp. 127.—Ferns and Flowering Plants of South Dakota.—A catalogue of species, with notes on distribution.

Bulletin 65, pp. 32, pls. 5.—Root Killing of Apple Trees.—A discussion of this subject, with tables showing the number and variety of apples root killed during two winters; notes on varieties of *Pyrus baccata* and *P. prunifolia;* a review of the experience of other stations with root killing; results of a test of the value of growing stocks from hardy varieties of cultivated apples, and a discussion on the relative merits of bud and piece-root grafting, and on the winter protection of nursery stock.

In South Dakota the question of hardy and drought-resistant varieties of agricultural and horticultural plants is of prime importance, as also questions of soil study with special reference to conservation of soil moisture. The station is collecting and testing native forage plants and introducing hardy kinds. The State has not now a satisfactory list of varieties of orchard fruits and vegetables suited to the local conditions, and hence the horticulturist is endeavoring, by the introduction of hardy Russian and other foreign varieties and more especially by breeding, to produce varieties adapted to local requirements.

The work of the station is being wisely kept within comparatively few lines, and is being actively prosecuted on a definite plan. The college with which the station is connected is growing in strength and number of students. This success is causing temporary embarrassment through lack of funds to meet the enlarged demands of the institution. This affects the station by making it necessary for the station funds to bear an undue amount of the general expenses which elsewhere are borne by the college. In view of the rapidly increasing agricultural interests of South Dakota, it is hoped that in the near future the national fund will be supplemented by the State, so that the investigations of the station may more thoroughly cover the diverse conditions of different localities.

TENNESSEE.

Tennessee Agricultural Experiment Station, Knoxville.

DEPARTMENT OF THE UNIVERSITY OF TENNESSEE.

The work of the Tennessee Station during the past year has included investigations on the susceptibility of peach foliage to injury by copper compounds; investigations on the life history of apple trees; variety experiments with the common farm crops of the State; studies on the influence of different soils and climates on grains; experiments in restoring and maintaining the fertility of the soil; the influence of soil moisture on different methods of culture and fertilization; rotation experiments; plant breeding and seed selection; feeding experiments; studies on the relative merit of protein in cotton-seed meal and in

cowpea-vine hay for milk and for beef production; dairying; demonstrations in double cropping; demonstration experiments in the use of silage; studies of the cost of producing silage from various crops; studies of the root systems of farm crops, and soil studies, both mechanical and chemical, combined with which are field experiments with fertilizers on the typical soils of different parts of the State.

During the year the staff has been increased by the addition of a meteorologist. In a number of ways the equipment of the agricultural and horticultural departments has been improved for both college and station purposes. The barn which was completed a year ago has been further improved this year and its equipment enlarged. A dairy building (Pl. VII, fig. 1) has been erected and equipped at an expense of over $10,000. The greenhouse of the horticultural department has been removed to a more convenient place on the college grounds and enlarged and rearranged so as to provide rooms for potting, grafting, etc. The heating apparatus has been improved. All of the college farm is to be used hereafter by the agricultural department, and a tract of nearly 100 acres, partly uncleared land located about one-half mile from the university farm, has been assigned to the horticultural department. Several acres were planted last spring to a great variety of fruits for experimental purposes. Further plantings are to be made. In the agricultural department additions have been made to the herd, and stables have been provided for sheep, hog, and beef feeding experiments. A soil physics laboratory has been equipped with modern appliances. During the past year a permanent exhibit of the products of the farm has been prepared with funds furnished by the Knoxville Chamber of Commerce. The velvet-lined cases are 5 feet high and 2 feet wide. Two of these are hinged together, so that they can be closed and locked ready for shipment to any point with the greatest dispatch. The station has a well-managed system of plat experiments (Pl. VII, fig. 2).

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	3,768.62
Miscellaneous	103.00
Total	18,871.62

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins Vol. 11, Nos. 2–4, and Vol. 13, No. 1, and the Annual Report for 1899.

Bulletin Vol. 11, No. 2, pp. 72, pls. 2, figs. 40.—Grasses and Forage Plants.—Part I, Domesticated Grasses.—Illustrated descriptions of 29

domesticated grasses growing in the vicinity of the station, with cultural notes in each instance, and information regarding harvesting, marketing, and uses.

Bulletin Vol. 11, No. 3, pp. 39, figs. 8.—Grasses and Forage Plants.—Part II, Domesticated Leguminous Plants.—Popular cultural notes on 12 of the more important leguminous plants grown for forage in Tennessee.

Bulletin Vol. 11, No. 4, pp. 32, figs. 20.—Grasses and Forage Plants.—Part III, Meadows and Wild Pastures.—Popular directions for the establishment, care, and management of meadows in Tennessee, with formulas for mixing grass seed for planting lawns, orchards, and permanent pastures on different soils, and notes on some of the highway and mountain pastures of the State.

Bulletin Vol. 13, No. 1, pp. 16, figs. 5, charts 2.—Frost Protection.—Climate of Tennessee.—A discussion of the formation of frost and when to expect frost, and a description of various methods of protection from frost, with notes on the climate of Tennessee.

Annual Report, 1899, pp. 79, pl. 1, figs. 31.—Contains a general report on the work of the station; a description, with drawings, of a new dairy barn erected at the station; an outline of the work of the agricultural department; a financial statement for the fiscal year ended June 30, 1899; an outline of a short course in agriculture, and short popular discussions on the following subjects: Dairy farming, feeding the dairy cow, use and abuse of rations, effect of churning on fat globules, soil studies, principles of plowing, root systems of farm crops, principles in the use of fertilizers, fertilizer experiments with corn, cooperative experiments with fertilizers, renovation of unproductive orchards, fertilizers for the orchard, onions, utility of the cowpea, why grasses fail, notes on grasses, and seed selection.

The farming interests of the State lie along the lines of general agriculture, and the various crops commonly cultivated are receiving attention at the hands of the station. Work relating to stock raising and dairying is being especially emphasized and developed. Station officers continue to assist the State commissioner of agriculture in farmers' institute work as heretofore. The university has undertaken the publication of an annual agricultural handbook, to give the more practical matters from the experience of the college and station during the previous year. The agricultural and horticultural departments have been greatly strengthened in equipment and work. As regards both experimental inquiries and dissemination of information, this institution is now doing a larger and more important service for the agriculture of the State than ever before. It is considering the agricultural interests of the State in a broad way and, as far as its limited funds will permit, is carrying on investigations which are of general benefit to Tennessee.

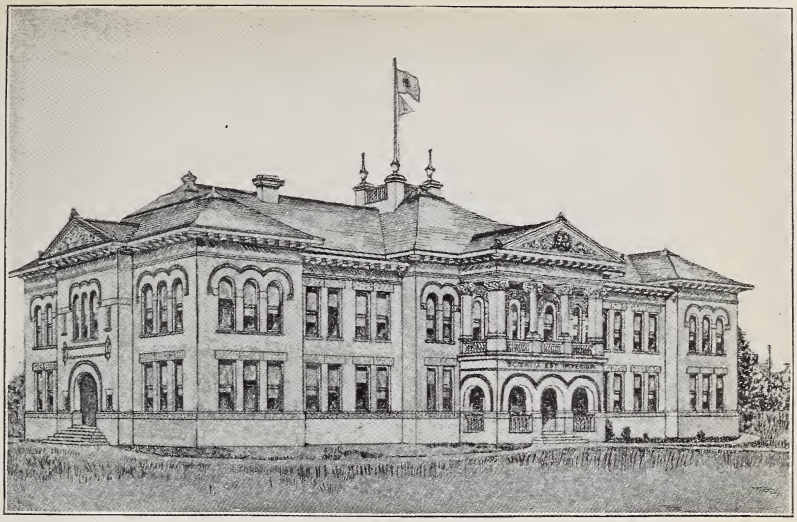


FIG. 1.—TEXAS COLLEGE AND STATION—AGRICULTURAL AND HORTICULTURAL BUILDING.

FIG. 2.—VIRGINIA COLLEGE AND STATION—BARN AND SILO.

TEXAS.

Texas Agricultural Experiment Station, College Station.

DEPARTMENT OF THE STATE AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS.

The work of the Texas Station during the past year has included variety tests with corn, sorghum, cotton, and forage plants; experiments in improving pastures; chemical and physical studies of the tobacco soils of east Texas, and of soils suited for truck gardening; studies of methods for treating and breaking down bones with sulphuric acid and similar materials; inoculation experiments for Texas fever; variety tests of orchard fruits and grapes; demonstrations in pruning the peach; studies of varieties of strawberries, blackberries, and dewberries, and experiments with onions.

Arrangements have recently been entered into with this Department for cooperative experiments with grasses and other forage plants, and four special grass and forage-plant stations are now being organized to determine the adaptability of extreme south Texas, extreme east Texas, the black lands of north Texas, and of the vicinity of the station for winter grazing, for summer grazing, and for summer meadow. During the year the station's work in cooperation with farmers and truck growers in testing field crops, forage plants, grasses, and fertilizers, and in variety and fertilizer experiments with strawberries near the coast has been greatly extended. The investigations of soils adapted for truck growing have also been much extended during the year. The important work which this station has been carrying on in cooperation with the Missouri Station in the inoculation of cattle for protection against Texas fever has been continued and extended to include much cooperative work throughout the State. In this way some 400 head of imported cattle have been treated during the past season. Cheap sheds for the protection and feeding of cattle undergoing treatment have been built at the station, and the demands for assistance are greater than the station can meet. The owners of the cattle are charged only for the cost of maintenance of their animals.

A station council has very recently been organized by the board of directors, but its duties are not yet defined. It will consist of three members—the president of the college, chairman; the director of the station, secretary; and the station chemist. There is now in process of erection for the college and station an agricultural and horticultural building (Pl. VIII, fig. 1) which is to cost $35,000. The headquarters of the station will be located in it.

The work of the Beeville substation has been continued along much the same lines as heretofore, and has included experiments in growing cabbage, cauliflower, and melons, with studies of varieties of orchard fruits and grapes. The station has met with great success in growing

cabbage and cauliflower by irrigation as winter crops, and the quality of the product shipped to Northern markets has demonstrated that large profits may be expected from such lines of vegetable culture in extreme south Texas. The work done by the Beeville substation has already greatly stimulated market gardening throughout a large area in south Texas.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	2,500.00
Miscellaneous, including balance from previous year	1,056.42
Total	18,556.42

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 51–56 and the Annual Report for 1899.

Bulletin 51, pp. 15.—Fertilizers and Fertilizer Analyses.—Text of the State law providing for the inspection of fertilizers and commercial poisons; discussions of the nature, function, valuation, and use of fertilizers; and analyses of 15 samples of fertilizing materials.

Bulletin 52, pp. 11.—Report of Beeville Station on Cabbage and Cauliflower.—Data for tests of 35 varieties of cabbage and 8 varieties of cauliflower.

Bulletin 53, pp. 54, figs. 13.—Texas Fever.—A detailed report on investigations on Texas fever carried out under the cooperation of the Texas and Missouri experiment stations and the Missouri State Board of Agriculture, involving experiments to determine whether the sterile blood serum of immune cattle would produce immunity in other cattle; experiments in immunizing cattle by tick infestation, and experiments in immunizing cattle by blood inoculation.

