ELEVENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK
Agricultural Experiment Station,

(GENEVA, ONTARIO CO.)

FOR THE YEAR 1892,

WITH REPORTS OF DIRECTOR AND OTHER OFFICERS.

TRANSMITTED TO THE LEGISLATURE APRIL, 1893.

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STATE OF NEW YORK.

No. 82.

IN ASSEMBLY,

APRIL, 1893.

REPORT

OF THE

Board of Control of the New York Agricultural Experiment Station.

HON. WILLIAM SULZER,

Speaker of the Assembly:

SIR.— I herewith transmit to the Legislature the Eleventh Annual Report of the New York Agricultural Experiment Station.

Very respectfully,

Your obedient servant.

W. C. BARRY,

President of Board of Control.

1892.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

ROSWELL P. FLOWER, *Governor*.. Albany.
W. C. BARRY, *President*............ Rochester, Monroe County.
JAMES McCANN.................... Elmira, Chemung County.
DANIEL BATCHELOR............. Utica, Oneida County.
CHARLES JONES.................. Geneseo, Livingston County.
G. S. MILLER....................... Peterboro, Madison County.
GEORGE F. MILLS .... Fonda, Montgomery County.
PHILIP N. NICHOLAS .... Geneva, Ontario County.
ADRIAN TUTTLE.................. Watkins, Schuyler County.
S. H. HAMMOND.................. Geneva, Ontario County.

STATION OFFICERS.

Director .... Dr. PETER COLLIER.
First Assistant........................... WM. P. WHEELER.
Chemist.................................. L. L. VAN SLYKE, Ph. D.
Horticulturist............................ S. A. BEACH, M. S.
Assistant Chemist....................... C. G. JENTER, Ph. C.
Assistant Chemist....................... A. L. KNISELY, B. S.
Assistant Chemist....................... W. B. CADY, Ph. C.
Assistant Chemist....................... *B. L. MURRAY, Ph. C.
Assistant Chemist....................... *A. D. COOK, Ph. C.
Assistant Chemist....................... *J. T. SHEEDY, Ph. C.
Assistant Horticulturist................. C. E. HUNN.
Agriculturist .... GEO. W. CHURCHILL.
Clerk and Stenographer.................. FRANK E. NEWTON.

Post-office address: Geneva, Ontario County, N. Y.

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* Connected with Fertilizer Control.

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Eleventh Annual Report

of the

Board of Control of the New York State Agricultural Experiment Station.

REPORT OF THE EXECUTIVE COMMITTEE.

Since our last report your committee have held their regular monthly meetings at the station, often with other members of the board being present during our deliberations.

At these monthly meetings the director has submitted a statement from each member of the staff, giving in detail the work which has been carried forward by each during the month previous to this meeting, and the treasurer at such monthly meetings has furnished a statement of the expenditures and balances remaining of the several appropriations for the station, general and special, by which means your committee have been able to keep fully informed of the nature and progress of the work being done in the several lines at the station, as also of its financial condition from month to month.

Your committee have to report the following work in the line of permanent improvements, as having been accomplished during the past year, for several of which, in accordance with their recommendations, the Legislature at its last session made special provision, viz.:

1. The two basement laboratories in the wings of the new chemical laboratory have been completed substantially uniform in style and finish with the remainder of the building, thus bringing all the chemical work of the station, a portion of which had previously been done in the village, into one building, and providing

ample facilities for carrying forward the various lines of chemical investigation, which may be grouped together as follows:

(a.) The analysis of commercial fertilizers under the provisions of "An act for the protection and education of farmers and manufacturers in the purchase and sale of fertilizers." (Chapter 437 of the Laws of New York.) The extent of this work may be inferred when we say that over one thousand samples in all of such fertilizers have been taken by agents of the station from the several counties of the State.

(b.) The analysis, chemical and microscopic, of the milk from each individual of the seven different breeds of dairy cows under investigation at the station.

(c.) The analysis of the several foods, hay, roots, ensilage, fodder, green forage crops and grain for the different breeds of dairy cattle, by which means the amount of each food constituent consumed by these animals is accurately determined.

(d.) A determination, at present in progress, of the quantity and composition of the ash of the several varieties of fruit trees, and the fruit of the same, in order that the demands of these upon the soil may be definitely determined, and its supply more intelligently provided for by our fruit growers and nurserymen.

(e.) General chemical work so far as it may be done without interfering with the regular investigations in progress, in reply to the requests of correspondents.

1. A supply of gas for the laboratory and the house has been secured by connections made with the gas mains of the village, thus greatly facilitating the work in the laboratories.

2. Four cold-storage rooms have been constructed by the Wicke's Refrigerator Company, by which it is hoped that important results may be secured in reference to the preservation of the several varieties of fruits and berries.

3. An ice-house twenty-four feet wide, forty-eight feet long and 30 feet high has been built according to the most improved methods of construction, and capable of holding 450 tons of ice, a quantity ample for the needs of the station in its investigations in the dairy and with the cold-storage system.

4. An artificial pond has been formed by inclosing a space seventy-five by 200 feet along and aside of the course of the creek passing through the farm, by which an ample supply of ice was obtained for filling our ice-house. It may be that this pond will also be utilized for the growing of carp.

5. The buildings have all received a new coat of paint with the exception of the dwelling house, upon which the tin gutters have been replaced by new ones, and a coat of paint applied to them.

6. The southern boundary of the farm has been carefully ascertained by survey, and a line fence built sufficient for the protection of the property and crops of the station from the encroachments of the cattle of adjoining neighbors; and a sidewalk of stone has been laid from the dairy to the rear entrance of the chemical laboratory, as also from the front of the laboratory to the street, thus completing these approaches to this building.

7. Several lines of drain-tile have been laid during the past year, mainly to carry off the accumulations of surface water in the spring.

During the past year there have been published, in editions of 10,000 copies of each, ten bulletins, aggregating 336 pages, giving information from time to time of the results of the investigations being pursued at the station. Three additional bulletins are now in press.

A farmers' bulletin, being practically an address given by the director at one of the farmers' institutes, entitled "What the New York Agricultural Experiment Station is doing for the farmer," has been widely distributed at the several farmers' institutes held throughout the State, and has been very helpful in calling the attention of our farmers to the work being done in their behalf, as is evidenced by the greatly increased demand for the bulletins of the station, which demand has resulted in the exhaustion of the supply of several of these bulletins.

For the information of those who have not secured this farmers' bulletin, it has been embodied in the report of the director, and will obviate the necessity of your committee referring in detail to the work carried forward by the director and his several assistants.

The correspondence of the station and the applications for its bulletins and other publications increases daily, and the letters for advice on all matters pertaining to agriculture, all give conclusive testimony that the work of the station is rapidly becoming more and more appreciated by the people, and, by its increased dissemination, of rapidly increasing value to the farmers of the State, in whose behalf directly it is being done.

Your committee desires to urge again the importance in carrying forward this work, that provision be made by the Legislature for the following necessary equipments in order that the fullest opportunity shall be presented for making the work of the station still more effective, viz.:

1. Four residences for married members of the staff, several of whom are forced to reside for one mile to a mile and a half from the station.

2. A green-house and forcing-houses, by which much of our horticultural work may be carried on the entire year, thus often gaining a year in solving many important questions of immediate value to the farmer, the fruit grower and the market gardener.

3. The means of printing and distributing an edition of 1,000 of each of our bulletins in each county of the State. At present the bulletin mailing list contains about 8,000 names and is daily and rapidly increasing.

JAMES McCANN,
CHARLES JONES,
GERRITT S. MILLER,
P. N. NICHOLAS,
S. H. HAMMOND,
ADRIAN TUTTLE,
Executive Committee.

Geneva, New York, January 1, 1893.

REPORT OF THE TREASURER.

GENEVA, N. Y., *October* 1, 1892.

To the Board of Control of the New York Agricultural Experiment Station:

As treasurer of the board of control, I do respectfully report:

That I have received from the Treasurer of the State of New York for the twelve months ending September 30, 1892	$40,000 00
That the balance on hand September 30, 1891, was	18 69
Total	$40,018 69

And I do further report that I have expended during the twelve months ending September 30, 1892, $40,002.47, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Farm	$1,343 97
Freight, cartage and express	273 15
Fuel	1,171 79
Furniture	8 25
Labor	11,452 77
Laboratory department	1,013 47
Library	110 45
Live stock	715 10
Manure and fertilizer	287 64
Meteorological department	16 75
Permanent improvement	2,766 65
Postage expenses	1,032 07

Printing	$1,564 97
Repairs	436 50
Salaries	12,765 88
Scientific apparatus	291 50
Stationery	541 75
Sundries	35 01
Supplies	2,661 17
Tenement-houses	423 59
Travel	280 78
Board of control	511 8[illegible]
Insurance	252 37
Water	45 08
	$40,002 47
Balance on hand	16 22
Total	$40,018 69

And I do further report that I have received from the Treasurer of the State of New York on account of fertilizer control for the twelve months ending September 30, 1892, $15,000; that th balance on hand September 30, 1891, was $4,231.30; total, $19,231.30. And I further report that I have expended on this account $16,622.46, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Freight, cartage and express	$39 70
Fuel	23 75
Laboratory construction	12,013 52
Postage expenses	530 00
Printing	514 40
Salaries	1,365 03
Supplies	397 19
Gas	287 00
Miscellaneous	20 55
Rent	375 00

Water	$51 81
Securing samples	569 43
Plumbing	435 08
	$16,622 46
Balance on hand	2,608 84
Total	$19,231 30

And I do further report that I have received from the treasurer of the State of New York a special appropriation of $6,000 for completion of laboratory. And I do further report that I have expended on this account $4,273.26, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Balance of laboratory contract	$2,500 60
Masonry	497 47
Carpentry	562 50
Materials	266 14
Shutters	411 95
Painting	21 46
Furniture	8 50
Printing	4 64
	$4,273 26
Balance on hand	1,726 74
Total	$6,000 00

WILLIAM O'HANLON,
Treasurer.

Report of the Director.

PETER COLLIER, A. M., M. D., Ph. D.

To the Board of Control of the New York Agricultural Experiment Station:

Gentlemen.— I herewith sumbit the eleventh annual report of the experiment station for the calendar year 1892.

The report of the executive committee of the board of control will show what has been accomplished under their direction during the past year in the completion of the new chemical laboratory and in building of an icehouse, cold-storage rooms the construction of an ice-pond, and in the necessary repairs and improvements to buildings, fences and roads. Their report presents also their opinion as to what additional facilities are demanded in order to render the work of the station of still greater value to the farmers of the State.

Bulletins Published During the Year 1892.

During 1892 there have been distributed eleven bulletins containing an aggregate of 336 pages, upon the following subjects:

Bulletin No. 38, January, 1892.— Oyster shells as food for laying hens.

Bulletin No. 39, January, 1892.— Feeding experiments with poultry; skim-milk for growing chicks; feeding tallow to hens; feeding salt to hens.

Bulletin No. 40, March, 1892.— Black knot on plum and cherry.

Bulletin No. 41, April, 1892.— First, influence of copper compounds in soils upon vegetation; second, spraying with fungicides for prevention of potato blight; third, analyses of materials used in spraying plants.

Bulletin No. 42, May, 1892.—Analyses of commercial fertilizers.

Bulletin No. 43, June, 1892.—Experiments in the manufacture of cheese during May.

Bulletin No. 44, August, 1892.—Strawberries.

Bulletin No. 45, August, 1892.—Experiments in the manufacture of cheese during June.

Bulletin No. 46, September, 1892.—Experiments in the manufacture of cheese; Part I, experiments made during July; Part II, experiments made during August.

Bulletin No. 47, November, 1892.—Experiments in the manufacture of cheese; first, experiments made during September; second, experiments made during October.

Bulletin No. 48, December, 1892.—Some bean diseases.

The Farmers' Institute Bulletin.

In addition to the above regular bulletins there was prepared by the director, at the request of George T. Powell, director of the farmers' institutes, an address upon the subject, "What is the New York Agricultural Experiment Station doing for the Farmer?" which address was delivered at the institute held at Auburn, and was afterwards printed and distributed widely at the remaining institutes held about the State.

The result of such distribution has been manifest in a very great increase in the requests of the farmers for copies of those bulletins and reports which contained information concerning matters of special interest to them, and in certain cases appears to have been the first evidence to many of our farmers that such an institution as the New York Agricultural Experiment Station existed.

It has appeared desirable, therefore, to reproduce this bulletin in order that our farmers may know what work is being done in their behalf and that they may avail themselves of whatever of benefit there is to them in these investigations continued now for the past twelve years.

WHAT THE NEW YORK STATE AGRICULTURAL EXPERIMENT STATION IS DOING FOR THE FARMER.

An address given at the Farmers' Institute, held at Auburn, by Dr. PETER COLLIER, Director N. Y. Agricultural Experiment Station, Geneva, N. Y.

The New York Agricultural Experiment Station.

June 26, 1880, an act was passed establishing an agricultural experiment station, the object of which was set forth in section 1 of the act which reads as follows: "For the purpose of promoting agriculture in its various branches by scientific investigation and experiment."

Some little time was expended in the selection and purchase of a suitable location, the result being that upon February, 1882, a deed was executed transferring to the State of New York approximately 125 acres of land near the village of Geneva, Ontario county. The experiment station therefore is now in the eleventh year of its active life.

During all these years it has regularly published an annual report which in addition to the many bulletins which have been issued, have enabled all who have chosen to avail themselves of these publications to possess constant information of the work during all these years of its existence.

It is, however, a matter rather for regret than surprise that comparatively few of our farmers are in possession of this information which by careful experimentation and constant labor is obtained for their benefit by those engaged in the work of the station, and questions are constantly asked at our farmers' institutes which seem to prove that the objects, aims and results of the work at our experiment station are by no means as clearly understood by our farmers, for whom directly this work is being done, as they should be, and the director of the institutes has therefore thought it best to request Dr. Collier, the director of the station, to present briefly a statement of the work of the Agricultural Experiment Station.

Personally I can say from a more or less intimate knowledge of the various lines of work being carried on at the station that, at this juncture in our agricultural experience when farmers are struggling in the toils of competition and are reaching out for knowledge and greater information to bring to their aid in farm management, the station is doing much practical and valuable work, which, if it could be more generally disseminated, and farmers would take more time to note, study more carefully and apply the carefully worked out results to their farm practice, would greatly benefit them and a larger measure of prosperity would attend their work.

In horticulture there were never so many difficulties to meet as at the present time, and the station is working upon these thoroughly, solving some very important questions as to the value of varieties, the treatment of the various fungus attacks upon them, the knowledge of which fruit growers can not afford not to be in full possession of.

The work at the station along the dairy line has been no less important than others. Our cheese-makers in some localities have been working at serious disadvantage for years under the impression that by removing a portion of the butter fat from milk in process of manufacture they were making a small gain financially, which the station has proved during the past two years to be a mistake beyond all question of doubt.

While farmers' institutes and dairy conferences are being held in all parts of our great State to awaken farmers to the importance of applying more skill and intelligence in all of their methods, which is doing great good, the State has equipped and furnished the experiment station in the interest of a more prosperous agriculture, and farmers should awaken to the privilege and opportunity which is theirs to make demands upon and use its work to their especial benefit, and those who do not avail themselves of the knowledge that is being worked out in these various lines and apply it in their farming will certainly be forced sooner or later to abandon their farms.

GEO. T. POWELL,
Director Farmers' Institute.

REMARKS OF DR. COLLIER.

Director of the New York Agricultural Experiment Station.

Ladies and Gentlemen.— I am greatly under obligations to my friend, Director Powell, that he has given me this opportunity to appear before you at this time, and especially that he has been good enough to have assigned for me the subject upon which I am to speak to you, since had I chosen it myself it might seem as though I had made for myself the opportunity to perhaps boast somewhat as to the work which we have already accomplished at Geneva, and upon which we are at present engaged.

As preliminary to what I may have to say, I desire at the outset to state for the information of those who may not, perhaps, know about the general organization of the station, that it is under a board of control, consisting of ten members, the Governor of the State being at the head; and I would say that upon this board there have been at least three ex-presidents of the State Agricultural Society and many others equally prominent in agricultural matters. I would add that, while this board meets not infrequently, they have appointed from their number an executive committee of six members, who meet every month, and to whom is regularly submitted a detailed statement of the work which has been carried forward in each department of the station's work during the preceding month. Besides an auditing committee, composed of three members of the board of control, make personal examination of every item of expense incurred. It may therefore be taken for granted, I think, first, that there is no wasteful expenditure of public money, and also that the work upon which we are engaged at the station is such as will commend itself to the critical judgment of all those who may investigate it as being directly in the line of that work for which, by the act of incorporation, the station was established, and directly calculated to render invaluable service to the farmers of the State, for whom directly these investigations are being planned and carried forward.

In presenting, therefore, at this time, as I shall do, a necessarily brief mention of the several items of work which have been accomplished in the several divisions into which our work naturally divides itself, it is obvious that I can not stop to enlarge upon the importance of many, if any, of these, nor dwell upon the amount of labor and time spent in each investigation before satisfactory conclusions have been reached, but I shall give the volume and page of each annual report or the number and page of each bulletin where all the data concerning each investigation has been carefully recorded, so that whoever of you may be interested in any particular matter may, by application to the station, possess such bulletin or report, provided that they are not already in your possession as they should be.

As evidence of the rapidly increasing interest among our farmers in the work of the station, the following statement of the clerk and stenographer (Mr. F. E. Newton) is submitted. Besides the mailing of bulletins and circulars, which now amounts to a daily average of over 350, the number of letters written, of which copies have been kept as worth preserving, will show the increase in the correspondence of the station since its establishment:

1882	644
1883	662
1884	218
1885	401
1886	600
1887	405
1888	1,204
1889	1,209
1890	1,360
1891	1,561
1892	1,756

As will appear from the above, the station has become to many of our people a bureau of information concerning matters pertaining to agriculture. At present there are about 7,500 names upon our bulletin mailing list, and this number could be without effort quadrupled were the means at hand to meet the expense of printing and mailing such increase in number, since, as will be seen, we at present average not more than one to every fifty of our farmers. Applications for the bulletins of the station increase daily. Eleven bulletins have been issued during the present year, aggregating 333 pages, and the demand for publications and for advice on all matters pertaining to agriculture gives conclusive testimony that the work of the station is rapidly becoming more and more appreciated by the people, and by the increased dissemination of its publications rapidly increasing in value to the farmers of the State in whose behalf directly the work is being done.

The value of the agricultural products in New York amount in the aggregate to at least $130,000,000 and probably to $150,000,000 annually, or upon an average from $340 to $400 a year for each of our 380,000 farmers.

The leading crops of New York are equal in value to 5.7 per cent of the total production of the United States; the farm animals to 5.8 per cent; number of milch cows to 9.7 per cent; while their value is 12.4 per cent of the value of all the cows in the United States.

It will be seen, therefore, that our State is not only in name but in comparison with other States, the Empire State, and that the work of our experiment station is one of the most important factors in enabling us to retain this proud pre-eminence.

When we consider the great diversity which exists in our State in soil, climate and in the character of its agricultural products, it is doubtful whether New York is surpassed by an equal area upon the globe.

It would appear most desirable therefore that everything should be done which may enable the station, now for ten years established, to carry forward the work of investigation and accomplish that purpose for which it was organized.

It is gratifying to observe that for ten years the average acreage yield of the principal farm crops in New York has, in every crop, exceeded the average of the New England and Middle States.

In 1888 the principal farm crops had an acreage of 8,967,318 and a value of $121,333,857, while all the New England and Middle States, without New York and Pennsylvania, had an aggregate acreage of 8,912,373 acres, and their products were valued at $121,298,366; somewhat less in area and in value than New York alone.

The New England States and the Middle States excepting New York and Pennsylvania, have in all nine experiment stations. Had New York a number proportional to its acreage of cultivated land it would have eleven. Had it stations in proportion to the aggregate value of its leading crops, it would have twelve.

The following table presents a comparison of certain of the agricultural statistics of New York with the New England and Middle States, excepting Pennsylvania, an examination of which may surprise many who have not had their attention directed to the matter.

COMPARATIVE STATISTICS OF NEW YORK AND THE NEW ENGLAND AND MIDDLE STATES.

	Number acres in leading crops 1888.	Total value of leading crops 1888.	Number of farms.	Number of farmers.	Number of cows.	Value of cows.	Acres improved in farms.	Acres unimproved in farms.	Total acres in farms.	Area in square miles.	Per cent in farms.
Maine	1,594,252	$20,136,946	64,309	82,130	175,940	$4,398,725	3,484,908	3,067,670	6,552,578	33,040	31
New Hampshire	802,184	9,574,799	32,181	44,490	103,011	2,846,194	2,308,112	1,413,061	3,721,173	9,365	62
Vermont	1,303,476	14,592,101	35,522	55,251	234,642	5,572,748	3,286,461	1,596,127	4,882,588	9,565	80
Massachusetts	792,638	14,905,768	38,406	64,973	174,729	5,678,693	2,128,311	1,230,768	3,359,079	8,315	63
Rhode Island	132,755	2,394,387	6,216	10,945	24,041	745,271	298,486	216,327	514,813	1,250	64
Connecticut	741,800	13,112,938	30,598	44,026	134,897	4,192,599	1,642,188	811,353	2,453,541	4,990	77
New Jersey	1,305,537	19,604,856	34,307	59,214	183,493	6,325,004	2,096 297	833,476	2,929,773	7,815	59
Delaware	398,877	4,062,271	8,749	17,849	29,543	812,433	746,958	343,287	1 090,245	2,050	83
Maryland	1,840,854	22,914,300	40,517	90,927	141,826	3,454,881	3,342,700	1,777,131	5,119,831	12,210	66
Total	8,912,873	$121,298,366	290,805	469,805	1,202,122	$34,026,548	19,334,421	11,289,200	30,623,621	88,600	Av. 54
New York	8,967,318	121,333,857	241,058	377,460	1,552,373	43,637,205	17,717,862	6,062,892	23,780,754	49,170	76
Ratio	100.6	100.3	82.8	80.3	129.1	128.3	91.6	53.7	77.7	55.5	141

But not only is our State imperial in its extent of area and the aggregate of its productions. but also, and this is a most pertinent point of the discussion, in the great diversity of its agricultural products.

William C. Barry told us in his address as president of the Western New York Horticultural Society, that there were in New York 43,350 acres in vineyards. That in 1889 the grapes sold in New York amounted to $5,512,215, and those of California to $4,745,097. New York equals sixteen per cent more.

Our dairy cattle numbered January, 1892, 1,552,217, valued at $40,637,041, nine and one-half per cent of the total number and eleven and one-half per cent of the aggregate value of all the dairy cattle in the United States.

It is estimated that the capital invested in the dairy industry in the State of New York is $400,000,000.

For simply protecting the products of this industry the sum of $95,000 has been placed upon the appropriation bill.

As to all police supervision, we may say in the words of Burns, "what's done we partly may compute, we know not what's resisted." But with all which has been accomplished by this expenditure we will all agree that it has not brought substantial relief to the dairymen of our State in increased prosperity and enhanced prices.

We do not wish to be understood as objecting or even offering to object to this appropriation of $95,000, but to our minds it is clear that had an equal sum been expended in educating and informing our dairymen as to the details and the economies of their business, we feel confident that their products might bid defiance to oleomargarine and all its allies in our markets, and this dairy industry instead of being depressed might soon become one of the most profitable industries of the country.

Let us briefly point out how this may be accomplished.

We have, mainly as gifts outright to the State from the several breeding associations of the country, one of the finest herds of cattle ever brought together, consisting of: Five Holsteins, five Ayrshires, four American Holderness, six Guernseys, five Jerseys, three short horns and five Devons.

These came from herds in New York, Pennsylvania, Vermont, Massachusetts, Connecticut and Rhode Island, and are all registered animals of the finest blood. They are fed the same food, receive the same care, and yet in cost of production of milk the best is to poorest as 100 is to 162, while in cost of production of butter the best is to the poorest as 100 is to 196, while one may be among the least profitable for milk and among the most profitable for butter production.

The annual average of our dairy cows in butter is from 125 to 127 pounds, but we have the report of one dairyman whose herd averaged last year 394 pounds of butter per cow, and he explains why it was not fifty pounds more, and says his herd for the past sixteen years has not failed to yield him an average of 300 pounds per cow and a net profit of over fifty dollars each per annum. On the other hand, we find that seventy-five per cent of the cows in one of our best dairy sections of the State have not paid their cost.

We have proved at the experiment station at Geneva that milch cows gave back in the liquid and solid manure a value in fertilizing constituents, nitrogen, potash and phosphoric acid equal to seventy per cent of the market value of the feed fed the animals, and that three-fifths of this was in the liquid portion. Now the milch cows of this State annually consume, at thirty-six dollars each, $56,000,000 worth of food, seventy per cent of which is $39,200,000; we have besides 1,462,872 horses, mules and oxen costing quite as much more, as also 2,234,747 sheep and hogs. It is safe to estimate the manure made upon the farms of this State at $100,000,000, of which it is also safe to estimate that one-half or two-thirds is allowed to waste.

If we can impress our farmers with the importance of this single point in their practice we shall have repaid many hundred-fold all the expense of our experiment station.

We have sought to impress these facts upon our farmers by means of a colored chart which gives the relative amount of these fertilizing and food constituents in the several farm products and cattle foods. These charts have been distributed to granges agricultural societies and farmers' clubs throughout the State, and have been ordered by stations of several other States for distribution in those States.

In connection with this subject it is well to mention that we annually buy in this State $4,000,000 or $5,000,000 worth of commercial fertilizers, and through the supervision of this business on the part of the experiment stations of the country it has resulted that in their purchase of $4,000,000 worth of these products, the farmers of this State are able to save at least $6,000,000 annually.

This may appear a paradox but it is literally true, since such has been the improvement in quality and reduction in price of these commercial fertilizers during the past twenty years, that the farmers of to-day can for $4,000,000 buy the same aggregate of nitrogen, potash and phosphoric acid, for which they would have had to pay $10,000,000 or $11,000,000 twenty years ago. While business competition has been largely the cause of this improvement in quality and reduction in price, such competition has arisen through the increased information concerning these products which the experiment stations have diffused among the people.

A delegation of grape growers visited the station lately to confer with reference to certain diseases of the vine, foliage and fruit, which were putting in an appearance in the vineyards. As evidence of the amazing rapidity of these invasions of disease, one gentleman who had inspected a diseased vineyard in one section of the State reached home on a Saturday, and carefully inspected his vines to see if this new disease had appeared in his own vineyards, and said that he easily carried in one hand the vines and leaves he found infested, but the following Monday, as he said, a hay rack would not have held the diseased vines, so rapid had been the progress of this disease.

The gooseberry as is known has largely disappeared from our market owing the mildew, and yet at the experiment station we have for successive years grown it absolutely free from any trace of mildew upon either foliage or fruit.

Many have doubtless heard of how suddenly the black-knot invaded and destroyed several thousand plum trees for Mr. George T. Powell, apparently free one year before; and yet after half a century of the ravages of this destructive pest of the fruit grower it is but recently that its true character and life-history has become known and the means of its destruction determined.

Another line of investigation has been developed within recent years and it is found that many of our prevalent diseases, in both the animal and vegetable kingdoms, are due to minute forms of life now known as bacteria; not only this but many of the commonest phenomena of farm life are found to be attributable to these bacteria.

Agricultural science need never lack friends so long as the memory of Pasteur and his achievements remains. It may be recalled how not many years ago a unique consignment passed through this State consisting of two car-loads of silk-worm eggs en-route from Japan to Italy, valued at $250,000, the commercial result wholly of Pasteur's investigations.

In carrying forward the work for which the station was organized, it is obviously impossible to enter upon every line of investigation at once, but it is equally clear that "no branch of the agricultural industry" is to be permanently denied the benefits which may follow scientific investigation and experiment." It is obvious, therefore, that such a station, if it is to accomplish that for which it is established, must gradually reach out into new fields of inquiry, extend its researches into new branches of agriculture, and be prepared to meet new problems which are constantly presenting themselves to the farmer; in short, it must be a growing institution, and must be constantly presenting its needs for the means of such development.

During the past four years the Legislature has generously responded to these demands, and the increased work done appears to have met the cordial approval of those who have been cognizant of the work, and for whom directly it has been done. We know of no expenditure of public money which can result in greater pecuniary return to our people.

We need hardly say that for the work of such investigation as the demands of modern agriculture have forced upon us, there is need for the highest skill which the State can secure. For the solution of the problem of that silk-worm disease, now known as Pebrine, the president of the French academy selected his most esteemed pupil and friend. The results secured at our experiment stations, the lessons taught by those who are engaged in these investigations, are to be at once carried into practice by those of our farmers who seek guidance and counsel from these stations, and the very best service which can be rendered is none too good for the important work, and for such service we must expect to pay as liberally at least as do our colleges, universities and private corporations for similar service.

Before proceeding with a detailed enumeration of the work which has been accomplished thus far, and I shall confine myself to those years with which I am naturally most familiar (though at this point I wish to add my testimony to the excellent work done under my predecessor, work which gave the station an acknowledged and honorable position both at home and abroad and laid ample foundation for the more extended work which has been entered upon during these later years of its existence); it has occurred to me that perhaps it would be well to select at first certain features of the work already accomplished in each of the branches of our labor and explain their necessity and importance, leaving the reader of the reports and bulletins to examine at leisure equally valuable investigations for which there is no time for special mention at this hour.

I would first call your attention to the investigations which have been carried forward at the station in connection with the production of milk, butter and cheese. We have several individuals of each of the seven leading dairy breeds of cattle and every problem connected with the important industry we are endeavoring if possible to satisfactorily solve in our work.

In this connection and as evidence of the magnitude of the work we have undertaken I would quote from one of the most eminent among those who have also given much attention to the solution of these problems. During a recent visit to the station and in speaking of this work he remarked: "Well, Doctor, the truth is that we don't as yet know anything about milk;" and yet while this surprising statement doubtless he would materially modify, the fact remains that it was not far from the whole truth.

For results thus far secured I must refer you to the numerous bulletins which have been issued giving the results of our work.

Concerning ensilage we have by careful feeding experiments found that milch cows digested 334 pounds of food constituents in a ton of fresh orchard grass, and 318 pounds of the same constituents in a ton of such ensilage as we make at the station, so that it is entirely practicable to feed dairy cows during the entire fall, winter and spring upon what is nutritious as is fresh orchard grass. The cows of a winter dairy therefore may be kept upon a ration practically the same as that of summer when our meadows and pastures are at their best.

Chemical Work.

The chemical analyses are mainly connected with the following lines of work:

First. The comparison of dairy breeds of cows with reference to production of milk, butter and cheese. (Tenth Annual Report, pp. 28-121, 299-387.)

Second. Experiments relating to the manufacture of cheese. (Tenth Annual Report, pp. 221-295.)

Third. Analyses of commercial fertilizers according to the provisions of the New York State fertilizer law. (Tenth Annual Report, pp. 404-456.)

Fourth. Miscellaneous analyses, including a great variety of substances.

In the year 1890-91 the number of separate chemical estimations actually performed reached nearly 15,000, and in the year 1891-2, it is much larger.

Some of the more important results reached in connection with the investigations are stated below.

Comparisons of dairy breeds of cattle with reference to production of milk, butter and cheese.

The results presented below are not yet complete but represent the first period of lactation for from one to four animals of each breed:

	Ayrshires.	Devons.	Guernseys.	Holderness.	Holsteins.	Jerseys.
Cost of one quart of milk	$0 0161	$0 0166	$0 0169	$0 0165	$0 0158	$0 0213
Cost of one pound of butter.......	2303	2217	1470	2204	2261	1670
Cost of one pound of cheese	0724	0820	0661	0748	0695	0795
Average monthly cost of food ...	4 33	3 37	3 94	3 46	5 45	4 46
Average monthly profit from milk at two cents per quart	1 05	05	72	72	1 47	*28
Average monthly profit from butter at twenty-five cents per pound	37	43	2 76	47	58	2 22
Average monthly profit from cheese at ten cents per pound...	1 65	76	2 02	1 17	2 10	1 15

In addition to the foregoing data, numerous details are given for each individual animal and for each breed in the tenth annual report in regard to the following points:

(1) Amount of fat in milk. (2) Amount of fat lost in skim-milk and buttermilk. (3) Amount of fat recovered in cream and butter. (4) Yield of butter. (5) Pounds of milk required to make one pound of butter. (6) Pounds of milk required to make one pound of cream. (7) Pounds of cream required to make one pound of butter. (8) Per cent of fat in cream. (9) Daily yield of milk and butter. (10) Monthly yield of milk, cream, skim-milk, butter-milk and butter. (11) Temperature and time of churning. (12) Size and number of fat globules.

Results are also presented showing what effect advance of the lactation period has upon the composition of milk and upon the yield of butter and cheese. (Tenth Annual Report, pp. 369-389.)

Experiments Relating to the Manufacture of Cheese.

