

**Historical Document**  
Kansas Agricultural Experiment Station

EXPERIMENT STATION

OF THE

KANSAS STATE

AGRICULTURAL COLLEGE.

---

REPORT FOR 1897,

CONSISTING OF THE

TENTH ANNUAL REPORT

AND

BULLETINS 65 TO 74, BOTH INCLUDED.

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MANHATTAN, KANSAS.  
1897.



KANSAS STATE AGRICULTURAL COLLEGE.

STATION STAFF — 1896.\*

COUNCIL.

- GEO. T. FAIRCHILD, LL. D., Chairman, President of the College.
GEO. H. FAILYER, M.S., Professor of Chemistry.
E. A. POPENOE, A.M., Professor of Entomology and Zoology.
C. C. GEORGESON, M. S., Professor of Agriculture.
N. S. MAYO, D.V.S., M. S., Professor of Physiology and Veterinary Science.
A. S. HITCHCOCK, M. S., Professor of Botany.
S. C. MASON, M. S., Professor of Horticulture.
I. D. GRAHAM, A. M., Secretary.

ASSISTANTS.

- J. T. WILLARD, M.S. Chemistry.
FRED. A. MARLATT, B.S. Entomology.
F.C. BURTIS, M.S. Agriculture.
D. H. OTIS, B. S. Agriculture.
GEO. L. CLOTHIER, B.S. Botany.
F. C. SEARS, M. S. Horticulture.
ISAAC JONES, B. S., April 20 to October 31 Irrigation.

\*For Station staff, 1897, see pages xviii, xix.

**Historical Document**  
Kansas Agricultural Experiment Station

KANSAS STATE AGRICULTURAL COLLEGE,  
MANHATTAN, KAN., July, 1897.

*To his Excellency, Governor J. W. Leedy:*

DEAR SIR—I herewith transmit, as required by act of Congress approved March 7, 1887, the tenth annual report of the Experiment Station of the Kansas State Agricultural College, for the year 1897, including the financial statement to June 30, 1897.

Respectfully yours,           GEO. T. FAIRCHILD,  
*Secretary Board of Regents.*



EXPERIMENT STATION

OF THE

KANSAS STATE AGRICULTURAL COLLEGE,  
MANHATTAN.

TENTH ANNUAL REPORT—FOR THE YEAR 1897.

FINANCIAL STATEMENTS.

Report of the Treasurer.

To the Board of Regents of the Kansas State Agricultural College:

GENTLEMEN—Herewith is submitted my report of receipts and expenditures on account of the Experiment Station, for the period between July 1, 1896, and March 31, 1897:

Received from the treasurer of the United States.....	\$15,000 00
Received from cash sales of products.....	512 94
<b>Total .....</b>	<b>\$15,512 94</b>
Paid approved vouchers Nos. 1 to 194, including credits.....	12,085 32
<b>Balance paid to C. B. Hoffman, Treasurer.....</b>	<b>\$3,427 62</b>

C. B. DAUGHTERS, *Treasurer.*

To the Board of Regents of the Kansas State Agricultural College:

GENTLEMEN—Herewith please find a report of my expenditures and receipts on account of the Experiment Station, for the period between April 1 and June 30, 1897:

Received from C. B. Daughters, ex-Treasurer.....	\$3,427 62
Received from cash sales of products.....	1,532 84
<b>Total .....</b>	<b>\$4,960 46</b>
Paid approved vouchers Nos. 195 to 320.....	4,960 46

C. B. HOFFMAN, *Treasurer.*

*Report of the Secretary.*

*To the Board of Regents of the Kansas State Agricultural College:*

GENTLEMEN — Herewith is submitted the following report of the financial affairs of the Experiment Station of the Kansas State Agricultural College for the year ending June 30, 1897, as prepared under directions from the United States department of agriculture. The several items of this account are covered by vouchers approved by the disbursing officer, certified by the Secretary, and allowed by the President and Board of Regeants:

*Experiment Station, Kansas State Agricultural College, in account with the United States appropriation, 1896-'97:*

DR.

To receipts from the treasurer of the United States as per appropriation for fiscal year ending June 30, 1897, as per act of Congress approved March 2, 1887. . . . . \$15,000 00

CR.