Bulletin 54, pp. 20, figs. 10.—The Irish Potato.—Results of variety and fertilizer tests with potatoes and of experiments in storing potatoes, comparing Northern and Southern grown potatoes for seed, and testing different-sized pieces for planting; notes on marketing potatoes and on growing a second crop of potatoes during the season; and illustrated descriptions of a potato cutter, digger, sprayer, and harrow.

Bulletin 55, pp. 84, pl. 1.—Feeding Steers.—Feed Value of Cotton Seed and its Products.—A detailed report of two feeding experiments with steers undertaken to study the value of corn meal, oats, and hay when added to a cotten-seed meal and cotton-seed hull ration, and an extended discussion of the feeding value of cotton seed and its products, the experience of the station and of a number of individual feeders being cited in detail.

Bulletin 56, pp. 70, pls. 20.—Investigation and Improvement of American Grapes.—An outline of over twenty years' work in the study

and improvement of grapes at the Munson Experiment Grounds near Denison, Tex., including a consideration in some detail of the wild or native grapes of the United States; a partial list of the varieties that have been or are growing on the Munson Experiment Grounds; an account of methods followed in the creation of new varieties by pure breeding, crossing, and hybridizing; a discussion of some of the results obtained in the twenty years of selection and hybridization; and a descriptive list of 38 varieties originated on the experiment grounds.

Annual Report, 1899, pp. 36.—A general review of the organization, equipment, and work of the station by the director; resolutions of the Texas Farmers' Congress and the Texas Live Stock Association relating to the needs and work of the station and substations; reports of the heads of departments on the various lines of station work; conclusions from experiments with corn and cotton reprinted from earlier publications of the station; financial statement for the fiscal year ended June 30, 1899; and a subject list of station publications.

Texas raises more cattle than any other State in the Union, and the station is doing all in its power to further this industry by studying forage crops and methods of improving pasture, as well as by feeding experiments. Its investigations on the prevention of Texas fever by inoculation are deserving of special mention, as the results obtained are of the greatest practical value. Various lines of horticulture are of importance and are receiving due attention. The growing of early crops for Northern markets is an infant industry especially rich in promise, and this industry the station is carefully fostering. Large areas of land in the State lie in the arid region, and this fact immediately suggests that problems of irrigation should receive considerable attention. Such work is now being carried on, and the station hopes to develop it very much in the near future.

The station has been quite successful in enlisting the interest of farmers through congresses of farmers' organizations. The summer schools in agriculture and horticulture which have been organized at the college will assist in this direction. A large number of farmers are also reached through a voluminous and growing correspondence and through press notes and bulletins.

UTAH.

Agricultural Experiment Station, Logan.

DEPARTMENT OF THE AGRICULTURAL COLLEGE OF UTAH.

The work of the Utah Station during the past year has been along the same general lines as heretofore, and has included dairying; breeding and feeding experiments with dairy cattle and sheep; feeding experiments with calves; feeding experiments with alfalfa for pigs and horses, with observations made to determine whether alfalfa affects the

amount of water drunk; digestion experiments; studies of rations for laying hens; individual records of egg production; studies of transmission of qualities with eggs from different classes of layers; comparisons of hens of different ages; comparisons of yards of different areas for hens; studies of the fertility of eggs as affected by different conditions; experiments in thinning peaches, ringing grapes, and spraying apples for the codling moth; variety tests of orchard fruits, with notes on blooming, growth, etc.; experiments in root grafting; trials of various cover crops; irrigation and other experiments with vegetables; experiments in forcing vegetables; a soil experiment with tomatoes; tests of the keeping qualities of different varieties of apples; experiments in curing alfalfa and in the repression of dodder without sacrificing the alfalfa; comparisons of various mixtures of alfalfa for grasses and pasturage, with studies of its effect on the bloating of animals; irrigation experiments to determine the water requirements of different crops; observations on evaporation; tests of varieties of wheat, oats, and barley sent out by this Department; investigations in corn culture; chemical studies of the composition of peas and barley at different stages of growth; and experiments with sugar beets.

Investigations have been continued, in cooperation with this Department, on soils and in irrigation. A main line of the station's work has been the improvement of native cows. Owing very largely to the work of the station, the number of creameries and skimming stations in the State has rapidly grown. The station follows up the returns from these and tabulates them. During the year the college has built a new greenhouse, at a cost of about $3,000, and the old house has been devoted wholly to the use of the station. During the year the president, secretary, and the director of the station resigned. The station chemist, who has been in Europe on leave of absence for study, was made director.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	3,168.96
Total	18,168.96

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 60–65 and the Annual Report for 1899.

Bulletin 60, pp. 18, figs. 10.—Poultry Experiments.—Results of feeding experiments comparing year-old hens and pullets, early and late hatched pullets, and different breeds, as well as testing the effect of exercise on egg production. The results of the present and earlier experiments are summarized.

Bulletin 61, pp. 60.—Alfalfa or Lucern.—A report on the comparative yield, composition, digestibility, and feeding value of different crops and cuttings of alfalfa as determined in experiments at the station. Analyses of different crops and cuttings of alfalfa for several years are tabulated, and two feeding tests with steers are reported on the value of alfalfa of different crops and cuttings, and comparing alfalfa with timothy hay, shredded corn fodder, red clover, and a mixture of alfalfa and straw.

Bulletin 62, pp. 46, pls. 2, figs. 12.—Tree Planting in Utah.—Descriptions and notes on the behavior of 40 species of timber and shade trees tested at the station, with diagrams showing the annual precipitation and temperature for the State, and notes on the planting and caring for the trees.

Bulletin 63, pp. 22.—Sugar Beets in Sanpete and Sevier Counties.—Results of cooperative experiments in these counties, with cultural suggestions, a discussion of factory conditions, and tabulated analyses of beets grown in the years 1897 to 1899 in Sanpete, Sevier, Utah, and Weber counties.

Bulletin 64, pp. 32, pls. 8.—Codling Moth.—A Wasp that Destroys the Apple Worm.—Sour Cherries.—The Oregon Evergreen Blackberry.—An account of spraying experiments conducted upon 20 varieties of apples for the control of the codling moth; observations on a digger wasp (*Ammophila prunosa*) observed as preying upon the larvæ of the codling moth; a discussion on the possibility and profits of sour-cherry culture in Utah, and yields and descriptions of 23 varieties growing at the station, and notes on the yields and characteristics of the Oregon evergreen blackberry, with replies to letters of inquiry from eight nurserymen regarding its history and culture.

Bulletin 65, pp. 40, pls. 6, figs. 5.—Plant Diseases and Insect Pests.—San José Scale.—A popular bulletin containing brief notes on approved methods of making insecticides and fungicides, and a brief account of some of the more common fungus and insect enemies of fruit trees.

Annual Report, 1899, pp. 45, pls. 2, figs. 2.—Contains a report of the director on the staff, buildings and equipment, publications, and lines of investigation; a subject list of all the bulletins issued by the station; departmental reports reviewing at some length the different lines of station work, and noting briefly methods and results in some cases; a financial statement for the fiscal year ended June 30, 1899; list of periodicals received by the station library; and an index to the Annual Report and the bulletins published during the year. The report of the veterinarian contains in addition brief notes on the tuberculin test, together with a general account of the use of blackleg vaccine and practical directions for preparing and applying it.

As Utah lies in the arid region, problems of irrigation, soils, and alkali are of prime importance. The work in irrigation has had to do

principally with the water requirements of various crops. Alfalfa is a crop which thrives admirably in this region, and the station's investigations of it have been extensive and comprehensive. Sugar beets are another crop of promise in the State and are receiving attention. The station is doing much to promote the interests of the growing dairy industry. The sheep interests of the State are growing very rapidly and becoming very large, hence the station is giving increased attention to this branch of animal industry. The work in poultry culture has been continued as heretofore with results of marked value.

The past year has witnessed another change in the administration of both college and station. It is due to the retiring director of the station to say that he left the station in a better condition than it had ever attained before. There must be something radically wrong in the management of a station when an officer is forced to retire at the time when his administration is proving most efficient and successful. The difficulties which this institution has had in maintaining a consistent policy of management have seriously affected its work and have prevented this Department from cooperating with it as fully as is desirable.

VERMONT.

Vermont Agricultural Experiment Station, Burlington.

DEPARTMENT OF UNIVERSITY OF VERMONT AND STATE AGRICULTURAL COLLEGE.

The work of the Vermont Station during the past year has been along the same lines as heretofore, including chemical studies of potatoes, artichokes, maple sap, and fertilizers; horticultural investigations, with special attention to the classification, pollination, and hybridization of plums; botanical investigations, especially on the diseases of potatoes, apples, and carrots; weeds, the purity of seeds, and the physiology of flow of maple sap; entomological studies, especially on the forest tent caterpillar; investigations on animal diseases, and feeding experiments with dairy cows. The work in dairying looks especially to the improvement of methods of experimentation in feeding milch cows. The horticulturist has taken up the subject of graft stocks for plums and has made some interesting experiments in combinations of stocks and grafts. The station is about to undertake nutrition investigations in cooperation with this Department, the special subject of investigation being farmers' dietaries. The station is also cooperating with this Department in studying the growth of various forest trees. The inspection of fertilizers, feeding stuffs, and creamery glassware has been continued as heretofore.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees from inspection service	2,902.06
Farm products	6,210.92
Total	24,112.98

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 68–80; Special Bulletins, October, 1899, and March, 1900, and the Annual Report for 1899.

Bulletin 68, pp. 6.—Inspection of Milk Tests and Feeding Stuffs.—Text of the Vermont laws on these subjects, with brief discussions.

Bulletins 69, pp. 11; 70, pp. 14; 71, pp. 46.—Analyses of Commercial Fertilizers.—These bulletins report results of inspection of fertilizers in Vermont during the spring of 1899, comparing the results with those obtained in previous years. Analyses of 137 brands are tabulated, and the results are discussed and summarized.

Bulletin 72, pp. 32, figs. 17.—Certain Potato Diseases and Their Remedies.—A résumé of the work done at the station in investigating certain potato diseases and their remedies from 1889 to 1899, largely revised and compiled from earlier publications of the station.

Bulletin 73, pp. 53, figs. 58.—The Trees of Vermont.—Descriptions of 97 species of native and cultivated trees, representing 18 families.

Bulletin 74, pp. 9.—The Home Fruit Garden.—Popular directions for the location, preparation of the soil, planting, and tending of the various orchard and small fruits which go to make up a home fruit garden.

Bulletin 75, pp. 12.—Check List of Hybrid Plums.—A list of 65 varieties, with the following data respecting each: Name, original publication of the same, Vermont publications concerning it, certain facts relative to its origin and introduction, and its parentage.

Bulletin 76, pp. 27, figs. 13.—The Forest Caterpillar.—A description of the forest tent caterpillar in its various stages, with notes on its feeding habits, life history, and natural enemies; an account of the ravages of this insect in Vermont; and a discussion of remedial measures.

Bulletin 77, pp. 22.—Analyses of Commercial Fertilizers.—Includes analyses and valuations of 39 samples of fertilizers, with tables showing the average composition of all fertilizers examined by the station during the past five years.

Bulletin 78, pp. 22, fig. 1.—Analyses of Commercial Feeding Stuffs.—Tabulated analyses of 265 samples of commercial feeding stuffs, with a discussion of the results of inspection.