In the fall of 1891, eight preliminary experiments were made. In May, 1892, the experiments were continued on a more extended plan. Cheese has been made one week in each month from May to October at five different cheese factories located in Oneida, Oswego, Jefferson and St. Lawrence counties. Fifty of these fac-

* Loss.

tory experiments have been made. In addition, cheese has been made one week in each month for the same period at this station. Fifty-six station experiments have been made. In these 106 experiments, over 200,000 pounds of milk were used, representing not less than 1,500 different individual cows. The results may, therefore, be relied upon as representing a very good average for New York State. Bulletins have been issued giving the results of these experiments month by month. Since every sample of milk, whey and cheese in all these experiments was subjected to complete analyses, an enormous amount of analytical work has been done. The general purpose of these experiments was to learn all that was possible about the conditions that benefit and injure cheese-making. Among the many valuable and entirely new facts brought out, some of the more important are stated below.

1. The amount of fat lost in cheese-making at factories averages about five ounces for each hundred pounds of milk, and this is about eight and one-half per cent of the fat in the milk. The amount of loss is practically independent of the amount of fat in the milk, but is mainly dependent upon conditions of manufacture. Milk rich in fat can be made into cheese with a smaller proportion of loss than can milk poor in fat. The use of "tainted" milk may double the ordinary loss:

2. About all of the albumen of the milk and a small amount of the caseine passes into the whey. Of the caseine and albumen together, there are lost, on an average, about twelve ounces for each hundred pounds of milk, which is about twenty-four per cent of the caseine and albumen in the milk.

3. The average yield from 100 pounds of milk is about ten pounds of cheese.

4. Skimming milk, even as little as one-tenth, makes a marked difference in the composition of cheese, diminishing the fat and increasing the caseine.

5. The amount of fat in the milk is a very accurate guide as to the amount of cheese than can be made from milk.

Other facts studied show the following points: (1) The average composition of factory milk, whey and cheese in this State and variation in composition from May to October. (2) The relation of fat in milk to yield of cheese. (3) The influence of skimming milk and of adding cream upon yield and quality of cheese. (4) The influence of using high temperature, small and large amounts of rennet, of cutting curd soft and hard, fine and coarse, of aerating and separating milk and of various other conditions is given.

Analysis of Commercial Fertilizers.

About 1,000 samples of commercial fertilizers have been collected from every portion of the State and have been analyzed. Most of these results have been given in previous bulletins and reports.

Feeding Experiments.— Poultry and Swine.

Feeding trials have been made with various coarse foods which have been and are often recommended for swine.

Feeding experiments made with good quality of corn silage showed that the silage was fed at a loss except when forming only a small proportion of the ration. (Ninth Report, pp. 141-151. Bulletins 22 and 28.)

Prickley comfrey could not be profitably fed to pigs. (Ninth Report, pp. 151-152. Bulletins 22 and 28.)

Clover forage was not fed profitably except when forming only a small per cent of the total food. This refers to pigs fed in a pen and not at pasture. When clover forage constituted only about twenty per cent of the water-free food in a ration the larger part of which was corn meal, it was profitably fed. (Ninth Report, pp. 154-156. Bulletin 28.)

Short feeding trials with sorghum and mangolds gave encouraging results, and more extended trials are now being made. (Ninth Report, pp. 156-158. Bulletin 28.)

The feeding of salt to pigs in small quantities has given good results when added to the rations usually fed, but with mangolds was of disadvantage. (Tenth Report, p. 205. Bulletins 22 and 28.)

Analyses of pig manure from lots fed different rations have been made, indicating the value of solid manure from every 1,000 pounds hogs to be raised from eighteen to nineteen dollars per year.

The results of experiments in feeding dry grain food and food soaked in water from eighteen to forty-eight hours are not yet ready for publication, but show little difference between the methods.

Experiments are being made to ascertain how long young pigs can profitably be kept with the sow.

Several feeding experiments have been made with pens of laying hens, several feeding periods each extending through one whole laying season and one feeding period through two seasons. It was found that while disease attended the exclusive or excessive feeding of corn meal, yet of two mixed grain rations that containing the more corn meal gave the best results in egg production except with the largest breeds when closely confined, when less corn gave better results. (Eighth Report, p. 61. Ninth Report, pp. 123-127. Bulletin 29.)

When laying hens were fed an unusually large proportion of fat in their rations no disadvantage in laying was apparent so long as a fair amount of proteine was fed, but the period of moulting was delayed and lengthened, while moulting was hastened under a liberal feeding of linseed meal. (Tenth Report, p. 194-199. Bulletin 39.)

Experiments in feeding salt to hens indicated that fine salt at the rate of one ounce per day for 100 fowls could be fed without injury. (Tenth Report, p. 200. Bulletin 39.) Experiments have shown that skim-milk can be profitably fed to growing chicks, chicks being grown to marketable age at cost for food of less than five and a half cents per pound. (Tenth Report, pp. 139-193. Bulletin 39.)

It has been found that oyster shells can be used by the hens as a source of material for egg shell. Hardly any question has been the cause of more controversy among poultrymen during the last few years. (Tenth Report, pp. 182-189. Bulletin 38.)

Experiments with capons have been made and are being continued.

Results of feeding experiments with capons made in 1891 are held for publication with those obtained in 1892 as the additional data will make conclusions more reliable.

Methods of preserving egg have been tried. (Tenth Report, pp. 201-202.)

Analyses of poultry manures from pens of fowls fed differently have been made. (Eighth Report, pp. 61, 62, 64.)

About 500 determinations of specific gravity of hens' eggs were made of fresh eggs, and those kept different lengths of time. (Seventh Report, pp. 65, 67, 68.)

Analyses of many eggs were made. (Seventh Report, pp. 64, 65, 68, 69. Eighth Report, pp. 61, 65.)

A breeding experiment with fowls has been undertaken which will necessitate several years' record before reliable conclusions can be obtained. (Ninth Report, p. 140.)

Investigations of Sorghum.

Many varieties of sorghum have been grown during last few years and the juices analyzed. Only the few to be recommended are retained. In all 289 varieties have been grown, many of them duplicated, however. Only about six of these are of value for this State. (Seventh Report, pp. 71-84. Eighth Report, pp. 67-69. Ninth Report, pp. 162-168. Tenth Report, pp. 208-215.)

Experiments in regard to the value of application of carbonate of lime to the soil on which sorghum is grown have been made. (Ninth Report, p. 168. Tenth Report, p. 210.)

Twenty-one plats in field have been laid out for continued experiment with use of crude chemicals, the plats being treated each year. Record has been kept for three seasons, but results for several years will be necessary before enough data for valuable conclusions will be obtained.

Horticultural Work.

Special attention is given to the disease of cultivated plants. Some important results of this work may be outlined as follows:

Nursery stock has been successfully treated for the leaf blight of plum and cherry, and encouraging results have been obtained in treating the leaf spot of pear seedlings. This nursery work was carried on in co-operation with the United States Department of Agriculture. (Results not yet published by the station.)

The station has also found a cheap and effective remedy for the mildew which heretofore has been so destructive to English gooseberries as to nearly drive them from cultivation. (Eighth Annual Report, pp. 334, 335; Ninth Annual Report, pp. 284 and 307; Tenth Annual Report, p. 475; Bulletin 36.) It has treated successfully the blight of potatoes. (Tenth Annual Report, pp. 465-487), and has been experimenting with remedies for potato scab. (Results will soon be published in a bulletin.)

A very destructive bean disease has been studied during the past season and the results published in an illustrated bulletin. (Bulletin No. 48.) It is found that the disease can be successfully treated at comparatively small cost. The importance of this investigation will be seen at once when it is remembered that in 1880 nearly one-half of the dry beans produced in the United States were grown on New York farms. (The latest results of this work will appear in due time either in the next annual report or in bulletin form.)

Experiments in treating the following diseases have also been made, namely: Apple scab, strawberry leaf-blight. (Ninth Annual Report, p. 270. Tenth Annual Report, p. 467. Bulletins 24, 36 and 44.) Celery leaf blight and stem rot and raspberry anthracnose. (Bulletin 36, Tenth Annual Report, p. 470.) The chrysanthemum leaf-blight which is quite troublesome to florists has been successfully treated. (Results not yet published.) The question whether copper compounds used in spraying have an injurious effect on the soil is also being investigated.

Early in the year an illustrated bulletin on black knot of plum and cherry (No. 40) was issued in which the destructive nature of the disease, its cause and the best means for its control were plainly set forth.

Not the least important work in this line is the answering of numerous questions from every part of the State concerning the diseases of farm and garden crops, nursery stock, and orchard and small fruits, so that the station really serves the agricultural and horticultural interests of the State as a bureau of information on these as well as other subjects.

The horticultural work at the station is devoted chiefly to variety tests of new fruits and vegetables. The orchards now contain of apples, 444 varieties, pears 140 varieties, peaches 108 varieties, apricots fifteen varieties, nectarines ten varieties, plums sixty varieties and cherries forty varieties.

The vineyard contains 161 specimens of named grapes and 106 seedlings not named.

It requires but a short time comparatively speaking to test the small fruits. Many varieties of these fruits have already been reported on and then removed to make room for new comers. (Eighth Annual Report, pp. 298--311; Ninth Annual Report, pp. 259--280; Tenth Annual Report, pp. 460--472; Bulletins, Nos. 24, 36 and 44.) At present we are testing of strawberries, named varieties, 165; station seedlings not named, 400; gooseberries, 226; raspberries, sixty-six; blackberries, thirty-six; currants (red and white), twenty-two, and currants (black), ten.

Encouraging results have been obtained in improving strawberries by systematic crossing. Bulletins 24, 36 and 44; Eighth Annual Report, p. 307; Ninth Annual Report, pp. 274--276; Tenth Annual Report, p. 457.) The work of originating desirable varieties by systematic plant breeding has also been extended to other fruits. The results of testing these varieties of fruit are published each year in the station bulletins or in the annual report.

Black knot of plum and cherry.—The disease of plum and cherry trees known as the black-knot has devastated the plum orchards in some of the oldest plum growing localities of the State. Its destruction in these places literally defies description, and riding through the country one wearies of the sight of black and dying trees. In some other sections of the State where the area devoted to plum growing is being constantly increased this disease is also increasing in prevalence and menaces orchards which have been brought into bearing at great expense.

Some enterprising plum growers realizing that they could not afford to trifle with the presence of the black knot if they would preserve their orchards, by united effort secured the passage of the black knot law by the last Legislature. Since the passage of this law every plum grower is enabled to protect his orchards from the invasion of this disease.

At the time when this subject was being agitated the station prepared an illustrated black knot bulletin for the purpose of presenting in a popular way the results of scientific investigation on this subject. In this bulletin the cause of the malady is plainly set forth and attention is called to the fact that there is no cure for the disease. It is stated that the germs of the disease are produced in the knots in myriads year after year, that they readily float in the air and that when they are ripening every breeze passing over an infected tree may carry away countless numbers of the disease germs and so spread the black knot from neighborhood to neighborhood. Burning the black knot is, therefore, advocated as the only practical way of preventing the disease. Attention is also called to the fact that the same disease which infests the cultivated plum and cherry is also found on several species of the wild plum and cherries, and, therefore, the source of infection may be found in woodlands or hedgerows as well as in diseased orchards.

Gooseberry mildew.— Many people are not aware that English gooseberries far excel American varieties in size of fruit, and that many varieties are not only very large, but also very handsome, sweet and pleasant flavored. Not only is it true that English gooseberries are better than ours but it is also true that comparatively few of them are grown in this State. One great obstacle to the cultivation of these mammoth gooseberries in this country heretofore has been their susceptibility to a fungus disease known as the gooseberry mildew. In experiments conducted at this station this mildew has been successfully and cheaply fought and the result is that English gooseberries are successfully grown on the station grounds year after year. The fungicide used for this purpose is a solution of potassium sulphide at the rate of one pound to thirty-two gallons of water. Fruit sprayed with this mixture may be eaten without fear of any poisonous results. With the knowledge of good methods of culture and successful treatment of mildew we expect that many people will find the cultivation of English gooseberries profitable, and that the area devoted to this crop will doubtless be largely extended as a result of this station's investigations in this line.

Potato scab.— Probably all of the farmers of New York State know this old offender by the above name and do not need an extended description to enable them to recognize its characters. But, possibly, few have stopped to think of the aggregate amount of tubers of marketable size that each year are debarred from the market on account of the scab disfigurations. No careful estimate of the amount of annual loss thus occasioned can be here presented, but it certainly is immense. Recent investigations by experiment station workers in other States have demonstrated that the scab is caused by a fungus parasite. Experiments in preventing this disease have been conducted by this station during the past season, some with partial success, some with total failure. A bulletin on this subject soon to be issued will discuss quite fully the measure of success attained in some cases and the reason for failure in others and will present some valuable hints on the prevention of this disease.

The potato blight, which is the primary cause of a blight of the vines and a dry rot of the tuber frequently followed by soft rot has been successfully and profitably treated at this station by using Bordeaux mixture applied in the form of a spray three or four times during the summer. A good pump and the Vermorel nozzle are believed to be necessary to secure the best results. The treated plants this year gave an increased yield of forty bushels per acre, as compared with the untreated plants. At sixty cents per bushel this means an increase of twenty dollars per acre in the value of the crop. The cost of labor and of materials for four applications of the Bordeaux mixture was at the rate of seven dollars and eight cents per acre, leaving a net gain of sixteen dollars and ninety-two cents per acre apparently due to the spraying.

Bean anthracnose.— Probably few people even in the bean growing districts realize the extent and importance of the bean crop in this State. In the last annual report of this station the director called attention to the fact that but a few years ago New York State produced nearly half (over forty-two per cent) of the total product of dry beans in the United States. If disease, therefore, eats away but a small percentage of this yield the aggregate loss to the State must be thousands of dollars annually. The fact is that many bean fields are invaded by disease every year and the owners do not know it. Unless the loss is large they may not realize that the yield is less than it ought to be. Bean anthracnose is one disease which often causes serious damage to the bean crop. It frequently is called "bean rust," but bean rust is a different disease. During the past year the station has been investigating some of the bean diseases. It has found that the anthracnose may be largely prevented and bulletin 49 tells how and why. It is there stated that the disease is due to a parasite which lives over winter in the seed, and that the selection of good seed is very important. It tells how the disease may be recognized, and gives the formula for a fungicide which has been used with good results in treating bean anthracnose.

EXTRACT FROM POSSIBILITIES IN FRUIT GROWING IN NEW YORK STATE.

By S. D. WILLARD, Vice-President, Western New York Horticultural Society.

"While considering the 'Possibilities in Fruit Growing' we should not forget the work being done directly in the interest of the fruit grower at our experiment station.

"At no other place in the United States can there be found so large a line of varieties of fruits of every description, from the strawberry up to the apple, all being tested with special reference to hardiness, productiveness, ability to resist disease and quality and other essentials especially adapted to the wants of the commercial fruit grower or amateur.

"Are you desirous of knowing more of the habits and value of different varieties of strawberries? It will be strange, indeed, if out of the 600 varieties you can there find in fruit, your curiosity can not be satisfied.

"If interested in the culture of the gooseberry, you can take your choice from 250 sorts; or, if time will admit, study the characteristic of 450 varieties of apples, besides some 600 other varieties of pears, peaches, plums, cherries and other fruits. Such a field for observation can be found nowhere else, and deserves a degree of consideration from the hands of those interested in horticulture not yet given it.

"As in 'the line of our possibilities' comes the question of how best to succeed in the fight as against insect life, fungus and plant diseases of every nature.

"We reply: These subjects are receiving their full share of attention also at our experiment station, and in the near future the intelligent fruit grower of New York State, we believe, will find every difficulty of this kind easily overcome by carefully reading the bulletins and putting to a practical test such information as may be found in them."

REMARKS BY MR. F. E. DAWLEY,

Secretary of New York Poultry Society.

Director Powell, Ladies and Gentlemen.— I wish to call the attention of our friends to the great practical value of the work which is being done at the Geneva station. The execution and enforcement of the fertilizer control law, as spoken of by the doctor is saving to the consumers of commercial fertilizers in this State thousands of dollars annually. It has driven all the goods that were being sold at a great advance over their actual value out of our markets, and to-day we can buy fertilizers with about as much assurance as we can sugar. Speaking of sugar reminds me that many careful and exhaustive experiments have been carried out at the station in this line also. Our citizens who have been growing sorghum have been cheered and encouraged by the director, and the growing of sugar beets experimentally to learn in what sections they contain the most saccharine matter has been encouraged. I predict that at some day not far distant we will be consuming in this State fine granulated sugar grown upon our own lands. Some of the best growing experiments in my own county (Onondaga) have been very flattering, and I have learned within a few days that a great factory is to be erected there next season to manufacture beet sugar on a large scale. The company is already formed, and I understand that many acres of beets are contracted for.

Mr. Powell has referred to what the doctor said relating to the fruit, grain, stock and dairy departments. It would richly pay any of you dairymen especially to visit the Geneva station, if only to see the excellent herd of cattle of seven leading breeds which are there under experiment. And let me exhort you to send for the bulletins and study the cattle feeding experiments, for you can not help being profited by so doing. I wish I had an hour to tell you farmers what they are doing for the poultry interest up there. We must, before we can appreciate what these poultry experiments amount to, know that the farm hen is a great factor in our agriculture. At a recent meeting of the butter, cheese and egg dealers of the country, statistics were presented showing that the poultry sold in 1891 amounted to more than $1,000,000 and the eggs $200,000,000 more, or $300,000,000 for the poultry product of that year. Aside from this we are importing nearly $3,000,000 worth of eggs each year. Now to be brief, the average cost to the farmer to raise a chicken is about nine cents a pound, as near as I can figure it, but at the station they have raised broilers for five and one-half cents per pound. Their bulletins tell you how you can do it, too. At the recent poultry show at Madison Square Garden the Geneva station was awarded the first prize for their splendid exhibit of capons, which exhibit received most marked attention from all in attendance at this grand exhibition. The feeding of oyster shells to help furnish the shell of the egg has been carefully experimented on, and, as the shell is about ten per cent of the whole egg, you can readily see how necessary it is that we know whether this form of lime is of value or not. The experiments which they have made regarding the feeding of clover hay to fowls are, I think, the most valuable to poultry breeders and farmers who keep fowls of any poultry experiments that have been made. I know many breeders who took up this line of feeding as soon as the station recommended it, and they have saved hundreds of dollars by doing so. When we remember that practically no scientific research had been made in this line we may know that the work was very tedious, and many experiments had to be carried on for comparison and verification, and we may well be proud as a State of this work in which our station has been the pioneer.

The cordial indorsements of the work being done at the station by those so well known throughout the State as are Messrs. Powell, Willard and Dawley, is sufficient evidence, were all else lacking, as to the practical as well as scientific value of our investigations, the results of which should be in the possession of every farmer of the State in whatever branch of agriculture he may be engaged.

Agricultural Experiment Stations of Europe, New England and New York.

In my last report I presented certain statistics setting forth the extent of the agricultural industries of New York, as compared with the New England and Middle States, excepting only Pennsylvania, from which it appeared that New York exceeded all the States by six-tenths of one per cent in the acreage of its leading crops, was slightly in excess of all in the aggregate value of its leading crops; that the number of farms and of farmers in New York was over eighty per cent of those in all these States, and that while upon an average in these States but fifty-four per cent of the land was in farms there was seventy-six per cent of the area of New York in farms.

In advancing these great interests by scientific investigation and experiment, New York has by no means been unmindful, but if our State should provide for such work in proportion to what has been done in these New England and Middle States, it should annually appropriate for experiment stations, if in proportion to its number of farmers, $145,542; and if in proportion to the value of its crops, $181,792; and if in proportion to its acreage in crops, $192,123.

The following table shows by comparison how the several governments of Europe have provided for advancing the intelligence and welfare of their agricultural classes by means of scientific investigation of the constantly increasing number of practical agricultural problems.

AGRICULTURAL EXPERIMENT STATIONS OF EUROPE, NEW ENGLAND AND NEW YORK.

	Area in square miles.	Experiment stations.	Square miles for station.	Equivalent number for New York.	Population.	Equivalent number for New York.
Germany	212,028	67	3,164	7	45,234,000	8
France	204,177	53	3,852	6	37,672,000	7
Austria	115,925	35	3,312	7	38,000,000	5
Italy	114,380	17	6,728	3	28,459,451	3
Sweden	170,713	24	7,113	3	4,683,000	3
Russia	2,132,136	14	152,296	$\frac{1}{3}$	98,356,100	$\frac{2}{3}$
Belgium	11,347	9	1,261	19	5,665,197	8
Switzerland	15,992	9	1,777	13	3,000,000	15
Denmark	14,784	8	1,848	13	2,096,400	19
Great Britain	124,282	8	15,535	2	35,246,683	12
Holland	12,687	4	3,172	7	4,000,000	5
Norway	122,780	4	30,695	$1\frac{1}{2}$	1,913,000	11
New England	66,525	8	8,316	6	4,010,529	10
New York	47,620	2	23,810	......	5,082,871	....

If we even include Russia with its vast territory, much of which is wilderness, these countries average one experiment station for every 12,902 square miles, and in proportion New York should have four stations.

If Russia be excluded the average is one station for every 4,702 square miles, and thus proportionally New York should have ten stations.

In respect to population, these countries, including Russia, have one station for every 1,208,436 of their people, and in proportion New York should have four stations, while, if we exclude Russia, the remaining countries have one station to each 886,260 of their population, and in proportion New York State should have six experiment stations.

From the annual reports of the several New England and Middle States the following table has been prepared which gives the income of the several stations and the aggregate amounts paid by each for salaries and for labor; and it will be seen that while the New York station expends for salaries no more than the average of these other eleven stations, it expends nearly four times the average of these eleven stations for labor and while, on an average, the expenses for labor are only twenty-four per cent of the amount paid by these stations for salaries, the New York station pays for labor 91.6 per cent as much as is paid for salaries.

The expenses of the fertilizer-control station consist largely in the skilled chemical work of making analyses.

SALARY AND LABOR EXPENSES COMPARED.

Year.	STATES.	Income.	Salaries.	Labor.	Ratio salaries to labor.	
1890	Maine	$15,812	$9,052	$417	100	4.6
1890	New Hampshire	15,000	7,198	1,101	100	15.3
1890	Vermont	20,250	6,187	2,541	100	41.7
1891	Massachusetts, Amherst	16,397	5,243	2,330	100	44.4
1891	Massachusetts, Hatch	15,000	6,886	1,697	100	24.6
1891	Rhode Island	15,000	5,509	3,975	100	72.1
1891	Connecticut, New Haven	18,608	11,613	1,195	100	10.3
1891	Connecticut, Storrs	8,181	3,962	653	100	16.5
1891	New Jersey	27,000	5,799	872	100	15.0
1891	Maryland	15,000	6,795	2,551	100	37.5
1889	Delaware	15,000	6,712	685	100	10.1
	Average	....	$74,956	$18,017	100	24.0
1891	New York Experiment Station	$40,000	$6,874	$6,296	100	91.6
1891	New York Fertilizing Control	10,000	2,705	987	100	36.5
	Average	$50,000	$9,579	$7,283	100	76.0

THE INVESTIGATION OF THE SEVERAL BREEDS OF DAIRY CATTLE, WITH REFERENCE TO THEIR RELATIVE VALUE IN THE PRODUCTION OF MILK, BUTTER AND CHEESE.

In reference to this important investigation, I can but repeat the words of a former report:

The investigation of this problem planned at this station has from the first been upon lines clearly laid down, confident that in no other way can a satisfactory conclusion be secured, and it is along these lines that it is intended to continue until an accumulation of testimony shall have been secured sufficient to reconcile many at present apparently conflicting opinions to confirm many others which appear to be conclusive, as also to determine many questions intimately associated with the leading problems, concerning which at present no rule of practice exists founded upon well ascertained experimental data.

Of such immense practical importance is this investigation and of such scientific interest that it has been entered upon and carried forward with as little delay as possible, and so manifold and intricate are the questions involved in its discussion that a speedy conclusion of the whole matter can only be hoped for as the result of prolonged investigation.

In the following pages is presented additional data secured since the publication of the last report, a general discussion of which will be reserved until it has been presented.

The following table gives the names of the several animals under investigation, their breed, date of birth, and dates of calving.

NAME OF COW.	When born.	Date of calving, first period of lactation.	Date of calving, second period of lactation.	Date of calving, third period of lactation.
AYRSHIRES.				
Queen Duchess	Feb. 21, 1888	July 24, 1890	Nov. 24, 1891	Dec. 6, 1892
Junietta Peerless	July 26 1888	Feb 4, 1891	May 2, 1892	....
Manton Belle	June 16, 1888	Dec. 11, 1890	Dec. 29, 1891	Nov. 21, 1892
Miss Flow 5th	March 1, 1888	Feb. 5, 1890	Feb 18, 1891	....
JERSEYS.				
Gilderbloom	April 6, 1888	Sept. 9, 1890	Feb. 29, 1892	....
Countess Flavia	May 14, 1888	April 19, 1890	Nov. 14, 1891	Nov. 12, 1892
Barbara Allen	Aug. 18, 1888	Aug. 29, 1890	April 11, 1892	....
Albert's Carol	Jan. 12, 1890	....	....	....
AMERICAN HOLDERNESS.				
Nellie 6th	Aug. 10, 1888	Sept. 13, 1890	Nov. 26, 1891	Dec. 12, 1892
Maggie 6th	Aug. 15, 1888	Sept. 25, 1890	May 17, 1892	....
GUERNSEYS.				
Rosette Ford	May 10, 1888	Nov. 14, 1890	....	....
Oriole	Aug 25, 1888	Dec. 7, 1890	Dec. 8, 1892	....
Stella Select	Dec. 8, 1889	....	....	....
Madame Select	March 3, 1889	....	Oct. 13, 1892	....
DEVONS.				
Ione	March 5, 1888	March 7, 1891	June 30, 1892	....
Genevie's Gift	Sept. 19, 1889	May 15, 1891	Oct. 30, 1892	....
Artalia	Jan. 12, 1889	Dec. 24, 1891	....	....
HOLSTEIN-FRIESIANS.				
Esel 2d	June 22, 1888	July 16, 1890	Aug. 28, 1892	....
Tolsma Art's	April 2, 1888	May 24, 1890	May 23, 1891	Aug 4, 1892
Netherland Constance	July 17, 1890	Oct. 13, 1892	....	....
Beauty Pledge	....	April 5, 1892	....	....
SHORTHORNS.				
Betsy 10th	Nov. 18, 1889	May 5, 1892	....	....
Lady Spencer	Jan. 9, 1890	Oct. 18, 1892	....	....

Quality and Quantity of Food Fed.

The following table which is a continuation of a similar table in the tenth annual report, gives the kind and amount of each food eaten by each animal during each month of the experiment, and it will serve as a guide to those who may desire, during the different months of the year, to supply their animals with a similar ration.

Letters of inquiry are frequently addressed to the station asking for information as to the rations needed for production of the best results, and by consulting the following table one may learn what ration was fed the several animals of our herd each month in the year, and by comparing with other tables presented in this report the effect of such feed, as also of the changes from one kind of feed to another, may be determined, and the knowledge thus obtained is sure to be of interest and may be of great value by way of suggesting certain experiments indicated by the results here recorded. As is well known to the practical feeder, very marked differences are found to result from simply a change of feed without regard to the difference in composition of such feed, and the following pages will record many such changes made with our herd and the results presumably produced thereby.

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FOOD FED COWS DURING EXPERIMENTS.

First period of lactation, continued from Tenth Annual Report.

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1892.						
January	Esel 2d.	426.2	620.0	....	....	247.0
January	Junietta Peerless	310.0	465.0	....	....	186.0
January	Gilderbloom	246.1	434.0	....	....	164.5
January	Barbara Allen	309.9	465.0	....	....	217.0
January	Rosette Ford	309.9	465.0	....	....	217.0
January	Oriole	309.2	465.0	....	....	232.5
January	Ione	247.3	402.4	....	....	186.0
January	Genevie's Gift	239.5	397.9	....	....	124.0
January	Artalia	244.5	417.0	....	....	157.5
February ...	Esel 2d	415.2	580.0	....	....	261.0
February ...	Junietta Peerless	288.9	435.0	....	....	174.0
February ...	Gilderbloom	225.5	402.0	....	....	117.5
February ...	Barbara Allen	260.0	405.6	....	....	154.5
February ...	Rosette Ford	248.9	385.7	....	....	149.8
February ...	Oriole	273.8	421.0	....	....	131.0
February ...	Ione	231.1	377.0	....	....	174.0
February ...	Genevie's Gift	220.9	375.1	....	....	116.0
February ...	Artalia	278.2	377.0	....	....	145.0
February ...	Madame Select	61.4	77.9	....	....	25.0
February ...	Stella Select	62.6	70.2	....	....	25.0
March	Esel 2d	234.0	1,264.0	....	....	279.0
March	Junietta Peerless	184.2	851.0	....	....	126.5
March	Barbara Allen	153.3	844.0	....	....	144.5
March	Rosette Ford	172.0	825.8	....	....	172.0

March	Oriole	176.8	882.0	....	....	173.5
March	Ione	144.3	838.0	....	....	175.5
March	Genevie's Gift	92.3	732.6	....	....	124.0
March	Artalia	152.3	892.0	....	....	155.0
March	Madame Select	178.0	881.1	....	....	173.5
March	Stella Select	180.0	882.0	....	....	173.5
April	Esel 2d	321.6	750.0	....	....	247.5
April	Junietta Peerless	275.3	449.6	....	....	42.8
April	Barbara Allen	87.9	149.8	....	....	24.0
April	Rosette Ford	296.8	381.7	....	....	150.0
April	Oriole	297.0	450.0	....	....	180.0
April	Ione	236.0	449.5	....	....	120.5
April	Genevie's Gift	173.6	449.8	....	....	120.0
April	Artalia	293.2	539.9	....	....	150.0
April	Madame Select	220.1	396.9	....	....	111.1
April	Stella Select	299.8	450.0	....	....	180.0
April	Beauty Pledge	241.4	408.0	....	....	107.8
April	Albert's Carol	34.4	64.0	....	....	17.5
May	Esel 2d	366.7	773.2	....	....	84.5
May	Rosette Ford	309.5	465.0	....	....	155.0
May	Oriole	314.5	465.0	....	....	186.0
May	Ione	243.8	465.0	....	....	33.5
May	Genevie's Gift	188.5	464.6	....	....	124.0
May	Artalia	277.5	558.0	....	....	155.0
M1y	Madame Select	306.0	465.0	....	....	155.0
May	Stella Select	327.0	465.0	....	....	186.0
May	Beauty Pledge	344.5	556.0	....	....	184.0
May	Albert's Carol	283.1	500.3	....	....	184.0
May	Betsy 10th	232.3	363.0	....	60.0	89.5
June	Esel 2d	208.0	....	1503.4	....	6.3
June	Rosette Ford	149.9	....	1308.3	....	150.0

FOOD FED COWS DURING EXPERIMENTS — (*Continued*).

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds grain, mixed.
1892.						
June	Oriole	148.1	....	1309.4	....	170.3
June	Genevie's Gift	119.2	....	1107.9	....	66.0
June	Artalia	150.0	....	1534.0	....	180.0
June	Madade Select	148.6	....	1186.1	....	147.3
June	Stella Select	177.0	....	1409.4	....	180.0
June	Beauty Pledge	180.0	....	1402.3	....	180.0
June	Albert's Carol	149.4	....	1151.7	....	210.0
June	Betsy 10th	131.8	....	1164.1	....	163.9
July	Esel 2d	241.8	....	1377.3	....	....
July	Rosette Ford	154.8	....	1547.6	....	155.0
July	Oriole	153.0	....	1552.1	....	130.2
July	Genevie's Gift	82.9	....	805.9	....	....
July	Artalia	154.2	....	1791.0	....	186.0
July	Madame Select	145.0	....	1297.9	....	124.0
July	Stella Select	185.2	....	1558.3	....	185.7
July	Beauty Pledge	185.0	....	1576.9	....	186.0
July	Albert's Carol	155.0	....	890.6	....	217.0
July	Betsy 10th	123.6	....	1205.8	....	147.4
August	Rosette Ford	154.8	....	1376.8	....	114.5
August	Oriole	154.5	....	1594.9	....	124.0
August	Artalia	154.2	....	1725.3	....	186.0
August	Madame Select	121.7	....	1439.9	....	177.0
August	Stella Select	181.3	....	1619.0	....	211.0
August	Beauty Pledge	184.9	....	1644.9	....	186.0
August	Albert's Carol	133.3	....	968.0	....	241.5

August	Betsy 10th	122.6	....	1097.2	....	147.5
September	Rosette Ford	150.0	....	1254.3	....	30.0
September	Oriole	150.0	....	1374.5	....	120.0
September	Artalia	150.0	....	1469.9	....	180.0
September	Madame Select	143.0	....	1298.5	....	180.0
September	Stella Select	180.0	....	1370.8	....	210.0
September	Beauty Pledge	178.7	....	1481.2	....	180.0
September	Albert's Carol	119.1	....	1049.8	....	240.0
September	Betsy 10th	140.9	....	946.6	....	114.2
October	Oriole	153.3	1179.7	....	....	121.9
October	Artalia	153.4	1360.0	....	....	184.0
October	Mad me Select	60.0	476.5	....	....	36.5
October	Stella Select	185.3	1236.4	....	....	215.0
October	Beauty Pledge	178.3	1402.6	....	....	188.5
October	Albert's Carol	123.7	963.2	....	....	246.0
October	Betsy 10th	124.6	965.5	....	....	168.3
October	Netherland Constance	118.8	667.6	....	260.0	75.0
October	Lady Spencer,	96.9	332.0	....	160.0	50.5
November	Oriole	167.3	540.0	....	363.1	33.0
November	Artalia	159.0	660.0	....	720.0	184.0
November	Stella Select	179.2	600.0	....	712.0	212.0
November	Beauty Pledge	201.9	659.9	....	772.0	216.0
November	Albert's Carol	132.8	515.0	....	658.0	244.0
November	Betsy 10th	169.9	599.1	....	712.0	243.9
November	Netherland Constance	199.0	664.8	....	772.0	234.0
November	Lady Spencer	229.0	647.9	....	772.0	200.9

FOOD FED COWS DURING EXPERIMENTS.