By salaries . . . . .	\$9,640 02	
Labor . . . . .	3,078 46	
Publications . . . . .	1,442 04	
Postage and stationery. . . . .	29 47	
Heat, light, and water . . . . .	6 15	
Chemical supplies . . . . .	46 58	
Seeds, plants, and sundry supplies . . . . .	244 00	
Fertilizers. . . . .	9 25	
Library . . . . .	76 04	
Tools, implements, and machinery . . . . .	14 35	
Furniture and fixtures. . . . .	12 86	
Scientific apparatus . . . . .	186 72	
Traveling expenses. . . . .	201 86	
Contingent expenses. . . . .	12 20	
Totals . . . . .	<u>\$15,000 00</u>	<u>\$15,000 00</u>

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the Experiment Station, Kansas State Agricultural College, for the fiscal year ending June 30, 1897; that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been \$15,000, and the corresponding disbursements \$15,000; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving no balance.

And we further certify, that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

[SEAL.] (Signed) \_\_\_\_\_ } *Auditors.*  
 \_\_\_\_\_ }  
 \_\_\_\_\_ }

ATTEST: GEO T. FAIRCHILD, *Custodian.*



**Supplementary Statement.**

DR.

To receipts from other sources than the United States for the year ending June 30, 1897:

Farm and garden products..... \$2,045 78

CR.

Labor .....	\$1,015 68	
Freight and express.....	107 53	
Feeding stuffs.....	156 35	
Live stock.....	541 12	
Building and repairs.....	225 10	
Totals .....	\$2,045 78	\$2,045 78

The accounts covering the Station fund are kept in a separate set of books, as provided in the act of Congress under which the Station was organized, and duplicate vouchers covering every item of expenditure made during the year are on file in the office of the Secretary.

See statement of expenditures by departments on next page.

All correspondence of this office concerning the issue of bulletins is on record. Nearly 6,000 copies of each bulletin have been distributed upon the revised lists of the year, 1,000 of each being retained for binding with the annual report, for future needs. The total number of copies of all publications distributed during the past year is over 60,000.

Respectfully submitted.

I. D. GRAHAM, *Secretary.*

**EXPLANATORY NOTES.**

1. The following names of members of the finance committee of the Board of Regents, which should appear as auditors on the preceding page (vi), were omitted by oversight in the change of administration:

J.N. LIMBOCKER,	} <i>Auditors.</i>
C.B. DAUGHTERS,	
C.R. NOE,	

2. Bulletin No. 75 was ordered printed April 5, 1897, by the former Station Council; but by later action, August 31, 1897, Bulletin No. 72 was substituted therefor, and the report was prepared accordingly. Bulletin No. 75, however, being regarded by the present Council as a part of the old series, is inserted herewith, beginning on page 212.

EXPENDITURES BY DEPARTMENTS, 1896-'97.

	Farm.	Horticultural.	Chemical.	Botanical.	Veterinary.	Entomological.	Irrigation.	General.	Total.
By salaries.....	\$2,600 00	\$1,173 34	\$1,333 34	\$1,260 00	\$780 00	\$1,433 34	\$180 00	\$880 00	\$9,640 02
Labor.....	2,122 30	1,583 70	41 88	191 25	61 32	.....	93 69	.....	4,094 14
Publications.....	.....	60 92	.....	52 62	1 50	.....	.....	1,327 00	1,442 04
Postage and stationery.....	1 75	4 22	.....	1 40	.....	.....	50	21 60	29 47
Freight and express.....	45 78	14 02	3 70	11 50	4 66	.....	5 75	22 12	107 53
Chemical supplies.....	.....	13 20	23 24	.....	10 14	.....	.....	.....	46 58
Seed, plants, and sundry supplies,	98 06	104 22	14 02	1 10	5 56	75	20 29	.....	244 00
Feeding stuffs.....	112 28	6 00	2 00	.....	36 07	.....	.....	.....	156 35
Library.....	.....	.....	.....	70 48	5 56	.....	.....	.....	76 04
Tools, implements, and machinery,	1 98	12 37	.....	.....	.....	.....	.....	.....	14 35
Furniture and fixtures.....	5 50	.....	.....	7 36	.....	.....	.....	.....	12 86
Scientific apparatus.....	.....	10 80	.....	6 00	84 95	.....	84 97	.....	186 72
Live stock.....	509 12	.....	32 00	.....	.....	.....	.....	.....	541 12
Traveling expenses.....	12 75	.....	.....	76 63	29 66	4 75	4 50	73 57	201 86
Contingent expenses.....	.....	2 20	.....	.....	.....	.....	.....	10 00	12 20
Building and repairs.....	3 15	221 95	.....	.....	.....	.....	.....	.....	225 10
Heat, light, and water.....	5 15	.....	.....	.....	1 00	.....	.....	.....	6 15
Fertilizers.....	.....	.....	9 25	.....	.....	.....	.....	.....	9 25
Totals.....	\$5,517 82	\$3,206 94	\$1,459 43	\$1,678 34	\$1,020 42	\$1,438 84	\$389 70	\$2,334 29	\$17,045 78