Bulletins 79, pp. 10; 80, pp. 45.—Analyses of Commercial Fertilizers.—Tabulated analyses of 132 brands of fertilizers, including 39 previously reported, with a discussion of the valuation and selling price of fertilizers, the usefulness of a fertilizer control, sources from which plant food is derived, availability of organic nitrogen, and the selection and purchase of fertilizers.

Special Bulletin, October, 1899, pp. 4.—Sampling Milk and Cream.—Detailed directions are given.

Special Bulletin, March, 1900, pp. 4.—Spray Calendar.—Directions for preparing and applying insecticides and fungicides for controlling the more common insects and fungus diseases.

Annual Report, 1899, pp. 236, pls. 3, figs. 7, maps 3, dgm. 1.—This includes the organization list of the station; a financial report for the fiscal year ended June 30, 1899; a report of the director reviewing at some length the work and publications of the station during the year; abstracts of Bulletins 60–71 of the station; and departmental reports, including: Results of tests of the alkaline permanganate method for determining the availability of organic nitrogen in fertilizers; text of the Vermont law regulating the sale of concentrated feeding stuffs and analyses of a number of samples made in compliance with this law; text of the Vermont law relating to testing milk and cream at dividend-making creameries and cheese factories and the results of the operation of the law; tabulated analyses of a number of samples of drinking water, sugar beets, insecticides, and fertilizing materials; an account of observations and experiments made on potato diseases and their control in 1898; results of experiments in spraying for the prevention of apple scab; results of an investigation of the brown spot of the Baldwin apple, with a review of the literature relating to this disease; a second partial list of the parasitic fungi of Vermont; a report on tests of a number of chemicals for killing weeds; a report on a series of experiments in the pollination of plums, including a list of pollenizers recommended for the different varieties, notes on insects and pollination, and the results of an investigation of the cause of the phenomenon known as June drop; a discussion of the older and the more modern types of European plums, with a classification of present-day types; a second report on hybrid plums, giving the parentage of 18 known hybrids and notes on 39 hybrid varieties; a discussion of the variation of native American species of Prunus, which occurs in different sections of the country; notes relating to history, culture, etc., on 18 varieties of cherries; details and results of experiments made to compare various rations and to test different feeding stuffs for dairy cows to determine the effect of feeding liquid fat to cows, to compare methods of watering cows, to test the effect of grooming on production, and to determine the extent of experimental error in feeding tests; results of a study of the effect of various concentrated feeding stuffs upon the quality of butter; a record of the station herd of 42 cows for the year ended October 31, 1898; notes on a number of forage crops; and observations on the effect of fatigue upon the quantity and quality of milk.

The most important agricultural product of Vermont commercially is butter, and dairying is a prominent line of investigation at the sta-

tion. Vermont produces more maple sugar than any other State in the Union, and the subject of maple-sugar production is being scientifically investigated. The most important horticultural crop is apples, which is being investigated both as to certain points in cultural practice and especially as to the nature and treatment of certain diseases that are very destructive locally. Potatoes are a money crop of importance, the station's investigations of the diseases of which are well known. The investigations of the horticulturist on plums are of general importance. The station continues its well-established policy of concentrating its efforts on a few lines. The officers of the station render frequent assistance at farmers' institutes. A relatively large amount of experimental work is being done and the affairs of the station are in good condition.

VIRGINIA.

Virginia Agricultural and Mechanical College Experiment Station, Blacksburg.

DEPARTMENT OF VIRGINIA AGRICULTURAL AND MECHANICAL COLLEGE.

The work of the Virginia Station during the past year has been along much the same lines as heretofore, and has included a systematic chemical examination of the various cattle foods sold in the State; studies of animal parasites, especially cattle ticks; feeding experiments with silage and the common feeding stuffs of the State; systematic studies of certain of the Papilionaceæ; chemical and factory investigations in the manufacture of vinegar and studies of conditions controlling fermentation; investigations in the utilization of unmerchantable fruits for the manufacture of jellies, jams, cider, and vinegar, and studies of fungicides and insecticides.

During the year the horticulturist has published a series of bulletins dealing with the technique of apple growing in Virginia, and treating the subject comprehensively from various standpoints. During the year the college with which the station is connected has erected a general-purpose barn (Pl. VIII, fig. 2) and a machinery barn, and is now building a feed barn with abattoir for experimental purposes. It has also purchased several thousand dollars' worth of improved stock. The horticulturist continues the inspection for insect pests under State laws. The veterinarian continues to devote a large share of his time to the manufacture and distribution of blackleg vaccine under State laws.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Local communities	161.11
Farm products	3,886.57
Total	19,047.68

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 88–102 and the Annual Report for 1899.

Bulletin 88, pp. 11.—Growing Forest Tree Seedlings.—A report on cooperative experiments undertaken in connection with this Department to study the effect of climate on several species of forest trees grown from seeds collected from different parts of the country. The more important data concerning the growth of the different species tested are given in tabular form.

Bulletin 89, pp. 9.—Equine Distemper.—A brief account of the history, etiology, symptoms, course, pathological anatomy, and treatment of horse distemper.

Bulletin 90, pp. 11, figs. 2.—Blackleg Vaccine.—Directions for the preparation and use of blackleg vaccine.

Bulletin 91, pp. 14.—Variety Tests of Strawberries.—Tabulated data for tests of 91 varieties of strawberries, with descriptive notes on each variety.

Bulletin 92, pp. 12.—The Influence of Commercial Fertilizers upon the Quality of the Irish Potato.—A report of investigations extending over a period of three years, made to determine the effect of different amounts and combinations of commercial fertilizers upon the quality of potatoes, and also to observe in what manner the amount of plant food taken up by potatoes is affected by fertilizers. The yield and composition of the potatoes grown in the experiments are shown in tabular form and the results are discussed.

Bulletin 93, pp. 6, dgms. 3.—Tests of Fertilizers on Wheat.—Results obtained in 1899 in fertilizer experiments with wheat begun in 1896, with a comparison of the results with those obtained in previous years.

Bulletin 94, pp. 25, figs. 6.—The Experimental Vineyard—Second Report.—This discusses the establishment, planting, and training of young vineyards, especially for home use, and gives descriptive notes on 39 varieties of black grapes, 28 of red, and 44 of white grapes growing at the station.

Bulletin 95, pp. 7.—Bovine Distemper.—A brief account of the history, etiology, symptoms, course, pathology, prognosis, and treatment of bovine distemper.

Bulletin 96, pp. 6.—Experiments with Chickens.—Brief statements concerning the breeds and crosses of chickens raised at the station.

Bulletin 97, pp. 20.—The Nature and Use of Certain Insecticides.—Notes on the different insecticides and their methods of application, and the results of experiments in spraying potatoes with various arsenical poisons, in spraying fruit trees with pure kerosene and with a

kerosene and water mixture, and in testing different insecticides for combating the pea louse, with brief notes on this insect.

Bulletin 98, pp. 23, map 1.—Orchard Technique: I. The Fruit Soils of Virginia. II. Fruit List for Virginia.—A discussion of the fruit soils of the State, which are divided for this purpose into six natural divisions, namely, tidewater, middle Virginia, Piedmont, the Blue Ridge section, the valley, and Appalachia; and a list of orchard and small fruits and grapes recommended for planting in the State.

Bulletin 99, pp. 27, figs. 12.—Orchard Technique: III. Growing the Apple Orchard.—Detailed popular directions for laying out apple orchards, selecting nursery stock, planting trees, pruning, cultivating, etc.

Bulletin 100, pp. 22, figs. 10.—Orchard Technique: IV. Spraying the Orchard.—Results of experiments in spraying old and young apple orchards; directions for preparing the more important fungicides and insecticides, with notes on spraying apparatus, and a short account of the fire blight of the pear.

Bulletin 101, pp. 19, map 1.—Orchard Technique: V. Apple Production in Virginia.—Statistical data obtained in cooperation with the traffic managers of Virginia railroads in regard to the production of apples in the different sections of the State.

Bulletin 102, pp. 24, map 1.—The Crop Pest Law.—This contains the text of the State law creating a State board of crop pest commissioners, and the rules and regulations of the board for the prevention of the spread of injurious insects and plant diseases within the State, with reprints of portions of Bulletin 79 of the station and of the latest report of the State inspector.

Annual Report, 1899, pp. 14.—The organization list of the station, a brief report of the director summarizing Bulletins 77–88 of the station, a financial statement for the fiscal year ended June 30, 1899, a summary of meteorological observations, and brief outlines of the work of the different departments.

The leading lines of investigation at the Virginia Station are those in the interest of the apple-growing industry, in which the State ranks second only to New York among the States of the Atlantic seaboard. The usual cultural investigations have been made and now the work is being developed along a different and somewhat novel line. This is the utilization of unmerchantable apples, from which ordinarily very little is realized. This is an interesting line of investigation and promises valuable results. The cultural investigations included among others an extended study of the adaptability of the various soils of the State for apple growing, and this work might now well be developed into a general agricultural and soil survey in cooperation with this Department. Another line of work at the station deserving especial mention is the feeding experiments recently begun. The prosecution of these systematically and on a sufficiently extended scale has

been rendered possible by the recent extensive additions to the college equipment, of which the station has free use. This station is now in a better position than ever before to develop its work for the general benefit of the agricultural interests of the entire State, if provided with funds which would enable it to extend its operations into different localities where diverse agricultural conditions require investigations of a special character.

WASHINGTON.

Washington Agricultural Experiment Station, Pullman.

DEPARTMENT OF WASHINGTON AGRICULTURAL COLLEGE AND SCHOOL OF SCIENCE.

The work of the Washington Station during the past year has been along much the same lines as heretofore, and has included studies of grasses and cereals, emphasizing especially work in plant breeding; feeding experiments with cattle and pigs; breeding experiments with pigs; studies of glanders, diseases of the teeth of horses, and blackleg; studies of plants supposedly poisonous; experiments in the destruction of spermophiles by infectious diseases; studies of crown mold, apple scab, etc.; chemical studies of alkali and other soils, Paris green, and grasses and forage plants, and entomology, with special reference to the codling moth.

The engineering department of the college with which the station is connected is cooperating with this Department in irrigation investigations. The agriculturist has devised tables for calculating errors in the testing of cream and an ingenious machine for calculating rations. The entomologist has discovered and described a new insect pest of the sugar beet and recommended methods of treatment. The chemist continues to make some analyses of fertilizers and dairy and food products under State law. A new science hall has been erected for the use of the college and station with a State appropriation of $60,000. The substation at Puyallup is managed as heretofore with a State appropriation. The State continues to maintain the oyster-culture station on Puget Sound, and the station entomologist and biologist has conducted investigations there. He has been quite successful in propagating Eastern oysters on a small scale.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
State appropriation	4,164.16
Miscellaneous	552.22
Total	19,716.38

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department and has been approved.

The publications of this station received during the past fiscal year were Bulletins 37–42 and the Annual Reports for 1897 and 1898.

Bulletin 37, pp. 14, map 1.—The Present Status of the Russian Thistle in Washington.—Observations on the distribution of the Russian thistle throughout the State, notes on the damage caused by the Russian thistle, and a discussion of the possibility and cost of eradicating this weed.

Bulletin 38, pp. 44, figs. 11.—Prunes.—A brief discussion of cultural methods in common use; notes on the Italian, French, and Silver varieties of prunes; an extended account of the preparation of fruit for market, and brief notes on a number of insects and diseases affecting the prune.