Second period of lactation.

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grains.
1891.						
March	Miss Flow 5th	157.4	668.0	....	....	45.5
April	Miss Flow 5th	296.8	359.2	....	....	121.0
May	Miss Flow 5th	186.0	849.6	....	....	189.0
May	Tolsma Artis	32.0	117.0	....	....	....
June	Miss Flow 5th	180.0	198.0	678.1	....	195.0
June	Tolsma Artis	240.0	213.0	731.3	....	83.0
July	Miss Flow 5th	90.0	470.0	699.0	....	209.5
July	Tolsma Artis	120.0	502.0	742.6	....	260.0
August	Miss Flow 5th	....	876.0	507.2	....	217.0
August	Tolsma Artis	....	980.0	549.1	....	279.0
September	Miss Flow 5th	179.8	....	928.4	....	210.0
September	Tolsma Artis	239.5	....	1028.4	....	270.0
October	Miss Flow 5th	318.0	....	547.0	....	210.0
October	Tolsma Artis	420.1	....	627.0	....	282.5
November	Miss Flow 5th	269.8	629.0	....	....	210.0
November	Tolsma Artis	359.6	723.8	....	....	285.0
November	Countess Flavia	99.0	376.0	....	17.0	43.5
December	Miss Flow 5th	186.0	868.0	....	....	217.0
December	Tolsma Artis	246.8	1078.9	....	....	294.5
December	Countess Flavia	214.4	865.8	....	....	203.0
December	Queen Duchess	177.6	390.1	....	....	196.5
December	Nellie 6th	103.0	435.0	....	....	150.0
1892.						
January	Miss Flow 5th	309.4	465.0	....	....	205.5

January	Tolsma Artis	426.3	619.9	....	....	243.7
January	Countess Flavia	361.3	463.2	....	....	232.5
January	Queen Duchess	419.6	493.0	....	....	195.5
January	Nellie 6th	230.6	343.5	....	....	213.5
January	Manton Belle	410.5	463.0	....	....	191.0
February	Miss Flow 5th	288.6	435.0	....	....	146.0
February	Tolsma Artis	405.8	580.0	....	....	261.0
February	Countess Flavia	289.5	434.3	....	....	217.5
February	Queen Duchess	435.8	522.0	....	....	202.9
February	Nellie 6th	233.8	340.6	....	....	203.0
February	Manton Belle	441.7	522.0	....	....	203.0
March	Tolsma Artis	215.4	1255.1	....	....	253.5
March	Countess Flavia	150.6	898.4	....	....	232.5
March	Queen Duchess	244.4	1043.8	....	....	217.0
March	Nellie 6th	135.4	753.8	....	....	217.0
March	Manton Belle	245.2	1044.0	....	....	217.0
March	Gilderbloom.	99.8	824.8	....	....	140.0
April	Tolsma Artis	366.9	750.0	....	....	141.0
April	Countess Flavia	275.4	480.0	....	....	225.0
April	Queen Duchess	405.2	600.0	....	....	239.5
April	Nellie 6th	171.2	434.1	....	....	210.0
April	Manton Belle	403.7	600.0	....	....	239.5
April	Gilderbloom.	156.1	476.2	....	....	123.2
April	Barbara Allen	184.1	292.5	....	....	77.5
May.	Tolsma Artis	407.9	775.0	....	....	151.0
May.	Countess Flavia	305.7	495.7	....	....	232.5
May	Queen Duchess	430.9	620.0	....	....	248.0
May	Nellie 6th	179.3	445.7	....	....	217.0
May	Manton Belle	430.2	620.0	....	....	248.0
May	Gilderbloom	233.8	496.0	....	....	126.5
May	Barbara Allen	339.1	492.7	....	....	172.5

FOOD FED COWS DURING EXPERIMENTS — (*Continued*).

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1892.						
May	Junietta Peerless	310.7	402.6	....	60.0	96.6
May	Maggie 6th	138.8	179.8	....	45.0	47.0
June	Tolsma Artis	105.0	....	725.1	....	16.0
June	Countess Flavia	148.7	....	1292.1	....	218.0
June	Queen Duchess	209.4	....	1550.7	....	240.0
June	Nellie 6th	91.4	....	1003.8	....	194.6
June	Manton Belle	210.0	....	1549.9	....	240.0
June	Gilderbloom	149.5	....	1309.3	....	150.0
June	Barbara Allen	179.6	....	1416.1	....	180.0
June	Junietta Peerless	179.7	....	1362.7	....	180.0
June	Maggie 6th	149.6	....	1253.5	....	180.0
July	Countess Flavia	141.6	....	1503.0	....	217.0
July	Queen Duchess	210.9	....	1628.9	....	242.0
July	Nellie 6th	74.7	....	1062.0	....	186.0
July	Manton Belle	202.8	....	1788.1	....	229.6
July	Gilderbloom	153.8	....	1528.2	....	155.0
July	Barbara Allen	185.6	....	1681.6	....	192.5
July	Junietta Peerless	185.9	....	1722.6	....	192.4
July	Maggie 6th	152.1	....	1301.0	....	198.0
July	Ione	107.3	....	1342.3	....	144.3
August	Countess Flavia	123.8	....	1236.6	....	190.0
August	Queen Duchess	201.3	....	1577.2	....	211.5
August	Nellie 6th	53.5	....	1258.0	....	186.0
August	Manton Belle	185.7	....	1722.9	....	212.0
August	Gilderbloom	150.9	....	1472.7	....	153.6
August	Barbara Allen	184.8	....	1684.5	....	213.0

August	Junietta Peerless	185.6	....	1780.1	....	246.5
August	Maggie 6th	147.7	....	1434.1	....	248.0
August	Ione	100.2	....	1372.3	....	248.0
September	Countess Flavia	120.0	....	1084.0	....	280.0
September	Queen Duchess	179.8	....	1377.4	....	110.0
September	Nellie 6th	74.2	....	1064.9	....	180.0
September	Manton Belle	185.0	....	1620.7	....	209.9
September	Gilderbloom	149.4	....	1306.1	....	150.0
September	Barbara Allen	180.0	....	1378.2	....	210.0
September	Junietta Peerless	184.9	....	1617.6	....	240.0
September	Maggie 6th	148.6	....	1308.3	....	240.0
September	Ione	143.0	....	1298.6	....	240.0
September	Esel 2d	212.0	....	1365.3	....	261.8
October	Countess Flavia	145.5	890.0	....	116.0	51.0
October	Queen Duchess	195.2	1000.0	....	120.0	59.0
October	Manton Belle	247.0	1297.7	....	156.0	58.0
October	Gilderbloom	152.1	1090.7	....	....	153.0
October	Barbara Allen	185.7	1348.8	....	....	215.0
October	Junietta Peerless	215.7	1423.9	....	....	246.0
October	Maggie 6th	149.0	1034.6	....	....	246.0
October	Ione	152.9	1124.8	....	....	246.0
October	Esel 2d	221.5	1574.2	....	....	305.0
October	Madame Select	83.6	760.4	....	....	101.0
November	Gilderbloom	148.2	539.5	....	656.0	154.0
November	Barbara Allen	180.0	660.0	....	720.0	214.0
November	Junietta Peerless	215.7	636.0	....	772.0	237.9
November	Maggie 6th	158.4	579.5	....	708.0	244.0
November	Ione	158.9	534.0	....	656.0	244.0
November	Esel 2d	230.7	779.8	....	892.0	304.0
November	Madame Select	162.7	659.9	....	720.0	244.0
November	Genevie's Gift	133.7	497.4	....	652.0	162.0

FOODS FED COWS DURING EXPERIMENTS.

Third period of lactation.

	NAME.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1892.						
May........	Miss Flow 5th..........................	266.6	359.8	....	57.3	88.5
June	Miss Flow 5th..........................	180.0	....	1424.0	....	180.0
July........	Miss Flow 5th..........................	185.4	....	1727.4	....	192.5
August	Miss Flow 5th..........................	185.3	....	1781.8	....	246.5
August	Tolsma Artis...........................	201.2	....	1279.1	....	136.4
September ..	Miss Flow 5th..........................	185.0	....	1616.5	....	239.5
September ..	Tolsma Artis...........................	216.3	....	1600.5	....	284.9
October.....	Miss Flow 5th..........................	212.1	1459.8	....	....	246.0
October.....	Tolsma Artis...........................	225.4	1647.8	....	....	263.9
November...	Miss Flow 5th..........................	210.0	711.1	....	78[illegible].0	244.0
November...	Tolsma Artis...........................	231.4	810.0	....	896.0	245.6
November...	Countess Flavia	127.9	....	....	808.0	114.0
November...	Manton Belle...........................	80.5	....	....	512.0	57.0

COMPOSITION BY WEIGHT OF GRAIN MIXTURES.

	Cotton seed meal.	Corn meal.	Wheat bran.	Ground oats.	Linseed meal, old process.	Linseed meal, new process.	Wheat middlings.
Number 24	2	....	7	....	1	....	5
Number 25	3	....	6	2	1	....	2
Number 26	2	3	....	6	....	....	....
Number 27	....	3	5	2	....	2	....
Number 28	2	....	5	3	2	....	....
Number 29	1	....	5	1	....	4	1

PROXIMATE CONSTITUENTS OF THE DRY MATTER IN FOODS FED COWS DURING EXPERIMENT.

Analysis of cattle foods, 1892.

FOODS.	Time fed.	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Fat.	Invert sugar.	Sucrose.	Starch.	Albuminoid nitrogen.	Amide nitrogen.
Mixed grain, No. 23	December 1 to January 31, 1892	13.62	5.44	21.38	8.61	58.79	5.78	0.24	4.88	47.00	3.32	0.10
Ground oats	December 22 to March 31	12.61	3.17	10.81	12.24	69.09	4.69	0.40	1.92	49.20	1.71	0.02
Mixed hay	January 1 to March 31	13.17	5.22	8.13	33.62	49.93	3.10	2.92	2.56	23.90	1.22	0.08
Corn ensilage	January 1 to 31	69.56	3.76	7.56	18.66	66.95	3.07	3.56	0.17	28.90	1.08	0.13
Corn ensilage	February 1 to May 31	71.01	4.01	8.77	18.54	63.66	5.02	0.33	1.02	50.17	1.03	0.38
Mixed grain, No. 24	February 1 to March 31	14.09	5.05	20.69	7.02	62.99	4.25	1.42	3.84	34.90	3.31	......
Mixed hay	April 1 to July 31	11.69	6.62	8.91	33.06	47.61	3.80	3.14	3.54	24.28	1.32	0.11
Mixed grain, No. 25	April 1 to May 31	10.72	5.41	22.06	6.94	58.91	6.68	0.97	3.42	39.50	3.52	0.01
Wheat bran	April 1 to November 30	11.72	6.16	19.13	8.25	60.73	5.73	0.24	4.55	44.92	2.72	0.34
Ground oats	April 1 to November 30	9.99	3.38	12.38	10.38	68.05	5.81	1.69	2.13	39.92	1.91	0.07
Beets	April 1 to September 30	87.40	14.81	16.06	8.87	57.51	2.75	6.25	37.95	2.20	1.71	0.86
Alfalfa forage	June 1 to 30	80.09	10.05	14.06	25.87	43.21	6.81	2.32	0.61	16.10	2.25	0.44
Mixed grain, No. 26	June 1 to July 31	11.54	3.18	18.06	7.46	64.77	6.53	0.51	2.71	57.09	2.89	0.07
Oat and pea forage	July 1 to 24	73.71	6.68	9.06	26.50	51.34	6.42	6.02	3.51	15.50	1.45	0.51
Alfalfa forage	July 25 to August 13	75.49	9.94	12.25	27.72	43.42	6.67	1.48	2.29	11.90	1.96	0.65
Mixed hay	August 1 to January 1, 1893	11.54	5.16	6.00	32.74	51.39	4.71	3.55	4.16	18.30	0.96	0.01
Oat and pea forage	August 14 to September 15	76.92	7.32	14.69	26.33	44.49	7.17	3.42	1.75	17.80	2.35	0.65
Mixed grain, No. 27	August 1 to September 30	11.76	4.37	17.63	7.77	64.85	5.38	0.38	1.78	50.60	2.82	0.12
Alfalfa forage	September 16 to 30	79.03	11.96	20.12	23.39	37.68	6.85	1.68	1.81	10.40	2.63	0.59
Corn ensilage	October 1 to November 15	69.77	3.92	9.00	18.79	62.30	5.99	4.59	0.63	38.70	1.26	0.18
Mixed grain, No. 28	October 1 to November 30	15.34	4.93	20.69	11.76	56.44	6.18	0.75	2.24	22.10	3.06	0.25
Beets	November 16 to December 13	84.95	......	......	......	......	......	......	......	......	......	......

PROXIMATE COMPOSITION OF FOOD FED AND ALSO THE WEIGHT OF EACH ANIMAL FOR EACH MONTH OF THE INVESTIGATION.

The following tables give the number of pounds of each food constituent consumed every month, as also the weight of each animal.

Each table will show very considerable changes in the proximate composition of the several rations, and the result of such changes may be studied with profit in connection with the tables following later, in which tables are given the milk yield and its composition for each month of the experiment.

The first seven tables are continuations from the Tenth Annual Report of the first period of lactation of these animals, and the seven following, complete the milk yield and composition of the milk for these.

The tables following give the same data for those cows whose first period of lactation began after the publication of the Tenth Annual Report.

Finally are similar tables giving the pounds of the proximate constituents of the food fed, followed by the monthly yield of milk, and its composition, for those cows which were in their second period of lactation.

ESEL 2D — HOLSTEIN-FRIESIAN.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1891.							
November	1,212	85.25	464.6	273.5	27.1	151.6	35.4
December	1,221	92.94	476.1	277.3	29.8	142.4	36.6
January	1,251	85.37	437.9	281.5	29.6	178.0	38.0
February	1,295	85.75	439.5	247.5	26.1	169.9	36.7

JUNIETTA PEERLESS — AYRSHIRE.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1891.							
November	934	62.62	335.3	193.3	19.3	111.8	25.7
December	925	64.44	333.1	191.5	20.6	101.9	25.7
January	957	63.50	324.7	209.0	22.0	130.7	28.1
February	1,007	59.00	308.1	176.9	18.2	119.5	25.6
March	1,034	50.56	305.8	217.8	21.6	107.1	23.7
April	1,077	17.12	223.4	161.6	17.0	107.5	23.5

GILDERBLOOM — JERSEY.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1891.							
November	885	52.87	297.0	170.1	17.1	94.6	23.1
December	925	58.62	308.6	178.0	19.0	92.0	23.4
January	965	54.75	279.6	180.0	18.9	108.7	23.8

ROSETTE FORD — GUERNSEY.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1891.							
November	950	66.06	362.7	213.8	21.1	117.2	27.4
December	943	56.81	307.7	173.6	18.5	94.3	23.2
January	960	69.00	340.5	222.9	23.5	133.0	29.5
February	985	51.00	267.6	153.5	15.8	103.6	22.2

ORIOLE — GUERNSEY.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1891.							
November	788	69.06	378.7	235.0	22.1	120.5	28.4
December	777	75.06	381.4	224.4	24.1	112.0	29.3
January	811	71.75	348.2	229.7	24.3	134.0	30.2
February	815	50.06	275.4	156.9	16.1	111.7	22.9

IONE — DEVON.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1891.							
November	892	62.31	354.4	202.9	20.1	116.5	26.6
December	909	65.25	344.0	197.2	21.1	104.0	26.2
January	931	58.06	284.7	186.8	19.7	108.9	24.5
February	948	53.94	271.1	157.4	16.1	99.4	22.3
March	974	56.37	312.2	222.5	22.5	97.7	23.9
April	1,033	34.25	245.5	178.9	21.7	100.5	24.8

GENEVIE'S GIFT — DEVON.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1891.							
November	672	46.56	271.4	150.7	15.1	92.1	20.5
December	675	49.00	271.8	150.8	16.1	84.9	20.5
January	715	46.31	248.6	156.4	16.4	101.7	21.2
February	725	42.94	235.0	133.6	13.7	92.8	19.3
March	727	41.87	242.4	167.8	17.7	73.8	18.1
April	724	33.62	218.1	161.7	20.5	82.3	21.2

ESEL 2D—HOLSTEIN-FRIESIAN.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November . . .	563.8	12.96	3.11	3.92	5.11	0.82	73.0	17.5	22.1	28.8	4.6
December . . .	540.3	12.67	2.80	3.39	5.72	0.76	68.4	15.1	18.3	30.9	4.1
January	367.5	12.88	3.15	3.00	6.06	0.67	47.3	11.6	11.0	22.3	2.4
February . . .	322.1	13.53	3.30	3.95	5.52	0.76	43.6	10.6	12.7	17.8	2.5

Junietta Peerless — Ayrshire.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November ...	410.1	12.86	2.91	3.44	5.78	0.73	52.7	11.9	14.1	23.7	3.0
December ...	434.9	13.16	2.93	2.99	6.59	0.65	57.2	12.7	13.0	28.7	2.8
January	409.7	14.65	3.88	3.70	6.51	0.56	60.0	15.9	15.1	26.7	2.3
February ...	305.7	14.36	3.70	3.79	6.19	0.68	43.9	11.3	11.6	18.9	2.1
March	176.0	16.65	4.60	3.86	7.35	0.84	29.3	8.1	6.8	12.9	1.5
April	69.9	18.76	6.20	5.02	6.83	0.71	13.1	4.3	3.5	4.8	0.5

GILDERBLOOM — JERSEY.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November ..	155.9	16.31	5.87	4.26	5.41	0.77	25.4	9.2	6.6	8.4	1.2
December ..	164.3	15.96	6.45	4.24	4.45	0.82	26.2	10.6	7.0	7.3	1.3
1892.											
January	123.9	16.88	5.97	3.76	6.56	0.59	20.9	7.4	4.7	8.1	0.7

ROSETTE FORD — GUERNSEY.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November . .	347.3	16.34	6.20	4.61	4.78	0.75	56.7	21.5	16.0	16.6	2.6
December . .	324.3	16.25	6.16	4.05	5.28	0.76	52.7	20.0	13.1	17.1	2.5
January	301.7	17.05	6.60	3.82	5.75	0.88	51.4	19.9	11.5	17.3	2.7
February . . .	222.7	16.61	6.25	3.86	5.70	0.80	37.0	13.9	8.6	12.7	1.8

ORIOLE — GUERNSEY.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent caseine.	Per cent sugar.	Per cent ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November . .	495.5	15.95	5.24	3.91	5.98	0.82	79.0	26.0	19.4	29.6	4.0
December . .	538.4	16.23	5.21	4.52	5.69	0.81	87.4	28.1	24.3	30.6	4.4
January	510.2	15.83	5.68	3.52	5.93	0.70	80.8	29.0	18.0	30.2	3.6
February . . .	390.2	16.60	6.05	4.05	5.78	0.72	64.8	23.6	15.8	22.6	2.8

IONE — DEVON.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November ..	311.9	15.43	5.31	4.04	5.33	0.75	48.1	16.6	12.6	16.6	2.3
December ..	328.8	15.32	4.66	3.73	6.23	0.70	50.4	15.3	12.3	20.5	2.3
1892.											
January	308.1	16.14	4.75	3.76	6.86	0.77	49.7	14.6	11.6	21.1	2.4
February ...	235.9	16.48	5.13	4.68	5.86	0.81	38.8	12.1	11.0	13.8	1.9
March......	158.0	16.36	4.90	4.78	5.79	0.89	25.8	7.7	7.6	9.1	1.4
April	89.0	16.81	5.60	4.46	5.98	0.77	15.0	5.0	4.0	5.3	0.7

GENEVIE'S GIFT — DEVON.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November...	243.2	16.70	6.31	3.88	5.73	0.78	40.6	15.4	9.4	13.9	1.9
December...	291.7	15.70	5.51	3.26	6.19	0.74	45.8	16.1	9.5	18.0	2.2
1892.											
January	276.1	16.07	5.90	3.55	5.86	0.76	44.4	16.3	9.8	16.2	2.1
February ...	255.5	16.25	6.06	4.00	5.41	0.78	41.5	15.5	10.2	13.8	2.0
March......	271.2	16.84	6.30	3.92	5.86	0.76	45.7	17.1	10.6	15.9	2.1
April.	279.7	15.70	5.85	3.54	5.52	0.79	43.9	16.4	9.9	15.4	2.2

Beauty Pledge — Holstein-Friesian.

First period — Calved April 5, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
May	873	49.81	344.2	249.4	30.7	141.9	35.5
June	899	69.81	299.4	198.4	35.5	136.7	43.6
July	902	71.37	385.2	242.1	43.4	175.5	46.6
August	902	91.79	362.0	206.5	43.5	171.1	48.5
September	893	87.94	321.1	188.1	39.1	146.6	45.4
October	930	73.31	435.2	267.3	42.7	150.1	32.7
November	950	69.12	384.2	220.6	34.4	125.6	39.2

ALBERT'S CAROL — JERSEY.

First period — Arrived at station April 26, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
May	619	48.12	308.1	229.4	27.8	120.9	31.2
June	641	67.19	282.2	196.5	32.8	116.8	37.7
July	615	58.69	302.5	209.8	32.6	121.2	32.5
August	633	75.62	300.0	188.0	32.9	117.2	35.1
September	648	79.31	288.3	183.8	32.7	109.3	36.2
October	658	69.25	355.2	208.6	35.4	115.0	27.4
November	668	65.37	329.3	185.5	30.0	99.0	33.5

MADAM SELECT — GUERNSEY.

First period — Arrived at station February 23, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
February	.....	10.12	56.0	32.0	3.3	23.8	4.7
March	735	59.12	323.7	236.9	24.0	109.7	25.8
April	775	30.81	219.2	159.0	19.4	91.0	22.5
May	745	42.00	296.0	213.9	26.3	123.9	30.8
June	765	58.19	248.9	164.2	29.6	114.2	36.5
July	755	53.69	298.8	183.3	33.8	140.5	36.7
August	764	80.37	306.7	178.2	37.1	139.0	41.1
September	814	79.81	287.6	171.7	34.7	125.9	40.2

STELLA SELECT — GUERNSEY.

First period — Arrived at station, February 23, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
February		10.00	55.0	32.6	3.2	23.8	4.7
March	758	59.31	324.8	237.6	24.0	110.4	25.9
April	755	46.56	303.7	219.7	27.4	122.9	31.4
May	761	48.25	321.2	231.7	28.9	132.0	33.4
June	781	70.06	298.7	197.8	35.5	136.1	43.6
July	769	70.75	383.6	241.7	43.0	174.3	46.1
August	797	94.44	372.1	215.6	44.1	170.4	49.0
September	786	88.87	328.7	197.7	38.9	142.9	44.3
October	822	74.06	419.8	252.5	41.3	145.3	32.1
November	753	65.19	355.6	203.5	32.0	114.6	36.2

ARTALIA — DEVON.

First period — Calved December 24, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1891.							
December	949	4.44	27.5	14.1	1.5	9.3	2.2
1892.							
January	914	52.81	272.3	174.7	18.2	106.7	23.2
February	876	51.94	275.9	158.4	16.3	111.4	23.2
March	849	54.31	314.6	225.6	22.8	101.7	24.0
April	851	42.31	301.8	219.6	26.7	123.9	30.6
May	870	43.50	301.2	220.0	26.7	120.6	30.2
June	851	73.19	298.1	195.2	36.3	134.7	44.5
July	857	76.31	400.4	246.0	45.9	181.3	48.8
August	895	92.62	356.4	202.9	43.6	166.5	48.8
September	889	86.00	306.7	181.2	37.7	137.7	43.8
October	893	70.25	413.7	255.0	40.6	140.0	30.8

BETSEY 10TH — SHORT HORN.

First period — Calved May 5, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen, free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
May	1,193	26.44	217.0	157.7	18.1	93.7	23.3
June	1,020	60.12	249.4	167.6	29.7	109.3	35.6
July	935	55.25	290.1	183.0	32.9	129.3	34.7
August	935	65.19	254.7	147.7	30.1	115.9	33.6
September	863	57.19	217.4	125.9	26.1	101.6	30.0
October	823	56.75	319.0	192.5	31.4	107.7	24.2
November	889	69.87	366.5	208.0	33.2	115.1	37.1

BEAUTY PLEDGE — HOLSTEIN FRIESIAN.

First period — Calved April 5, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
May........	660.6	12.97	3.62	2.82	5.84	0.69	85.7	23.9	18.6	38.6	4.6
June........	702.4	12.32	3.23	2.76	5.66	0.67	86.5	22.7	19.4	39.4	4.7
July........	709.4	11.68	2.59	2.56	5.84	0.69	82.9	18.4	18.2	41.4	4.9
August.....	591.9	11.85	3.04	2.73	5.56	0.52	70.1	18.0	16.1	32.9	3.1
September ..	530.8	11.53	2.96	2.75	5.34	0.48	61.2	15.7	14.6	28.3	2.6
October	566.2	11.63	3.24	2.76	5.04	0.59	65.8	18.3	15.6	28.5	3.4
November ..	588.3	12.18	3.14	3.07	5.32	0.65	71.6	18.5	18.1	31.2	3.8

ALBERT'S CAROL — JERSEY.

First period — Arrived at station April 26, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
May	603.6	13.52	3.99	2.85	5.95	0.73	78.3	21.9	17.0	35.2	4.2
June........	553.6	14.23	4.59	3.12	5.80	0.72	78.8	25.4	17.3	32.1	4.0
July	554.0	14.02	4.03	3.10	6.17	0.72	77.7	22.3	17.2	34.2	4.0
August	469.7	14.20	4.64	3.33	5.64	0.59	66.7	21.8	15.6	26.5	2.8
September ..	433.6	14.64	4.60	3.45	6.05	0.54	63.5	20.0	15.0	26.2	2.3
October	438.5	15.05	5.14	3.85	5.31	0.75	66.0	22.5	16.9	23.3	3.3
November ..	432.2	17.06	6.44	4.15	5.69	0.78	73.7	27.8	17.9	24.6	3.4

MADAM SELECT — GUERNSEY.

First period—Arrived at station February 23, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
February ...	109.9	15.74	5.10	4.05	5.83	0.76	17.3	5.6	4.5	6.4	0.8
March	516.9	15.74	5.36	3.78	5.84	0.76	81.4	27.7	19.6	30.2	3.9
April	385.4	15.40	5.45	3.66	5.54	0.75	59.4	21.0	14.1	21.4	2.9
May........	455.0	15.32	5.07	3.71	5.76	0.78	69.7	23.1	16.9	26.2	3.5
June	359.6	16.14	6.18	3.82	5.39	0.75	58.0	22.2	13.7	19.4	2.7
July	369.7	14.69	4.17	3.51	6.36	0.65	54.3	15.4	13.0	23.5	2.4
August.....	319.1	15.91	5.63	4.05	5.54	0.69	50.8	18.0	12.9	17.7	2.2
Septemb r ..	253.0	16.58	6.20	4.17	5.61	0.60	41.9	15.7	10.5	14.2	1.5

STELLA SELECT — GUERNSEY.

First period — Arrived at station February 23, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
February ...	136.4	13.74	3.85	2.82	6.34	0.73	18.7	5.3	3.8	8.6	1.0
March	743.0	13.45	3.94	2.96	5.86	0.69	99.9	29.3	22.0	43.5	5.1
April	636.6	13.51	4.13	2.91	5.77	0.70	86.0	26.3	18.5	36.7	4.5
May	602.4	13.38	3.95	2.87	5.87	0.69	80.0	23.8	17.3	35.4	4.1
June	610.9	13.61	4.48	2.92	5.46	0.75	83.1	27.4	17.8	33.3	4.6
July	616.0	13.43	3.68	3.11	5.92	0.72	82.7	22.7	19.1	36.5	4.4
August	526.0	14.07	4.30	3.46	5.77	0.54	74.0	22.6	18.2	30.4	2.8
September ..	397.7	14.57	4.82	3.84	5.38	0.53	57.9	19.1	15.3	21.4	2.1
October	422.7	15.52	5.57	4.01	5.24	0 70	65.6	23.5	17.0	22.1	3.0
November ..	383.2	16.39	5.87	4.16	5.54	0.82	62.7	22.5	15.9	21.2	3.1

ARTALIA — DEVON.

First period—Calved December 24, 1891.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
December ..	47.1	15.82	4.82	4.08	6.25	0.67	7.4	2.3	1.9	2.9	0.3
1892.											
January	587.1	15.15	5.14	3.25	6.05	0.71	88.9	30.2	19.1	35.5	4.1
February ...	591.6	14.21	4.37	3.34	5.81	0.69	84.1	25.8	19.8	34.4	4.1
March	588.7	14.46	4.52	3.33	5.95	0.66	85.1	26.6	19.6	35.0	3.9
April	563.6	14.52	4.60	3.51	5.69	0.72	81.8	25.9	19.8	32.1	4.0
May	548.7	14.63	4.38	3.69	5.84	0.72	80.2	24.0	20.2	32.0	4.0
June	555.3	15.23	4.20	3.82	6.53	0.68	84.6	23.3	21.2	36.3	3.8
July	526.7	14.50	3.69	3.84	6.14	0.83	76.3	19.4	20.2	32.3	4.4
August	399.6	14.35	4.25	3.68	5.75	0.67	57.3	17.0	14.7	23.0	2.6
September ..	341.6	14.03	4.09	4.90	5.48	0.56	47.9	14.0	13.3	18.7	1.9
October	311.1	14.66	4.11	4.27	5.38	0.90	45.6	12.8	13.3	16.7	2.8

BETSY 10TH — SHORT-HORN.

First period — Calved May 5, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
May	567.0	14.82	4.56	3.53	5.98	0.75	84.0	25.9	20.0	33.9	4.2
June	687.1	14.40	4.16	3.15	6.33	0.76	98.9	28.6	21.6	43.5	5.2
July	650.6	13.72	3.92	3.22	5.84	0.74	89.2	25.5	20.9	38.0	4.8
August	531.6	13.37	3.87	3.27	5.51	0.72	71.1	20.6	17.4	29.3	3.8
September ..	425.5	13.69	3.95	3.57	5.53	0.64	58.2	16.8	15.2	23.5	2.7
October	433.7	14.35	4.13	3.47	5.93	0.82	62.2	17.9	15.0	25.7	3.6
November ..	437.8	14.78	4.45	4.13	5.40	0.80	64.7	19.5	18.1	23.6	3.5

ESEL 2D — HOLSTEIN-FRIESIAN.

Second period — Calved August 28, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen, free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
September	1,195	98.44	369.9	226.3	42.2	154.2	48.6
October	1,154	98.50	542.9	324.8	53.6	183.8	41.5
November	1,219	88.87	472.0	268.2	42.8	150.8	47.6

TOLSMA ARTIS — HOLSTEIN-FRIESIAN.

Second period — Calved May 23, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1891.							
June	1,045	60.44	233.7	146.4	32.7	144.4	36.1
July	976	77.00	346.3	248.5	34.7	129.0	35.2
August	991	77.56	369.1	273.2	32.1	116.9	38.4
September	1,031	101.44	376.0	213.0	29.0	145.1	47.3
October	1,042	90.25	478.7	288.8	28.3	163.5	36.5
November	1,125	87.44	473.1	281.1	27.7	152.9	36.0
December	1,113	95.87	485.1	284.7	30.6	144.0	37.4
1892.							
January	1,165	84.75	436.3	280.0	29.5	177.8	37.8
February	1,167	85.12	435.4	251.1	25.9	167.1	36.3
March	1,205	82.81	462.3	329.9	33.4	145.6	35.3
April	1,265	45.19	366.8	267.5	31.7	156.1	37.0

MISS FLOW 5TH — AYRSHIRE.