## REPORT OF THE COUNCIL.

*To the Board of Regents of the Kansas State Agricultural College:*

GENTLEMEN—At the request of the secretary of agriculture of the United States, and in accord with your order, we present a report for the half year since January 1, 1897, including the fiscal report for the year ending June 30, 1897, with the expectation that hereafter all annual reports shall be made to cover the period embraced in the fiscal year. Of course, there is little to report for this short period beyond the completion for publication of several bulletins, and the plans of work as outlined for the season.

Since the publication of the report for 1896, two bulletins have been printed, in the usual edition of 8,000 copies, 1,000 of which are preserved for binding with this report. The subjects treated appear in the following

### Outline of Bulletins.

**BULLETIN No. 65. June, 1897. Horticultural Department.**

*Grafting the Apple* (pp. 1-18), with illustrations: Whole root and piece root, long and short; long and short scions.

**BULLETIN No. 66. June, 1897. Botanical Department.**

*Fourth Report on Kansas Weeds.* — Fruits and seeds, illustrated (pp. 19-54): Containing a key to weeds by characters of fruits and seeds; a descriptive list of fruits and seeds of 209 kinds of Kansas weeds, with both scientific and common names; 17 pages of illustrations, showing fruit and seed of each weed, designated by number.

We have also ready for printing the following bulletins, several of which have been in the printer's hands since early in June:

**BULLETIN No. 67. June, 1897. Farm Department:**

*Steer-Feeding Experiment*, series VI, (pp. 55-74): Giving the results of feeding 15 steers in three lots of five each, of which lot I was fed on corn-meal, lot II on red Kaffir-corn meal, and lot III on white Kaffir-corn meal. The bulletin shows the amount of feed of each kind eaten, the gain made, and the profit on each lot, with full details of progress in the experiment.

**BULLETIN No. 68. June, 1897. Chemical Department:**

*Soil Moisture* (pp. 75-102): Giving detailed account of experiments during the last two years in testing the moisture of soils by comparison (1) of original prairie sod with plowed ground; (2) of shallow-plowed, deep-plowed, and sub-soiled land; (3) of soils treated with salt and gypsum; (4) of soils cultivated but not cropped, mulched but not cropped, cropped but not cultivated, untreated; (5) in galvanized-iron pails of mulching with pulverized soil and with hay; of



sandy and clay soils; and of soils treated with salt, gypsum, lime, and magnesium chloride.

**BULLETIN No. 69. June, 1897. Veterinary Department.**

Some Diseases of Cattle (pp. 103-134): Giving account of investigations of (1) Texas itch, a contagious skin disease, with effective treatment; (2) blackleg, a germ disease of young cattle, with preventive; (3) bovine tuberculosis, with tuberculin test and means of eradication; (4) Texas fever, conveyed from southern cattle to northern cattle by a micro-organism in cattle-ticks, with preventives.

**BULLETIN No. 70. July, 1897. Horticultural Department.**

*Vegetable Growing* (pp. 135-162): Treating of the construction and use of hotbeds and cold-frames; cultivation of cauliflower, early cabbage, asparagus; varieties and methods; early potatoes, onions, lettuce forcing, tomato forcing.