Bulletin 39, pp. 33, figs. 21.—The Improvement of Country Roads.—A general discussion of this subject, especially as applied to Washington conditions.

Bulletin 40, pp. 32.—Fertilizers.—A general discussion of the principles underlying the use of fertilizers and of the sources and composition of fertilizers, with the text of the State fertilizer law.

Bulletin 41, pp. 60, figs. 10, map 1.—Forage Plants in Washington.—A discussion of the climatic divisions of the State, including notes on the wheat growing, grazing, and alfalfa sections; notes on leguminous plants, grasses, and other forage crops adapted to the State; a classification of farm crops, with special reference to the different sections of the State; suggestions with regard to the seeding and management of pastures and meadows, and a rainfall map of the State.

Bulletin 42, pp. 14, figs. 5.—A New Sugar Beet Pest, and Other Insects Attacking the Beet.—An account of the appearance, life history, habits, etc., of a plant louse described as new under the name *Pemphigus betæ*, with suggestions as to remedies, and notes on flea beetles and cutworms.

Annual Report, 1897, pp. 8.—Includes the organization list of the station, a brief review of station work by the director, and a financial statement for the fiscal year ended June 30, 1897.

Annual Report, 1898, pp. 8.—Contains the organization list, a brief report by the director reviewing the station work for the year, and a financial statement for the fiscal year ended June 30, 1898.

From the financial point of view, the most important agricultural products of Washington are the staple field crops, and these are receiving a due amount of attention from the station. A large amount of useful work has already been done on problems relating to grasses and forage plants, and it is planned to further develop this work in cooperation with this Department. The investigations of the station on sugar beets have led to the establishment of a beet-sugar factory, which this year is making a considerable amount of sugar from beets of high quality. Some work is also being done in the interests of the live-stock industry along the lines of feeding and breeding experiments and investigations of certain diseases. A portion of the eastern

part of the State lies in the arid region, and hence problems of alkali, soils, and irrigation are of importance and are receiving attention. The problem of dealing with the codling moth is not the same in details as in the Eastern States; hence the entomologist's investigations of this insect with reference to the conditions on the Pacific coast.

The college and station are conducting farmers' institutes as heretofore, but need the assistance of State funds. The new Science Hall gives ample room for most of the scientific departments of the college and station, and as the station laboratories are separate in this building, the station will have much better facilities for its work. The college with which the station is connected is growing in strength and number of students. The agricultural interests of the State are also rapidly developing. It is hoped, therefore, that on the good foundation already laid the agricultural department will soon be further developed by the better equipment of the farm, with special reference to work in animal husbandry, and the consequent differentiation of college and station management and operations.

WEST VIRGINIA.

West Virginia Agricultural Experiment Station, Morgantown.

DEPARTMENT OF THE WEST VIRGINIA UNIVERSITY.

The work of the West Virginia Station during the past year has been along the same lines as heretofore, and has included entomological investigations, especially on insects in their relation to forests and forest products, and on the repression of insects injurious to fruits and general farm crops; chemical analyses of forage crops, sugar beets, grains, and fruits; chemical analyses of the soils of the State, accompanied by pot experiments; field experiments with grasses, forage and grain crops, sugar beets, and vegetables; fertilizer experiments; feeding experiments with sheep; feeding experiments with poultry with reference to the economic production of meat and eggs; studies of the relative effects of nitrogenous and nonnitrogenous foods on the fecundity and yield of eggs; studies of the different kinds of incubators; investigations of the principles underlying artificial incubations; experiments looking to the discovery of an economic means for preserving eggs; spraying experiments, chiefly for San José scale, codling moth, apple scab, brown rot, and bitter rot; tests of new or little-known insecticides and fungicides and of novel combinations of the same; cultural tests; experiments in breeding roses and carnations; studies of the influence of incandescent gaslight on greenhouse crops; field experiments with a variety of horticultural crops; comparisons of fertilizers for renovating old orchards; fertilizer experiments on young peach orchards; investigations on the food requirements of celery, cabbage, and onions on mountain-glade lands, and experiments in the repression of the woolly aphis.

Experiments in the preservation of perishable food stuffs by subjecting them to hydraulic pressure have been continued, and give still greater promise of results of practical value. The spraying experiments are being carried on in orchards of persons largely interested in fruit growing. The details of the work serve both an experimental and an educational end, and are proving very popular. The station has continued the fertilizer inspection as heretofore.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Fees	5,718.31
Farm products	114.95
Miscellaneous	1,274.00
Total	22,107.26

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 56–65.

Bulletin 56, pp. 269, figs. 99.—Report on Investigations to Determine the Cause of Unhealthy Conditions of the Spruce and Pine from 1880 to 1893.—This report contains an account of the author's investigations upon the destructive pine-bark beetle as the chief enemy of spruce and pine in West Virginia, together with notes on a trip to Europe for the purpose of collecting living specimens of the European bark-beetle destroyer (*Clerus formicarius*) for introduction into America, and an appendix giving a list of 197 species of insects taken from spruce and pine during the years 1890 to 1898.

Bulletin 57, pp. 12.—Commercial Fertilizers.—A schedule of trade values of fertilizing materials and tabulated analyses and valuations of 149 samples of fertilizers.

Bulletin 58, pp. 24, figs. 6.—The Effect of Pressure in the Preservation of Milk.—This is a preliminary report on investigations to determine the effect of pressure in the preservation of milk, and contains the details and results of a large number of experiments.

Bulletin 59, pp. 11.—Whole Corn Compared with Corn Meal for Fattening Hogs.—An account of a test with 9 pigs to compare whole corn with corn meal, and of a test with 12 pigs to compare whole corn soaked in water until soft with corn meal mixed with water.

Bulletin 60, pp. 20.—Poultry Experiments.—An account of experiments conducted during two years to test the effect of nitrogenous and carbonaceous rations for laying hens, floored *v.* unfloored poultry houses, and the effect of age of fowls upon egg production.

Bulletin 61, pp. 12.—Sheep Feeding Experiments.—An account of

an experiment with 25 lambs to test the profitability of winter fattening of lambs, and notes on a second experiment with 60 lambs, which was discontinued.

Bulletin 62, pp. 37, pls. 9, figs. 4, charts 7.—A Study of the Effect of Incandescent Gaslight on Plant Growth.—This bulletin reports the results obtained in a series of greenhouse experiments carried on during the years 1895 to 1899 with lettuce, radishes, spinach, tomatoes, sugar beets, and seedling cabbage, mainly from an economic standpoint. Plans of the greenhouse used and photographic, diagrammatic, and auxanometer records of the growth and development of the different crops form an important part of the bulletin.

Bulletin 63, pp. 40.—Commercial Fertilizers.—Text of the State fertilizer law, statistics of the value and of the consumption of fertilizers in West Virginia during the last five years, and analyses and valuations of 204 brands of fertilizers.

Bulletin 64, pp. 26, map 1.—Sugar Beet Investigations in 1899.—A report on experiments with sugar beets at the station, involving a study of the influence of different fertilizers and of lime upon the sugar content and purity of juice, different dates of planting and harvesting, and tests of varieties, and of cooperative culture experiments carried on with farmers throughout the State, including tabulated analyses of 155 samples of sugar beets.

Bulletin 65, pp. 18.—Commercial Fertilizers.—A schedule of trade values of fertilizing materials, text of the State fertilizer law, and analyses and valuations of 140 samples of fertilizers.

West Virginia offers an inviting field for the horticulturist, but until quite recently the possibilities of the State have been but little developed. The station is now doing all in its power to aid in this development by field and laboratory investigations at the station and by cooperative experiments at various points in the State. In the latter way the station has come into very cordial relations with the fruit growers about the State, and is using their orchards quite largely for experimental purposes. The forestry interests of the State are very important, and are receiving attention at the hands of the station along the unique line of investigation of insects injurious to forests or forest products. These investigations have already yielded results of great practical value. The investigations on the preservation of perishable food products, including eggs, are of general importance.

The purchase of the new station farm, which has already been reported, has rendered possible the organization of field and feeding experiments on a larger scale and along more satisfactory lines. Station officers have attended a number of farmers' institutes. On the whole, the condition of the West Virginia Station has very materially improved, and there are many evidences of the utility of its work. Its influence is broadening, especially among the fruit growers, and the less conservative farmers are following its teaching.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin, Madison.

DEPARTMENT OF THE UNIVERSITY OF WISCONSIN.

The work of the Wisconsin Station during the past year has been along the same lines as heretofore, and has included investigations on the relation of galactase to cheese ripening, especially with foreign types of cheese; investigations on the influence of rennet on the ripening of cheese; investigations upon causes operative in silage production; work on a new standard for pasteurization of milk; tests of dairy cows; comparisons of turbine milk testers on the market; sugar-beet investigations; analyses of commercial fertilizers; investigations of the characteristic differences in the composition of milk of different breeds of cattle; feeding experiments with dairy cows; studies of types of cows for milk and butter-fat production; studies of the needs of dairy cows for salt; studies of soiling crops peculiarly adapted to dairy farming; feeding experiments with lambs; comparisons of various fodders for breeding ewes in winter; studies of types of breeding ewes; feeding experiments with pigs; comparisons of wide and narrow rations for pigs; comparisons of rape and grain for growing pigs; breeding experiments with pigs; investigation on the influence of a high temperature (212° F.) on tests of skim milk by the Babcock method; the estimation of fat in sweetened condensed milk by the Babcock test; comparisons of various makes of churns; studies in the calculation of dividends for milk and for cream at the same factory; experiments with a modified Pott's pasteurizer as a cream-ripening vat; tests of dairy herds; investigations of the Wisconsin curd test and of the influence which the coating of cheese with different substances has on the outside molding of cheese during the curing process; investigations of certain unfertile marsh soils of the State; experiments in grinding feed on the farm with small engines and with wind power; a study of the unavoidable losses of silage in silos, and the best method of construction of silos and handling of silage to reduce these losses to a minimum; a study of the development of nitric nitrogen and of soluble salts in field soils under crop conditions; studies of the relations of soil moisture to crop production; irrigation experiments; experiments in pinching raspberry shoots at different heights; experiments with seed gathered at different stages of maturity; experiments in the prevention of apple blight; investigations on the development of flower buds and flowers in certain fruit plants; investigations on the cumulative effect of cutting seed potatoes upon the vigor of the plants; tests of the varieties and the growing of seedlings of the native plum; investigations on the duration of growth period in fruit trees, both of roots and of stems; investigations to determine the amount of variation in strawberry

plants of the same variety, and the extent to which these variations are hereditary; investigations on the effect of light on the formation of stamens in the strawberry; investigations on the interdependence of roots and branches; investigations on an outbreak of anthrax and on the cause and treatment of scours in calves; investigations on the process of rumination in cattle and sheep; and an inquiry into the cause of calculi in the bladder and urethra in rams and wethers.