Second period—Calved February 18, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1891.							
March	809	30.44	185.8	64.5	16.0	81.3	18.1
April	736	51.56	220.1	143.3	22.9	117.7	26.1
May	758	58.31	249.4	181.8	28.4	110.3	26.4
June	776	69.25	273.1	184.7	34.5	125.8	34.6
July	818	65.37	296.3	212.2	29.7	112.8	30.8
August	812	64.62	313.7	230.9	27.3	103.5	33.2
September	375	83.12	303.9	170.8	23.6	119.8	39.4
October	868	69.19	374.8	224.8	22.0	127.7	28.1
November	923	66.87	370.3	217.5	21.4	119.3	27.9
December	931	72.50	374.2	217.7	23.3	111.3	28.6
1892.							
January	967	66.94	334.4	217.6	22.9	132.0	29.0
February	1,015	54.06	292.8	167.2	17.2	117.7	24.4

QUEEN DUCHESS — AYRSHIRE.

Second period — Calved November 24, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract	Starch and sugar.	Crude fat.	Fiber.	Ash.
1891.							
December	892	50.50	320.8	156.7	20.7	102.0	28.5
1872.							
January	758	72.69	383.4	244.0	25.5	165.0	33.8
February	779	75.62	405.2	233.0	24.0	169.1	34.5
March	813	74.25	416.1	294.2	29.7	140.5	32.6
April	817	62.06	407.0	294.3	36.6	165.4	42.2
May	824	64.37	425.0	307.6	38.3	174.5	44.4
June	837	83.81	358.9	244.1	42.0	156.8	50.0
July	838	81.50	436.8	238.7	48.4	190.4	50.3
August	872	94.44	376.9	218.9	44.3	173.3	48.8
September	906	89.12	329.1	197.9	38.9	143.2	44.5
October	937	46.56	315.3	196.6	29.7	120.5	25.3

Manton Belle — Ayrshire.

Second period — Calved December 29, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
January	1,127	69.62	367.0	233.5	24.5	159.8	32.5
February	1,165	76.06	407.8	244.6	24.2	170.8	34.8
March	1,071	74.31	416.5	293.4	29.8	140.7	32.6
April	1,047	62.06	407.4	293.0	36.6	164.9	42.1
May	1,069	64.37	425.7	307.4	38.3	174.3	44.3
June	1,065	83.75	359.1	244.2	42.0	157.0	50.0
July	1,050	83.50	446.0	283.8	50.0	198.2	52.7
August	1,109	98.37	385.4	222.3	46.1	178.2	51.1
September	1,118	97.62	353.3	208.7	42.9	157.9	49.9
October	1,065	53.31	384.3	241.6	36.8	151.0	29.1

JUNIETTA PEERLESS — AYRSHIRE.

Second period — Calved May 2, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
May	1,067	28.94	261.4	188.1	21.5	119.2	28.7
June	877	68.69	295.8	196.8	35.0	134.5	42.8
July	855	76.12	408.0	254.5	46.2	186.2	49.6
August	882	105.50	411.1	240.8	48.7	184.2	53.7
September	903	102.25	370.2	222.6	44.3	159.7	51.0
October	918	86.62	496.9	299.2	48.2	169.5	39.7
November	959	72.81	396.4	225.3	35.7	130.5	40.4

Gilderbloom — Jersey.

Second period— Calved February 29, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
March	1,019	46.94	271.4	197.3	19.8	81.9	20.2
April	907	30.12	221.4	165.6	17.8	80.0	20.3
May	846	32.87	259.3	190.2	21.5	103.9	25.1
June	847	62.06	261.4	170.5	31.5	121.0	39.1
July	836	64.75	348.2	215.0	39.5	161.0	43.8
August	879	79.25	310.1	175.2	37.8	148.2	42.4
September	846	75.75	274.0	159.4	33.7	126.0	39.5
October	846	58.69	347.6	212.3	34.1	121.2	26.3
November	870	52.19	297.7	173.0	26.3	95.8	30.7

COUNTESS FLAVIA — JERSEY.

Second period — Calved November 14, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1891.							
November	869	21.69	130.6	157.3	10.2	53.1	11.1
December	794	72.37	379.7	216.4	23.3	117.1	29.3
1892.							
January	803	75.19	370.4	242.8	25.7	149.1	32.6
February	809	66.75	331.7	192.0	19.8	122.3	27.5
March	811	72.63	356.9	252.9	25.7	106.2	27.3
April	820	55.69	322.7	235.2	29.7	120.1	32.5
May	825	57.81	342.3	258.7	31.4	130.3	34.9
June	847	72.44	298.5	205.9	35.2	124.3	40.7
July	835	73.69	377.1	244.2	42.5	159.8	43.1
August	853	75.94	294.0	174.8	34.5	127.8	37.8
September	850	71.25	257.9	157.8	30.5	107.6	34.5

BARBARA ALLEN — JERSEY.

Second period — Calved April 11, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1882.							
May.	891	46.31	324.2	253.9	38.9	136.2	33.9
June	902	70.19	300.4	198.8	35.7	137.2	43.9
July.	864	75.12	402.6	251.9	45.5	183.3	48.9
August	876	97.06	381.6	220.3	45.5	175.7	50.6
September.	848	89.12	329.4	198.0	39.0	143.3	44.5
October	861	76.75	441.1	267.5	43.4	151.8	33.5
November	911	67.06	368.9	212.4	33.2	118.6	37.2

MAGGIE 6TH — AMERICAN-HOLDERNESS.

Second period — Calved May 17, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
June	917	65.31	273.0	183.9	32.4	119.5	38.8
July	850	66.19	342.5	222.6	38.2	147.5	39.9
August	871	91.87	358.7	216.3	41.5	151.4	45.2
September	846	89.81	325.2	201.2	37.9	132.1	43.0
October	870	72.31	380.1	223.9	37.8	126.4	29.4
November	891	68.75	357.3	202.5	32.4	110.6	36.3

NELLIE 6TH — AMERICAN-HOLDERNESS.

Second period— Calved November 26, 1891.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1891.							
December	841	43.56	205.1	132.6	16.5	68.9	18.1
1892.							
January	767	60.62	279.6	189.1	20.1	102.7	24.4
February	771	58.56	280.7	173.5	16.9	99.8	23.3
March	798	61.62	315.3	222.0	22.6	93.1	24.3
April	790	50.94	202.5	193.9	24.6	86.3	25.2
May	784	52.62	271.8	200.7	25.5	89.7	26.1
June	800	60.12	236.2	166.9	28.0	91.2	30 9
July	803	57.12	274,1	182.6	31.1	107.6	30.0
August	826	72.25	262.0	157.6	31.7	108.7	35.0
September	875	68.19	235.0	146.1	28.2	93.1	32.2
October	918	56.31	300.2	183.1	29.8	93.6	22.3

IONE — DEVON.

Second period — Calved June 30, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugar.	Crude fat.	Fiber.	Ash.
1892.							
July	1,056	58.06	299.0	185.0	34.4	133.8	36.3
August	919	88.12	330.6	201.8	38.4	133.5	41.6
September	901	89.19	322.0	199.6	37.6	130.0	42.5
October	922	74.62	398.9	237.0	39.6	132.7	30.6
November	953	67.19	344.6	193.9	31.4	107.6	34.9

Esel 2d — Holstein-Friesian.

Second period — Calved August 28, 1892.

Month.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash
September ..	997.4	12.43	3.50	2.86	5.53	0.54	124.0	34.9	28.5	55.2	5.4
October	1033.4	11.86	3.18	3.08	4.87	0.73	122.5	32.9	31.8	50.3	7.5
November ..	893.4	12.35	3.31	3.14	5.10	0.80	110.3	29.6	28.0	45.6	7.1

TOLSMA ARTIS — HOLSTEIN-FRIESIAN.

Second period — Calved May 23, 1891.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
June	895.8	10.37	2.65	2.62	4.40	0.70	92.9	23.7	23.5	39.4	6.3
July	966.5	9.94	2.31	2.40	4.56	0.67	96.1	22.3	23.2	44.1	6.5
August	880.5	10.24	2.11	2.97	4.49	0.67	90.2	18.6	26.2	39.5	5.9
September	723.4	10.78	2.77	2.72	4.56	0.73	78.0	20.0	19.7	33.0	5.3
October	765.8	11.65	2.92	3.47	4.40	0.86	89.2	22.3	26.6	33.7	6.6
November	736.6	11.90	3.20	3.13	4.86	0.71	87.7	23.6	23.1	35.8	5.2
December	748.8	12.18	3.15	2.93	5.35	0.75	91.2	23.6	21.9	40.1	5.6
1892.											
January	646.7	12.71	3.46	3.00	5.52	0.73	82.2	22.4	19.4	35.7	4.7
February	569.5	12.84	3.25	3.51	5.42	0.66	73.1	18.5	20.0	30.9	3.7
March	548.4	13.36	3.32	3.56	5.78	0.70	73.3	18.2	19.5	31.7	3.9
April	304.0	14.59	3.23	4.57	6.00	0.79	44.3	9.8	13.9	18.2	2.4

Miss Flow 5th — Ayrshire.

Second period — Calved February 18, 1891.

Month.	Milk yield, pounds.	Per cent. solids.	Per cent. fat	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
March	541.4	13.20	3.97	3.54	5.06	0.63	71.5	21.5	19.2	27.4	3.4
April	581.7	11.72	3.09	3.04	4.90	0.69	68.2	18.0	17.7	28.5	4.0
May	624.2	12.10	2.93	3.44	5.07	0.66	75.5	18.3	21.5	31.6	4.1
June	604.8	12.27	3.17	3.23	5.15	0.72	74.2	19.2	19.5	31.1	4.4
July	566.2	12.51	3.20	3.72	4.91	0.68	70.8	18.1	21.1	27.8	3.8
August	533.2	13.41	3.47	3.83	5.39	0.72	71.5	18.5	20.4	28.7	3.9
September	452.2	13.54	3.90	3.96	4.95	0.73	61.2	17.6	17.9	22.4	3.3
October	456.2	13.94	3.76	4.58	4.87	0.73	63.5	17.1	20 9	22.2	3.3
November	410.0	14.00	3.80	3.75	5.71	0.74	57.4	15.6	15.4	23.4	3.0
December	346.5	13.86	3.58	3.48	6.02	0.78	48.0	12.4	12.1	20.8	2.7
1892.											
January	172.9	14.75	4.53	3.56	5.94	0.72	25.5	7.8	6.2	10.3	1.2
February	30.0	14.92	4.38	4.93	4.77	0.84	4.5	1.3	1.5	1.4	0.3

QUEEN DUCHESS — AYRSHIRE.

Second period — Calved November 24, 1891.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
December ..	715.4	13.23	3.79	2.99	5.77	0.68	94.6	27.1	21.4	41.3	4.8
1892.											
January	916.9	13.05	3.80	2.32	6.26	0.67	119.6	34.8	21.3	57.4	6.1
February ...	864.1	12.93	3.50	3.13	5.74	0.56	111.7	30.3	27.0	49.6	4.8
March......	872.3	13.44	3.72	2.96	6.16	0.60	117.2	32.5	25.8	53.7	5.2
April	854.1	13.25	3.45	2.81	6.26	0.73	113.2	29.5	24.0	53.5	6.2
May	825.2	13.19	3.67	3.56	5.31	0.65	108.8	30.3	29.4	43.8	5.3
June	772.6	13.08	3.32	3.26	5.72	0.78	101.1	25.7	25.2	44.2	6.0
July	701.5	13.65	3.55	3.61	5.74	0.75	95.8	24.9	25.3	40.3	5.3
August.....	418.1	14.23	3.78	3.97	5.75	0.73	59.5	15.8	16.6	24.0	3.1
September ..	187.1	14.97	4.25	4.45	5.68	0.59	28.0	8.0	8.3	10.6	1.1
October . ..	42.0	15.82	4.60	5.39	4.76	1.07	6.6	1.9	2.3	2.0	0.4

MANTON BELLE — AYRSHIRE.

Second period — Calved December 29, 1891.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
January	824.4	14.01	4.29	2.85	6.15	0.72	115.5	35.4	23.5	50.7	5.9
February	872.0	13.05	3.96	3.02	5.48	0.59	113.8	34.5	26.3	47.8	5.2
March	843.4	13.44	3.72	2.96	6.16	0.60	113.4	31.4	25.0	51.9	5.1
April	739.6	13.46	4.22	3.15	5.46	0.63	99.6	31.2	23.3	40.4	4.7
May	738.5	13.30	3.68	3.02	5.96	0.64	98.2	27.2	22.3	44.0	4.7
June	747.6	12.77	3.13	3.19	5.87	0.58	95.4	23.4	23.8	43.9	4.3
July	699.5	12.81	2.99	3.32	5.87	0.66	89.6	20.9	23.2	41.1	4.4
August	467.5	12.80	3.18	3.57	5.45	0.60	59.8	14.8	16.7	25.5	2.8
September	259.4	13.10	3.20	3.62	5.73	0.55	34.0	3.3	9.4	14.9	1.4
October	66.1	13.59	3.43	4.80	4.66	0.70	9.0	2.2	3.2	3.1	0.5

JUNIETTA PEERLESS — AYRSHIRE.

Second period — Calved May 2, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
May	852.7	13.71	4.15	3.27	5.67	0.62	116.9	35.4	27.9	48.3	5.3
June	958.8	12.13	2.98	2.73	5.86	0.56	116.3	28.6	26.2	56.2	5.3
July	966.1	11.73	2.60	2.48	6.03	0.62	113.3	25.1	24.0	58.2	6.0
August	868.3	11.72	2.55	2.93	5.70	0.54	101.7	22.1	25.4	49.5	4.7
September ..	789.6	11.70	2.74	2.95	5.49	0.52	92.4	21.6	23.3	43.4	4.1
October	809.5	12.04	3.15	3.08	5.12	0.69	97.5	25.5	25.0	41.4	5.6
November...	742.1	12.39	3.39	3.03	5.33	0.64	91.9	25.2	22.5	39.5	4.7

GILDERBLOOM — JERSEY.

Second period — Calved February 29, 1892.

MONTH.	Milk yield pounds.	Per cent solids.	Per cent. fat.	Per cent caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash
1892.											
March	525.9	15.59	5.39	3.99	5.43	0.78	82.0	28.3	21.0	28.6	4.1
April	539.1	15.19	5.23	3.36	5.87	0.73	81.9	28.2	18.1	31.7	3.9
May	549.3	14.96	5.00	2.95	6.32	0.69	82.2	27.5	16.2	34.7	3.8
June	519.4	14.81	4.73	3.55	5.83	0.70	76.9	24.6	18.4	30.3	3.6
July	513.4	14.50	4.55	3.40	5.85	0.70	74.4	23.4	17.4	30.0	3.6
August	438.0	14.76	4.95	3.54	5.59	0.68	64.6	21.6	15.5	24.5	3.0
September ..	360.8	15.40	5.10	3.67	6.09	0.54	55.6	18.4	13.2	22.0	2.0
October	331.1	15.84	6.15	3.85	5.10	0.74	52.4	20.4	12.7	16.9	2.4
November ..	267.8	15.54	5.65	4.08	5.00	0.81	41.6	15.1	10.9	13.4	2.2

COUNTESS FLAVIA — JERSEY.

Secona period — Calved November 14, 1891.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November ..	240.0	16.06	5.43	4.19	5.63	0.81	38.5	13.0	10.1	13.5	1.9
December ..	720.8	16.04	5.52	3.50	6.19	0.83	115.6	39.8	25.2	44.6	6.0
1892.											
January	626.8	16.53	6.17	3.18	6.45	0.73	103.6	38.7	19.9	40.4	4.6
February ..	506.7	16.64	6.16	3.86	5.97	0.65	84.3	31.2	19.5	30.3	3.3
March.	504.1	17.40	5.33	4.82	6.50	0.75	87.7	26.9	24.3	32.7	3.8
April	491.1	16.96	6.33	4.20	5.68	0.75	83.3	31.1	20.6	27.9	3.7
May	506.7	16.71	6.05	4.00	6.00	0.66	84.7	30.7	20.3	30.4	3.3
June	453.9	16.64	5.05	3.88	6.02	0.69	71.0	22.9	17.6	27.4	3.1
July	453.2	15.90	4.84	3.75	6.57	0.74	72.1	21.9	17.0	29.8	3.4
August.....	349.8	17.16	6.44	4.21	5.87	0.64	60.0	22.5	14.7	20.6	2.2
September ..	275.0	16.78	6.15	3.99	6.03	0.61	46.1	16.9	10.9	16.6	1.7

BARBARA ALLEN — JERSEY.

Second period — Calved April 11, 1892.

MONTH.	Milk yield. pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
May	680.8	14.80	4.76	3.28	6.09	0.67	100.8	32.4	22.3	41.5	4.6
June	648.0	14.33	4.24	3.30	6.15	0.64	92.9	27.5	21.4	39.9	4.1
July	633.8	14.50	4.49	3.30	5.98	0.73	91.9	28.5	20.9	37.9	4.6
August	542.4	14.28	4.58	3.69	5.43	0.58	77.5	24.8	20.1	29.5	3.1
September ..	462.7	14.72	4.80	3.83	5.54	0.55	68.1	22.2	17.7	25.6	2.6
October	480.6	15.32	5.14	5.06	5.38	0.74	73.6	24.7	19.5	25.8	3.6
November ..	435.2	15.83	5.56	4.25	5.24	0.78	68.9	24.2	18.5	22.8	3.4

MAGGIE 6TH — AMERICAN-HOLDERNESS.

Second period — Calved May 17, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
June.......	905.9	13.30	4.04	3.10	5.50	0.66	120.5	36.6	28.1	49.8	6.0
July	934.3	12.06	3.28	2.60	5.43	0.75	112.6	30.6	24.3	50.7	7.0
August......	766.1	12.44	3.42	2.80	5.61	0.61	95.3	26.2	21.4	43.0	4.7
September ..	622.1	12.22	3.25	2.92	5.44	0.61	76.0	20.2	18.2	33.8	3.8
October	607.3	12.68	3.65	3.02	5.30	0.71	77.0	22.2	18.3	32.2	4.3
November ..	565.0	13.20	3.58	3.37	5.51	0.74	74.6	20.2	19.1	31.1	4.2

NELLIE 6TH — AMERICAN-HOLDERNESS.

Second period — Calved November 26, 1891.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1891.											
November...	....	....	....	....	....	....	....	....	....	....	....
December...	575.7	12.66	3.16	2.96	5.84	0.70	72.8	18.2	17.0	33.6	4.0
1892.											
January	684.2	12.36	3.16	2.43	6.14	0.63	84.5	21.6	16.6	42.0	4.3
February ...	615.2	12.40	3.03	3.28	5.37	0.72	76.2	18.6	20.2	33.0	4.4
March......	622.0	13.03	3.70	2.89	5.77	0.67	81.0	23.0	18.0	35.9	4.1
April	541.5	12.87	3.55	3.64	4.99	0.69	69.7	19.2	19.7	27.0	3.8
May	484.1	13.44	3.57	3.29	5.96	0.62	65.1	17.3	15.9	28.9	3.0
June.......	429.6	13.55	3.65	3.58	5.67	0.65	58.2	15.7	15.4	24.3	2.8
July	402.5	12.84	3.00	3.03	6.13	0.68	51.7	12.1	12.2	24.7	2.7
August.....	202.8	14.06	3.59	3.88	6.02	0.57	28.5	7.3	7.9	12.2	1.1
September ..	69.3	13.86	3.24	4.53	5.36	0.73	9.5	2.2	3.1	3.7	0.5
October	5.4	14.09	4.40	5.23	3.75	0.71	0.7	0.2	0.3	0.2	0.0

IONE — DEVON.

Second period — Calved June 30, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. caseine.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds caseine.	Pounds sugar.	Pounds ash.
1892.											
July	735.6	14.02	4.20	3.14	5.94	0.74	103.1	30.9	23.1	43.7	5.4
August	748.1	13.74	4.28	3.36	5.47	0.63	102.7	32.0	25.1	40.9	4.7
September ..	563.8	13.48	3.86	3.63	5.42	0.57	76.0	21.8	20.5	30.5	3.2
October	537.4	14.66	4.41	3.93	5.67	0.65	78.8	23.7	21.1	39.5	3.5
November...	459.7	14.35	4.66	3.87	5.20	0.62	66.0	21.4	17.8	23.9	2.9

Crude Fats in Food Consumed Each Month of Second Period of Lactation — Pounds.

Breed.	Names of Animals.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	42.2	53.6	42.8									
Holstein-Friesian	Tolsma Artis	32.7	34.7	32.1	29.0	28.3	27.7	30.6	29.5	25.9	33.4	31.7	
Ayrshire	Miss Flow 5th	16.0	22.9	28.4	34.5	29.7	27.3	23.6	22.0	21.4	23.3	22.9	17.2
Ayrshire	Queen Duchess	20.7	25.5	24.0	29.7	36.6	38.3	42.0	48.4	44.3	38.9	29.7	
Ayrshire	Manton Belle	24.5	24.2	29.8	36.6	38.3	42.0	50.0	46.1	42.9	36.8		
Ayrshire	Junietta Peerless	21.5	35.0	46.2	48.7	44.3	48.2	35.7					
Jersey	Gilderbloom	19.8	17.8	21.5	31.5	39.0	37.8	33.7	34.1	26.3			
Jersey	Countess Flavia	10.2	23.3	25.7	19.8	25.7	29.7	31.4	35.2	42.5	34.5	30.5	
Jersey	Barbara Allen	38.9	35.7	45.5	45.5	39.	43.4	33.2					
American-Holderness	Maggie 6th	32.4	38.2	41.5	37.9	37.8	32.4						
American-Holderness	Nellie 6th	16.5	20.1	16.9	22.6	24.6	25.5	28.0	31.1	31.7	28.2	29.8	
Devon	Ione	34.4	38.4	37.6	39.6	31.4							
	Average	25.8	30.8	32.7	34.1	34.1	35.2	34.2	35.2	33.6	32.5	28.9	17.2

ALBUMINOIDS NOT AMIDES IN FOOD CONSUMED EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	98.44	98.50	88.87	...	...	...	...	...	...	...	...	...
Holstein-Friesian	Tolsma Artis	60.44	77.00	77.56	101.44	90.25	87.44	95.87	84.75	85.12	82.81	45.19	...
Ayrshire	Miss Flow 5th	30.44	51.56	58.31	69.25	65.37	61.62	83.12	69.19	66.87	72.50	66.94	54.06
Ayrshire	Queen Duchess	50.50	72.69	75.62	74.25	62.06	64.37	83.81	81.50	94.44	89.12	46.56	...
Ayrshire	Manton Belle	69.62	76.06	74.31	62.06	64.37	83.75	83.50	98.37	97.62	53.31	...	...
Ayrshire	Junietta Peerless	28.94	68.69	76.12	105.50	102.25	86.62	72.81	...	...	...	...	...
Jersey	Gilderbloom	46.94	30.12	32.87	62.06	64.75	79.25	75.75	58.69	52.19	...	...	...
Jersey	Countess Flavia	21.69	72.37	75.19	66.75	72.63	55.69	57.81	72.44	73.69	75.94	71.25	...
Jersey	Barbara Allen	46.31	70.19	75.12	97.06	89.12	76.75	67.06	...	...	...	...	...
American-Holderness	Maggie 6th	65.31	66.19	91.87	89.81	72.31	68.75	...	...	...	...	...	...
American-Holderness	Nellie 6th	43.56	60.62	58.56	61.62	50.94	52.62	60.12	57.12	72.25	68.19	56.31	...
Devon	Ione	58.06	88.12	89.19	74.62	67.19	...	...	...	...	...	...	...
	Average	51.69	69.34	72.80	78.58	72.84	71.99	75.54	74.58	77.45	73.64	57.21	54.06

CARBOHYDRATES IN FOOD CONSUMED EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	369.9	542.9	472.0	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	233.7	346.3	369.1	376.0	478.7	473.1	485.1	436.3	435.4	462.3	366.8	......
Ayrshire	Miss Flow 5th	185.8	220.1	249.4	273.1	296.3	313.7	303.9	374.8	370.3	374.2	334.4	292.8
Ayrshire	Queen Duchess	320.8	383.4	405.2	416.1	407.0	426.0	358.9	436.8	376.9	329.1	315.3	......
Ayrshire	Manton Belle	367.0	407.8	416.5	407.4	425.7	359.1	446.0	385.4	353.3	384.3	......	......
Ayrshire	Junietta Peerless	261.4	295.8	408.0	411.1	370.2	496.9	396.4	......	......	......	......	......
Jersey	Gilderbloom	271.4	221.4	259.3	261.4	348.2	310.1	274.0	347.6	297.7	......	......	......
Jersey	Countess Flavia	130.6	379.7	370.4	331.7	356.9	322.7	342.3	298.5	377.1	294.0	257.9	......
Jersey	Barbara Allen	324.2	300.4	402.6	381.6	329.4	441.1	368.9	......	......	......	......	......
American-Holderness	Maggie 6th	273.0	342.5	358.7	325.2	380.1	357.3	......	......	......	......	......	......
American-Holderness	Nellie 6th	205.1	279.6	280.7	315.3	262.5	271.8	236.2	274.1	262.0	235.0	300.2	......
Devon	Ione	299.0	330.6	322.0	398.9	344.6	......	......	......	......	......	......	......
	Average	270.2	337.5	359.5	354.3	363.6	377.2	356.9	364.8	353.3	346.5	314.9	292.8

STARCH AND SUGARS IN FOOD CONSUMED EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	226.3	324.8	268.2	....	....	....	....	....	....	....	....	....
Holstein-Friesian	Tolsma Artis	146.4	248.5	273.2	213.0	288.8	281.1	284.7	280.0	251.1	329.9	267.5	....
Ayrshire	Miss Flow 5th	64.5	143.3	181.8	184.7	212.2	230.9	170.8	224.8	217.5	217.7	217.6	167.2
Ayrshire	Queen Duchess	156.7	244.0	233.0	294.2	294.3	307.6	244.1	238.7	218.9	197.9	196.6	....
Ayrshire	Manton Belle	233.5	244.6	293.4	293.0	307.4	244.2	283.8	222.3	208.7	241.6	....	....
Ayrshire	Junietta Peerless	188.1	196.8	254.5	240.8	222.6	299.2	225.3	....	....	....	....	....
Jersey	Gilderbloom	197.3	165.6	190.2	170.5	215.0	175.2	159.4	212.3	173.0	....	....	....
Jersey	Countess Flavia	157.3	216.4	242.8	192.0	252.9	235.2	258.7	205.9	244.2	174.8	157.8	....
Jersey	Barbara Allen	253.9	198.8	251.9	220.3	198.0	267.5	212.4	....	....	....	....	....
American-Holderness	Maggie 6th	183.9	222.6	216.3	201.2	223.9	202.5	....	....	....	....	....	....
American-Holderness	Nellie 6th	132.6	189.1	173.5	222.0	193.9	200.7	166.9	182.6	157.6	146.1	183.1	....
Devon	Ione	185.0	201.8	199.6	237.0	193.9	....	....	....	....	....	....	....
	Average	177.1	216.4	231.5	224.4	236.6	244.4	222.9	223.8	210.1	218.0	204.5	167.2

CRUDE FIBER IN FOOD CONSUMED EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	154.2	183.8	150.8									
Holstein Friesian	Tolsma Artis	144.4	129.0	116.9	145.1	163.5	152.9	144.0	177.8	167.1	145.6	156.1	
Ayrshire	Miss Flow 5th	81.3	117.7	110.3	125.8	112.8	103.5	119.8	127.7	119.3	111.3	132.0	117.7
Ayrshire	Queen Duchess	102.0	165.0	169.1	140.5	165.4	171.5	156.8	190.4	173.3	143.2	120.5	
Ayrshire	Manton Belle	159.8	170.8	140.7	164.9	174.3	157.0	198.2	178.2	157.9	151.0		
Ayrshire	Junietta Peerless	119.2	134.5	186.2	184.2	159.7	169.5	130.5					
Jersey	Gilderbloom	81.9	80.0	103.9	121.0	161.0	148.2	126.0	121.2	95.8			
Jersey	Countess Flavia	53.1	117.1	149.1	122.3	106.2	120.1	130.3	124.3	159.8	127.8	107.6	
Jersey	Barbara Allen	136.2	137.2	183.3	175.7	143.3	151.8	118.6					
American-Holderness	Maggie 6th	119.5	147.5	151.4	132.1	126.4	110 6						
American-Holderness	Nellie 6th	68.9	102.7	99.8	93.1	86.3	89.7	91.2	107.6	108.7	93.1	93.6	
Devon	Ione	133.8	133.5	130.0	132.7	107.6							
	Average	112.9	134.9	141.0	139.8	137.0	137.8	135.0	132.5	140.2	128.7	122.0	117.7

ASH IN FOOD CONSUMED EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	48.6	41.5	47.6	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	36.1	35.2	38.4	47.3	36.5	36.0	37.4	37.8	36.3	35.3	37.0	......
Ayrshire	Miss Flow 5th	18.1	26.1	26.4	34.6	30.8	33.2	39.4	28.1	27.9	28.6	29.0	24.4
Ayrshire	Queen Duchess	28.5	33.8	34.5	32.6	42.2	44.4	50.0	50.3	48.8	44.5	25.3	......
Ayrshire	Manton Belle	32.5	34.8	32.6	42.1	44.3	50.0	52.7	51.1	49.9	29.1	......	......
Aryshire	Juniette Peerless	28.7	42.8	49.6	53.7	51.0	39.7	40.4	......	......	......	......	......
Jersey	Gilderbloom	20.2	20.3	25.1	39.1	43.8	42.4	39.5	26.3	30.7	......	......	......
Jersey	Countess Flavia	11.1	29.3	32.6	27.5	27.3	32.5	34.9	40.7	43.1	37.8	34.5	......
Jersey	Barbara Allen	33.9	43.9	48.9	50.6	44.5	33.5	37.2	......	......	......	......	......
American-Holderness	Maggie 6th	38.8	39.9	45.2	43 0	29.4	36.3	......	......	......	......	......	......
American Holderness	Nellie 6th	18.1	24.4	23.3	24.3	25.2	26.1	30.9	30.0	35.0	32.2	22.3	......
Devon	Ione	36.3	41.6	42.5	30.6	34.9	......	......	......	......	......	......	......
	Average	29.2	34.5	37.2	38.7	37.2	37.4	40.3	37.8	38.8	34.6	29.6	24.4

MILK YIELD EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	997.4	1033.4	893.4	....	....	....	....	....	....	....	....	....
Holstein-Friesian	Tolsma Artis	895.8	966.5	880.5	723.4	765.8	736.6	748.8	646.7	569.5	548.4	304.0	....
Ayrshire	Miss Flow 5th	541.4	581.7	624.2	604.8	566.2	533.2	452.2	456.2	410.0	346.5	172.9	30.0
Ayrshire	Queen Duchess	715.4	916.9	864.1	872.3	854.1	825.2	772.6	701.5	418.1	187.1	42.0	....
Ayrshire	Manton Belle	824.4	872.0	843.4	739.6	738.5	747.6	699.5	467.5	259.4	66.1	....	....
Ayrshire	Junietta Peerless	852.7	958.8	966.1	868.3	789.6	809.5	742.1	....	....	....	....	....
Jersey	Gilderbloom	525,9	539.1	549.3	519.4	513.4	438.0	360.8	331.1	267.8	....	....	....
Jersey	Countess Flavia	240.0	720.8	626.8	506.7	504.1	491.1	506.7	453.9	453.2	349.8	275.0	....
Jersey	Barbara Allen	680.8	648.0	633.8	542.4	462.7	480.6	435.2	....	....	....	....	....
American-Holderness	Maggie 6th	905.9	934.3	766.1	622.1	607.3	565.0	....	....	....	....	....	....
American-Holderness	Nellie 6th	575.7	684.2	615.2	622.0	541.5	484.1	429.6	402.5	202.8	69.3	5.4	....
Devon	Ione	735 6	748.1	563.8	537.4	459.7	....	....	....	....	....	....	....
	Average	707.6	800.3	735.6	650.8	618.4	611.1	571.9	494.2	368.7	261.2	159.9	30.0

TOTAL SOLIDS IN MILK EACH MONTH OF SECOND PERIOD OF LACTATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	12.43	11.86	12.35	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	10.37	9.94	10.24	10.78	11.65	11.90	12.18	12.71	12.84	13.36	14.59	......
Ayrshire	Miss Flow 5th	13.20	11.72	12.10	12.27	12.51	13.41	13.54	13.94	14.00	13.86	14.74	14.92
Ayrshire	Queen Duchess	13.23	13.05	12.93	13.44	13.25	13.19	13.08	13.65	14.23	14.97	15.82	......
Ayrshire	Manton Belle	14.01	13.05	13.44	13.46	13.30	12.77	12.81	12.80	13.10	13.59	......	......
Ayrshire	Junietta Peerless	13.71	12.13	11.73	11.72	11.70	12.04	12.39	......	......	......	......	......
Jersey	Gilderbloom	15.59	15.19	14.96	14.81	14.50	14.76	15.40	15.84	15.54	......	......	......
Jersey	Countess Flavia	16.06	16.04	16.53	16.64	17.40	16.96	16.71	15.64	15.90	17.16	16.78	......
Jersey	Barbara Allen	14.80	14.33	14.50	14.28	14.72	15.32	15.83	......	......	......	......	......
American-Holderness	Maggie 6th	13.30	12.06	12.44	12.22	12.68	13.20	......	......	......	......	......	......
American-Holderness	Nellie 6th	12.66	12.36	12.40	13.03	12.87	13.44	13.55	12.84	14.06	13.86	14.09	......
Devon	Ione	14.02	13.74	13.48	14.66	14.35	......	......	......	......	......	......	......
	Average	13.61	12.96	13.09	13.37	13.54	13.70	13.94	13.92	14.24	14.47	15.21	14.92