**BULLETIN No. 71. July, 1897. Farm Department.**

*Experiments with Wheat* (pp. 163-174): Treating of wheat continuously without manure; of subsoiling for wheat; of times of seeding; of rotations with barn-yard manure and with leguminous crops; variety tests.

**BULLETIN No. 72. July, 1897. Farm Department.**

*Growth of Young Stock* (issued herewith): Giving food consumed and gains made in wintering young cattle of Shorthorn, Holstein-Friesian, Hereford and Jersey breeds.

**BULLETIN No. 73. July, 1897. Horticultural Department.**

*Miscellaneous Fruit Notes* (issued herewith): Munson's Hybrid grapes; Mariana plum as a stock; peach vs. plum stocks for peaches; Russian fruits; twin trees from peach pits.

**BULLETIN No. 74. July, 1894. Farm Department.**

*Experiments with Oats* (issued herewith): Giving results upon ground plowed in spring, in fall, and not at all; from different times of seeding; from different weights of seed; from seeding broadcast, in drills, with hoe drill, shoe drill with press wheels, and without; from various amounts of seed; from land subsoiled compared with surface plowed; from use of the subsurface packer; from use of *ceres pulver* for smut; and tests of varieties.

***Work in Progress.***

CHEMICAL DEPARTMENT.—In addition to the work described in Bulletin No. 68, the chemical department has had in hand work in the lines mentioned below:

In coöperation with the farm department, the chemical department conducted three digestion experiments during the last spring. The analyses connected with these experiments are not yet completed. The plan of the work was the usual one. After a preliminary feeding period, using the feed to be tested in the same quantities as in the actual trial, the faxes and the feed refused were collected for one meek. By comparing them in composition and quantity with the feed offered, the digestibility of the feed in question will be calculated.

The first experiment was with red Kaffir-corn fodder without the grain; the second was with a combination of the same fodder and red Kaffir-corn grain; the third was like the second, except that soy-beans were substituted for the Kaffir-corn grain. The experiments were performed upon a two-year-old steer, and seemed quite satisfactory; they were with important feeds concerning the digestibility of which we have little or no data, and we recommend the publication of the results as soon as the matter can be prepared.

The chemical department is also preparing for a repetition of some of the observations on evaporation of soil moisture described in Bulletin No. 68, now in the printer's hands. The objects will be to study in a more extended way the effects of tillage and of fertilizers. The tillage experiments will be in the field, and will include a study of the effect of the roller, disk-harrow, Campbell's subsurface soil packer, and other varieties of treatment. The experiments with fertilizers will be conducted in pots, in a manner similar to those described in Bulletin No. 68, but will include additional substances and be performed under more uniform conditions.

The experiments in cooperation with the horticultural department, on the effects of certain fertilizers on grapes and strawberries, have been continued.

Experiments looking to an increase of the nitrogenous contents of common grains have been in progress during the last year. The susceptibility of plants to variation, and the possibility of magnifying characteristics and fixing them, has been thoroughly established. In the problem in question, how to increase the value of grain foods by making them more highly nitrogenous, there is little to guide one. The method of seed selection has proved entirely satisfactory in our work on increasing the sugar content of the sorghum plant. In that case the stalk could be analyzed and the seed be left for planting. Some of the seeds from a stalk produce richer canes than others. But by planting all the seeds of a sorghum head the best of a crop can be selected, and this continued in subsequent years will raise the quality. When the grain is the desired product, seed selection by analysis is not so simple a matter. The grain used in the analysis cannot of course be also used for seed. But by saving the seeds from each stalk separately, analyzing a portion of them, and making proper selections, the general average might be raised. Another method of possible improvement is by use of fertilizers in excessive quantity. It has seemed probable that by supplying a large amount of any element of plant food, in this case an assimilable compound of nitrogen, that more of it would enter the plant and be assimilated and built into organic combination. Our experiments so far have been with the

latter method. Sodium nitrate, Chili saltpeter, was the source of nitrogen. The plants under trial are corn, sorghum, and Kaffir-corn. Several years will doubtless be required to reach definite results.