The investigations of the station on the influence of rennet on the ripening of cheese have led to the conclusion that the increase in rate of digestion of cheese, where varying quantities of rennet were added, is solely attributable to the pepsin normally contained in commercial rennet extracts. The work upon the causes operative in silage production has shown that the generally accepted bacterial theory of silage formation is untenable, and it has been determined that the causes operative in the production of good silage are inherent in the plant itself, and that bacteria and other extracellular ferments act only in an injurious manner. Work on the new standard for pasteurization of milk has been completed by a determination of the thermal death point of the tubercle bacilli of diverse bovine origin when grown in milk and exposed to heat in this medium. It has been shown, by using a method suggested by the station, that the destruction of the germ may be safely accomplished at 140° F. in a period of from fifteen to twenty minutes. This method does away with the use of "viscogen," and also removes the only valid objection ever urged against pasteurized products. The tests of private dairy herds conducted by the station have met with great popular favor, the bulletin in which original publication of the work was made (No. 75) having passed through two editions, besides an edition of 10,000 copies printed privately by a creamery company for distribution among its patrons. The dairy plant of the college and station is being enlarged, at a cost of about $7,000 by an extension to the building, which will contain a room for experiments in cheese curing, especially foreign cheese. A central heating plant for the buildings connected with the agricultural college and experiment station has been erected at a cost of $17,000. In this building two floors will be devoted to dairy machinery, the intention being to teach students the practical management of engines, and the doing of plumbing necessary in creameries and cheese factories. An arrangement has recently been made for irrigation experiments in the northern part of the State in cooperation with this Department.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000
State appropriation	14,000
Fees	125
Total	29,125

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 74–83, and the Annual Report for 1899.

Bulletin 74, pp. 45, pls. 5, fig. 1.—A Study of Dairy Salt.—This bulletin presents in tabular form chemical and mechanical analyses of 81 samples of dairy salt, with a discussion of the data; gives the results of a number of experiments in salting butter; outlines the methods of manufacture and discusses the comparative value of 5 leading brands of dairy salt; and discusses, among other topics, the production of dairy salt, ideal butter salt, the use of salt in butter making, composition of salted and unsalted butter, salt as a butter preservative and as a flavor producer, and the use of salt in cheese making.

Bulletin 75, pp. 30, pls. 8, fig. 1.—Testing Cows at the Farm.—A detailed account of farm tests extending through one year of 6 dairy herds supplying milk to the university creamery, with a discussion of the data as regards variations in the test of milk, most profitable month for fresh cows, how often should cows be tested, etc.

Bulletin 76, pp. 53, figs. 39.—Noxious Weeds of Wisconsin.—Text of the Wisconsin weed law and descriptions and methods of eradication of 18 weeds.

Bulletin 77, pp. 18, figs. 2.—Effects of the February Freeze of 1899 upon Nurseries and Fruit Plantations in the Northwest.—An account of the injury to fruit trees and nursery stock by freezing, as observed at the station, and as reported by over one hundred correspondents, with suggestions based on the results.

Bulletin 78, pp. 16, figs. 7.—The History of a Tuberculous Herd of Cows.—An account of an outbreak of tuberculosis in a private herd, and of experiments made by the station on this herd from 1896 to 1899 in the application of Bang's weeding-out process.

Bulletin 79, pp. 48, figs. 28.—Principles of Construction and Maintenance of Country Roads.—A general discussion of this subject as illustrated mainly in the construction of a section of a model road near Menominee, Wis., under the supervision of a special agent of the Office of Road Inquiry of this Department.

Bulletin 80, pp. 39, figs. 14.—The Character and Treatment of Swamp or Humus Soil.—A description of the extent and character of swamp or humus soils in Wisconsin, and a report of experiments on their management, including a study of the influence of a large number of different fertilizing materials—clay, sand, drainage, etc.—on humus soil, as shown by the growth of corn in plant house and field tests.

Bulletin 81, pp. 10.—Analyses of Licensed Commercial Fertilizers, 1900.—Text of the State fertilizer law and analyses with explanatory notes of 7 samples of fertilizers.

Bulletin 82, pp. 37, figs. 24.—Experiments in Grinding with Small Steel Feed Mills.—A record of the results of something over 400 tests "to determine the rate at which feed for stock on the farm may be ground with several of the types of small steel mills now on the market; the power required to run them, and the approximate cost of grinding."

Bulletin 83, pp. 68, figs. 28.—Silage, and the Construction of Modern Silos.—This bulletin discusses the value of silage as a feeding stuff; the essential conditions for preserving silage; the details of construction, cost, and efficiency of silos of different kinds; the selection and culture of crops suitable for ensiling; the preparation of silage, and the losses which occur in the preparation and feeding of silage.

Annual Report, 1899, pp. 332, figs. 79.—In addition to the organization list, a detailed account of the history and present status of the station, lists of exchanges and acknowledgments, and a financial statement for the fiscal year ended June 30, 1899, the following work is reported in greater or less detail: Tests to compare whole and ground corn for fattening pigs, and rape and clover for young growing pigs; a test with 4 pigs to determine the amount of food required at different weights for maintenance and for growth; a test with 2 lots of 17 lambs each to compare ground corn and ground peas for lambs before and after weaning; an experiment with 8 cows, lasting three months, made to study the proportion of grain feed to coarse fodder best adapted for the economical production of milk and butter; a record of a dairy herd of 18 cows, purchased for the purpose of comparing the cost of the milk and butter production of cows of the special-purpose dairy type, represented by Jersey and Guernsey grades, and cows of the dual-purpose type, represented by Shorthorn grades; a test with 8 cows, to study the effect of the constant changing of milkers; an experiment to determine the protection from flies afforded cows by stabling, with a brief account of two species of flies troublesome to cattle; a study of the effect of salt on the water content of butter, including a number of experiments; a study of dairy salt, reprinted in an abridged form from Bulletin 74 of the station; tests made to demonstrate the cause of white spots entirely unlike mottles or white curd spots appearing on the surface of butter; a discussion of methods and advantages of pasteurizing skim milk at creameries, and a description of a device for heating skim milk by means of exhaust steam; studies on pasteurization of milk and cream at 140° F., with a discussion of the conditions of efficient pasteurization, thermal death point of the tubercle bacillus, and the cause of diminished consistency of pasteurized products; official tests, made by representatives of the station, of 82 cows; trials of coating cheese with paraffin for the prevention of mold; description of a pipette designed for taking composite milk samples; extended investigations on the action of proteolytic ferments on milk, conducted

especially to differentiate galactase from trypsin and other ferments; tests of the influence of galactase in the ripening of cottage cheese; a comparative study of a long list of reagents for separating the nitrogenous compounds of milk and their decomposition products into distinct groups, with notes on the Kjeldahl method for nitrogen determination; experiments conducted to determine if losses occurring in the manufacture of cheese from tainted milks are due to the digestion of the casein of the milk by bacteria; a study of the effect of different influences on the normal temperature of cattle and the relation of same to the tuberculin test; a test of Thörner's method for the examination of milk for tubercle bacilli; a study of the influence of the right amount and right distribution of water in crop production, including culture and irrigation experiments with a number of crops; observations on the rate of percolation from saturated sandy loam and clay loam soil and on loss of water by evaporation from similar soils, mulched and not mulched; an extended investigation on the influence of tillage on the soluble salt content of soils; a summary of investigations on the treatment of swamp or humus soils, reported in Bulletin 80 of the station; tests of several varieties of grains; investigations on sugar beets in 1898, reported in Bulletin 71 of the station; fertilizer inspection during 1899, with analyses of five fertilizers; analyses of sow's milk and of several feeding stuffs; experiments made to ascertain to what extent the pinching of the tips of raspberry shoots promotes productiveness and increases the size of fruit; a study of the comparative hardiness of flower buds in the cherry; an investigation to ascertain the time of origin and the rate of development in the flowers of 4 of the most common fruit trees; the influence of heredity upon vigor in the potato; tests of methods of preserving fruits for exhibition purposes; and tests to determine the effect of transplanting on time of maturity.

The Wisconsin Station is not attempting at the present time to cover the entire field of agricultural endeavor as found in the State. It rather continues to adhere to its well-established policy of restricting its efforts to a few lines of original and scientific investigations of immediate practical importance to the State. These lines at present are dairying, including dairy bacteriology, animal husbandry, agricultural physics, and horticulture. Work in veterinary science has very recently been undertaken.

It is the policy of the college, of which this station is a department, to use its strongest and best-paid men in research work, requiring them to give only a quite limited amount of instruction to agricultural students. The station has also been able to increase the results of its work by combining in many cases the efforts of two or three officers in a single line of work. The results of this policy have demonstrated its wisdom. The success of the Wisconsin Station, from both scientific and practical standpoints, has been very great. Not only have its

investigations greatly benefited the agriculture of its own State, but they have yielded results of much general value to the agriculture of this and other countries. They have demonstrated that original research of a high order, wisely planned, and thoroughly executed will secure the widest practical results. Without doubt, the combination of effort under a strong and compact organization has been a large factor in the successful work of this station.

The State continues to supplement the national funds given to this station and to print its reports and bulletins without charge. The farmers' institute work connected with the university is being successfully conducted as heretofore. Very effective work continues to be done by the dairy school connected with the college of agriculture. Nearly 1,000 men have here received training in the theory and practice of butter and cheese-making and the mangement of dairies, creameries, and cheese factories. The school keeps in close touch with its former students by correspondence, and has had great success in securing good positions for them in Wisconsin and other States. The recent additions to the equipment of this school will materially enhance its facilities for thorough training in dairying.

One strong element in the success of the Wisconsin Station has been its concentration of effort on a few main lines of investigation. It has now so far perfected its organization that it is believed it may safely extend its operations into some new lines, provided the State will supply the necessary funds. There is much demand for investigations relating to the poultry industry, and without doubt the station might easily be put in position to do effective work in this line. It needs also to develop its studies of the staple crops and to have the means to engage more actively in the general movement in this country to better these crops by the introduction and dissemination of improved varieties, and more especially by the breeding of varieties especially adapted to particular localities. The State and National governments may properly aid this work in Wisconsin by providing means for the cooperation of the station and this Department in this important enterprise.

WYOMING.

Wyoming Agricultural Experiment Station, Laramie.

DEPARTMENT OF THE UNIVERSITY OF WYOMING.

The work of the Wyoming Station during the past year has been along the same lines as heretofore, and has included experiments in subsoiling; studies of alfalfa as a hay crop and as a fertilizer; water measurements; variety tests with various field crops, especially wheat, oats, and barley; experiments with forage plants; studies on the germination of wheat and oats treated for smut; studies on the growth of

economic plants on alkali soil; laboratory investigations of the comparative effects of sodium and potassium sulphates and chlorids on seed germination and plant growth when the salts are present in strengths represented by equal osmotic pressures; fertilizer experiments with potatoes with especial reference to the comparative values of potassium chlorid and sulphate, sodium nitrate, and barnyard manure; breeding of potatoes; experiments with hardy fruits and with celery; chemical investigations of the effect of alkali on plant life; analyses of the water of the Laramie River to determine the increase in alkali content and accumulation of silt by the passage of the river through the Laramie plains; investigations on the origin and geological occurrence of alkali in the State; studies of wind erosion and its relation to soil making; meteorological observations; studies of the movements of alkali in soils; observations on evaporation from the surface of soils; studies of the effects of mulching the soil to various depths on the evaporation of moisture; and studies of terrestrial radiation of sunshine.