FAT IN MILK EACH MONTH OF SECOND PERIOD OF LACTATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	3.50	3.18	3.31	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	2.65	2.31	2.11	2.77	2.92	3.20	3.15	3.46	3.25	3.32	3.23	......
Ayrshire	Miss Flow 5th	3.97	3.09	2.93	3 17	3.20	3.47	3.90	3.76	3.80	3.58	4.53	4.38
Ayrshire	Queen Duchess	3.79	3.80	3.50	3.72	3.45	3.67	3.32	3.55	3.78	4.25	4.60	......
Ayrshire	Manton Belle	4.29	3.96	3.72	4.22	3.68	3.13	2.99	3 18	3.20	3.43	......	......
Ayrshire	Junietta Peerless	4.15	2.98	2.60	2.55	2.74	3.15	3.39	......	......	......	......	......
Jersey	Gilderbloom	5.39	5.23	5.00	4.73	4.55	4.95	5.10	6.15	5.65	......	......	......
Jersey	Countess lavia	5.43	5.52	6.17	6.16	5.33	6 33	6.05	5.05	4.84	6.44	6.15	......
Jersey	Barbara Allen	4.76	4.24	4.49	4.58	4.80	5.14	5.56	......	......	......	......	......
American-Holderness	Maggie 6th	4.04	3.28	3.42	3.25	3.65	3.58	......	......	......	......	......	......
American-Holderness	Nellie 6th	3.16	3.16	3.03	3.70	3.55	3.57	3.65	3.00	3.59	3.24	4.40	......
Devon	Ione	4.20	4.28	3.86	4.41	4.66	......	......	......	......	......	......	......
	Average	4.11	3.75	3.68	3.93	3.87	4.02	4.12	4.12	4.02	4.04	4.58	4.38

CASEINE IN MILK EACH MONTH OF SECOND PERIOD OF LACATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Essel 2d	2.86	3.08	3.14	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	2.62	2.40	2.97	2.72	3.47	3.13	2.93	3.00	3.51	3.56	4.57	......
Ayrshire	Miss Flow 5th	3.54	3.04	3.44	3.23	3.72	3.83	3.96	4.58	3.75	3.48	3.56	4.93
Ayrshire	Queen Duchess	2.99	2.32	3.13	2.96	2.81	3.56	3.26	3.61	3.97	4.45	5.39	......
Ayrshire	Manton Belle	2.85	3.02	2.96	3.15	3.02	3.19	3.32	3.57	3.62	4.80	......	......
Ayrshire	Junietta Peerless	3.27	2.73	2.48	2.93	2.95	3.08	3.03	......	......	......	......	......
Jersey	Gilderbloom	3.99	3.36	2.95	3.55	3.40	3.64	3.67	3.85	4.08	......	......	......
Jersey	Countless Flavia	4.19	3.50	3.18	3.86	4.82	4.20	4.00	3.88	3.75	4.21	3.99	......
Jersey	Barbara Allen	3.28	3.30	3.30	3.69	3.83	4.06	4.25	......	......	......	......	......
American-Holderness	Maggie 6th	3.10	2.60	2.80	2.92	3.02	3.37	......	......	......	......	......	......
American-Holderness	Nellie 6th	2.96	2.43	3.28	2.89	3.64	3.29	3.58	3.03	3.88	4.53	5.23	......
Devon	Ione	3.14	3.36	3.63	3.93	3.87	......	......	......	......	......	......	......
	Average	3.23	2.93	3.10	3.26	3.50	3.52	3.56	3.65	3.79	4.19	4.55	4.93

Sugar in Milk Each Month of Second Period of Lactation — Per Cent.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	5.53	4.87	5.10	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	4.40	4.56	4.49	4.56	4.40	4.86	5.35	5.52	5.42	5.78	6.00	......
Ayrshire	Miss Flow 5th	5.06	4.90	5.07	5.15	4.91	5.39	4.95	4.87	5.71	6.02	5.94	4.77
Ayrshire	Queen Duchess	5.77	6.26	5.74	6.16	6.26	5.31	5.72	5.74	5.75	5.68	4.76	......
Ayrshire	Manton Belle	6.15	5.48	6.16	5.46	5.96	5.87	5.87	5.45	5.73	4.66	......	......
Ayrshire	Junietta Peerless	5.67	5.86	6.03	5.70	5.49	5.12	5.33	......	......	......	......	......
Jersey	Gilderbloom	5.43	5.87	6.32	5.83	5.85	5.59	6.09	5.10	5.00	......	......	......
Jersey	Countess Flavia	5.63	6.19	6.45	5.97	6.50	5.68	6.00	6.02	6.57	5.87	6.03	......
Jersey	Barbara Allen	6.09	6.15	5.98	5.43	5.54	5.38	5.24	......	......	......	......	......
American-Holderness	Maggie 6th	5.50	5.43	5.61	5.44	5.30	5.51	......	......	......	......	......	......
American-Holderness	Nellie 6th	5.84	6.14	5.37	5.77	4.99	5.96	5.67	6.13	6.02	5.36	3.75	......
Devon	Ione	5.94	5.47	5.42	5.67	5.20	......	......	......	......	......	......	......
	Average	5.58	5.60	5.64	5.56	5.49	5.47	5.58	5.55	5.76	5.56	5.30	4.77

ASH IN MILK EACH MONTH OF SECOND PERIOD OF LACTATION — PER CENT.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	0.54	0.73	0.80	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	0.70	0.67	0.67	0.73	0.86	0.71	0.75	0.73	0.66	0.70	0.79	......
Ayrshire	Miss Flow 5th	0.63	0.69	0.66	0.72	0.68	0.72	0.73	0.78	0.74	0.78	0.72	0.84
Ayrshire	Queen Duchess	0.68	0.67	0.56	0.60	0.73	0.65	0.78	0.75	0.73	0.59	1.07	......
Ayrshire	Manton Belle	0.72	0.59	0.60	0.63	0.64	0.58	0.63	0.60	0.55	0.70	......	......
Ayrshire	Junietta Peerless	0.62	0.56	0.62	0.54	0.52	0.69	0.64	......	......	......	......	......
Jersey	Gilderbloom	0.78	0.73	0.69	0.70	0.70	0.68	0.54	0.74	0.81	......	......	......
Jersey	Countess Flavia	0.81	0.83	0.73	0.65	0.75	0.75	0.66	0.69	0.74	0.64	0.61	......
Jersey	Barbara Allen	0.67	0.64	0.73	0.58	0.55	0.74	0.78	......	......	......	......	......
American-Holderness	Maggie 6th	0.66	0.75	0.61	0.61	0.71	0.74	......	......	......	......	......	......
American-Holderness	Nellie 6th	0.70	0.63	0.72	0.67	0.69	0.62	0.65	0.68	0.57	0.73	0.71	......
Devon	Ione	0.74	0.63	0.57	0.65	0.62	......	......	......	......	......	......	......
	Average	0.69	0.68	0.66	0.64	0.68	0.69	0.68	0.70	0.69	0.69	0.58	0.84

Total Solids in Milk Each Month of Second Period of Lactation — Pounds.

Breed.	Names of Animals	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	124.0	122.5	110.3	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	92.9	96.1	90.2	78.0	89.2	87.7	91.2	82.2	73.1	73.3	44.3	......
Ayrshire	Miss Flow 5th	71.5	68.2	75.5	74.2	70.8	71.5	61.2	63.5	57.4	48.0	25.5	4.5
Ayrshire	Queen Duchess	94.6	119.6	111.7	117.2	113.2	108.8	101.1	95.8	59.5	28.0	6.6	......
Ayrshire	Manton Belle	115.5	113.8	113.4	99.6	98.2	95.4	89.6	59.8	34.0	9.0	......	......
Ayrshire	Junietta Peerless	116.9	116.3	113.3	101.7	92.4	97.5	91.9	......	......	......	......	......
Jersey	Gilderbloom	82.0	81.9	82.2	76.9	74.4	64.6	55.6	52.4	41.6	......	......	......
Jersey	Countess Flavia	38.5	115.6	103.6	84.3	87.7	83.3	84.7	71.0	72.1	60.0	46.1	......
Jersey	Barbara Allen	100.8	92.9	91.9	77.5	68.1	73.6	68.9	......	......	......	......	......
American-Holderness	Maggie 6th	120.5	112.6	95.3	76.0	77.0	74.6	......	......	......	......	......	......
American-Holderness	Nellie 6th	72.8	84.5	76.2	81.0	69.7	65.1	58.2	51.7	28.5	9.5	0.7	......
Devon	Ione	103.1	102.7	76.0	78.8	66.0	......	......	......	......	......	......	......
	Average	94.4	102.2	95.0	85.9	82.4	82.2	78.0	68.1	52.3	38.0	24.6	4.5

FAT IN MILK EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	34.9	32.9	29.6	....	....	....	....	....	....	....	....	....
Holstein-Friesian	Tolsma Artis	23.7	22.3	18.6	20.0	22.3	23.6	23.6	22.4	18.5	18.2	9.8	....
Ayrshire	Miss Flow 5th	21.5	18.0	18.3	19.2	18.1	18.5	17.6	17.1	15.6	12.4	7.8	1.3
Ayrshire	Queen Duchess	27.1	34.8	30.3	32.5	29.5	30.3	25.7	24.9	15.8	8.0	1.9	....
Ayrshire	Manton Belle	35.4	34.5	31.4	31.2	27.2	23.4	20.9	14.8	8.3	2.2	....	....
Ayrshire	Junietta Peerless	35.4	28.6	25.1	22.1	21.6	25.5	25.2	....	....	....	....	....
Jersey	Gilderbloom	28.3	28.2	27.5	24.6	23.4	21.6	18.4	20.4	15.1	....	....	....
Jersey	Countess Flavia	13.0	39.8	38.7	31.2	26.9	31.1	30.7	22.9	21.9	22.5	16.9	....
Jersey	Barbara Allen	32.4	27.5	28.5	24.8	22.2	24.7	24.2	....	....	....	....	....
American-Holderness	Maggie 6th	36.6	30.6	26.2	20.2	22.2	20.2	....	....	....	....	....	....
American-Holderness	Nellie 6th	18.2	21.6	18.6	23 0	19.2	17.3	15.7	12.1	7.3	2.2	0.2	....
Devon	Ione	30.9	32.0	21.8	23.7	21.4	....	....	....	....	....	....	....
	Average	28.1	29.2	26.2	24.8	23.1	23.6	22.4	19.2	14.6	10.9	7.3	1.3

Caseine in Milk Each Month of Second Period of Lactation — Pounds.

Breed.	Names of Animals.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	28.5	1.8	28.0	…	…	…	…	…	…	…	…	…
Holstein-Friesian	Tolsma Artis	23.5	23.2	26.2	19.7	26.6	23.1	21.9	19.4	20.0	19.5	13.9	…
Ayrshire	Miss Flow 5th	19.2	17.7	21.5	19.5	21.1	20.4	17.9	20.9	15.4	12.1	6.2	1.5
Ayrshire	Queen Duchess	21.4	21.3	27.0	25.8	24.0	29.4	25.2	25.3	16.6	8.3	2.3	…
Ayrshire	Manton Belle	23.5	26.3	25.0	23.3	22.3	23.8	23.2	16.7	9.4	3.2	…	…
Ayrshire	Junietta Peerless	27.9	26.2	24.0	25.4	23.3	25.0	22.5	…	…	…	…	…
Jersey	Gilderbloom	21.0	18.1	16.2	18.4	17.4	15.5	13.2	12.7	10.9	…	…	…
Jersey	Countess Flavia	10.1	25.2	19.6	19.5	24.3	20.6	20.3	17.6	17.0	14.7	10.9	…
Jersey	Barbara Allen	22.3	21.4	20.9	20.1	17.7	19.5	18.5	…	…	…	…	…
American-Holderness	Maggie 6th	28.1	24.3	21.4	18.2	18.3	19.1	…	…	…	…	…	…
American-Holderness	Nellie 6th	17.0	16.6	20.2	18.0	19.7	15.9	15.4	12.2	7.9	3.1	0.3	…
Devon	Ione	23.1	25.1	20.5	21.1	17.8	…	…	…	…	…	…	…
	Average	22.1	23.1	22.5	20.8	21.1	21.2	19.8	17.8	13.9	10.1	6.7	1.5

SUGAR IN MILK EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

Breed.	NAMES OF ANIMALS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	55.2	50.3	45.6	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	39.4	44.1	39.5	33.0	33.7	35.8	40.1	35.7	30.9	31.7	18.2	......
Ayrshire	Miss Flow 5th	27.4	28.5	31.6	31.1	27.8	28 7	22.4	22.2	23.4	20.8	10.3	1.4
Ayrshire	Queen Duchess	41 3	57.4	49.6	53.7	53.5	43.8	44.2	40.3	24.0	10.6	2.0	......
Ayrshire	Manton Belle	50.7	47.8	51.9	40.4	44.0	43.9	41.1	25.5	14.9	3.1	......	......
Ayrshire	Junietta Peerless	48.3	56.2	58.2	49.5	43.4	41.4	39.5	......	......	......	......	......
Jersey	Gilderbloom	28.6	31.7	34.7	30.3	30.0	24.5	22.0	16.9	13.4	......	......	......
Jersey	Countess Flavia	13.5	44.6	40.4	30.3	32.7	27.9	30.4	27.4	29.8	20.6	16.6	......
Jersey	Barbara Allen	41.5	39.9	37.9	29.5	25.6	25.8	22.8	......	......	......	......	......
American-Holderness	Maggie 6th	49.8	50.7	43.0	33.8	32.2	31.1	......	......	......	......	......	......
American-Holderness	Nellie 6th	33.6	42.0	33.0	35.9	27.0	28.9	24.3	24.7	12.2	3.7	0.2	......
Devon	Ione	43.7	40.9	30.5	30.5	23.9	......	......	......	......	......	......	......
	Average	39.4	44.5	41.3	36.2	34.0	33.2	31.9	27.5	21.2	15.1	9.5	1.4

Ash in Milk Each Month of Second Period of Lactation — Pounds.

Breed.	Names of Animals.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	Esel 2d	5.4	7.5	7.1	......	......	......	......	......	......	......	......	......
Holstein-Friesian	Tolsma Artis	6.3	6.5	5.9	5.3	6.6	5 2	5.6	4.7	3.7	3.9	2.4	......
Ayrshire	Miss Flow 5th	3.4	4.0	4.1	4.4	3.8	3.9	3.3	3.3	3.0	2.7	1.2	0.3
Ayrshire	Queen Duchess	4.8	6.1	4.8	5.2	6.2	5.3	6.0	5.3	3.1	1.1	0.4	......
Ayrshire	Manton Belle	5.9	5.2	5.1	4.7	4.7	4.3	4.4	2.8	1.4	0.5	......	......
Ayrshire	Junietta Peerless	5.3	5.3	6.0	4.7	4.1	5.6	4.7	......	......	......	......	......
Jersey	Gilderbloom	4.1	3.9	3.8	3.6	3.6	3.0	2.0	2.4	2.2	......	......	......
Jersey	Countess Flavia	1.9	6.0	4.6	3.3	3.8	3.7	3.3	3.1	3.4	2.2	1.7	......
Jersey	Barbara Allen	4.6	4.1	4.6	3.1	2.6	3.6	3.4	......	......	......	......	......
American-Holderness	Maggie 6th	6.0	7.0	4.7	3.8	4.3	4.2	......	......	......	......	......	......
American-Holderness	Nellie 6th	4.0	4.3	4.4	4.1	3.8	3.0	2.8	2.7	1.1	0.5	0.0	......
Devon	Ione	5.4	4.7	3.2	3.5	2.9	......	......	......	......	......	......	......
	Average	4.8	5.4	4.9	4.2	4.2	4.2	3.9	3.5	2.6	1.8	1.1	0.3

AVERAGE CRUDE FATS IN FOOD CONSUMED BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein Friesian	37.4	44.1	37.4	29.0	28.3	27.7	30.6	29.5	25.9	33.4	31.7	....
Ayrshire	20.7	26.9	32.1	37.4	37.2	39.2	37.8	38.8	36.2	33.0	26.3	17.2
Jersey	23.0	25.6	30.9	32.3	34.7	37.0	32.8	34.6	34.4	34.5	30.5	....
American-Holderness	24.4	29.1	29.2	30.2	31.2	28.9	28.0	31.1	31.7	28.2	29.8	....
Devon	34.4	38.4	37.6	39.6	31.4	....	....	....	....	....	....	....
Average	28.0	32.8	33.4	33.7	32.6	33.2	32.3	33.5	32.0	32.3	29.6	17.2

AVERAGE ALBUMINOIDS NOT AMIDES IN FOOD CONSUMED BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	79.44	87.75	83.21	101.44	90.25	87.44	95.87	84.75	85.12	82.81	45.19	....
Ayrshire	47.87	67.25	71.09	77.76	73.51	74.84	80.81	83.02	86.31	71.64	56.75	54.06
Jersey	38.31	57.56	61.06	75.29	75.50	70.56	66.87	65.56	62.94	75.94	71.25	....
American-Holderness	54.44	63.40	75.21	75.71	61.62	60.68	60.12	57.12	72.25	68.19	56.31	....
Devon	58.06	88.12	89.19	74.64	67.19	....	....	....	....	....	....	....
Average	55.62	72.81	75.95	80.97	73.61	73.38	75.92	72.61	76.65	74.64	57.37	54.06

AVERAGE CARBOHYDRATES IN FOOD CONSUMED BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	301.8	444.6	420.5	376.0	478.7	473.1	485.1	436.3	435.4	462.3	366.8	....
Ayrshire	283.7	326.8	369.8	376.9	374.8	398.9	376.3	399.0	366.8	362.5	324.8	292.8
Jersey	242.1	300.5	344.1	324.9	344.8	358.0	328.4	323.0	337.4	294.0	257.9	....
American-Holderness	239.0	311.0	319.7	320.2	321.3	314.5	236.2	274.1	262.0	235.0	300.2	....
Devon	299.0	330.6	322.0	398.9	344.6	....	....	....	....	....	....	....
Average	273.1	342.7	355.2	359.4	372.8	386.1	356.5	358.1	350.4	338.4	312.4	292.8

AVERAGE SUGAR AND STARCH IN FOOD CONSUMED BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	186.3	286.6	270.7	213.0	288.8	281.1	284.7	280.0	251.1	329.9	267.5	....
Ayrshire	160.7	207.2	240.7	253.2	259.1	270.5	231.0	228.6	215.0	219.1	207.1	167.2
Jersey	202.8	193.6	228.3	194.3	222.0	226.0	210.2	209.1	208.6	174.8	157.8	....
American-Holderness	158.2	205.8	194.9	211.6	213.4	201.6	166.9	182.6	157.6	146.1	183.1	....
Devon	185.0	201.8	199.6	237.0	193.9	....	....	....	....	....	....	....
Average	178.6	219.0	226.8	221.8	235.4	244.8	223.2	225.1	204.1	217.5	203.9	167.2

AVERAGE CRUDE FIBER IN FOOD CONSUMED BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	149.3	156.4	133.8	145.1	163.5	152.9	144.0	177.8	167.1	145.6	156 1	....
Ayrshire	115.6	147.0	151 6	153.8	153.0	151.1	151.3	165.4	150.2	135.2	126.2	117.7
Jersey	90.4	111.4	145.4	139.7	136.8	140.0	125.0	122.7	127.8	127.8	107.6	....
American-Holderness	94.2	125.1	125.6	112.6	106.3	100.1	91.2	107.6	108.7	93.1	93.6	....
Devon	133.8	133.5	130.0	132.7	107.6	....	....	....	....	....	....	....
Average	116.6	134.7	137.3	137.0	133.4	136.0	127.9	143.4	138.4	125.3	120.9	117.7

AVERAGE ASH IN FOOD CONSUMED BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION—POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	42.3	38.3	43.0	47.3	36.5	36.0	37.4	37.8	36.3	35.3	37.0	......
Ayrshire	26.9	34.4	35.8	40.7	42.1	41.8	45.6	43.2	42.2	34.1	27.1	24.4
Jersey	21.7	31.2	35.5	39.1	38.5	36.1	37.2	33.5	36.9	37.8	34.5	......
American-Holderness	28.4	32.1	34.2	33.6	27.3	31.2	30.9	30.0	35.0	32.2	22.3	......
Devon	36.3	41.6	42.5	30.6	34.9	......	......	......	......	......	......	......
Average	31.1	35.5	38.2	38.3	35.9	36.3	37.8	36.1	37.6	34.8	30.2	24.4

AVERAGE MILK YIELD BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	946.6	999.9	886.9	723.4	765.8	736.6	748.8	646.7	569.5	548.4	304.0	....
Ayrshire	733.5	832.3	824.4	771.2	737.1	728.9	666.6	541.7	362.5	193.9	107.4	30.0
Jersey	482.2	636.0	603.3	522.8	493.4	469.9	434.2	392.5	360.5	349.8	275.0	....
American-Holderness	740.8	809.2	690.6	622.0	574.4	524.5	429.6	402.5	202.8	69.3	5.4	....
Devon	735.6	748.1	563.8	537.4	459.7	....	....	....	....	....	....	....
Average	727.7	805.1	713.8	635.4	606.1	615.0	569.8	495.8	373.8	291.8	172.9	30.0

AVERAGE TOTAL SOLIDS IN MILK BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	11.40	10.90	11.29	10.78	11.65	11.90	12.18	12.71	12.84	13.36	14.59	....
Ayrshire	13.54	12.49	12.55	12.72	12.69	12.85	12.95	13.46	13.73	14.14	15.28	14.92
Jersey	15.48	15.19	15.33	15.24	15.54	15.68	15.98	15.74	15.72	17.16	16.78	....
American-Holderness	12.96	12.21	12.42	12.62	12.77	13.32	13.55	12.84	14.06	13.86	14.09	....
Devon	14.02	13.74	13.48	14.66	14.35	....	....	....	....	....	....	....
Average	13.48	12.91	13.01	13.20	13.40	13.44	13.66	13.55	14.10	14.63	15.18	14.92

AVERAGE FAT IN MILK BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	3.07	2.74	2.71	2.77	2.92	3.20	3.15	3.46	3.25	3.32	3.23	....
Ayrshire	4.05	3.46	3.19	3.41	3.27	3.35	3.40	3.50	3.59	3.75	4.56	4.38
Jersey	5.19	5.00	5.55	5.16	4.89	5.47	5.57	5.60	5.24	6.44	6.15	....
American-Holderness	3.60	3.22	3.22	3.47	3.60	3.57	3.65	3.00	3.59	3.24	4.40	....
Devon	4.20	4.28	3.86	4.41	4.66	....	....	....	....	....	....	....
Average	4.02	3.74	3.71	3.84	3.87	3.90	3.94	3.89	3.92	4.19	4.58	4.38

Average Caseine in Milk by Breeds Each Month of Second Period of Lactation — Per Cent.

Breed.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	2.74	2.74	3.05	2.72	3.47	3.13	2.93	3.00	3.51	3.56	4.57	....
Ayrshire	3.16	2.78	3.00	3.07	3.12	3 41	3.39	3.92	3.78	4.24	4.47	4.93
Jersey	3.82	3.39	3.14	3.70	4.02	3.93	3.97	3.86	3.91	4.21	3.99	....
American-Holderness	3.03	2.51	3.04	2.90	3.33	3.33	3.58	3.03	3.88	4.53	5.23	....
Devon	3.14	3.36	3.63	3.93	3.87	....	....	....	....	....	....	....
Average	3.18	2.96	3.17	3.26	3.56	3.45	3.47	3.45	3.77	4.13	4.56	4.93

AVERAGE SUGAR IN MILK BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	4.96	4.71	4.79	4.56	4.40	4.86	5.35	5.52	5.42	5.78	6.00	....
Ayrshire	5.66	5.62	5.75	5.62	5.65	5.42	5.47	5.35	5.73	5.45	5.35	4.77
Jersey	5.72	6.07	6.25	5.74	5.96	5.55	5.78	5.56	5.78	5.87	6.03	....
American-Holderness	5.67	5.78	5.49	5.60	5.14	5.73	5.67	6.13	6.02	5.36	3.75	....
Devon	5.94	5.47	5.42	5.67	5.20	....	....	....	....	....	....	....
Average	5.59	5.53	5.54	5.44	5.27	5.39	5.57	5.64	5.74	5.61	5.28	4.77

AVERAGE ASH IN MILK BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	0.62	0.70	0.73	0.73	0.86	0.71	0.75	0.73	0.66	0.70	0.79	....
Ayrshire	0.66	0.63	0.61	0.62	0.64	0.66	0.69	0.69	0.67	0.69	0.89	0.84
Jersey	0.75	0.73	0.72	0.64	0.67	0.72	0.66	0.71	0.77	0.64	0.61	....
American-Holderness	0.68	0.69	0.66	0.64	0.70	0.68	0.65	0.68	0.57	0.73	0.71	....
Devon	0.74	0.63	0.57	0.65	0.62	......	......	......	......	......	......	....
Average	0.69	0.68	0.66	0.66	0.70	0.69	0.69	0.70	0.67	0.69	0.75	0.84

AVERAGE TOTAL SOLIDS IN MILK BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	108.4	109.3	100.2	78.0	89.2	87.7	91.2	82.2	73.1	73.3	44.3	......
Ayrshire	99.6	104.5	103.5	98.2	93.6	93.3	85.9	73.0	50.3	28.3	16.0	4.5
Jersey	73.8	96.8	92.6	79.6	76.7	73.8	69.7	61.7	56.8	60.0	46.1	......
American-Holderness	96.6	98.5	85.7	78.5	73.3	69.8	58.2	51.7	28.5	9.5	0.7	......
Devon	103.1	102.7	76.0	78.8	66.0	......	......	......	......	......	......	......
Average	96.3	102.4	91.6	82.6	79.8	81.1	76.2	67.1	52.2	42.8	26.8	4.5

Average Fat in Milk by Breeds Each Month of Second Period of Lactation — Pounds.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	29.3	27.6	24.1	20.0	22.3	23.6	23.6	22.4	18.5	18.2	9.8	....
Ayrshire	29.8	29.0	26.3	26.2	24.1	24.4	22.3	18.9	13.2	7.5	4.8	1.3
Jersey	24.6	31.8	31.6	26.9	24.2	25.8	24.4	21.6	18.5	22.5	16.9	....
American-Holderness	27.4	26.1	22.4	21.6	20.7	18.7	15.7	12.1	7.3	2.2	0.2	....
Devon	30.9	32.0	21.8	23.7	21.4	....	....	....	....	....	....	....
Average	28.4	29.3	25.2	23.7	22.5	23.1	21.5	18.7	14.4	12.6	7.9	1.3

AVERAGE CASEINE IN MILK BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	26.0	27.5	27.1	19.7	26.6	23.1	21.9	19.4	20.0	19.5	13.9	....
Ayrshire	23.0	22.9	24.4	23.5	22.7	24.6	22.2	21.0	13.8	7.9	4.2	1.5
Jersey	17.8	21.6	19.0	19.3	19.8	18.5	17.3	15.1	13.9	14.7	10.9	....
American-Holderness	22.5	20.4	20.8	18.1	19.0	17.5	15.4	12.2	7.9	3.1	0.3	....
Devon	23.1	25.1	20.5	21.1	17.8	....	....	....	....	....	....	....
Average	22.5	23.5	22.4	20.3	21.2	20.9	19.2	16.9	13.9	11.3	7.3	1.5

Average Sugar in Milk by Breeds Each Month of Second Period of Lactation — Pounds.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	47.3	47.2	42.5	33.0	33.7	35.8	40.1	35.7	30.9	31.7	18.2	....
Ayrshire	41.9	47.5	47.8	43.7	42.2	39.4	36.8	29.3	20.8	11.5	6.1	1.4
Jersey	27.9	38.7	37.7	30.0	29.4	26.1	25.1	22.1	21.6	20.6	16.6	....
American-Holderness	41.7	46.3	38.0	34.8	29.6	30.0	24.3	24.7	12.2	3.7	0.2	....
Devon	43.7	40.9	30.5	30.5	23.9	....	....	....	....	....	....	....
Average	40.5	44.1	39.3	34.4	31.8	32.8	31.6	27.9	21.4	16.9	10.3	1.4

AVERAGE ASH IN MILK BY BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third	Fourth.	Fifth.	Sixth.	Seventh.	Eight.	Ninth.	Tenth.	Eleventh.	Twelfth.
Holstein-Friesian	5.8	7.0	6.5	5.3	6.6	5.2	5.6	4.7	3.7	3.9	2.4	....
Ayrshire	4.8	5.1	5.0	4.7	4.7	4.8	4.6	3.8	2.5	1.4	0.8	0.3
Jersey	3.5	4.7	4.3	3.3	3.3	3.4	2.9	2.7	2.8	2.2	1.7	....
American-Holderness	5.0	5.6	4.5	3.9	4.0	3.6	2.8	2.7	1.1	0.5	0.0	....
Devon	5 4	4.7	3.2	3.5	2.9	....	....	....	....	....	....	....
Average	4.9	5.4	4.7	4.1	4.3	4.2	4.0	3.5	2.3	2.0	1.2	0.3

GENERAL AVERAGES OF ALL BREEDS EACH MONTH OF SECOND PERIOD OF LACTATION.

	First.	Second.	Third	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth	Tenth.	Eleventh.	Twelfth.
Milk yield, pounds	727.7	805.1	713.8	635.4	606.1	615.0	569.8	495.8	373.8	291.8	172.9	30.0
Total solids, per cent	13.48	12.91	93.01	13.20	13.40	13.44	13.66	13.55	14.10	14.63	15.18	14.92
Fats, per cent	4.02	3.74	3.71	3.84	3.87	3.90	3.94	3.89	3.92	4.19	4.58	4.38
Caseine, per cent	3.18	2.96	3.17	3.26	3.56	3.45	3.47	3.45	3.77	4.13	4.56	4.93
Sugar, per cent	5.59	5.53	5.54	5.44	5.27	5.39	5.57	5.64	5.74	5.61	5.28	4.77
Ash, per cent	0.69	0.68	0.66	0.66	0.70	0.69	0.69	0.70	0.67	0.69	0.75	0.84
Total solids, pounds	96.3	102.4	91.6	82.6	79.8	81.1	76.2	67.1	52.2	42.8	26.8	4.5
Fats, pounds	28.4	29.3	25.2	23.7	22.5	23.1	21.5	18.7	14.4	12.6	7.9	1.3
Caseine, pounds	22.5	23.5	22.4	20.3	21.2	20.9	19.2	16.9	13.9	11.3	7.3	1.5
Sugar, pounds	40.5	44.1	39.3	34.4	31.8	32.8	31.6	27.9	21.4	16.9	10.3	1.4
Ash, pounds	4.9	5.4	4.7	4.1	4.3	4.2	4.0	3.5	2.3	2.0	1.2	0.3
Crude fats in foods, pounds	28.0	32.8	33.4	33.7	32.6	33.2	32.3	33.5	32.0	32.3	29.6	17.2
Albuminoids in foods, pounds	55.62	72.81	75.95	80.97	73.61	73.38	75.92	72.61	76.65	74.64	57.37	54.06
Carbohydrates in foods, pounds	273.1	342.7	355.2	359.4	372.8	386.1	356.5	358.1	350.4	338.4	312.4	292.8
Starch and sugars in foods, pounds	178.6	219.0	226.8	221.8	235.4	244.8	223.2	225.1	204.1	217.5	203.9	167.2
Crude fiber in foods, pounds	116.6	134.7	137.3	137.0	133.4	136.0	127 9	143.4	138.4	125.3	120.9	117.7
Ash in foods, pounds	31.1	35.5	38.2	38.3	35.9	36.3	37.8	36.1	37.6	34.8	30.2	24.4

Composition of Milk in Successive Periods of Lactation.

The following tables present the changes in the yield and composition of milk, the first table during the first and second, and the second table during the first, second and third periods of lactation.

Thus far the number of cows to be compared for the three periods is perhaps too limited to more than indicate the probable changes which will be shown by subsequent investigation, and should such changes be found in accord with a general rule it will prove of great practical importance to the dairymen.

In comparing the first and second periods, it will be seen that during the first months of the second period of lactation the milk yield is very considerably in excess of the yield for the same months of the first period and that gradually this excess disappears, so that after the seventh month the average yield of milk becomes much less even than it was during the latter months of the first period. The same is true as to the amount of total solids while the per cent. of total solids during the entire second period is a little more than during the first period but remains nearly constant during the entire period.

The per cent. of fat in the milk of the second period is at first 4 or 5 per cent. less than during the first period but during the fourth, fifth and sixth months equals the per cent. for the same months of the first period, but again falls off in the latter months of the second period.