The sugar-beet experiments carried on by the Station for several years, by distributing beet seed, the beets produced being analyzed at the Station, were discontinued because of apparent lack of interest on the part of the people of the state. Last winter there was apparently a revival of interest in the sugar-beet industry, and the Station accepted the offer by the department of agriculture, at Washington, of beet seed for distribution. Circulars of instruction were prepared, and 400 half-pound packages of seed sent, franked, to parties who were willing to undertake to follow instructions in growing the beets and in taking and sending samples for analysis. It will be necessary for the Station to pay transportation charges on these samples of beets.

The Missouri, Kansas & Texas Railway Company has distributed beet seed to about 400 farmers along its line. We have agreed to analyze these beets if delivered to us free, and will make public use of the results.

The work of analyzing these beets as received will crowd the force of the department, especially as work in teaching will be handled at the same time.

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ENTOMOLOGICAL DEPARTMENT.—The work in this department for the six months ending June 30, 1897, covered the following points:

*Canker-worm.*—Full observations on the time of appearance and numbers of moths under as nearly as possible natural conditions in the breeding cages. Also the same observation in the orchard, with the time of egg deposit and preference as to place; the date of hatching and period covered by egg stage under the different conditions; the value of paper-band traps for the female moth; the value of paper bands covered with dendrolene as bars to the ascent of the female moths. After the hatching of the larvæ, trial was made of the efficiency in their destruction of various insecticide spray applications as given below: (1) Paris green in water, 1 ounce to 10 gallons; (2) soluble white arsenic and sal soda, made by boiling together in water for 15 minutes 2 pounds of arsenic to 4 pounds of sal soda, using the liquor, 1 pint in 40 gallons of water; (3) Professor Kedzie's formula for insoluble mixture of arsenic, and lime; (4) kerosene emulsion (Hubbard's formula).

*Peach-tree Borer.*—Continuation of the study of the value of dendrolene as a destructive agent and as a protection to the tree, with observations of its effect upon the health of the tree itself.

*Apple Aphis.*—Preliminary observations upon life-history and modes of destruction.

Other work consisted in the answering of numerous letters of inquiry as to the best treatment of the destructive insects of the season, and the identification of the many specimens of insects sent in by correspondents.

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FARM DEPARTMENT.—The following experiments have been begun, but not completed at this writing:

*Experiments with Corn.*—Subsoiling for corn, comprising trials to ascertain the merits of subsoiling on land which was subsoiled in the spring and in the fall of 1895, in the spring and the fall of 1896, and in the spring of 1897; subsurface packing of subsoiled and surface-plowed ground for corn; time of planting corn; butt, middle and tip kernels of corn for seed; a comparison of early, medium and late varieties of corn; number of times to cultivate corn; a comparison of listed and surface-planted corn; test of varieties of corn.

*Experiments with Kaffir-corn.*—A comparison of white and red Kaffir-corn; use of the subsurface packer on subsoiled and surface-planted ground for Kaffir-corn; a comparison of corn and Kaffir-corn for grain; a comparison of corn and Kaffir-corn for forage.

*Other Experiments with Forage Crops.*—Soy-beans have again been planted, both in the spring and in midsummer, on the wheat stubble; and trials are made of several varieties and of selected seed.

Trials are also made of several varieties of field peas. In coöperation with the national department of agriculture, trial plats have been seeded with alfalfa seed grown in five different localities, and data are taken the first of each month in regard to the growth, in order to ascertain what characteristic differences each may develop.

Besides the above, we have seeded, also in coöperation with the United States department of agriculture, 135 species of grasses. The seed of these was furnished by the department. They are mostly native grasses from the semi-arid regions of the West, and their success here is, therefore, watched with interest. So far, a large majority of them are doing well. We also seeded larger plats of some half dozen of these grasses, which were especially promising, the seed for which was obtained by purchase.

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VETERINARY DEPARTMENT.—The work of this department during this period has been the investigation of a contagious skin disease among cattle, and the determination of efficiency and methods of application of various remedies for the disease. About 50 cattle have

been tested with tuberculine and observations made upon them. Investigation of Texas fever has also been carried on with special reference to the presence of the southern cattle-ticks in Kansas north of the quarantine line. A study has also been made of some common plants which occur in pastures and are reported to be poisonous to stock.