The chemical investigations on the effect of alkali on plant life have shown that an important factor in the retardation of the germination of seed caused by alkali was the osmotic pressure of the solution of salts in the soil, and that osmotic pressure has the same effect on growing plants. The station has found that Dwarf Essex rape succeeds admirably on strong alkali land, and this plant is rapidly coming into favor in many sections as a stock food, principally for pasturing. Experiments relating to the introduction of improved varieties of cereals and forage plants are being made in cooperation with this department. The botanist spent the summer vacation of 1899 in Yellowstone National Park, and made the most extensive collection of native plants ever gathered in that region. The native fungi have also been under investigation for several years, and the collections thus far made give a fair idea of what parasitic forms flourish under the climatic conditions of the State. For four summers the geologist has been investigating the artesian basins of the State, as a result of which a large and well-illustrated bulletin has been issued, accompanied by a geological map. The same officer has also been studying and collecting the native birds of the State. Measurements of water at various points have been continued in cooperation with this Department. During the year the agriculturist completed a design for a special water register which records the actual depth of water flowing over a weir. The time is recorded on a cylinder turned by clockwork. During the year the station farm has been increased in area and a number of improvements have been made on it and on the station buildings. A new building for mechanic arts is being erected at a cost of $35,000. It will give quarters to some of the scientific departments and will incidentally improve the facilities of the station. At the end

of the fiscal year, the vice-director and agriculturist resigned and was succeeded by the former director of the Utah Station.

The income of the station during the past fiscal year was as follows:

United States appropriation	$15,000.00
Farm products	340.35
Total	15,340.35

A report of the receipts and expenditures for the United States fund has been rendered in accordance with the schedules prescribed by this Department, and has been approved.

The publications of this station received during the past fiscal year were Bulletins 41–44 and the Annual Report for 1899.

Bulletin 41, pp. 21, figs. 4.—Some Experiments with Subsoiling.—The results of experiments in subsoiling for cereals and root crops, as a means of conserving the irrigation water applied, are reported for 3 years of work at the home station, 2 years at the Sheridan substation, and 1 year each at the Wheatland and Sundance substations.

Bulletin 42, pp. 24, figs. 12.—Some Native Forage Plants for Alkali Soils.—A discussion of the forage areas of Wyoming and descriptions with notes of native plants found upon the alkali plains, the object of the bulletin being to point out the more valuable plants and to suggest measures for increasing their yield.

Bulletin 43, pp. 46, pls. 5.—Alfalfa as a Hay Crop.—Results are reported of investigations at the station and elsewhere in the State on the culture of common and Turkestan alfalfa. The growth of alfalfa on alkali soils and the irrigation of alfalfa are discussed and some figures given bearing on these two factors in alfalfa growing in the State.

Bulletin 44, pp. 17, pls. 2.—Alfalfa as a Fertilizer.—This bulletin discusses briefly the fertilizer requirements of soils of arid regions, especially of Wyoming, and the value of alfalfa for increasing the nitrogen of the soil, improving the tilth, and destroying weeds; and gives the history of an acre plat of soil on the Laramie Plains, one-half of which had been in alfalfa since 1893, and the other half in other crops.

Annual Report, 1899, pp. 225, pls. 13, figs, 27, dgms. 10.—This contains notes on the origin and purpose of the station; a brief summary of bulletins issued during the year; an outline plan of station work; a financial statement for the fiscal year ended June 30, 1899; reports of the director and heads of departments reviewing the different lines of station work; a detailed statement of experiments, dealing principally with the effect of alkali on the germination of seeds, reported in an earlier publication of the station; an account of experiments made to determine the rate and amount of water imbibed by seeds from various salt solutions; a summary of meteorological observations during 1898;

a record of soil temperatures during 1898 taken at depths of from 3 to 72 inches; reprints of Bulletins 38–40 of the station, and Index Bulletin B, containing an index to Bulletins 27–37 of the station.

Wyoming being located in the arid region and largely in high altitudes, this station has naturally restricted its efforts to the investigation of the peculiar problems of agriculture under such conditions. Thus far its attention has been devoted for the most part to problems of soils and irrigation through a many-sided investigation, to which the plant physiologist, chemist, physicist, and geologist, as well as the agriculturist, have contributed, and in which results of both scientific and practical value have been obtained. Intimately associated with this is the problem of combining the use of range lands with irrigation farming, so as to conserve the natural forage and at the same time produce larger numbers of animals and send them to market in better condition. The station is now in a position to develop its work in this direction, provided it can secure the funds necessary to properly equip a division of animal husbandry. With the limited resources of the university the station is unable to extend its operations at present. It is hoped, however, that as the wisdom of concentration of the funds and work for higher education and research in this institution has now been demonstrated the State will steadily proceed in building on this foundation with reference to its growing needs and the development of the agriculture and other industries of Wyoming.

TABLE 1.—*General statistics of the agricultural experiment stations in the United States, 1900.*

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.	Number on staff.	Number of teachers on staff.	Publications during fiscal year 1899–1900.		Number of addresses on mailing list.	Principal lines of work.
							No.	Pages.		
Alabama (College)	Auburn	P. H. Mell	Feb. —, 1883	Feb. 24, 1888	13	8	7	394	8,402	Botany; soils; analyses of fertilizers and food materials; field and pot experiments; hortieulture; diseases of plants; feeding experiments; diseases of animals.
Alabama (Canebrake)	Uniontown	H. Benton	Jan. 1, 1886	Apr. 1, 1888	3	2	....	.....	2,311	Soil improvement; field experiments; hortieulture; florieulture; diseases of plants; diseases of animals.
Arizona	Tucson	R. H. Forbes	.....	1889	9	7	5	180	2,900	Chemistry; field experiments; meteorology; diseases of plants; horticulture (including date-palm orchard).
Arkansas	Fayetteville	R. L. Bennett	.....	1887	8	2	5	245	6,000	Chemistry of foods; field experiments; horticulture; diseases of plants; feeding experiments; diseascs of animals.
California	Berkeley	E. W. Hilgard	1875	Mar. —, 1888	30	9	5	170	5,200	Physics; ehemistry and geographieal distribution of soils; fertilizers; field crops; hortieulture; botany; meteorology; teehnology of wine and olive oil, ineluding zymology; chemistry of foods and feeding stuffs; entomology; drainage and irrigation; reelamation of alkali lands; plant introduetion.
Colorado	Fort Collins	L. G. Carpenter	1879	Feb. —, 1888	16	8	27	186	6,500	Chemistry; field experiments; horticulture; entomology; irrigation.
Connecticut (State)	New Haven	E. H. Jenkins	Oct. 1, 1875	May 18, 1887	14	.....	1	40	9,000	Analysis and inspection of fertilizers, foods, and feeding stuffs; chemistry; diseases of plants; horticulture; forestry; field experiments; entomology.
Connecticut (Storrs)	Storrs	W. O. Atwater	.....	.....do	7	1	3	248	7,000	Food and nutrition of man and animals; baeteriology of dairy products; field experiments; dairying.
Delaware	Newark	A. T. Neale	.....	Feb. 21, 1888	8	7	5	287	6,800	Chemistry; baeteriology; field experiments; hortieulture; diseases of plants; feeding experiments; diseases of animals; entomology; dairying.
Florida	Lake City	W. F. Yocum	.....	1888	11	5	4	190	4,000	Chemistry; field experiments; hortieulture; entomology.
Georgia	Experiment	R. J. Redding	Feb. 18, 1888	July 1, 1889	8	1	5	174	15,238	Field experiments; hortieulture; entomology; myeology; pig feeding; dairying.

Idaho	Moscow	J. A. McLean		Feb. 26, 1892	11	8	6	112	3,000	Physics; botany; field experiments; horticulture; entomology; feeding experiments.
Illinois	Urbana	E. Davenport		Mar. 21, 1888	12	7	5	172	18,000	Chemistry; bacteriology; field experiments; horticulture; forestry; diseases of plants; feeding experiments; entomology; dairying.
Indiana	Lafayette	C. S. Plumb	1885	Jan. —, 1888	11	7	4	196	17,452	Chemistry; pot and field experiments; horticulture; feeding experiments; diseases of plants and animals.
Iowa	Ames	C. F. Curtiss		Feb. 17, 1888	20	14	6	296	20,000	Chemistry; bacteriology; field experiments; horticulture; diseases of plants; feeding experiments; entomology; dairying.
Kansas	Manhattan	J. T. Willard		Feb. 8, 1888	15	12	10	170	17,102	Soils; horticulture; seed breeding; field experiments; feeding and digestion experiments; diseases of animals; entomology.
Kentucky	Lexington	M. A. Scovell	Sept. —, 1885	Apr. —, 1888	11	1	7	346	7,000	Chemistry; soils; fertilizer analysis field experiments; horticulture; diseases of plants; entomology; dairying.
Louisiana (Sugar)	New Orleans	W. C. Stubbs	Sept. —, 1885							Chemistry; bacteriology; soils and soil physics; field experiments; horticulture; sugar making; drainage; irrigation.
Louisiana (State)	Baton Rouge	do	Apr. —, 1886		21	6	6	384	15,000	Chemistry; geology; botany; bacteriology; soils; inspection of fertilizers and paris green; field experiments; horticulture; diseases of animals; entomology.
Louisiana (North)	Calhoun	do	May —, 1887							Chemistry; soils; fertilizers; field experiments; horticulture; feeding experiments; stock raising; dairying.
Maine	Orono	C. D. Woods	Mar. —, 1885	Oct. 1, 1887	14	6	15	404	11,000	Chemistry; botany; analysis and inspection of fertilizers, concentrated commercial feeding stuffs, and creamery glassware; horticulture; diseases of plants; seed tests; food and nutrition of man and animals; poultry raising; diseases of animals; entomology; dairying.
Maryland	College Park	H. J. Patterson	1888	Apr, —, 1888	16	8	6	171	8,500	Chemistry; soils; field experiments; horticulture; diseases of plants; feeding experiments; entomology.
Massachusetts	Amherst	H. H. Goodell	[1]1882	Mar. 2, 1888	20	8	20	374	16,350	Chemistry; meteorology; analysis and inspection of fertilizers and concentrated commercial feeding stuffs; field experiments; horticulture; electro-germination; diseases of plants; digestion and feeding experiments; diseases of animals; entomology.

[1] In 1882 the State organized a station here and maintained it until June 18, 1895, when it became a part of the Hatch Station at the same place.

TABLE 1.—*General statistics of the agricultural experiment stations in the United States, 1900*—Continued.

Station.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.	Number on staff.	Number of teachers on staff.	Publications during fiscal year 1899-1900.		Number of addresses on mailing list.	Principal lines of work.
							No.	Pages.		
South Carolina	Clemson College	H. S. Hartzog		Jan. —, 1888	14	9	8	185	8,500	Soils; analysis and control of fertilizers; field experiments; horticulture; plant breeding; diseases of plants; feeding experiments; veterinary science; entomology; dairying.
South Dakota	Brookings	J. H. Shepard		Mar. 13, 1887	12	5	4	202	9,000	Bacteriology; chemistry of soils and soil physics; field experiments; forestry; diseases of plants; feeding experiments; entomology; irrigation.
Tennessee	Knoxville	A. M. Soule[1]	June 8, 1882	Aug. 4, 1887	12	4	5	84	9,000	Chemistry; soils; fertilizers; field experiments; horticulture; seeds; weeds; diseases of plants; feeding experiments; entomology; dairying.
Texas	College Station	J. H. Connell			14	7	6	283	15,055	Chemistry; soils; fertilizers; field experments; horticulture; feeding dairy cows; sheep husbandry; diseases of animals; irrigation.
Utah	Logan	J. A. Widtsoe		1890	10	7	8	460	4,450	Chemistry of soils and feeding stuffs; alkali soil investigations; meteorology; field experiments; horticulture; forestry; diseases of plants; cattle and sheep breeding; feeding experiments; dairying; poultry experiments; irrigation.
Vermont	Burlington	J. L. Hills	Nov. 24, 1886	Feb. 28, 1888	13	5	10	481	10,500	Chemistry; analysis and control of fertilizers and feeding stuffs; inspection of creamery glassware; field experiments; horticulture; diseases of plants; feeding experiments; diseases of animals; dairying.
Virginia	Blacksburg	J. M. McBryde	1888	1891	10	6	11	150	8,200	Field crops; horticulture; cider and vinegar making; feeding experiments; veterinary science; entomology.
Washington	Pullman	E. A. Bryan		1891	12	7	7	203	5,000	Chemistry; botany; bacteriology; soils; field experiments; horticulture; diseases of plants; feeding and breeding experiments; oyster culture; diseases of animals; entomology; dairying; irrigation.