The total amount of fat and of caseine of the second period follows closely the changes in milk yield, while the per cent. of caseine, at the first about 95 per cent of what it was during the first parts of the first period gradually increased until during the ninth and tenth months it is ten per cent. above what it was at the same time in the first period.

The per cent. of sugar is 10 to 12 per cent. greater during the early months of the second period than during these early months of the first but diminishes slowly during lactation, while the total amount of sugar begins 40 per cent or more above what it was at the beginning of the first period but diminishes constantly until during the ninth month it is one-third less than it was the ninth month of the first period of lactation.

Comparison of Milk of First and Second Period of Lactation.

	Month of Lactation.										
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Average.
Number of cows	11	11	11	10	10	9	8	6	6	5	
Milk, first period	599.9	584.6	562.6	535.1	486.3	504.5	464.4	485.9	401.6	347.8	497.3
Milk, second period	780.9	725.0	663.4	603.8	577.5	553.8	511.9	369.9	243.7	112.3	514.2
Per cent	130.0	124.0	118 0	113.0	119.0	110.0	110.0	76.0	61.0	32.0	103.4
Total solids, per cent, first period	13.07	13.04	13.33	13.50	13.75	13.74	13.93	14.02	14.34	14.48	13.72
Total solids, per cent, second period	13.32	13.32	13.59	13.74	14.05	14.05	14.33	14.42	15.04	15.01	14.09
Per cent	102.0	102.0	102.0	102.0	102.0	102.0	103.0	103.0	105.0	104.0	102.7
Total solids, pounds, first period	78.2	75.9	74.4	71.9	66.3	68.5	64.0	67.5	57.5	49.7	67.4
Total solids, pounds, second period	102.9	95.4	89.0	81.9	79.8	76.4	71.9	53.1	37.1	17.5	70.5
Per cent	132.0	126.0	120.0	114.0	120.0	111.0	112.0	79.0	65.0	35.0	104.6
Fat, per cent, first period	4.07	4.05	4.17	4.11	4.20	4.19	4.39	4.46	4.62	4.44	4.27
Fat, per cent, second period	3.91	3.84	3.97	4.01	4.24	4.23	4.23	4.14	4.53	4.62	4.17
Per cent	96.0	95.0	95.0	98.0	101.0	101.0	96.0	93.0	98.0	104.0	97.7
Fat, pounds, first period	24.4	23.5	23.0	21.8	20.0	20.7	19.6	21.1	18.5	15.2	20.8
Fat, pounds, second period	29.9	27.2	25.5	23.6	23.6	22.5	20.4	15.1	11.6	5.8	20.5
Per cent	123.0	117.0	111.0	108.0	118.0	109.0	103.0	72.0	63.0	38.0	98.7
Caseine, per cent, first period	3.10	3.29	3.36	3.33	3.51	3.51	3.56	3.73	3.74	4.13	3.53
Caseine per cent, second period	2.96	3.12	3.11	3.52	3.60	3.59	3.80	3.83	4.13	4.59	3.63
Per cent	95.0	95.0	93.0	106.0	103.0	102.0	107.0	103.0	110.0	111.0	102.8
Caseine, pounds, first period	18.6	19.0	18.7	17.9	17.0	17.3	16.2	17.9	15.0	13.9	17.2
Caseine, pounds, second period	22.8	22.3	21.6	20.7	20.4	19.4	19.1	14.1	9.8	4.6	17.5
Per cent	123.0	117.0	115.0	116.0	120.0	112.0	118.0	79.0	66.0	33.0	101.9
Sugar, per cent, first period	5.18	5.00	5.11	5.35	5.31	5.35	5.23	5.30	5.27	5.17	5.23
Sugar, per cent, second period	5.75	5.69	5.68	5.55	5.51	5.56	5.58	5.75	5.71	5.03	5.58
Per cent	111.0	114.0	111.0	104.0	104.0	104.0	107.0	108.0	108.0	97.0	106.8
Sugar, pounds, first period	31.1	29.2	28.7	28.5	25.8	27.1	24.6	25.3	21.1	16.2	25.8
Sugar, pounds, second period	44.8	41.1	37.8	33.6	31.7	30.8	28.8	21.4	14.1	6.4	29.1
Per cent	144.0	141.0	132.0	118 0	123.0	114.0	116.0	85.0	67.0	39.0	112.8

COMPARISON OF YIELD AND COMPOSITION OF MILK FOR THREE PERIODS OF LACTATION.

	Month of Lactation.									Average ratio of months.
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	
Number of cows	3	3	3	1	1	1	1	1	1	
Milk, first period	634.5	614.5	627.6	591.6	534.4	551.7	449.5	431.5	333.9	530.0
Milk, second period	724.8	698.1	6[illegible]7.0	566.2	533.2	452.2	456.2	410.0	346.5	601.0
Milk, third period	950 0	882.7	700.8	692.1	715.9	614.6	505.8	383.9	169.2	624.0
Per cent. of second period	114.0	114.0	98.0	96.0	100.0	82.0	101.0	95.0	104.0	113.0
Per cent. of third period	150.0	144.0	112.0	117.0	134.0	111.0	112.0	89.0	51.0	118 0
Fat, per cent. first period	4.95	3.93	4.02	4.00	3.80	4.11	4.05	4.37	4.34	4.17
Fat, per cent. second period	4.56	4.19	4.27	3.17	3.20	3.47	3.90	3.76	3.80	3.81
Fat, per cent. third period	4.57	4.08	4.37	3.47	3.18	3.34	3.89	4.21	4.63	3.97
Per cent. of second period	92.0	106.0	106.0	79.0	84.0	84.0	96.0	86.0	88.0	.91
Per cent. of third period	92.0	104.0	109.0	87.0	83.0	81 0	96.0	96.0	107.0	.95
Fat, pounds, first period	28.4	24.5	26.9	22.5	22.0	22.3	19.6	18.7	16.5	22.4
Fat, pounds, second period	30.8	29.5	27.2	18.1	18.5	17.6	17.1	15.6	12.4	20.8
Fat, pounds, third period	36.1	35.9	29.8	22.0	23.9	23.9	21.3	17.8	9.0	24.4
Per cent. of second period	108.0	120.0	101.0	80.0	84.0	79.0	87.0	83.0	75.0	93.0
Per cent. of third period	127.0	146.0	111.0	98.0	109.0	107.0	109.0	95.0	55.0	109.0
Caseine, per cent. first period	3.46	3.18	3.43	3.66	4.08	3.71	3.42	3.55	3.59	3.56
Caseine, per cent. second period	3.53	3.19	3.19	3 23	3.72	3.83	3.96	4.58	3.75	3.66
Caseine, per cent. third period	3.62	3.35	3.32	3.63	3.19	3.49	3.63	3.88	3.91	3.56
Per cent. of second period	102.0	100.0	93.0	88.0	91.0	103.0	116.0	129.0	104.0	103.0
Per cent. of third period	105.0	105.0	97.0	99.0	78.0	94.0	106.0	109.0	109.0	100.0
Caseine, pounds, first period	20.4	21.1	21.9	24.1	19.8	18.9	15.9	15.5	13.4	19.0
Caseine, pounds, second period	23.1	22 1	20.8	21.1	20.4	17.9	20.9	15.4	12.1	19.3
Caseine, pounds, third period	30.4	27.9	25.5	22.1	25.0	22.3	19.6	15.0	7.2	21.7
Per cent. of second period	113.0	105.0	95.0	88.0	103.0	95.0	131.0	99.0	90.0	101.0
Per cent. of third period	149.0	132.0	116.0	92.0	126.0	118.0	123.0	97.0	54.0	114.0

Water Consumed in Food and Drink.

During the past three years the records of this station have enabled us to determine the amount of water consumed by the several animals of the different breeds under experiment during lactation, and at the intervals between the successive periods of lactation, and with the results given in the following table:

	Weight.	Water in food.	Water drunk.	Milk.	Total water per month.	Total water per month for 1,000.	Water for 1 lb. milk.
Ayrshires	905	801.5	2,010	659.9	2,811.5	3 107	4.26
Guernseys	824	759.1	1,563	458.2	2,322.1	2 818	5.07
Holstein-Friesians	1,058	896.5	2,271	737.4	3,267.5	3 089	4.43
Jerseys	788	718.8	1,613	447.6	2,331.8	2 959	5.21
Short-Horns	1,071	944.0	1,593	506.9	2,537.0	2 369	5.00
American-Holderness	807	594.0	1,360	494.7	1,954.0	2 420	3.95
Devons	833	709.8	1,211	398.8	1,920.8	2 306	4.82
Average	898	774.8	1,660	529.1	2,434.8	2 738	4.68

When ensilage, roots, green forage or other food containing much water is introduced in the daily ration, the amount of water drunk is, as a rule, diminished by such amount as such food contains, as is clearly shown by comparison of the average results for August and September, 1891, and for December, 1892, and January, 1893, which are given in the following table:

WATER IN FOOD AND WATER DRUNK.

	August, 1891.			September, 1891.			December, 1892.			January, 1893.		
	Water drunk.	Water in food.	Total.	Water drunk.	Water in food.	Total.	Water drunk.	Water in food.	Total.	Water drunk.	Water in food.	Total.
Devons	1,047	1,004	2,051	1,500	661	2,161	937	1,092	2,029	1,145	499	1,644
Ayrshires	1,755	1,060	2,815	2,285	715	3,000	1,719	1,286	3,005	2,110	614	2,724
Jerseys	1,454	673	2,127	1,779	413	2,192	1,368	1,063	2,431	1,607	527	2,134
Guernseys	1,445	1,035	2,480	2,053	696	2,749	1,315	1,202	2,517	1,733	594	2,327
Holstein-Friesians	2,168	1,159	3,327	2,749	828	3,577	1,934	1,358	3 292	2,297	696	2,993
American Holderness	1,383	895	2,278	1,713	609	2,322	1,242	1,191	2,433	1,430	533	1,963
Average	1,542	971	2,513	2,013	654	2,667	1,419	1,199	2,618	1,720	577	2,298
Per cent	61.4	38.6	100.	75.5	24.5	100.	54.2	45.8	100.	74.9	25.1	100.

During the entire period of three years these animals averaged, while in milk, a monthly consumption of 2,435 pounds of water, of which 775 pounds, or 31.8 per cent., was in their food, and 1,660 pounds, or 68.2 per cent., was drunk.

These same animals, during the intervals between successive periods of lactation, averaged a monthly consumption of 1,586 pounds of water, or but 65.1 per cent. of the amount they consumed while in lactation, and of this amount 547 pounds, or 34.5 per cent, was in their food and 1,039 pounds, or 65.5 per cent, was drunk.

It will be observed that the difference of 849 pounds between the total water consumed during lactation and when not in milk is largely accounted for in the average monthly yield of milk of 529 pounds; also that upon an average for the entire herd, there was 4.6 pounds of water consumed for each pound of milk produced.

Relation of Food to Milk.

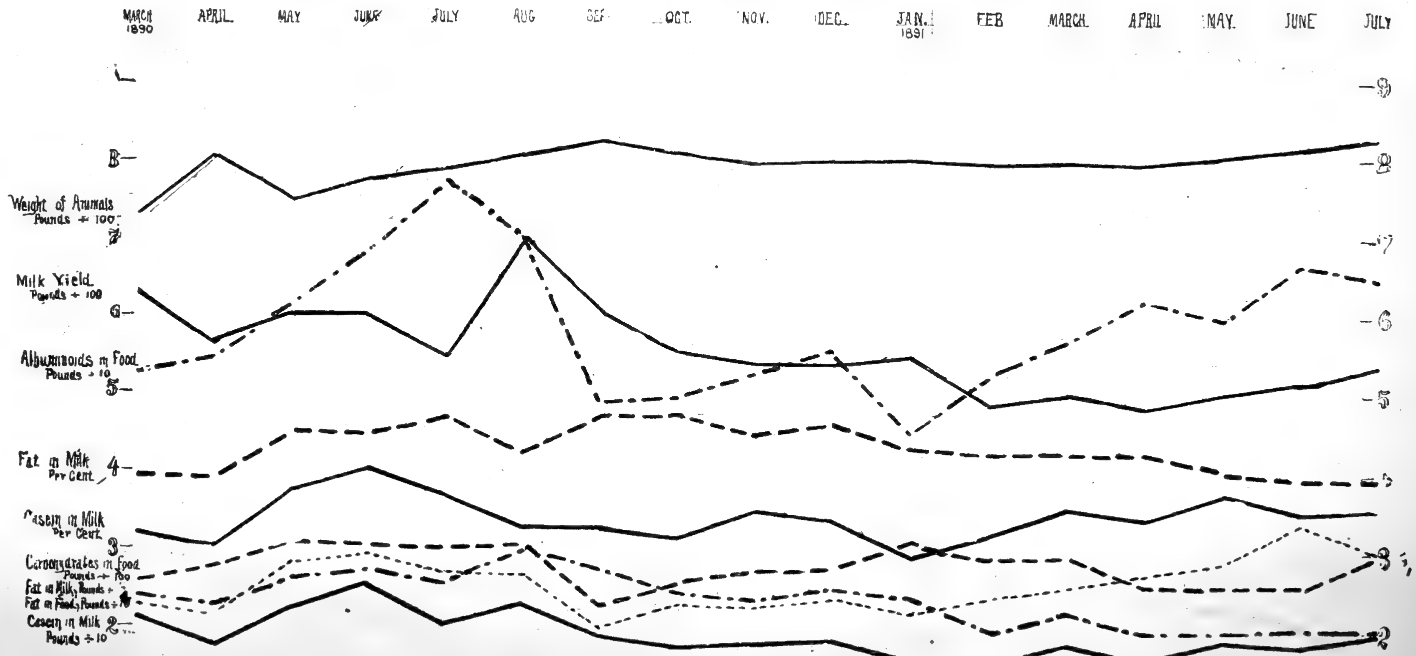
The following table presents the average results obtained at this station for nearly three years with all the animals under experiment, and only for those months when they were in full or nearly full flow of milk.

It may be studied with great interest by those who desire to learn what constituents of food favor the increase in the quantity and quality of the milk product.

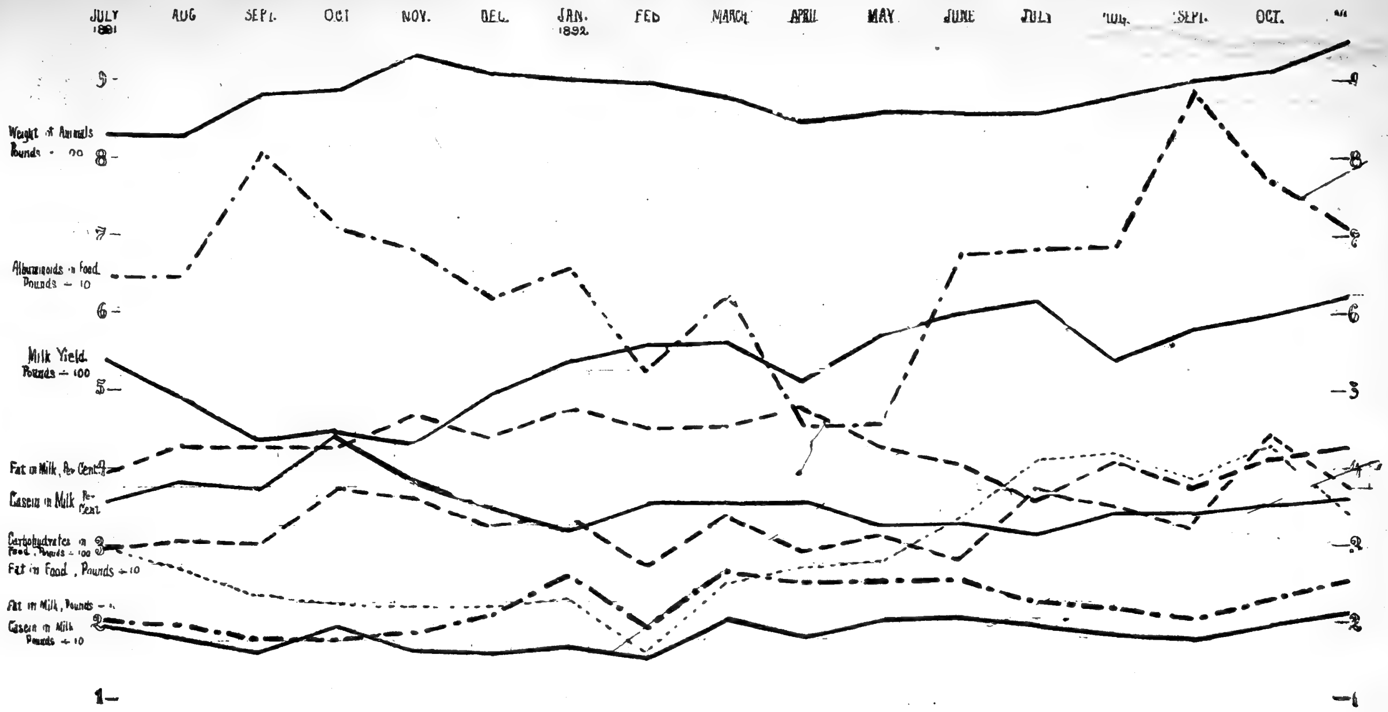
It will be seen that there was present in the food consumed an aggregate of 8,277 pounds of crude fat and the fat yielded in the milk was 7,145 pounds, or, if we allow 17.4 per cent. for the average impurity in the crude fat the food contained 95.67 per cent. of the fat found in the milk, and if the later periods of lactation were included, when the food remains nearly constant, but the milk yield falls off, it will be found that the food contains very appreciably more fat than that recovered in the milk, and gives reason for the belief that it is this fat in the food which normally furnishes that found in the milk.

	1890.											1891.						
	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.
Milk yield	......	626.1	573.6	607.8	603.0	557.4	703.8	605.4	563.4	533.5	532.6	552.9	487.3	510.6	486.6	511.5	536.5	541.2
Per cent. fat in milk	......	3.96	3.91	4.42	4.56	4.73	4.35	4.75	4.47	4.53	4.72	4.42	4.28	4.36	4.26	4.14	3.99	3.94
Per cent. caseine in milk	......	3.23	3.15	3.77	4.10	3.74	3.28	3.29	3.22	3.51	3.43	2.99	3.31	3.67	3.48	3.75	3.50	3.63
Pounds fat in milk	......	24.3	22.4	26.9	27.6	26.5	30.1	28.0	24.7	23.3	24.5	23.6	20.0	21.8	20.2	20.7	20.5	20.2
Pounds caseine in milk	......	21.22	18.97	22.97	24.75	20.88	22.69	19.40	18.01	18.46	18.21	16.39	15.82	18.50	16.77	18.98	18.39	19.21
Pounds fat in food	......	22.9	21.8	28.3	30.0	27.0	26.8	19.6	23.1	23.1	24.5	22.4	24.1	25.6	27.3	28.6	33.6	29.9
Pounds albuminoids in food	......	53.2	55.0	61.6	68.5	77.5	70.5	47.9	49.4	52.7	54.8	46.3	53.2	58.3	64.5	60.6	67.0	65.4
Pounds carbohydrates in food	......	263.3	282.0	314.9	304.4	299.8	309.6	228.4	268.1	274.7	283.9	310.3	288.5	289.2	267.0	259.7	269.7	295.5
Weight of animals	......	736	803	747	777	782	818	825	814	796	800	804	794	793	794	811	823	837
Number averaged	......	1	1	2	2	2	4	5	8	8	8	10	10	12	13	13	14	14

GENERAL AVERAGE OF CERTAIN CONSTITUENTS OF FOOD AND MILK



GENERAL AVERAGE OF CERTAIN CONSTITUENTS OF FOOD AND MILK. Continued



	1891.					1892.										
	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.
Milk yield	493.5	434.5	443.7	428.8	494.0	537.0	562.2	568.4	509.2	571.0	599.1	612.8	538.7	578.9	598.5	619.4
Per cent. fat in milk	4.33	4.31	4.29	4.69	4.43	4.80	4.53	4.53	4.76	4.28	4.07	3.65	4.10	3.80	4.14	4.24
Per cent. caseine in milk	3.76	3.75	4.39	3.86	3.50	3.22	3.54	3.52	3.53	3.26	3.28	3.17	3.42	3.35	3.49	3.56
Pounds fat in milk	19.5	18.0	18.3	18.8	20.9	25.3	19.9	26.1	25.4	26.2	25.5	23.0	21.7	20.6	22.9	24.5
Pounds caseine in milk	18.17	16.14	19.10	16.23	15.80	16.90	15.99	20.54	18.67	20.25	20.93	20.10	18.61	18.28	19.9	21.1
Pounds fat in food	27.0	23.6	22.4	21.8	22.1	22.7	16.3	24.7	26.5	28.1	33.6	40.6	41.1	38.6	42.3	34.2
Pounds albuminoids in food.	63.4	80.4	71.5	68.4	62.2	66.4	52.8	62.0	45.5	45.6	66.9	68.1	88.4	88.7	72.2	71.1
Pounds carbohydrates in f'd.	308.0	302.7	373.9	364.9	328.5	335.3	275.0	341.5	295.5	309.8	283.6	360.7	345.6	327.2	429.3	378.6
Weight of animals	831	888	892	934	914	905	897	879	847	865	865	864	876	897	909	948
Number averaged	14	11	11	9	13	12	8	12	11	16	18	18	16	13	13	13

The Source of Fat in Milk.

In the tenth annual report of this station we referred to the statement of Liebig that it was manifestly impossible that the scanty amount of fat in grass and fodder could account for the fat present in the milk of the cow, but as to the statement it would be far more readily accepted if the figures were given which prove it. It may be seriously questioned whether any cow fed entirely on grass or any other green fodder will for months continue to produce more fat in her milk than careful analysis will show to be present in such grass or fodder. In the experiment recorded last year we found that the aggregate number of pounds of crude fat consumed by the animals under investigation was 4,587.9 and the aggregate amount of milk fat produced by them was 3,793.4 pounds; or as 121 to 100. If we allow upon an average 17.4 per cent. of the crude fat as impurity, it would still leave fat enough in the food to account for all recovered in the milk. In the tenth report of this station there was given the averages of each animal for each month of lactation, and it was interesting to observe that during the earlier months the production of fat in milk was considerably in excess of even the crude fat of the food, but very soon the amount of crude fat eaten and the amount produced became equal, and by a rather steady increase relatively the amount of crude fat consumed became at later months of lactation, largely in excess of the fat produced in the milk. Such a result appears to be in accord with common observation, since, as is well known, the cow and other animals, as the time of giving birth to their offspring approaches, often become dangerously laden with the accumulation of fat stored up in their bodies, and it is also a matter of common remark that soon after the period of lactation begins with the cow, this stored up fat, which seems to be a provision of nature to enable her to meet such emergency, disappears, only to reappear again when a like emergency is to arise in the near future.

During the past year these experiments have been continued and the previous results appear to be fully confirmed.

The following table gives the results obtained from twenty animals, in their first period of lactation. It will be seen that those which had entered upon their second period of lactation had consumed between the first and second period of lactation a large amount of fat which may have been stored up for future demands.

It will be seen by the table that while fourteen of the twenty cows consumed an aggregate excess of fat in their food of 313 pounds over that produced in their milk, that six of the cows yielded an aggregate of 284 pounds more fat in their milk than they consumed in their food; but in this connection, and perhaps explaining this fact, it will be seen that during the short interval which elapsed between the first and second period of lactation, eleven of these cows consumed and may have stored up as body fat, 275 pounds of fat consumed in their food, and it is not improbable that the demand made upon these six cows for the extra 284 pounds of fat which they produced in their milk may easily have been stored up by them during the period preceding their first period of lactation.

It will be seen that the twenty animals consumed in all 5,421 pounds of pure fat, and yielded in milk 5,108 pounds, an average of fat consumed 6.1 per cent. in excess of that produced in their milk.

Also that fourteen of the cows consumed in all 3,570 pounds of pure fat and produced in milk 2,973 pounds, only 83.3 per cent. of the amount consumed by them, while the remaining six consumed in all 1,851 pounds and produced in milk 2,135 pounds, or 15.3 per cent. more than was consumed by them during this production.

RELATION OF FAT IN FOOD TO FAT IN MILK, FIRST PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Ether extract in food.	Pure fat in food.	Fat in milk.	Per cent. of pure fat in food to fat in milk.	Pure fat in food betw'n 1st and 2d periods.	No. of months.
Holstein-Friesian	Esel 2d	586.6	484.5	435.7	111.2	23.4	19
Holstein-Friesian	Beauty Pledge	269.3	222.4	135.5	164.1	....	7
Ayrshire	Queen Duchess	423.3	349.6	367.9	95.1	15.3	16
Ayrshire	Junietta Peerless	322.3	266.2	179.5	148.2	....	15
Ayrshire	Manton Belle	333.8	275.7	230 4	119.7	2.0	13
Ayrshire	Miss Flow	291.2	240.5	222.8	107.9	4.5	12
Jersey	Gilderbloom	378.9	313.0	293.0	106.8	....	17
Jersey	Countess Flavia	473.8	391.4	477.0	82.1	9.7	19
Jersey	Barbara Allen	402.9	332.8	376.4	88.4	....	16
Jersey	Albert's Carol	224.2	185.2	161.7	114.5	....	7
American-Holderness	Nellie 6th	232.2	191.8	145.5	131.8	29.5	13
American-Holderness	Maggie 6th	333.9	275.8	220.1	125.3	54.3	16
Guernsey	Rosette Ford	377.9	312.1	351.3	88.8	62.6	16
Guernsey	Oriole	357.6	295.4	388.5	76.0	7.8	15
Guernsey	Madam Select	208.2	172.0	148.7	115.7	....	8
Guernsey	Stella Select	318.3	262.9	222.5	118.2	....	10
Devon	Ione	305.8	252.6	201.9	125.1	8.2	14
Devon	Genevie's Gift	205.2	169.5	173.5	97.7	57.7	12
Devon	Artalia	316.3	261.3	221.3	118.1	....	11
Short Horn	Betsey 10th	201.5	166.4	154.8	107.5	....	7
	Totals	6563.3	5421.2	5108.0	....	....	....

Cost of Milk and Fat Production.

The first two tables following give the cost of food, the yield of milk and fat and the cost per pound for the same for each animal, and the average for each breed as also the general average of all the breeds for the entire period of the first lactation, as also the same data for comparison of the nearly completed second period of lactation.

The second two tables give the ratio of cost of production of milk and fat of the individual animals, as also of the breeds for the entire first period of lactation and for the nearly completed second period.

It will be seen that as a rule those animals and breeds which produce milk at the least cost are generally those which produce fat, and therefore butter, at the greatest cost.

It will also be remarked that while the estimated cost of the several constituents making up the rations of these animals has been kept the same for both years for greater ease of comparison, that the average daily cost of each animal for food during the second period has been 16.17 cents, while for the first it was 13.11 cents, or as 123.3 to 100, the average cost of milk the second period was but 90.6 per cent. of the cost for the first period, and the cost of the fat for the second period was 95.6 per cent., upon an average, of the cost during the first period of lactation.

The increased cost of food during the second period was due to the natural increase demanded for maintenance, the cows having averaged about forty pounds increase in weight during their second period over their weight during the first.

It will be of value to learn whether these relations in cost of production shall be retained when the data is secured for the entire second period of lactation, the data thus far at hand for this period covering an average of 273 days, while the average number of days of lactation for the first period was 498 days, several of the cows having been permitted to remain in milk far into the second year in order that the herd could be divided into a summer and winter herd.

It is to be observed that there is very great differences in the individual animals as to the relative cost of production of milk and fat for the two periods, which differences each reader may determine for himself from the data presented in the following tables:

RELATIVE COST OF PRODUCTION OF MILK AND FAT — FIRST PERIOD.

Breed.	NAME OF ANIMAL.	Total cost.	Number of days.	Average cost per day.	Total milk yield.	Total fat yield.	Average cost of milk per pound.	Average cost of fat per pound.
				Cents.	Pounds.	Pounds.	Cents.	Cents.
Holstein-Friesian	Esel 2d	$127 53	761	16.76	13,787.0	485.1	.925	26.3
Ayrshire	Miss Flow 5th	$55 81	361	15.46	5,251.2	222.8	1.052	24.8
Ayrshire	Queen Duchess	71 97	485	14.94	9,490.1	367.9	.758	19.6
Ayrshire	Manton Belle	52 68	379	13.90	6,796.8	230.4	.775	22.9
Ayrshire	Junietta Peerless	53 57	451	11.88	5,753.3	179.5	.931	29.8
	Average	....	....	14.05	....	....	.879	24.3
Jersey	Gilderbloom	$69 64	528	13.19	5,319.1	293.0	1.309	23.8
Jersey	Countess Flavia	82 69	529	14.79	8,035.5	477.0	1.029	17.3
Jersey	Barbara Allen	83 01	610	13.61	7,959.9	436.7	1.043	19.0
	Average	....	....	13.86	....	....	1.127	20.0
American-Holderness	Maggie 6th	$57 41	462	12.43	6,182.2	220.1	.928	26.1
American-Holderness	Nellie 6th	38 72	372	10.41	4,178.5	145.5	.927	26.6
	Average	....	....	11.42	....	....	.928	26.3
Guernsey	Rosette Ford	$89 75	670	13.40	8,143.2	447.0	1.102	20.1
Guernsey	Oriole	94 12	724	13.00	10,877.3	577.8	.865	16.3
Guernsey	Madam Select	28 18	237	11.90	2,849.3	148.7	.989	18.9
	Average	....	....	12.77	....	....	.985	18.4
Devon	Ione	$53 73	451	11.91	6,636.6	201.9	.809	26.6
Devon	Genevie's Gift	40 07	443	9.05	3,976.6	206.5	1.008	19.4
	Average	....	....	10.48	....	....	.908	23.0
	Average of individuals	....	....	13.11	....	....	.964	22.5
	Average by breeds	....	....	13.22	....	....	.959	23.1

SECOND PERIOD — RELATIVE COST OF PRODUCTION OF MILK AND FAT.

Breed.	NAME OF ANIMAL.	Total cost.	Number of days.	Average cost per day.	Total milk yield.	Total fat yield.	Average cost of milk per pound.	Average cost of fat per pound.
				Cents.	Pounds.	Pounds.	Cents.	Cents.
Holstein-Friesian	Esel 2d	$39 92	183	21.81	4,908	169.3	.813	23.6
Holstein-Friesian	Tolsma Artis	65 17	388	16.80	8,076.1	223.0	.807	29.2
	Average	....	....	19.31	....	....	.810	26.4
Ayrshire	Miss Flow	$48 53	365	13.30	5,319.3	185.4	.912	26.2
Ayrshire	Queen Duchess	54 48	335	16.26	7,169.3	260.8	.751	20.9
Ayrshire	Manton Belle	50 80	304	16.71	6,258.0	229.3	.812	22.2
Ayrshire	Junietta Peerless	69 89	302	23.14	7,297.9	232.7	.957	30.0
	Average	....	....	17.35	....	....	.858	24.8
Jersey	Gilderbloom	$45 94	365	12.58	4,685.3	249 9	.980	18.4
Jersey	Countess Flavia	49 34	350	14.10	5,207.7	295.6	.947	16.7
Jersey	Barbara Allen	51 04	323	15.80	5,259.0	249.0	.970	20.5
	Average	....	....	14.16	....	....	.966	18.5
American-Holderness	Maggie 6th	$45 41	287	15.82	6,048.3	211.3	.751	21.5
American-Holderness	Nellie 6th	37 34	304	12.28	4,626.9	155.2	.807	24.1
	Average	....	....	14.05	....	....	.779	22.8
Guernsey	Madam Select	$24 22	137	17.68	2,399.7	148.8	1.009	16.3
Guernsey	Oriole	13 94	82	17.00	1,769.4	94.1	.788	14.8
	Average	....	....	17.34	....	....	.899	15.6
Devon	Ione	$37 34	243	15.37	3,903 8	174.8	.956	21.4
Devon	Genevie's Gift	16 83	121	13.91	2,011.7	102.1	.837	16.5
	Average	....	....	14.64	....	....	.897	19.0
	Average of individuals	....	....	16.17	....	....	.873	21.5
	Average of breeds	....	....	16.14	....	....	.868	21.2

FIRST PERIOD — RELATIVE COST OF PRODUCTION OF FAT AND MILK.

MILK.	Ratio.	Fat.	Ratio.
Queen Duchess	100	Oriole	100
Manton Belle	102	Countess Flavia	106
Ione	107	Madam Select	116
Oriole	114	Barbara Allen	117
Esel 2d	122	Genevie's Gift	119
Nellie 6th	122	Queen Duchess	120
Maggie 6th	122	Rosette Ford	123
Junietta Peerless	123	Manton Belle	140
Madam Select	130	Gilderbloom	146
Genevie's Gift	133	Miss Flow 5th	152
Countess Flavia	136	Maggie 6th	160
Barbara Allen	138	Esel 2d	161
Miss Flow 5th	139	Nellie 6th	163
Rosette Ford	145	Ione	163
Gilderbloom	173	Junietta Peerless	183

Relative Cost by Breeds.