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BOTANICAL DEPARTMENT.—The work in progress but not published is as follows:

*Weeds.*—Observations upon the vegetation and propagation of our perennial weeds. This includes chiefly notes upon the underground parts, such as root stocks, tubers, and production of adventitious buds upon roots. The underground parts are carefully dug up, sketched, and notes taken upon the structure and method of propagation. This latter is also demonstrated by culture methods. It is important to know this, in order to determine the most efficient method of eradication. Since the publication of Bulletin No. 57, records have been kept of the new stations for weeds, and it is planned to publish the distribution of our weeds as recorded, including the additional years of 1896 and 1897. New, 10-foot-square plats of ground have been set aside for several seasons, and a record kept of all the weeds or other plants germinating in the soil. We have by this means an indication of relative ability of different weeds to occupy new soil. Notes have also been taken upon many other points relating to weeds: the method of fertilization, abundance and relative germinating power of weed seeds, the contrivances to resist unfavorable climatic conditions and ability to adapt themselves to changing conditions.

*Grasses.*—A study of the grasses of Kansas has been commenced. It is proposed to determine the range in Kansas of the native species, the economic value, the methods of propagation by vegetative methods and by seed, the amount and germinating power of the seed from wild grasses under the usual conditions. Perennial sorts have been transplanted to experimental plats, where their methods and rapidity of vegetative propagation can be observed.

*Plants of Kansas.*—In collecting data upon the weeds and grasses of the state, much has been learned concerning the other plants. It is proposed to publish these notes, especially those upon useful plants and upon the relation between the plants and the climate.

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HORTICULTURAL DEPARTMENT.—For convenience and conciseness, it seems wise to arrange the facts under separate heads.

*Orchard and Small Fruits.*—The apple orchard set in 1891 con-

tained 410 trees, of 59 varieties. These were mostly one year old; some on whole roots, some on piece roots, and some budded. The details of this planting have been published in a previous report. These rows have been added to on the east, and vacancies have been filled in, till the orchard now stands 434 trees, of 97 varieties. Notes on growth and on prevalence of blight, scab and other fungous diseases are on file for reference. Twenty-five varieties of these trees are bearing a little fruit this year. The date of coming into bearing, and the verification of the varieties, with constant attention to their productiveness, general hardiness, and the keeping qualities of the fruit, should constitute an important part of the Station observations from this on.

Of cherry, peach, and plum, numerous varieties are only partially tested, notes as far as this work has gone being on file for future use.

On strawberries, there are descriptive notes and tabulated exhibits of yield which include much material not yet published; and the same is true of raspberries, currants, and gooseberries.

The work of selection of varieties by planting plants propagated from more prolific and meritorious individual plants, especially in raspberries and strawberries, was planned last spring, and rows in the apple orchard of two varieties of raspberry, and in the berry plats of a number of varieties of strawberry, are in cultivation for the carrying out of such a line of work.

*Vineyard.*—The Station vineyard begun in 1888 now contains 160 varieties of grapes cultivated in this region, and nine wild species. Many of these have been reported upon in Bulletins 14, 28, and 44, in the last of which a scheme of classification, according to their specific origin, is given, which includes 100 varieties. Notes on file will refer the remainder of the collection to their proper places in this scheme, with a tenth class added, to include Munson's Post Oak hybrids.

A herbarium has been prepared, to which I wish to call special attention. On heavy cards, 18 x 22 inches, are mounted specimens of the young canes, showing characters of the leaf and tendril; specimens of the mature canes, showing characters of the wood pith and diaphragm; packets and mounted specimens of the seeds, and, in a part of the list, photographs of the seeds highly magnified; and finally, photographs of typical clusters of fruit of exact size. These details are nearly completed for the entire list, and negatives are on hand for several varieties of which photos are not yet mounted. A majority of these sheets are provided with printed labels, giving specific relationship and brief reference to origin and introduction of the variety.