[1] Vice director.

West Virginia	Morgantown	J. H. Stewart		June 11, 1888	12	4	7	236	7,000	Chemistry; analysis and control of fertilizers; field experiments; horticulture; feeding experiments; poultry experiments; entomology.
Wisconsin	Madison	W. A. Henry	1883	1887	21	16	10	692	12,000	Chemistry; soils; field experiments; horticulture; feeding experiments; dairying; drainage and irrigation.
Wyoming	Laramie	E. E. Smiley	1887	Mar. 1, 1891	8	6	5	374	2,700	Geology; botany; meteorology; waters; soils; fertilizers; field experiments; food analysis; feeding experiments; entomology.
Total					693	327	386	14,172	562,851	

TABLE 2.—*Revenue and additions to equipment*

Station.	Hatch fund.	State.	Individuals and communities.	Fees.	Farm products.	Miscellaneous.	Total.
Alabama (College)	$15,000.00	.....	.....	$5,628.21	$931.94	$1,668.87	$23,229.02
Alabama (Canebrake)	.....	$2,500.00	.....	.....	270.88	.....	2,770.88
Arizona	15,000.00	.....	.....	295.23	157.76	782.65	16,235.64
Arkansas	15,000.00	.....	.....	.....	.....	.....	15,000.00
California	15,000.00	11,560.00	.....	.....	817.61	.....	27,377.61
Colorado	15,000.00	.....	.....	.....	1,013.22	511.69	16,524.91
Connecticut (State)	7,500.00	12,500.00	$254.40	8,471.03	1,103.42	16.91	29,845.76
Connecticut (Storrs)	7,500.00	1,800.00	.....	.....	.....	1,684.75	10,984.75
Delaware	15,000.00	.....	.....	.....	.....	.....	15,000.00
Florida	15,000.00	.....	.....	.....	1,132.55	.....	16,132.55
Georgia	15,000.00	700.00	.....	.....	1,608.89	2,400.36	19,709.25
Idaho	15,000.00	.....	.....	.....	612.00	.....	15,612.00
Illinois	15,000.00	.....	.....	260.00	747.04	196.15	16,203.19
Indiana	15,000.00	.....	.....	.....	2,251.21	.....	17,251.21
Iowa	15,000.00	.....	.....	7.00	2,678.35	144.70	17,830.05
Kansas	15,000.00	.....	.....	.....	7,002.05	.....	22,002.05
Kentucky	15,000.00	[2]2,455.26	.....	[3]20,866.29	[3]3,334.34	[3]105.30	41,761.19
Louisiana	15,000.00	18,000.00	2,005.00	5,514.25	1,669.90	12,974.84	55,163.99
Maine	15,000.00	.....	.....	4,970.53	3,950.10	117.74	24,098.37
Maryland	15,000.00	.....	.....	.....	2,830.94	5.69	17,836.63
Massachusetts	15,000.00	11,200.00	.....	3,600.00	1,720.86	1,979.82	33,500.68
Michigan	15,000.00	2,500.00	.....	1,620.00	438.43	1,301.39	20,859.82
Minnesota	15,000.00	[4]32,033.09	.....	.....	[4]9,333.31	.....	56,366.40
Mississippi	15,000.00	.....	.....	.....	1,780.06	33.43	16,813.49
Missouri	15,000.00	.....	.....	1,129.95	2,520.00	1,195.83	19,845.78
Montana	15,000.00	1,500.00	.....	.....	3,128.89	.....	19,628.89
Nebraska	15,000.00	.....	.....	.....	1,806.12	949.78	17,755.90
Nevada	15,000.00	.....	.....	.....	110.15	135.63	15,245.78
New Hampshire	15,000.00	.....	.....	1,222.38	.....	.....	16,222.38
New Jersey (State)	.....	16,600.00	.....	.....	.....	.....	16,600.00
New Jersey (College)	15,000.00	.....	.....	.....	.....	.....	15,000.00
New Mexico	15,000.00	.....	.....	.....	153.58	661.80	15,815.38
New York (State)	1,500.00	69,489.80	.....	.....	.....	.....	70,989.80
New York (Cornell)	13,500.00	[5]17,500.00	.....	.....	867.68	517.02	32,384.70
North Carolina	15,000.00	.....	.....	.....	420.87	1,438.04	16,858.91
North Dakota	15,000.00	.....	.....	3.00	2,271.99	571.18	17,846.17
Ohio	15,000.00	25,879.15	.....	377.07	5,851.57	1,568.24	48,676.03
Oklahoma	14,999.07	.....	.....	.....	[3]3,895.91	.....	18,894.98
Oregon	15,000.00	.....	.....	.....	2,884.24	.....	17,884.24
Pennsylvania	15,000.00	.....	.....	8,217.00	1,446.94	5,946.84	30,610.78
Rhode Island	15,000.00	.....	.....	.....	615.41	186.30	15,801.71
South Carolina	15,000.00	.....	.....	.....	776.25	.....	15,776.25
South Dakota	15,000.00	400.00	.....	.....	464.01	.....	15,864.01
Tennessee	15,000.00	.....	.....	.....	3,768.62	103.00	18,871.62
Texas	15,000.00	2,500.00	.....	.....	.....	1,056.42	18,556.42
Utah	15,000.00	.....	.....	.....	3,168.96	.....	18,168.96
Vermont	15,000.00	.....	.....	2,902.06	6,210.92	.....	24,112.98
Virginia	15,000.00	.....	161.11	.....	3,886.57	.....	19,047.68
Washington	15,000.00	4,164.16	.....	.....	.....	[6]552.22	19,716.38
West Virginia	15,000.00	.....	.....	5,718.31	114.95	1,274.00	22,107.26
Wisconsin	15,000.00	14,000.00	.....	125.00	.....	.....	29,125.00
Wyoming	15,000.00	.....	.....	.....	340.35	.....	15,340.35
Total	719,999.07	247,281.46	2,420.51	70,927.31	90,088.84	40,140.59	1,170,857.78

[1] Including grounds.
[2] Including apparatus, farm implements, and live stock.
[3] Including balance.

of the agricultural experiment stations in 1900.

Additions to equipment in 1900.						
Buildings.	Library.	Apparatus.	Farm implements.	Live stock.	Miscellaneous.	Total.
$1,509.55	$437.03	$233.09	$78.48	$1,185.34	.....	$3,443.49
273.34	47.25	.....	69.20	.....	$181.09	570.88
337.92	7.97	103.93	581.58	410.00	950.00	2,391.40
744.25	92.25	20.00	93.75	114.82	.....	1,065.07
152.96	200.00	83.80	53.80	67.50	.....	558.06
213.70	10.75	83.53	135.81	42.75	.....	486.54
[1]657.05	625.66	110.09	66.35	.....	.....	1,459.15
71.65	.....	898.70	1.20	24.04	433.81	1,429.40
140.87	506.77	492.84	68.75	20.78	.....	1,230.01
914.91	232.33	157.43	655.71	892.81	.....	2,853.19
114.04	225.11	373.06	66.42	.....	.....	778.63
2,000.00	114.00	230.00	279.39	1,203.57	204.00	4,030.96
349.97	302.62	357.34	241.84	593.50	.....	1,845.27
181.47	93.92	37.90	422.11	93.10	.....	828.50
55.06	9.80	327.11	197.35	179.95	.....	768.77
402.49	277.91	278.54	70.26	.....	.....	1,029.20
2,463.57	578.16	511.21	475.52	668.00	3,129.40	7,825.86
6,605.48	141.58	85.70	658.89	360.55	.....	7,852.20
3,500.00	243.34	58.37	.....	140.47	.....	3,942.18
293.18	199.93	138.70	1,459.62	202.50	.....	2,293.93
1,131.65	254.26	931.33	781.44	185.96	.....	3,284.64
3.84	216.66	505.94	133.87	88.56	.....	948.87
30,000.00	69.35	5,000.00	672.77	3,844.95	.....	39,587.07
750.00	50.00	157.16	96.67	693.84	.....	1,747.67
308.48	232.55	176.06	166.37	1,089.00	.....	1,972.46
1,343.38	26.25	860.37	470.77	1,319.00	.....	4,019.77
576.29	124.09	369.56	488.70	902.15	.....	2,460.79
403.00	17.85	53.40	411.37	.....	.....	885.62
492.77	356.21	584.42	17.74	.....	.....	1,451.14
600.00	146.73	.....	.....	.....	[2]1,542.12	2,288.85
749.45	582.86	433.38	56.85	.....	171.68	1,994.22
1,439.40	74.08	323.94	133.35	732.40	.....	2,703.17
1,496.02	814.19	63.43	556.88	582.00	.....	3,512.52
456.00	161.59	281.96	6.00	22.00	.....	927.55
267.78	248.48	178.67	672.39	7.60	.....	1,374.92
750.00	500.00	91.85	328.59	100.40	.....	1,770.84
1,685.01	394.05	284.11	867.21	550.40	22.13	3,802.91
2,813.75	3.32	558.32	159.55	1,431.29	487.00	5,453.23
281.91	156.41	138.93	406.48	111.35	.....	1,095.08
4,078.00	79.47	1,137.84	178.03	50.50	.....	5,523.84
99.81	587.73	401.47	70.07	83.90	.....	1,242.98
814.22	91.64	49.69	705.75	424.20	.....	2,085.50
124.33	4.75	182.62	195.00	120.00	.....	626.70
472.65	176.54	201.36	1,172.11	831.17	1,298.02	4,151.85
14.05	82.08	72.77	65.16	.....	.....	234.06
732.84	81.82	179.57	329.70	267.50	19.25	1,610.68
956.28	250.22	340.67	417.84	712.25	.....	2,677.26
321.50	.....	100.69	134.09	16.00	.....	572.28
579.56	5.10	187.89	340.95	334.20	25.00	1,472.70
620.16	53.00	295.19	329.26	118.00	.....	1,415.61
13,000.00	533.45	188.34	611.70	890.80	.....	15,224.29
1,072.64	64.09	485.58	363.17	300.00	387.44	2,672.92
89,416.23	10,784.70	19,397.85	17,015.86	22,009.10	8,850.94	167,474.68

[4] Including subexperiment farms.
[5] Estimated amount of State appropriation spent for experimental purposes.
[6] Including fees and farm products.