Ayrshire	100	Guernsey	100
Devon	103	Jersey	109
Holstein-Friesian	105	Devon	125
American-Holderness	106	Ayrshire	132
Guernsey	112	American-Holderness	143
Jersey	128	Holstein-Friesian	143

SECOND PERIOD — RELATIVE COST OF PRODUCTION OF MILK AND FAT.

Queen Duchess	100	Oriole	100
Maggie 6th	100	Madam Select	110
Oriole	105	Genevie's Gift	111
Nellie 6th	107	Countess Flavia	113
Tolsma Artis	107	Gilderbloom	124
Manton Belle	108	Barbara Allen	138
Esel 2d	108	Queen Duchess	141
Genevie's Gift	111	Ione	145
Miss Flow 5th	121	Maggie 6th	145
Countess Flavia	126	Manton Belle	150
Ione	127	Esel 2d	159
Junietta Peerless	127	Nellie 6th	163
Barbara Allen	129	Miss Flow 5th	177
Gilderbloom	130	Tolsma Artis	197
Madam Select	134	Junietta Peerless	203

Relative Cost by Breeds,

American-Holderness	100	Guernseys	100
Holstein-Friesian	104	Jerseys	119
Ayrshires	110	Devons	122
Devons	115	American-Holderness	147
Guernseys	115	Ayrshire	160
Jerseys	124	Holstein-Friesian	170

Changes in the Relative Size of Milk Globules in Successive Periods of Lactation.

In the following table is given the size and number per thousand of milk globules in the several breeds of dairy cattle; of four breeds for first, second and third period of lactation, for six breeds for the first and second period of lactation and for seven breeds for the first period of lactation.

This table includes the actual count and measurement of 42,261 globules, or 536 counts averaging seventy-five globules each, of seven different breeds and of twenty-three different animals.

A careful study of this table will repay one who desires to learn the characteristic differences of the milk of these breeds, and will throw much light upon the deportment of the several milks in the operations of the dairy.

It will be seen that there is as a general rule, a steady increase in the number of the smaller globules and a decrease in the larger globules during successive periods of lactation, the average percentage changes being given at the bottom of the table, where it will be seen that the smaller globules below one on the micrometer scale have increased 68 per cent. in the second period over what they were in the first; the largest globules (from four to six upon the scale) have decreased during the second period of 67 per cent. of their number during the first period; while the intermediate globules during the second period (from one to four upon the scale) have fallen to eighty-three per cent. of their number during the first period.

A similar change is seen to have taken place when comparing the globules of the second period with those of the third period.

It is to be remembered that these changes are similar to in character but not the same as those taking place during any one period of lactation.

CHANGES IN RELATIVE SIZE MILK GLOBULES IN DIFFERENT PERIODS OF LACTATION.

BREED.	FIRST PERIOD OF LACTATION.						SECOND PERIOD OF LACTATION.						THIRD PERIOD OF LACTATION.					
	0-1.	1-2.	2-3.	3-4.	4-5.	5-6.	0-1.	1-2.	2-3.	3-4.	4-5.	5-6.	0-1.	1-2.	2-3.	3-4.	4-5.	5-6.
Holstein-Friesian	278	467	202	44	8	1	372	420	178	31	2	......	412	410	151	23	4	......
Ayrshire	276	484	183	47	10	1	430	390	149	24	6	1	430	387	152	45	6	......
American-Holderness	114	538	282	57	8	1	391	385	191	39	3	......	488	316	144	52	......	......
Jersey	206	343	255	133	53	10	347	305	225	92	26	5	235	341	229	172	19	4
Guernsey	174	370	308	111	32	5	309	277	248	128	33	4	......	......	......	......	......	......
Devon	212	474	239	62	13	2	267	404	249	64	15	1	......	......	......	......	......	......
Short-Horn	288	356	231	87	34	4	......	......	......	......	......	......	......	......	......	......	......	......

Average of first, second and third periods for four breeds.

......	219	458	230	70	20	3	385	375	186	47	9	2	391	363	169	73	7	1

Average of first and second periods for six breeds.

......	210	446	245	76	21	3	353	364	207	63	14	2	......	......	......	......	......	......

Percentage changes in first, second and third periods — Average of four breeds.

First	......	......	......	......	......	......	100	100	100	100	100	100	......	......	......	......	......	......
Second	......	......	......	......	......	......	176	82	81	67	45	67	......	......	......	......	......	......
Third	......	......	......	......	......	......	179	79	74	104	35	33	......	......	......	......	......	......

Percentage changes in first and second periods — Average of six breeds.

First	......	......	......	......	......	......	100	100	100	100	100	100	......	......	......	......	......	......
Second	......	......	......	......	......	......	168	82	84	83	67	67	......	......	......	......	......	......

Changes in Milk Yield and Number of Globlues During Months of Lactation.

	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Average pounds milk morning........	12.13	12.71	11.72	10.77	9.82	9.41	8.90	8.17	7.30	6.46	6.61	8.70
Ratio	100.	105.	97.	89.	81.	78.	73.	67.	60.	53.	54.	72.
Average number globules in .0001 c. m m..............................	80	97	105	121	126	130	146	153	178	209	190	200
Ratio	100	121	131	151	158	163	183	191	223	261	238	250

The above table presents the average actual as also percentage changes in milk yield and in the number of milk globules in .0001 c. m. m. during twelve months of the first period of lactation. It will be seen that there is, along with a steady diminution of milk, a steady increase in the number of globules in a given volume, and, as has been elsewhere shown, there is with this increase in number a decrease in the size of the milk globules.

Changes in Actual Number of Globules During Lactation.

During the first period of lactation of several of the animals it was found that there was an apparent and large increase in the actual number of globules, without regard to their size, found in the milk during the successive months of lactation. To determine whether this apparent increase was a characteristic change going on during lactation the following experiment was made during the second period of lactation and with greater care to avoid any possible error which may have existed before.

In the following tables the first gives the average number of milk globules in samples of milk of .0001 c. m. m. from each cow and for each month of lactation up to and including the twelfth month; also the average count for each breed per month, and a general average and ratio of all. It will be seen that the number of globules increases very steadily from the first to the last month, the increase being quite 150 per cent., although the difference in this increase is very marked between the several breeds, as for example the Jerseys and Guernseys as compared with the Ayrshires and Holstein-Friesians; and the study of this table will show characteristics and resemblances of the different breeds.

The second table gives the averages of the actual milk yields of each animal, on those mornings when samples were taken for microscopic examinations for each month of lactation and these amounts are just half of the daily milk yield.

The table gives also the average of each breed and a general average of all the breeds as also a ratio of change in yield during the first twelve months of lactation. This ratio shows the general falling off in milk yield of these animals. It will also be seen that there is a general resemblance of this ratio to that representing the monthly changes in the number of milk globules, the latter ratio being very nearly the former ratio reversed. By combining the two ratios we have the following:

Month first	100
Month second	126
Month third	131
Month fourth	137

Month fifth	128
Month sixth	132
Month seventh	128
Month eighth	129
Month ninth	124
Month tenth	126
Month eleventh	103
Month twelfth	128

The slight variations from equality in the above ratio, which is no greater than might be reasonably expected in work of such character, gives evidence, I think, that during the second period of lactation there is practically no change in the actual number of milk globules secreted by the individual cow, although the amount of milk yield varies greatly as lactation advances, as does also the size and number of globules in a definite quantity of milk at different months during lactation.

AVERAGE NUMBER OF GLOBULES IN .0001 C. M M. EACH MONTH OF LACTATION.

Breed.	NAME OF COW.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Guernsey	Rosette Ford	74	60	39	72	66	75	156	93	164	115	162	....
Guernsey	Oriole	69	79	91	49	66	65	42	84	89	92	109	118
Guernsey	Stella Select	....	132	123	129	120	110	154	172	222	170	119	171
Guernsey	Madam Select	66	105	138	110	105	88	104	110	93	130	210	....
	Average	70	94	98	90	89	85	114	117	142	127	150	145
Jersey	Gilderbloom	121	114	97	147	80	111	120	132	171	168	169	179
Jersey	Countess Flavia	76	52	97	134	153	116	98	69	55	179	140	....
Jersey	Barbara Allen	25	119	73	61	166	157	158	162	174	162	217	179
Jersey	Albert's Carol	....	46	67	44	48	55	69	93	119	107	105	....
	Average	74	83	79	97	112	110	111	114	130	154	158	179
Ayrshire	Queen Duchess	79	123	136	173	156	160	184	266	348	344	....	....
Ayrshire	Junietta Peerless	95	74	70	160	204	176	205	....	....	....	....	....
Ayrshire	Manton Belle	141	179	193	187	190	197	174	263	184	270	244	208
Ayrshire	Miss Flow 5th	68	89	89	128	155	153	242	272	303	304	....	....
	Average	96	116	122	162	176	172	201	267	278	306	244	208
American-Holderness	Nellie 6th	116	115	165	148	163	177	141	207	274	359	233	....
American-Holderness	Maggie 6th	55	65	74	218	97	114	139	102	142	208	210	....
	Average	86	90	120	183	130	146	140	155	208	284	222	....

AVERAGE NUMBER OF GLOBULES IN .0001 C. M M. EACH MONTH OF LACTATION — (*Concluded*).

Breed.	NAME OF COW.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Devon	Ione	52	152	149	174	179	237	213	221	131	211	261	484
Devon	Genevie's Gift	52	48	103	91	130	154	166	114	144	202	157	177
Devon	Artalia	111	135	158	149	167	159	113	131	251	258	....	....
	Average	72	112	137	138	159	183	164	155	175	224	209	331
Holstein-Friesian	Esel 2d	94	143	121	134	145	194	161	123	132	168	166	101
Holstein-Friesian	Tolsma Artis	114	118	112	123	107	189	175	153	238	334	366	....
Holstein-Friesian	Netherland Constance	72	70	79	111	80	64	136	....	....	....	....	....
Holstein-Friesian	Beauty Pledge	....	97	101	68	126	134	204	181	136	150	166	184
	Average	93	107	103	109	115	145	169	156	169	217	233	143
Short-Horn	Betsey 10th	70	64	59	76	113	104	69	117	164	174	....	....
Short-Horn	Lady Spencer	52	62	103	90	85	117	....	....	....	....	....	....
	Average	61	63	81	83	99	111	69	117	164	174	....	....
	Average of breeds	79	95	106	123	126	136	138	154	181	212	203	202
	Ratio	100	120	134	156	160	172	175	195	229	268	257	256

AVERAGE YIELD IN POUNDS OF MORNING'S MILK IN DIFFERENT MONTHS OF LACTATION.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Guernsey	Rosettea Ford	13.35	16.45	8.3	8.1	7.85	7.2	8.35	7.9	6.9	7.5	5.95	....
Guernsey	Oriole	9.56	11.92	11.1	10.95	9.05	9.15	9.75	9.4	8.63	8.2	7.9	9.05
Guernsey	Stella Select	....	11.7	11.2	9.8	10.0	10.05	7.45	6.2	6.85	6.15	6.6	6.1
Guernsey	Madame Select	10.15	9.2	8.76	8.2	6.7	7.2	5.6	5.9	4.93	4.1	3.0	....
	Average	11.02	12.32	9.84	9.26	8.40	8.40	7.79	7.35	6.83	6.49	5.86	7.58
Jersey	Gilderbloom	9.07	9.2	9 0	8.95	7.85	7.4	6.35	5.8	4.55	4.25	3.2	3.0
Jersey	Countess Flavia	9.9	12.0	11.0	9.26	8.05	8.05	8.15	7.45	7.7	5.23	4.15	....
Jersey	Barbara Allen	9.4	10.85	10.16	10.5	8.46	7.7	7.85	7.65	6.0	5.4	4.35	2.4
Jersey	Albert's Carol	....	9.9	9.36	9.45	7.86	6.75	6.95	7.6	7.15	7.0	7.05	....
	Average	9.46	10.49	9.88	9.54	8.06	7.49	7.33	7.13	6.35	5.47	4.69	2.70
Ayrshire	Queen Duchess	16.02	15.32	14.65	13.8	14.55	13.73	12.6	11.03	6.06	2.95	....	....
Ayrshire	Junietta Peerless	14.3	16.4	15.6	13.36	13.4	13.05	11.85	10.7	7.66	2.35	0.7	....
Ayrshire	Manton Belle	14.17	15.15	13.25	12.05	11.76	12.5	11.05	7.8	4.35	2.3	5.95	4.35
Ayrshire	Miss Flow 5th	13.75	15.25	14.6	13.3	12.45	11.9	10.65	7.45	6.45	3.35	....	....
	Average	14.56	15.53	14.53	13.13	13.04	12.80	11.54	9.25	6.13	2.74	3.33	4.35
American-Holderness	Nellie 6th	11.6	10.95	10.85	9.2	9.0	8.35	7.8	7.0	3.3	1.0	2.05	....
American-Holderness	Maggie 6th	9.15	14.55	14.75	12.2	10.45	9.7	9.2	8.25	6.95	5.35	1.4	....
	Average	10.38	12.75	12.80	10.70	9.73	9.03	8.50	7.63	5.13	3.18	1.73	....
Devon	Ione	12.6	13.06	9.45	8.45	7.9	7.4	5.06	2.1	.6	5.55	5.0	4.25
Devon	Genevie's Gift	6.9	6.7	6.47	5.4	4.6	4.8	4.0	5.4	4.55	4.5	4.5	4.8
Devon	Artalia	9.0	10.02	9.36	9.25	9.0	9.15	8.65	6.55	6.1	5.33	....	....
	Average	9.50	9.93	8.43	7.70	7.17	7.12	5.90	4.68	3.75	5.11	4.75	4.53
Holstein-Friesian	Esel 2d	17.77	16.8	15.85	12.8	10.4	9.85	9.15	12.4	10.23	8.95	9.95	11.95
Holstein-Friesian	Tolsma Artis	17.4	17.4	17.0	16.13	15.8	13.6	11.15	10.6	9.85	8.35	4.55	....
Holstein-Friesian	Netherland Constance	17.95	18.47	20.3	17.35	17.05	16.15	16.7	....	....	....	....	....
Holstein-Friesian	Beauty Pledge	....	10.8	13.16	13.65	10.3	9.0	9.75	10.15	9.2	8.96	8.8	9.
	Average	17.71	15.87	16.58	14.98	13.26	12.15	11.69	11.05	9.76	8.75	7.77	10.48

Short-Horn	Betsey 10th	10.9	11.4	10.7	8.85	7.7	7.16	7.7	7.85	7.16	6.95	....	....
Short-Horn	Lady Spencer	9.75	8.82	7.65	6.8	6.15	6.7	....	....	....	....	....	....
	Average	10.33	10.11	9.18	7.83	6.93	7.70	7.85	7.16	6.95	....	....	....
	Average of breeds	11.85	12.43	11.61	10.45	9.51	9.13	8.64	7.85	6.45	5.53	4.69	5.93
	Ratio	100	105	98	88	80	77	73	66	54	47	40	50

The Activity of the Physiological Processes.

In the tenth annual report of this station it was stated that in the secretion of milk, we have a ready and comparatively accurate means by which to measure the rapidity of physiological processes. We have seen that several cows under experiment secreted night and day an average of seven-tenths of a pound of milk each hour, or nearly 19.6 cubic inches of milk. As an average of over 150 determinations with the milk of the fifteen animals of the six breeds, we learn that there were in one-ten-thousandth of a cubic millimeter of milk an average of 152 fat globules, and a little calculation will show that by each of these animals there were secreted each second an average of 136,000,000 globules of fat.

Very closely corroborating the above, we find this year the average milk yield for the twenty-three cows under experiment those mornings when the milk samples taken for microscopic analysis, was 9.39 pounds per cow, or .7826 pounds per hour for the twelve cows before milking. The average number of globules counted in 536 counts was 144.6 for each .0001 c. m m. and this shows the average secretion of 138,210,000 globules per cow per second, a result remarkably in accord with that obtained previously.

Certain Changes Taking Place in the Silo.

It has seemed that by placing in stout bags weighed portions of the corn, sorghum or other material with which the silo is being filled, or the changes in which it is desired to investigate, and placing such bags in different parts of the silo while filling, that a convenient means was at hand for studying such changes as also to determine the uniformity or variation which might exist in different localities in the silo, and for this purpose we made use for this series of experiments of the ordinary grain bag, each holding fifty pounds of the freshly cut material, each bag labeled with lead tags and the location of each, the character and weight of contents was carefully recorded. Whenever, in the consumption of the ensilage, a series of bags were discovered they were promptly taken out and the weight of their contents determined and an analysis made of each sample, which analyses could be compared with the analysis of the fresh material with which the bag had been filled.

The large silo of the station is located in the northwest corner of the new cattle barn. The inside dimensions are fourteen by fifteen by thirty feet in depth, and the stone basement of the barn upon the west and north sides extends eleven and a half feet above and upon the south and east sides a stone foundation extended two and a half feet above the floor of the silo.

In the experiments to be described, the three bags of each experiment were placed upon a level and in a row extending from east to west, one bag in the center and each of the other bags within a foot of the east or west wall of the silo. One series of experiments was carried out in 1890 with corn and sorghum, three bags of each being filled with weighed quantities of the fresh ensilage and laid in the silo as it was being filled, and a similar series of experiments with corn and sorghum was conducted in 1891. The following are the details of these four experiments, which were undertaken for the purpose of learning somewhat of the changes which take place in the production of ensilage.

Experiments with Ensilage.

1. Three bags of corn ensilage numbered 1, 2, 3, fifty pounds in each bag, were put into the silo September 25, 1890. The condition of the corn was a medium glaze. The bags were placed on a level, one foot below the top of the stone basement and eight and one-half feet from bottom of silo. These bags Nos. 1, 2, 3, where taken from the silo June 2, 1891, in prime condition. The weights of the ensilage when taken from the silo were as follows: Bag No. 1, forty-seven pounds two ounces; bag No. 2, forty-seven pounds twelve ounces; bag No. 3, forty-eight pounds six ounces.

2. Three bags of Early Amber sorghum ensilage were put into the silo September 27, 1890, fifty pounds in each bag, numbered

4, 5, 6. The condition of the sorghum seed was a hard dough. The bags were placed upon a level sixteen and one-half feet above bottom of silo. These three bags of sorghum, Nos. 4, 5, 6, were taken from the silo March 31, 1891. Nos. 4 and 5 were in prime condition and bag No. 6 was somewhat musty. The weights of the sorghum ensilage when taken from the silo were as follows: Bag No. 4, forty-five pounds; No. 5, forty-five pounds two ounces; No. 6, forty-six pounds eight ounces.

3. October 1, 1891, three bags of sorghum ensilage were put into the silo, fifty pounds in each bag, which are numbered 20, 21, 22. The bags, containing mixed varieties some ripe and others in dough, were placed upon a level eighteen and one-half feet above bottom of silo. On March 17, 1892, these bags, Nos. 20, 21, 22, were taken from the silo in fine condition, being very acid, however. The weights at this time were as follows: No. 20, forty-six pounds twelve ounces; No. 21, forty-seven pounds six ounces; No. 22, forty-seven pounds.

4. October 1, 1891, three bags of corn ensilage were put into the silo, fifty pounds in each bag which were numbered 1, 2, 3. The condition of the corn was of a medium glaze. The bags were placed on a level one foot above the top of stone wall of basement and ten and one-half feet above bottom of silo. On May 9, 1892, these bags, Nos. 1, 2, 3, were taken from the silo in good condition, weighing at that time as follows: No. 1, forty-six pounds thirteen ounces; No. 2, forty-six pounds eight ounces; No. 3, forty-eight pounds.

5. September 20, 1892, three bags of corn ensilage were put into the silo, fifty pounds in each bag, numbered 1, 2, 21. The condition of the corn was a medium glaze. They were placed on a level about seventeen feet above bottom of silo. January 5, 1893, the three bags were taken out, the ensilage being in prime condition, the bags having settled about five feet in the silo. The weights of the ensilage when taken were as follows: No. 1, forty-eight pounds; No. 2, forty-nine pounds eight ounces; No. 21, forty-eight pounds eight ounces.

6. September 21, 1892, one bag of sorghum containing fifty pounds of the Early Amber variety, of which the seed was ripe was put in the silo. The bag was put in about nineteen feet above the bottom and in the center of the silo. November 11, 1892, this bag of sorghum ensilage was taken from the silo and was in prime condition. The ensilage weighed forty-seven pounds having shrunk three pounds.

GROSS WEIGHT PUT IN AND TAKEN OUT — POUNDS.

	SEPTEMBER 25, 1890.			OCTOBER 1, 1891.			SEPTEMBER 20, 1892.			
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 21.	
Corn ensilage put in	50.	50.	50.	50.	50.	50.	50.	50.	50.	....
	JUNE 2, 1891.			MAY 9, 1892.			JANUARY 5, 1893			
Corn ensilage taken out	47⅛	47¾	48⅜	46 13-16	46½	48.	48.	49½	48½	47.84
Per cent. taken out	94.25	95.50	96.75	93.63	93.00	96.00	96.00	99.00	97.00	95.68
	SEPTEMBER 27, 1890.			OCTOBER 1, 1891.			SEPTEMBER 21, 1892.			
	No. 4.	No. 5.	No. 6.	No. 20.	No. 21.	No. 22				
Sorghum ensilage put in	50.	50.	50.	50.	50.	50	50.	....	....	....
	MARCH 31, 1891.			MARCH 17, 1892.			NOVEMBER 11, 1892.			
Sorgum ensilage taken out	45.	45⅛	46½	46¾	47⅜	47.	47.	....	....	46.39
Per cent. taken out	90.00	90.25	93.00	93.50	94.75	94.00	94.00	....	....	92.78

The first lot of corn was in the silo eight months and seven days, the second lot seven months and eight days, and the last lot three months and fifteen days. The first lot of sorghum was in the silo six months and four days, the second lot seven months and sixteen days, and the last lot one month and twenty-one days. The average loss of the western bags was 6.3 per cent., of the central bags 5.6 per cent., and of the eastern bags 4.8 per cent. The average gross loss of corn ensilage was 4.32 per cent., and of the sorghum 7.22 per cent. The average loss of dry matter in the corn ensilage was 7.9 per cent. The average loss of dry matter in the sorghum ensilage was 15.5 per cent.

ANALYSES OF DRY MATTER PUT INTO BAGS.

Put in silo.	MATERIAL.	Water.	Dry matter.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Crude fat.	Albuminoid nitrogen.	Amide nitrogen.	Starch and sugar.
September 25, 1890	Corn, bags Nos. 1, 2, 3	76.47	23.53	5.05	4.50	30.75	47.97	5.17	0.72	1.05	30.05
September 27, 1890	Sorghum, bags Nos. 4, 5, 6	77.11	22.89	4.90	8.62	22.94	54.32	4.90	1.38	0.69	54.45
October 1, 1891	Sorghum, bags Nos. 20, 21, 22	74.14	25.86	4.05	6.81	21.74	65.57	1.95	1.09	....	36.31
October 1, 1891	Corn, bags Nos. 1, 2, 3	69.88	30.12	3.19	6.81	19.59	67.01	3.21	1.09	0.03	41.42
September 20, 1892	Corn, bags Nos. 1, 2, 21	73.73	26.27	4.11	7.19	20.10	61.01	6.34	1.15	0.20	41.88
September 21, 1892	Sorghum	71.25	28.75	3.53	4.69	19.82	68.44	3.15	0.75	0.06	34.45

ANALYSES OF DRY MATTER TAKEN OUT OF BAGS.

Taken out of silo.	MATERIAL.	Water.	Dry matter.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Fat.	Albuminoid nitrogen.	Amide nitrogen.	Starch and[1] sugars.
June 2, 1891	Corn ensilage, bag No. 1	77.33	22.67	5.11	8.50	23.09	54.39	7.72	1.36	.19	27.27
June 2, 1891	Corn ensilage, bag No. 2	77.85	22.15	4.38	5.44	21.43	54.14	10.61	0.87	.64	28.27
June 2, 1891	Corn ensilage, bag No. 3	74.85	25.15	4.35	7.38	20.95	58.45	7.87	1.18	.16	37.90
March 21, 1891	Sorghum ensilage, bag No. 4	81.32	18.68	5.27	6.25	31.32	49.28	5.82	1.00	.33	17.80
March 21, 1891	Sorghum ensilage, bag No. 5	81.29	18.71	5.62	5.19	33.04	42.14	9.07	0.83	.77	14.80
March 21, 1891	Sorghum ensilage, bag No. 6	80.66	19.34	4.87	5.19	30.45	51.73	5.12	0.83	.39	15.20
March 17, 1892	Sorghum ensilage, bag No. 20	72.85	27.15	4.95	5.13	24.69	60.67	3.63	0.82	.15	22.30
March 17, 1892	Sorghum ensilage, bag No. 21	71.43	28.57	4.99	4.69	24.92	59.46	3.75	0.75	.34	23.19
March 17, 1892	Sorghum ensilage, bag No. 22	73.43	26.57	5.00	5.00	23.32	60.78	3.46	0.80	.55	24.00
May 9, 1892	Corn ensilage, bag No. 1	75.33	24.67	4.86	6.06	21.18	56.01	9.45	0.97	.39	36.45
May 9, 1892	Corn ensilage, bag No. 2	72.44	27.56	4.05	5.44	18.07	61.51	8.99	0.87	.31	43.99
May 9, 1892	Corn ensilage, bag No. 3	71.38	28.62	4.31	6.25	19.73	58.52	8.75	1.00	.39	41.64
January 5, 1893	Corn ensilage, bag No. 1	74.20	25.80	4.08	5.63	17.35	62.42	7.02	0.90	.56	45.05
January 5, 1893	Corn ensilage, bag No. 2	75.95	24.05	4.34	6.06	21.67	58.37	6.37	0.97	.51	31.58
January 5, 1893	Corn ensilage, bag No. 21	69.82	30.18	3.65	5.69	14.78	63.78	8.35	0.91	.60	47.96
November 11, 1892	Sorghum ensilage	74.37	25.63	4.41	5.81	22.43	61.60	4.62	0.93	.17	37.16

ANALYSES OF FRESH MATERIAL PUT IN SILO.

When put in silo.	MATERIAL.	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Crude fat.	Albuminoid nitrogen.	Amide nitrogen.	Sugars and starch.
September 25, 1890	Corn, bags Nos. 1, 2, 3	76.47	1.19	1.06	7.23	11.29	1.22	.17	.25	7.07
September 27, 1890	Sorghum, bags Nos. 4, 5, 6	77.11	1.12	1.97	5.25	12.43	1.12	.31	.16	12.47
October 1, 1891	Sorghum, bags Nos. 20, 21, 22	74.14	1.05	1.76	5.62	16.96	.50	.28	.00	9.40
October 1, 1891	Corn, bags Nos. 1, 2, 3	69.88	.96	2.05	5.90	20.18	.97	.33	.01	12.33
September 20, 1892	Corn, bags Nos. 1, 2, 21	73.73	1.08	1.89	5.28	16.03	1.67	.31	.05	11.01
September 21, 1892	Sorghum	71.25	1.01	1.35	5.70	19.68	.91	.22	.02	9.91

ANALYSES OF FRESH MATTER TAKEN OUT OF SILO.

When taken out of silo.	MATERIAL.	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Crude fat.	Albuminoid nitrogen.	Amide nitrogen	Sugars and starch.
June 2, 1891	Corn ensilage, bag No. 1	77.33	1.16	1.93	5.23	12.33	1.75	.31	.04	6.18
June 2, 1891	Corn ensilage, bag No. 2	77.85	.97	1.21	4.75	11.99	2.35	.19	.14	6.26
June 2, 1891	Corn ensilage, bag No. 3	74.85	1.09	1.86	5.27	14.70	1.98	.30	.04	9.53
	Average	76.68	1.07	1.67	5.08	13.01	2.03	.27	.07	7.32
March 31, 1891	Sorghum ensilage, bag No. 4	81.32	.98	1.17	5.85	9.21	1.09	.19	.06	2.33
March 31, 1891	Sorghum ensilage, bag No. 5	81.29	1.05	.97	6.18	7.88	1.70	.16	.14	2.77
March 31, 1891	Sorghum ensilage, bag No. 6	80.66	.94	1.00	5.89	10.04	.99	.16	.08	2.94
	Average	81.09	.99	1.05	5.97	9.04	1.26	.17	.09	2.68
March 17, 1892	Sorghum ensilage, bag No. 20	72.85	1.34	1.39	6.70	16.47	.99	.22	.04	6.06
March 17, 1892	Sorghum ensilage, bag No. 21	71.43	1.43	1.34	7.12	16.99	1.07	.21	.10	6.62
March 17, 1892	Serghum ensilage, bag No. 22	73.43	1.33	1.33	6.20	16.15	.92	.21	.15	6.38
	Average	72.57	1.37	1.35	6.67	16.54	.99	.21	.10	6.35
May 9, 1892	Corn ensilage, bag No. 1	75.33	1.20	1.50	5.23	13.82	2.33	.24	.10	8.99
May 9, 1892	Corn ensilage, bag No. 2	72.44	1.12	1.50	4.98	16.95	2.48	.24	.09	12.12
May 9, 1892	Corn ensilage, bag No. 3	71.38	1.24	1.79	5.65	16.75	2.50	.29	.11	11.92
	Average	73.05	1.18	1.60	5.29	15.84	2.44	.26	.10	11.00
January 5, 1893	Corn ensilage, bag No. 1	74.20	1.05	1.45	4.48	16.10	1.81	.23	.14	11.64
January 5, 1893	Corn ensilage, bag No. 2	75.95	1.04	1.46	5.21	14.04	1.53	.23	.12	7.60
January 5, 1893	Corn ensilage, bag No. 21	69.82	1.10	1.72	4.46	19.25	2.52	.27	.18	14.47
	Average	73.32	1.06	1.54	4.72	16.46	1.95	.24	.15	11.24
November 11, 1892	Sorghum ensilage	74.37	1.13	1.49	5.75	15.79	1.18	.24	.04	9.53

Pounds Taken from Silo.

When taken out of silo.	Material.	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Crude fat.	Albuminoid nitrogen.	Amide nitrogen.	Sugars and starch.	Dry matter.
June 2, 1891	Corn ensilage, bag No. 1	36.44	.55	.91	2.46	5.81	0.82	.15	.02	2.91	10.68
June 2, 1891	Corn ensilage, bag No. 2	37.17	.46	.58	2.27	5.73	1.12	.09	.07	2.99	10.58
June 2, 1891	Corn ensilage, bag No. 3	36.20	.53	.90	2.55	7.11	0.96	.15	.02	4.61	12.17
	Average	36.60	.51	.80	2.43	6.22	0.97	.13	.04	3.50	11.14
March 31, 1891	Sorghum ensilage, bag No. 4	36.59	.44	.53	2.63	4.14	0.49	.08	.03	1.05	8.41
March 31, 1891	Sorghum ensilage, bag No. 5	36.68	.47	.44	2.79	3.56	0.77	.07	.06	1.25	8.44
March 31, 1891	Sorghum ensilage, bag No. 6	37.51	.44	.46	2.74	4.67	0.46	.07	.04	1.37	9.99
	Average	36.93	.45	.48	2.72	4.12	0.57	.07	.04	1.22	8.95
March 17, 1892	Sorghum ensilage, bag No. 20	34.06	.63	.65	3.13	7.70	0.46	.10	.02	2.83	12.69
March 17, 1892	Sorghum ensilage, bag No. 21	33.84	.68	.64	3.37	8.05	0.51	.10	.05	3.14	13.54
March 17, 1892	Sorghum ensilage, bag No. 22	34.51	.63	.63	2.91	7.59	0.43	.10	.07	3.00	12.49
	Average	34.14	.65	.64	3.14	7.78	0.47	.10	.05	2.99	12.91
May 9, 1892	Corn ensilage, bag No. 1	35.26	.56	.70	2.45	6.49	1.09	.11	.05	4.21	11.55
May 9, 1892	Corn ensilage, bag No. 2	33.68	.52	.70	2.32	7.88	1.15	.11	.04	5.64	12.82
May 9, 1892	Corn ensilage, bag No. 3	34.26	.60	.86	2.71	8.04	1.20	.14	.05	5.72	13.74
	Average	34.40	.56	.75	2.49	7.46	1.15	.12	.05	5.19	12.70
January 5, 1893	Corn ensilage, bag No. 1	35.62	.50	.70	2.15	7.73	0.87	.11	.07	5.57	12.38
January 5, 1893	Corn ensilage, bag No. 2	37.60	.52	.72	2.58	6.95	0.76	.12	.06	3.77	11.91
January 5, 1893	Corn ensilage, bag No. 21	33.86	.53	.83	2.16	9.34	1.22	.13	.09	7.02	14.64
	Average	35.69	.52	.75	2.30	8.01	0.95	.12	.07	5.45	12.98
November 11, 1892	Sorghum ensilage	34.95	.53	.70	2.70	7.42	0.56	.11	.02	4.48	12.06

POUNDS PUT IN AND TAKEN OUT OF SILO.