It is hoped that the Board of Regents may see the wisdom of al-

lowing the appropriation asked for at their last meeting, "that this collection may be placed in glass-mounted wing frames, where it can be preserved and yet be available for study and comparison," as there is not a better vineyard herbarium in any institution in the United States, and the opportunity which it affords is of great value to special students.

Accompanying the experiments in winter protection of tender varieties, observations have been kept during a portion of two winters on the comparative temperature to which vines are subject when covered and when exposed in open air. These notes are tabulated in the form of a line exhibit of the variations, and are in shape for an engraving. As the past two winters have been rather mild, a continuation of these experiments is desirable.

A young vineyard of 150 vines was set in 1896, and vacancies filled in 1897, just west of the original Station vineyard. There are 10 rows, running north and south, and in each row 15 vines, arranged as follows, beginning at the south: 3 Worden, 2 Concord, 2 Catawba, 2 Green Mountain, 2 Brighton, 2 Herbert, 2 El Dorado. The plan of this vineyard is to devote two rows each to five different methods of pruning and training:

*Proposed Plan of Training Vineyard.*—2 El Dorado, 2 Herbert, 2 Brighton, 2 Green Mountain, 2 Catawba, 2 Concord, 2 Worden.

Fan system, Station modification, row 10.

Kniffin two-wire, four-cane system (see Bailey, fig. 21\*), row 9.

Kiniffin overhead, five-foot post (Bailey, fig. 28), row 8.

Fuller renewal system (Fuller, "Grape Culturist"), row 7.

High renewal (Bailey, figs. 13 and 14), row 6.

Fan system, Station modification, row 5.

Kniffin two-wire, four-cane, row 4.

Kniffin overhead, row 3.

Fuller renewal, row 2.

High renewal, row 1.

It is believed that by the application of these methods, with an assortment of vines showing so much variation in hardiness and habit of growth as does the above list of varieties, a fair idea can be arrived at of the comparative fitness of these representative systems for Kansas conditions. This duplication of systems will also leave an opportunity for tests of spraying and non-spraying, and covering and exposure, of vines. West of these 10 rows are two others, one for *Vitis Solonis* and one of *Vitis Doniana*, which will afford protection from sweep of southwest winds and present more nearly uniform conditions to the 10 rows than if they were exposed on the west.

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\*"Grape Training," L. H. Bailey.



*Forestry.*—The forest plantations on the old College farm have come through the years of drought looking very badly, but this very fact, furnishes much valuable information and suggestion as to endurance of varieties. It may be seen that soft maple, cottonwood, and box-elder, so commonly planted on uplands because of the ease of obtaining young trees, are in no way to be compared with white or red elm, honey locust, Osage orange, or, of the conifers, Scotch and Austrian pines and red cedar, in their ability to live through years of drought. Another valuable lesson afforded is, that in the conditions of shade and shelter offered by some of these less permanent, but quick-growing sorts volunteer seedlings of some of our most valuable native trees, notably the chestnut oak, *Quercus acuminata*, and the red cedar, are beginning to come in in numbers, suggesting that with the planting of such at proper time, and the judicious removal of the nurse frees, the valuable sorts may readily be established, if necessary time is allowed.

A block of Scotch and Austrian pine on the bottom land just east of the fruit plantations has also been devoted to a forest experiment by vote of the Station council, and the space east of that to the public road, to a permanent pinetum.

Measurements of growth in height and circumference have been kept on the pines during the past two seasons, and the plan is to follow forestry methods in thinning, and recording development as completely as can be done on so small a scale. The record of years on this will be of very great value. The pinetum now comprises well-grown specimens of 10 to 25 years old, of six species of pine, four of spruce, and several other conifers, while younger trees are being added as rapidly as means will permit.

The extensive arboretum of ornamental trees and shrubs and the plantations about the grounds comprise the largest collection of suck material in the state. This, while the property of the College and planned primarily for the education of the students and the public, has afforded to the Station the opportunity for a large number of observations on the time of leaf and flower, behavior under stress of season and best means of propagation of the material included. Material is now on file and photographs in stock for a very valuable report on this subject.

A series of experiments on the pruning of forest-trees and ornamentals has been carried on in these grounds, and lacks but a year or two of completing what will afford valuable information on this subject.