TABLE 3.—*Expenditures of agricultural experiment stations from*

Station.	Amount.	Itemized.						
		Salaries.	Labor.	Publications.	Postage and stationery.	Freight and express.	Heat, light, and water.	Chemical supplies.
Alabama	$15,000.00	$8,528.31	$1,229.26	$1,150.00	.....	$284.71	$134.73	$506.54
Arizona	15,000.00	6,947.73	3,525.15	870.32	$204.72	348.08	108.90	127.85
Arkansas	15,000.00	9,624.09	1,482.38	722.16	187.47	146.99	60.21	122.99
California	15,000.00	7,184.96	4,421.46	135.69	274.75	115.87	276.27	523.32
Colorado	15,000.00	10,394.06	2,320.18	644.90	194.00	33.14	2.08	.....
Connecticut (State)	7,500.00	7,500.00	.....	.....	.....	.....	.....	.....
Connecticut (Storrs)	7,500.00	3,778.40	958.67	78.40	260.50	72.62	488.14	53.14
Delaware	15,000.00	9,570.44	1,238.01	804.20	237.62	150.93	257.90	127.19
Florida	15,000.00	5,063.90	3,156.34	659.37	252.46	278.99	223.84	348.09
Georgia	15,000.00	7,569.96	2,436.03	1,746.99	215.55	193.01	249.14	.....
Idaho	15,000.00	6,208.33	3,462.39	537.82	113.10	203.90	497.44	150.09
Illinois	15,000.00	6,457.91	2,947.64	1,452.11	357.64	115.77	120.00	123.13
Indiana	15,000.00	8,637.70	2,717.19	731.35	77.09	80.14	426.85	219.59
Iowa	15,000.00	8,181.96	2,318.71	1,471.18	422.64	238.12	288.24	338.75
Kansas	15,000.00	6,931.59	3,556.68	340.03	264.16	160.43	91.09	187.35
Kentucky	15,000.00	9,990.00	3,050.11	338.96	207.43	50.84	100.28	10.18
Louisiana	15,000.00	7,937.85	2,595.48	1,659.82	452.13	269.07	217.93	160.84
Maine	15,000.00	7,812.93	1,468.23	26.65	326.29	187.16	1,064.41	377.26
Maryland	15,000.00	7,375.92	2,947.40	851.18	134.17	235.66	355.58	152.80
Massachusetts	15,000.00	5,614.58	4,278.90	409.40	228.53	127.48	254.96	108.53
Michigan	15,000.00	8,820.05	2,599.25	711.35	501.36	199.13	.....	272.01
Minnesota	15,000.00	11,689.24	1,355.00	45.00	49.14	.....	101.31	83.61
Mississippi	15,000.00	9,398.49	1,325.22	250.35	176.61	320.20	242.67	236.72
Missouri	15,000.00	7,152.57	2,152.65	495.69	341.48	166.20	248.08	91.65
Montana	15,000.00	8,408.47	3,032.75	357.34	140.55	339.16	439.90	51.16
Nebraska	15,000.00	9,108.18	1,923.97	857.15	463.39	126.57	.....	337.88
Nevada	15,000.00	9,199.54	1,435.97	696.55	180.98	79.87	265.95	391.72
New Hampshire	15,000.00	9,362.81	1,400.43	1,363.15	118.09	80.26	523.76	56.67
New Jersey	15,000.00	9,430.00	803.90	1,002.49	163.28	65.58	308.61	43.05
New Mexico	15,000.00	9,038.44	1,587.05	549.19	379.18	175.60	91.40	168.32
New York (State)	1,500.00	.....	.....	.....	32.56	50.37	121.14	.....
New York (Cornell)	13,500.00	9,508.14	774.60	1,620.11	387.59	112.78	90.63	16.29
North Carolina	15,000.00	9,577.01	1,441.88	1,574.46	245.04	70.63	10.71	356.12
North Dakota	15,000.00	6,218.14	5,232.12	969.20	110.11	33.24	299.55	74.83
Ohio	15,000.00	12,073.10	1,310.27	13.13	69.27	.....	305.96	.....
Oklahoma	14,999.07	5,245.00	2,801.28	692.61	432.24	221.92	548.95	82.79
Oregon	15,000.00	8,979.60	3,323.82	230.98	39.55	166.58	.....	457.06
Pennsylvania	15,000.00	13,300.08	.....	426.21	89.09	.....	2.54	299.40
Rhode Island	15,000.00	7,730.74	3,377.43	216.49	216.50	199.34	303.67	27.64
South Carolina	15,000.00	7,330.10	2,654.42	836.90	79.43	161.69	27.54	292.35
South Dakota	15,000.00	10,432.94	1,421.93	1,170.25	50.00	205.79	716.04	151.59
Tennessee	15,000.00	6,662.29	2,978.02	1,008.27	241.11	100.50	315.04	35.00
Texas	15,000.00	9,055.00	1,169.37	2,384.20	472.15	170.55	337.65	294.19
Utah	15,000.00	5,881.20	3,533.43	1,327.60	163.52	238.62	207.33	485.98
Vermont	15,000.00	6,588.79	2,803.93	950.54	518.47	76.83	328.52	294.03
Virginia	15,000.00	8,727.36	2,666.00	1,408.86	113.72	242.18	270.45	162.66
Washington	15,000.00	7,949.97	3,158.54	552.10	94.26	239.06	547.99	56.90
West Virginia	15,000.00	12,591.82	898.65	.....	73.63	148.54	226.64	18.73
Wisconsin	15,000.00	9,947.00	3,202.32	.....	.....	.....	.....	64.43
Wyoming	15,000.00	2,875.00	5,032.76	1,143.53	384.08	316.81	932.02	423.58

[1] The expenditures under different heads are affected by

United States appropriation for year ended June 30, 1900.[1]

Itemized.											Balance.
Seeds, plants, and sundry supplies.	Fertilizers.	Feeding stuffs.	Library.	Tools, implements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	
$644.29	$369.61	$208.61	$437.03	$78.48	.....	$233.09	$1,185.34	.....	$10.00	.....	.....
211.46	208.65	190.31	7.97	708.58	$23.25	103.93	410.00	$599.50	10.30	$393.30	.....
751.24	21.00	87.96	92.25	127.27	128.15	20.00	114.82	441.27	125.50	744.25	.....
407.30	.....	193.90	73.62	479.14	4.95	83.80	67.50	587.50	29.50	190.47	.....
265.29	55.05	14.00	10.75	128.56	46.64	81.03	42.75	652.13	54.00	61.44	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
146.28	127.95	289.19	.....	1.20	407.31	677.69	17.24	61.62	10.00	71.65	.....
500.76	10.41	41.90	506.77	68.75	200.15	510.40	20.78	543.22	69.60	140.97	.....
679.15	455.73	697.97	220.53	649.23	12.53	157.43	892.81	611.71	54.25	585.67	.....
499.32	416.15	275.84	225.11	66.42	46.76	73.06	.....	271.10	.....	715.56	.....
406.87	15.20	43.05	114.00	279.39	204.00	230.00	1,202.57	391.25	190.60	750.00	.....
574.86	2.50	561.50	302.62	241.84	126.25	357.34	593.50	189.66	125.76	349.97	.....
705.01	8.55	527.60	93.92	422.11	68.30	37.90	53.10	40.85	4.13	148.62	.....
565.69	2.10	521.80	4.05	65.65	72.65	305.96	104.95	37.82	26.25	33.48	.....
408.52	9.55	736.31	267.64	70.26	79.95	209.84	1,195.49	76.98	11.64	402.49	.....
131.82	.....	.....	578.16	139.90	65.75	11.25	.....	149.96	110.47	65.89	.....
506.23	44.02	341.49	141.58	227.31	.....	85.70	360.55	.....	.....	.....	.....
646.40	171.73	1,107.02	243.34	190.78	262.01	58.37	352.24	297.52	.....	407.66	.....
761.04	.....	.....	199.93	1,459.62	11.00	138.70	.....	73.82	10.00	293.18	.....
602.04	1,168.55	136.62	157.31	673.63	51.90	384.95	60.30	22.02	125.25	595.05	.....
498.66	51.62	131.85	216.66	109.26	17.60	505.94	88.56	270.86	2.00	3.84	.....
417.20	.....	704.30	.....	98.12	6.75	.....	240.00	187.08	10.00	13.25	.....
354.54	11.59	696.69	95.38	185.50	.....	.....	440.60	677.39	10.00	578.05	.....
632.25	16.05	1,284.57	232.55	166.37	39.20	176.06	1,089.00	397.15	10.00	308.48	.....
464.36	8.50	51.83	26.25	470.77	129.29	860.37	150.00	59.30	10.00	.....	.....
566.41	.....	84.36	124.09	202.64	60.79	369.56	87.50	188.13	10.00	489.38	.....
612.99	.....	12.30	17.85	411.37	303.20	53.40	.....	424.33	192.55	721.43	.....
251.94	126.42	148.73	356.21	17.74	209.68	389.62	.....	90.51	11.21	492.77	.....
98.97	96.08	175.94	582.86	56.85	171.68	433.38	.....	651.88	166.00	749.45	.....
272.06	52.25	95.40	74.08	133.35	128.11	323.94	732.40	519.11	55.00	624.02	$1.10
385.74	.....	73.90	23.07	2.50	.....	58.79	500.00	186.94	64.99	.....	.....
191.89	15.60	205.66	161.59	6.00	102.28	99.73	22.00	157.69	10.00	17.42	.....
167.51	112.00	515.64	94.20	288.54	131.98	178.67	7.60	72.60	20.06	135.35	.....
287.97	35.00	237.60	.....	328.59	.....	91.85	100.40	155.40	76.00	750.00	.....
534.27	4.56	323.33	77.05	165.57	20.03	4.28	.....	.....	10.00	89.18	.....
692.10	9.74	581.87	3.32	154.10	487.00	558.32	1,421.29	296.54	20.00	750.00	.....
305.33	6.60	51.15	156.41	406.48	.....	138.93	91.35	96.95	324.95	224.26	.....
13.48	.....	.....	75.10	10.75	22.50	445.39	54.02	251.19	10.25	.....	.....
330.21	248.91	572.27	567.61	68.27	141.20	401.47	83.90	375.71	60.58	78.06	.....
673.11	172.46	342.70	91.64	552.63	73.80	49.69	270.00	742.82	28.20	620.52	.....
84.75	.....	.....	4.75	195.00	.....	182.62	120.00	103.25	36.76	124.33	.....
375.35	110.21	323.31	176.54	998.93	12.00	201.36	600.00	364.75	98.27	399.05	.....
195.87	72.60	117.19	82.08	65.16	45.62	72.77	.....	402.65	48.90	14.05	.....
470.53	49.50	887.66	81.82	329.70	19.25	179.57	267.50	133.95	10.00	732.84	.....
121.57	106.48	993.46	250.22	187.03	115.02	340.67	45.00	574.20	47.60	677.64	.....
397.19	90.50	221.71	.....	134.09	.....	100.69	16.00	117.09	10.00	321.50	.....
276.39	.....	168.44	5.10	340.95	25.00	187.89	334.20	473.65	10.00	579.56	.....
244.94	41.50	139.76	50.50	148.00	2.50	272.03	67.50	53.26	22.00	.....	.....
770.14	5.54	57.40	533.45	81.00	35.00	108.22	40.00	155.50	.....	.....	.....
592.57	.....	22.00	64.09	363.17	387.44	485.58	300.25	886.30	40.82	750.00	.....

the total revenue of the station, as shown in Table 2.

O