*Greenhouse Heating.*—In the greenhouses a complete record was kept for two months of the coal burned daily by periods, with records of the water temperature in the mains, and of the temperature maintained in all the houses and rooms connected with this heating system. A few notes were also made of the radiating temperature of the pipes in different parts of the system, flow and return. The most of the tedious detail of this work was kept by Mr. H. W. Moore, a post-graduate student, who has had charge of the heating system for the past two years, and who is making a special study of greenhouse heating and construction. I would earnestly recommend the continuance of these experiments, for the reason that in our country of dry, cold winds and clear skies the problems presented are very different from those offered in the eastern states.

#### Irrigation.

The general conditions were such, both at the College and in the state, no provision having been made by the legislature for continuing experiments, that it seemed best to both the Council and the Board to undertake no general experiments in irrigation. By order of the Board, the substation at Oberlin was abandoned, and Hon. W. D. Street, ex-Regent of the College, under whose direction all work there has been done, was requested to ship to the College the wind-mill and other property of the station. (He has promised to do so, but at this writing nothing has been received.)

#### The Staff.

No changes have been made since the last report, but for the coming year the reorganization of the College brings an almost complete reorganization of the Station force. Of the present Council Professor Hitchcock remains, though Secretary Graham retains former duties. Professor Willard is promoted to the Council as chemist. Assistants Burtis, Otis and Clothier retain their places. After September 1, 1897, by action of the Board of Regents, the staff will stand as follows:

#### COUNCIL.

President WILL, Chairman, *ex officio*.  
Professor COTTRELL, Agriculture.  
Professor HITCHCOCK, Botany.  
Professor WILLARD, Chemistry.  
Professor FAVILLE, Horticulture.  
Professor FISCHER, Veterinary Science.

ASSISTANTS.

F. C. BURTIS, M. S., Agriculture.  
D. H. OTIS, M. S., Agriculture.  
GEORGE L. CLOTHIER, B. S., Botany.  
PERCIVAL J. PARROTT, A. B., Entomology.  
WM. L. HALL, Horticulture.

***Conclusion.***

The Council have no hesitation in commending to the test of time and examination the work of the past nine years, as exhibited in its publications. It has presented a large variety of investigations, in a thoroughly scientific spirit, and in a manner to meet the approval of the best investigators and the most enterprising farmers of the United States. Criticisms offered have shown either a misapprehension as to the purpose of the Station, or imperfect information as to its work.

The list of publications, appended to this report, shows 73 bulletins and 10 annual reports, a total of — pages of matter, compact and explicit, worthy of preservation in every farmer's library for frequent reference. All this matter presents, not mere compilation of current information, but actual original investigations of fundamental importance in the advancement of scientific agriculture. It has settled beyond question the advantage of some methods of seeding and cultivation, as well as some methods of feeding; and has tested many varieties of grains, fruits and vegetables to the satisfaction of all. It has shown the possibilities in culture of sorghum and beets for sugar, and has introduced to the state its best forage plants and established their value as feeds. It has gathered data upon the life-history of a multitude of insects, injurious and beneficial, has tested and promulgated methods of fighting obnoxious ones, and laid foundations for much good work in the future.

That many important questions remain untouched must always be true, however extensive the researches. Many years of trial are required to reach satisfactory conclusions in even a few. We urge our successors and all interested farmers of the state to be willing to "make haste slowly" in drawing inferences to serve for all time. A genuine spirit of investigation has entered farming to stay, and must be allowed room and means and time for its work.

In the past it has been difficult to secure prompt and satisfactory printing of Station matter without expending too large a portion of available funds. We once more earnestly advise that the state be urged to put this printing with other state printing, where it naturally belongs, as many other states have already done. It is pleasant to re-

cord that the form of publications adopted by this Station in 1890 has, during the present year, been recommended for all the stations by a special committee of the Association of American Agricultural Colleges and Experiment Stations.

Respectfully submitted.

GEO. T. FAIRCHILD.  
GEO. H. FAILYER.  
E. A. POPENOE.  
C. C. GEORGESON.  
N. S. MAYO.  
A. S. HITCHCOCK.  
S. C. MASON.

COLLEGE, June 30, 1897.