When taken out of silo.	MATERIAL,	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen free extract.	Crude fat.	Albuminoid nitrogen.	Amid nitrogen.	Sugars and starch.	Dry matter.
September 25, 1890	Corn ensilage put in Nos. 1, 2, 3.......	38.24	.60	0.53	3.62	5.65	0.61	.085	.13	3.54	11.76
June 2, 1891	Corn ensilage taken out...............	36.60	.51	0.80	2.43	6.22	0.97	.128	.04	3.50	10.93
September 27, 1890	Sorghum ensilage put in Nos. 4, 5, 6...	38.56	.56	0.99	2.63	6.22	0.56	.158	.08	6.24	11.44
March 21, 1891	Sorghum ensilage taken out..........	36.93	.45	0.48	2.72	4.12	0.57	.077	.04	1.22	8.34
October 1, 1891	Sorghum ensilage put in Nos. 20, 21, 22	37.07	.53	0.88	2.81	8.48	0.25	.141	.00	4.70	12.93
March 17, 1892	Sorghum ensilage taken out..........	34.14	.65	0.64	3.14	7.78	0.47	.102	.05	2.99	12.68
October 1, 1891	Corn ensilage put in Nos. 1, 2, 3.......	34.94	.48	1.03	2.95	10.09	0.49	.165	.01	6.17	15.06
May 9, 1892	Corn ensilage taken out...............	34.40	.56	0.75	2.49	7.46	1.15	.120	.05	5.19	12.41
September 20, 1892	Corn ensilage put in Nos. 1, 2, 21......	36.87	.54	0.95	2.64	8.02	0.84	.152	.03	5.51	13.13
January 5, 1893	Corn ensilage taken out...............	35.69	.52	0.75	2.30	8.01	0.95	.120	.07	5.45	12.53
September 21, 1892	Sorghum ensilage put in...............	35.63	.51	0.68	2.85	9.84	0.46	.109	.01	4.96	14.37
November 11, 1892	Sorghum ensilage taken out..........	34.95	.53	0.70	2.70	7.42	0.56	.112	.02	4.48	11.91
	General average put in............	36.89	.537	0.843	2.917	8.050	0.535	.135	.043	5.187	13.12
	General average taken out........	35.45	.535	0.687	2.630	6.835	0.778	.110	.045	3.805	11.47
	Per cent. loss in silo..............	3.9	.4	18.5	9.8	15.1	—45.4	18.7	—3.7	26.6	12.6

From the preceding experiments it will be seen that as an average of the results there was a loss of 12.6 per cent. of the dry matter and a loss of 18.5 per cent. of the albuminoids and of 26.6 per cent. of the sugars and starch, two of the most valuable food constituents.

The apparent increase of 45.4 per cent. of crude fat is doubtless due to the fact that in the fermentation in the silo, a larer percentage is rendered soluble in ether and this "ether extract" is what is termed crude fat in the table.

The degree of uniformity which exists in the triplicate samples taken from the silo, shows that the silo is well constructed, and, it will be observed, that in but a single case was the ensilage in other than an excellent condition.

It will be seen, therefore, whatever may be the relative loss of nutritive matter in the process of dry curing of fodder, there is a considerable loss in these nutrients in the production of ensilage even under what must be regarded as very favorable conditions. When we consider that good ensilage constitutes a food most acceptable to dairy animals, available at all times during the late fall, winter and spring months, as also during seasons of drought, when the green forage falls short, thus furnishing, at it does, practically the equivalent of a green forage ration throughout the year, there can be little doubt that its use will increase in the future so soon as its merits come to be fully recognized.

Another advantage not to be overlooked is that in no other way can the corn crop be so economically harvested and both grain and stalks so well prepared, almost regardless of the vicissitudes of weather, as in placing it, when at its maximum food value, promptly in silo where until consumed it requires no further care and no further expense.

Analysis of Fruit Trees.

The examination has been continued of several varieties of nursery stock for the purpose of learning the quality and quantity of the mineral constitutents removed by them from the soil.

The trees were contributed for the purpose by several of the leading nurserymen of Geneva from their stock, and were taken up early in the spring before the buds were well developed. The roots were as carefully cleaned of adhering earth as was possible, and after weighing the trees were allowed to become air dry, when they were again weighed. Each tree was then divided into roots, trunk and branches, which were separately weighed, and after cutting up were placed in glass jars to await analysis. Each sample was burned at a low red heat, the ash weighed and preserved for analysis. It will be seen that the amount of ash in the roots and its composition in many cases seems to show that it was practically impossible to entirely remove from the roots the adhering earth.

The results obtained are presented in the following tables:

The purpose of the investigation has been to learn the nature and extent of the demands made upon the soil by the different varieties of nursery stock in order to ascertain the necessary means for maintaining the fertility of the soil, and also to throw light upon certain points which appear, in extended practice among many of our most intelligent nurserymen, to have been pretty clearly established although the reasons for such practice have not as yet been so clearly understood.

A discussion of certain of these points will be postponed until the facts of analysis have been presented.

WEIGHT OF ROOTS, BRANCHES AND TRUNKS OF NURSERY STOCK IN GRAMS.

Variety.	NAME.	Green tree.	Dry tree.	Water.	Dry roots.	Dry trunk.	Dry branches.	Roots, organic.	Roots, ash.	Trunk, organic.	Trunk, ash.	Branches, organic.	Branches, ash.	Total.
Apple	Hurlburt	1545.	844.7	700.3	355.3	393.2	89.7	339.9	15.43	381.8	11.36	85.4	4.32	31.11
Apple	Haas	713.	444.2	268.8	119.2	241.9	79.6	112.5	6.72	237.0	4.94	76.5	3.13	14.79
Apple	Golden Sweet	587.	339.2	347.8	122.9	145.7	69 1	118.6	4.34	142.4	3.33	67.0	2.10	9.77
Cherry	Yellow Spanish	1558.	854.8	703.2	357.0	339.5	153.3	344 9	12.08	332.7	6.75	146.2	7.14	25.97
Cherry	Napoleon Bigarreau	1143.	601.5	541.5	185.2	313.7	98.6	176.8	8.41	307.1	6.64	94.5	4.13	19.18
Cherry	Rockport Bigarreau	1786.	1104.0	682.0	335.3	504.5	257.2	321.7	13.61	496.9	7.57	91.0	7.61	28.79
Cherry	Windsor	2105.	1320.6	784.4	358.8	634.3	315.5	348.5	10.30	625.8	8.46	246.3	10.92	29.68
Peach	Honest John	247.	130.2	116.8	47.6	43.1	36.5	46.0	1.55	41.8	1.33	34.2	2.28	5.16
Peach	Red Roman	586.	314.6	271.4	129.0	111.9	73.7	125.5	3.52	123.2	2.28	69.4	4.25	10.05
Peach	Large Early York	347.	195.6	153.4	84.0	71.3	38.3	82.3	1.71	69.7	1.56	36.4	1.90	5.17
Peach	Heath Cling	608.	315.3	292.7	127.2	109.5	75.6	123.3	3.87	107.2	2.27	73.3	3.34	9.48
Peach	Stump	331.	180.3	150.7	61.2	71.6	45.0	59.5	1.71	69.8	1.82	42.6	2.42	5.95
Peach	Steven's Rareripe	464.	300.1	163.9	83.3	113.2	32.6	81.5	1.77	111.0	2.16	31.4	1.17	5.10
Peach	Solway	394.	224.9	169.1	87.9	84.6	52.4	84.9	2.99	83.1	1.51	50.7	1.65	6.15
Peach	Early Rivers	307.	193.7	113.3	84.1	56.7	30.8	81.2	2.92	55.5	1.19	29.3	1.54	5.65
Grape vine	Mixed	337.	174.5	162.5	......	......	174.5	......	......	......	......	169.1	5.36	5.36
Crab apples	Hyslop	873.	492.3	380.7	157.2	246.3	87.8	151.8	5.38	240.6	5.67	85.0	2.75	13.80
Crab apples	Orange	895.	498.8	390.2	174.2	246.6	77.0	166.3	7.85	236.1	10.53	73.6	3.39	21.77
Pear	Vicar	1336.	513.3	822.7	192.0	205.9	111.4	186.3	5.71	197.6	8.33	104.5	6.91	20.95
Pear	Doyennéd' Été	1923.	1027.6	894.4	392.1	434.7	195.8	377.3	14.79	418.0	16.69	185.9	9.85	41.33
Pear	Howell	1316.	778.7	537.3	255.6	375.9	137.2	242.3	13.27	365.4	10.50	131.7	5.47	29.24
Pear	Duchess de Bordeaux	1394.	642.1	751.9	209.0	309.1	119.0	202.0	6.98	299.9	9.24	111.5	7.54	23.76
Pear	Flemish Beauty	1525.	782.9	742.1	156.4	475.0	148.5	152.3	4.13	461.3	13.69	142.3	6.21	24.03
Pear	Russian 508	559.	248.9	310.1	110.7	106.1	28.1	105.9	4.84	101.1	4.99	27.0	1.07	10.90
Pear	Russian 358	425.	183.4	241.6	45.4	115.4	19.6	42.6	2.75	111.9	3.52	18.6	.99	7.26
Pear	Refreshing Russian	530.	232.2	297.8	76.9	130.4	21.4	72.8	4.09	126.8	3.57	20.6	.77	8.43
Plum	Coe's Golden	848.	467.9	380.1	172.6	224.9	66.4	164.1	8.45	219.0	5.92	64.1	2.28	16.65
Plum	Gueii	1165.	652.2	512.8	199.4	226.7	221.5	190.9	8.45	222.4	4.25	212.4	9.15	21.85
Plum	Smith's Orleans	1139.	590.1	548.9	193.1	259.6	134.4	184.1	9.03	253.1	6.46	130.6	3.79	19.28
Plum	Peter's Yellow Gage	1194.	689.4	504.6	176.4	237.0	183.0	170.8	5.58	231.4	5.57	176.7	6.33	17.48
Quince	Missouri Mammoth	324.	164.3	159.7	62.4	64.5	34.4	58.9	3.48	61.9	2.59	32.5	1.92	7.99
Quince	Orange	1053.	593.1	459.9	285.2	175.6	125.8	270.4	14.77	168.8	6.76	120.4	5.39	26.92

PER CENT OF DRY MATTER AND ASH IN NURSERY STOCK.

Variety.	NAME.	Per cent. of dry matter in roots.	Per cent. of dry matter in trunk.	Per cent. of dry matter in branches.	Per cent. of ash in dry roots.	Per cent. of ash in dry trunk.	Per cent. of ash in dry branches.	Per cent. of ash in green tree.	Per cent. of ash in dry tree.	Weight ash in roots.	Weight ash in trunks.	Weight ash in branches.	Total ash in trees.	Total ash in 2,000 pounds green tree.
Apple	Hurlburt	42.4	46.9	10.7	4.34	2.89	4.92	2.01	3.68	15.43	11.36	4.32	31.11	40.4
Apple	Haas	27.0	54.9	18.1	5.64	2.04	3.93	2.07	3.33	6.72	4.93	3.13	14.78	41.5
Apple	Golden Sweet	36.4	43.1	20.5	3.53	2.29	3.04	1.66	2.88	4.34	3.34	2.10	9.78	33.3
	Average	35.3	48.3	16.4	4.50	2.41	3.96	1.91	3.30	......	......	......	......	.....
Cherry	Yellow Spanish	42.0	40.0	18.0	3.38	1.99	4.66	1.67	3.04	12.07	6.76	7.14	25.97	33.3
Cherry	Napoleon Bigarreau	31.0	52.5	16.5	4.54	2.12	4.19	1.68	3.19	8.41	6.65	4.13	19.19	33.6
Cherry	Rockport Bigarreau	30.6	46.0	23.4	4.06	1.50	2.96	1.61	2.61	13.61	7.57	7.61	28.79	32.2
Cherry	Windsor	27.4	48.5	24.1	2.87	1.33	3.46	1.41	2.25	10.30	8.46	10.92	29.68	28.2
	Average	32.8	46.8	20.5	3.71	1.74	3.82	1.59	2.77	......	......	......	......	.....
Peach	Honest John	37.4	33.9	28.7	3.26	3.09	6.25	2.09	3.96	1.55	1.33	2.28	5.16	41.8
Peach	Red Roman	41.0	35.6	23.4	2.73	2.04	5.77	1.71	3.26	3.52	2.28	4.25	10.05	34.3
Peach	Large Early York	43.4	36.8	19.8	2.03	2.19	4.91	1.48	2.64	1.71	1.56	1.90	5.17	29.6
Peach	Heath Cling	40.7	35.1	24.2	3.04	2.07	4.42	1.56	3.01	3.87	2.27	3.34	9.48	31.2
Peach	Stump	34.4	40.3	25.3	2.79	2.54	5.38	1.80	3.30	1.71	1.82	2.42	5.95	36.0
Peach	Steven's Rareripe	36.4	49.4	14.2	2.12	1.91	3.53	1.10	1.70	1.78	2.16	1.15	5.09	21.9
Peach	Salway	39.1	37.6	23.3	3.40	1.78	3.15	1.56	2.74	2.99	1.51	1.65	6.15	31.2
Peach	Early Rivers	49.0	33.0	18.0	3.47	2.10	5.00	1.84	2.92	2.92	1.19	1.54	5.65	36.8
	Average	40.2	37.7	22.1	2.86	2.22	4.80	1.64	2.93	......	......	......	......	.....
Grape vines	Mixed	......	......	100.0	......	......	3.07	1.59	3.07	......	......	5.36	5.36	31.8
Crab apples	Hyslop	32.0	50.1	17.9	3.42	2.30	3.13	1.58	2.80	5.38	5.66	2.75	13.79	31.6
Crab apples	Orange	35.0	49.5	15.5	4.51	4.27	4.40	2.43	4.37	7.86	10.53	3.39	21.78	48.7
	Average	33.5	49.8	16.7	3.92	3.29	3.77	2.01	3.59	......	......	......	......	.....
Pear	Vicar	37.7	40.4	21.9	2.97	4.05	6.20	1.57	4.08	5.70	8.34	6.91	20.95	31.4
Pear	Doyenné d'Été	38.3	42.5	19.2	3.77	3.84	5.03	2.15	4.05	14.79	16.69	9.85	41.33	43.0
Pear	Howell	33.3	48.9	17.8	5.19	2.79	3.99	2.22	3.76	13.27	10.49	5.47	29.23	44.4
Pear	Dutchess de Bordeaux	32.8	48.5	18.7	3.34	2.99	6.34	1.70	3.70	6.98	9.24	7.54	23.76	34.1
Pear	Flemish Beauty	20.1	60.9	19.0	2.64	2.88	4.18	1.58	3.07	4.13	13.68	6.21	24.02	18.4

PER CENT. OF DRY MATTER AND ASH IN NURSERY STOCK — (*Concluded*).

Variety.	NAME.	Per cent. of dry matter in roots.	Per cent. of dry matter in trunk.	Per cent. of dry matter in branches.	Per cent. of ash in dry roots.	Per cent. of ash in dry trunk.	Per cent. of ash in dry branches.	Per cent. of ash in green tree.	Per cent. of ash in dry tree.	Weight ash in roots.	Weight ash in trunks.	Weight ash in branches.	Total ash in trees.	Total ash in 2,000 pounds green tree.
Pear	508 Russian	45.2	43.3	11.5	4.37	4.70	3.81	1.95	4.38	4.84	4.99	1.07	10.90	39.0
Pear	358 Russian	25.2	64.0	10.8	6.06	3.05	5.05	1.71	3.95	2.75	3.52	.99	7.26	34.2
Pear	Refreshing Russian	33.6	57.0	9.4	5.32	2.74	3.60	1.59	3.64	4.09	3.57	.77	8.43	31.8
	Average	33.3	50.7	16.0	4.21	3.38	4.78	1.81	3.83	......	......	......	......	.....
Plum	Coe's Golden	37.2	48.5	14.3	4.89	2.63	3.43	1.96	3.56	8.45	5.92	2.28	16.65	39.2
Plum	Gueii	30.8	35.0	34.2	4.24	1.87	4.13	1.87	3.35	8.45	4.24	9.15	21.84	37.5
Plum	Smith's Orleans	32.9	44.2	22.9	4.68	2.45	2.82	1.69	3.27	9.04	6.46	3.79	19.29	33.7
Plum	Peter's Yellow Gage	29.6	39.7	30.7	3.16	2.35	3.45	1.46	2.54	5.57	5 57	6.33	17.47	29.2
	Average	32.6	41.9	25.5	4.24	2.33	3.46	1.75	3.18	......	......	......	......	.....
Quinces	Missouri Mammoth	38.8	39.9	21.3	5.58	4.02	5.58	2.47	4.86	3.48	2.59	1.92	7.99	49.3
Quinces	Orange	48.7	29.9	21.4	4.18	3.85	4.28	2.56	4.54	14.77	6.76	5.38	26.91	51.1
	Average	38.8	34 9	21.4	5.38	3.94	4.94	2.52	4.70	......	......	......	......	.....

PERCENTAGE COMPOSITION OF ASH OF NURSERY STOCK.

		Roots.									
		SiO_2.	P_2O_5.	Cl.	SO_3.	CO_2.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas	26.84	9.44	0.42	5.11	1.42	4.32	32.98	9.30	4.74	5.43
Apple	Golden Sweet	27.65	7.71	0.45	2.83	20.66	3.00	26.99	4.84	3.87	2.00
Apple	Hurlburt	25.72	4.17	0.25	6.19	8.27	2.75	25.20	10.37	7.22	9.86
	Average	26.74	7.11	0.37	4.71	10.12	3.36	28.39	8.17	5.28	5.76
Crab apples	Hyslop	18.16	6.30	0.26	4.06	16.77	0.65	36.38	5.94	2.55	8.93
Crab apples	Orange	24.56	3.67	0.29	2.88	23.66	0.67	35.63	5.70	0.57	2.37
	Average	21.36	4.98	0.27	3.47	20.21	0.66	36.00	5.82	1.56	5.65
Pear	Vicar	26.03	5.74	0.32	4.18	20.27	1.27	25.32	4.92	0.92	11.03
Pear	Duchess de Bordeaux	30.16	5.26	0.21	3.06	20.90	1.11	27.81	4.92	1.44	5.13
Pear	408 Russian	16.63	11.13	0.29	5.67	23.79	0.54	24.71	7.06	2.94	7.24
Pear	358 Russian	18.12	2.70	0.32	3.31	30.04	0.74	43.58	6.49	0.59	4.11
Pear	Refreshing Russian	12.81	6.42	0.29	6.57	20.29	0.92	23.96	7.51	3.71	17.52
Pear	Howell	[illegible]	[illegible]	[illegible]	3.74	16.82	1.96	37.94	4.16	2.58	[illegible]
Pear	Doyenné d'Été	21.74	5.08	0.23	5.44	16.48	1.75	28.81	5.30	7.51	7.63
Pear	Flemish Beauty	35.46	6.25	0.24	4.84	3.90	2.32	30.59	3.68	2.55	10.17
	Average	23.17	5.73	0.27	4.60	19.06	1.33	30.34	5.51	2.78	8.46
Quince	Missouri Mammoth	16.04	[illegible]	0.17	3.47	14.09	0.00	50.90	[illegible]	0.72	5.69
Quince	Orange	21.48	5.36	0.22	3.25	28.63	1.29	30.88	6.82	0.57	1.50
	Average	18.76	5.56	0.19	3.36	21.36	0.64	40.89	6.98	0.64	3.59
Grapevines	Mixed	9.31	6.67	0.14	5.57	13.78	0.23	32.46	9.38	4.27	18.19
Peach	Honest John	19.22	14.45	0.42	2.73	17.92	0.00	32.45	7.28	0.87	4.66
Peach	Red Roman	16.04	12.15	0.23	3.94	20.27	0.53	26.29	8.02	0.90	11.63
Peach	Large Early York	16.64	10.80	0.14	2.45	19.98	0.00	29.08	9.11	1.54	10.26
Peach	Heath Cling	25.43	9.94	0.36	3.49	17.18	0.60	27.88	7.17	2.36	5.39
Peach	Stump	34.91	8.48	0.17	3.06	10.58	1.25	24.18	7.24	1.78	8.35
Peach	Steven's Rareripe	20.32	11.95	0.42	3.41	12.76	0.73	26.77	9.23	2.00	12.41
Peach	Salway	32.17	6.93	0.23	3.40	5.81	1.34	33.27	8.28	0.98	7.59
Peach	Early Rivers	29.87	6.54	0.47	2.86	14.49	0.49	22.27	9.32	2.89	10.50
	Average	24.32	10.15	0.30	3.16	14.87	0.64	27.77	8.20	1.66	8.84

Plum	Coe's Golden	27.78	6.30	0.13	2.20	15.05	0.69	34.11	6.62	1.46	5.65
Plum	Gueii	27.21	10.74	0.19	4.02	3.84	1.36	38.52	5.54	1.81	6.77
Plum	Smith's Orleans	29.13	9.05	0.16	2.65	17.89	1.43	22.13	7.41	1.45	8.70
Plum	Peter's Yellow Gage	25.68	9.84	0.15	2.80	15.85	1.04	26.74	7.26	1.15	9.49
	Average	27.45	8.98	0.15	2.91	13.15	1.13	30.37	6.70	1.46	7.65
Cherry	Napoleon Bigarreau	31.92	5.80	0.25	4.05	18.48	2.29	22.40	4.68	3.63	6.50
Cherry	Yellow Spanish	32.68	8.67	0.26	5.84	9.08	2.24	22.89	5.39	7.42	5.53
Cherry	Windsor	37.55	7.86	0.28	4.24	9.35	2.83	20.93	4.44	6.16	6.06
Cherry	Rockport Bigarreau	33.70	5.51	0.45	2.39	16.23	2.28	25.20	4.52	3.95	5.77
	Average	33.96	6.96	0.31	4.13	13.29	2.41	22.86	4.83	5.29	5.97

PERCENTAGE COMPOSITION OF ASH OF NURSERY STOCK — (*Continued*).

		BRANCHES.									
		SiO_2.	P_2O_5.	Cl.	SO_3.	CO_2.	Fe_2O_3.	CaO.	MgG.	Na_2O.	K_2O.
Apple	Haas	1.81	7.35	1.19	3.02	21.83	.00	43.68	10.02	2.51	8.59
Apple	Golden Sweet	2.49	5.89	.29	2.96	29.24	.00	40.60	8.07	7.09	3.37
Apple	Hurlburt	2.60	4.44	.57	3.57	33.61	.64	41.55	2.88	4.98	5.16
	Average	2.30	5.89	.68	3.18	28.23	.21	41.94	6.99	4.86	5.71
Crab apples	Hyslop	3.82	6.65	.24	1.31	22.64	.00	46.77	6.06	3.29	9.22
Crab apples	Orange	2.24	6.95	.20	2.72	28.78	.00	45.82	4.39	3.69	5.21
	Average	3.03	6.80	.22	2.01	25.71	.00	46.29	5.22	3.49	7.21
Pear	Vicar	13.08	8.66	.23	4.42	30.80	.00	23.38	4.47	1.08	13.88
Pear	Duchess de Bordeaux	2.71	7.19	.52	2.48	36.03	.00	38.58	8.08	.99	3.42
Pear	503 Russian	1.82	10.20	.26	4.00	11.78	.00	55.80	11.04	.35	4.75
Pear	353 Russian	2.73	8.55	.45	6.06	24.99	.00	36.80	6.70	1.44	12.28
Pear	Refreshing Russian	2.04	12.05	.44	2.63	9.05	.00	38.30	9.96	6.72	18.89
Pear	Howell	5.82	5.09	.29	3.38	12.70	.00	43.54	9.55	8.02	11.61
Pear	Doyenné d'Été	3.76	5.99	.27	1.86	27.09	.00	38.50	6.23	7.33	8.97
Pear	Flemish Beauty	3.15	4.12	.28	3.86	21.77	.00	43.05	7.06	6.72	9.99
	Average	4.39	7.73	.34	3.59	21.78	.00	39.74	7.89	4.08	10.47
Quince	Missouri Mammoth	3.82	6.97	.29	3.67	35.29	.00	37.90	6.38	1.66	4.02
Quince	Orange	3.43	7.05	.37	3.64	37.11	.00	40.05	6.98	.47	.90
	Average	3.62	7.01	.33	3.65	36.20	.00	38.97	6.68	1.06	2.46
Peach	Honest John	2.22	5.48	.19	3.16	23.32	.00	54.15	6.69	.19	4.49
Peach	Red Roman	2.37	6.78	.26	3.53	30.97	.00	40.92	6.15	.49	8.53
Peach	Large Early York	2.82	5.65	.26	3.08	33.73	.00	42.60	7.54	.68	3.64
Peach	Heath Cling	2.18	8.82	.33	3.55	23.32	.00	46.52	7.31	1.11	6.86
Peach	Stump	2.92	8.65	.29	3.62	17.98	.00	46.74	7.57	1.98	10.25
Peach	Stevens' Rareripe	4.41	6.68	.30	3.32	22.20	.53	43.52	6.20	6.63	6.21
Peach	Salway	3.57	5.62	.15	4.22	23.12	.00	45.65	8.19	.81	8.67
Peach	Early Rivers	3.87	5.52	.45	3.20	15.73	.00	49.27	7.69	2.00	12.27
	Average	3.04	6.65	.27	3.46	23.79	.06	46.17	7.16	1.73	7.61

Plum	Coe's Golden	2.31	5.38	.26	3.67	27.00	.00	41.34	5.74	4.45	9.85
Plum	Gueii	3.61	8.36	.35	4.28	28.47	.00	38.36	5.02	4.33	7.22
Plum	Smith's Orleans	1.78	6.19	.43	3.13	26.47	.00	39.98	8.34	2.05	11.63
Plum	Peter's Yellow Gage	2.61	7.15	.26	3.00	31.27	.00	32.65	6.71	8.06	8.29
	Average	2.57	6.77	.32	3.52	28.30	.00	38.08	6.45	4.72	9.24
Cherry	Napoleon Bigarreau	2.25	6.72	.27	5.04	22.21	.00	44.94	7.35	5.95	5.27
Cherry	Yellow Spanish	2.49	7.03	.25	2.68	24.30	.00	40.92	7.87	5.52	8.94
Cherry	Windsor	4.43	5.56	.36	2.36	24.00	1.33	41.51	6.52	4.15	9.78
Cherry	Rockport Bigarreau	3.34	3.85	.29	1.51	18.76	.46	45.50	7.24	11.20	7.85
	Average	3.13	5.79	.29	2.90	22.32	.45	43.22	7.27	6.71	7.96

PERCENTAGE COMPOSITION OF ASH OF NURSERY STOCK — (*Concluded*).

		Trunks.									
		SiO_2.	P_2O_5.	Cl.	SO_3.	CO_2.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas	2.04	6.13	.40	7.55	21.77	.00	44.52	9.30	1.33	6.96
Apple	Golden Sweet	4.98	4.61	.28	1.17	30.46	.00	41.96	4.61	3.91	8.02
Apple	Hurlburt	3.93	4.08	.61	3.85	33.72	.00	44.80	5.22	2.48	1.31
	Average	3.65	4.94	.43	4.19	28.65	.00	43.76	6.38	2.57	5.43
Crab apple	Hyslop	.98	4.57	.61	3.09	28.87	.00	47.67	4.37	1.35	8.49
Crab apple	Orange	1.78	3.21	.22	2.11	31.40	.00	50.67	3.21	1.06	6.34
	Average	1.38	3.89	.41	2.60	30.13	.00	49.17	3.79	1.20	7.41
Pear	Vicar	2.11	7.38	.26	4.78	35.79	.00	34.49	7.94	.76	6.49
Pear	Duchess de Bordeaux	3.73	7.49	.14	3.30	27.66	.00	42.13	6.31	1.29	7.95
Pear	508 Russian	3.61	8.11	.23	3.50	33.37	.51	34.96	8.32	2.37	2.02
Pear	358 Russian	2.82	5.72	.40	3.21	29.22	.38	34.26	7.03	2.34	14.62
Pear	Refreshing Russian	2.56	7.90	.25	6.75	17.51	.00	32.87	12.34	1.46	18.36
Pear	Howell	3.59	3.93	.27	2.85	28.34	.23	44.48	6.40	3.27	6.64
Pear	Doyenné d'Été	3.33	4.76	.29	2.72	29.31	.14	39.34	4.92	7.20	7.98
Pear	Flemish Beauty	4.00	3.77	.28	3.59	24.31	.37	41.98	6.69	7.38	7.63
	Average	3.22	6.13	.27	3.84	37.94	.20	38.02	7.49	3.26	8.96
Quince	Missouri Mammoth	2.92	6.07	.22	2.60	18.85	.00	55.80	8.46	1.29	3.79
Quince	Orange	6.26	6.17	.26	2.88	26.13	.00	43.38	6.64	1.05	7.23
	Average	4.59	6.12	.24	2.74	22.49	.00	51.09	7.55	1.17	5.51
Peach	Honest John	4.97	7.62	.30	3.93	23.19	.00	52.90	5.52	.57	1.00
Peach	Red Roman	5.92	9.77	.16	3.45	22.88	.00	37.26	7.03	1.06	12.47
Peach	Large Early York	5.97	7.00	.26	2.69	12.48	.00	50.52	7.73	2.47	10.88
Peach	Heath Cling	4.46	8.67	.23	4.93	35.50	.00	35.64	7.72	.87	1.98
Peach	Stumo	4.47	6.57	.22	4.66	24.85	.00	44.40	8.23	1.26	5.34
Peach	Stevens' Rareripe	10.44	9.02	.30	2.21	17.41	.81	37.27	7.95	2.30	12.79
Peach	Salway	6.33	3.08	.15	2.59	34.97	.00	31.26	7.36	1.38	12.88
Peach	Early Rivers	5.30	7.60	.15	6.09	28.77	1.33	25.25	7.78	2.32	15.41
	Average	5.98	7.41	.22	3.81	25.00	.20	39.31	7.41	1.52	9.09

Plum	Coe's Golden	6.58	3.59	.22	2.41	29.31	.16	43.08	4.74	1.97	7.94
Plum	Gueii	4.59	6.78	.41	3.87	30.28	.00	36.93	4.74	2.09	10.31
Plum	Smith's Orleans	3.57	1.95	.31	3.73	24.88	.00	43.40	7.84	2.02	12.30
Plum	Peter's Yellow Gage	4.23	5.97	.50	2.70	32.14	.00	32.65	7.35	1.71	12.75
	Average	4.74	4.57	.36	3.17	29.15	.04	39.01	6.16	1.94	10.82
Cherry	Napoleon Bigarreau	8.27	5.38	.23	3.60	28.18	1.26	39.62	5.59	3.18	4.69
Cherry	Yellow Spanish	6.39	5.30	.22	4.17	22.41	.94	41.09	6.13	5.29	8.06
Cherry	Windsor	5.53	4.22	.29	2.76	22.51	.72	41.44	6.45	8.13	7.95
Cherry	Rockport Bigarreau	4.30	3.42	.28	2.78	26.18	.40	44.80	5.43	4.79	7.62
	Average	6.12	4.58	.26	3.33	23.70	.83	41.74	5.90	5.35	7.08

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS.

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas roots	1.80	0.63	0.02	0.34	0.29	2.22	0.62	0.32	0.36
Apple	Haas branches	0.06	0.33	0.04	0.09	0.00	1.37	0.31	0.08	0.27
Apple	Haas trunks	0.10	0.30	0.02	0.37	0.00	2.19	0.46	0.07	0.34
	Total	1.96	1.26	0.08	0.80	0.29	5.78	1.39	0.47	0.97
Apple	Golden Sweet roots	1.20	0.33	0.02	0.12	0.13	1.17	0.21	0.17	0.09
Apple	Golden Sweet branches	0.05	0.12	0.01	0.06	0.00	0.85	0.17	0.15	0.07
Apple	Golden Sweet trunks	0.17	0.15	0.01	0.04	0.00	1.40	0.15	0.13	0.27
	Total	1.42	0.60	0.04	0.22	0.13	3.42	0.53	0.45	0.43
Apple	Hurlburt roots	4.07	0.64	0.04	0.95	0.42	3.86	1.60	1.11	1.52
Apple	Hurlburt branches	0.11	0.20	0.03	0.16	0.03	1.83	0.13	0.22	0.23
Apple	Hurlburt trunks	0.45	0.05	0.07	0.44	0.00	5.09	0.59	0.28	0.15
	Total	4.63	0.89	0.14	1.55	0.45	10.78	2.32	1.61	1.90
Crab apple ..	Orange roots	1.93	0.29	0.02	0.23	0.05	2.85	0.46	0.05	0.19
Crab apple ..	Orange branches	0.08	0.23	0.01	0.09	0.00	1.53	0.15	0.12	0.17
Crab apple ..	Orange trunks	0.19	0.32	0.02	0.21	0.00	5.32	0.32	0.01	0.64
	Total	2.20	0.84	0.05	0.53	0.05	9.70	0.93	0.18	1.00

Crab apple ..	Hyslop roots	0.98	0.34	0.01	0.22	0.04	1.96	0.30	0.14	0.48
Crab apple ..	Hyslop branches	0.11	0.18	0.01	0.03	0.00	1.29	0.17	0.09	0.25
Crab apple ..	Hyslop trunk	0.06	0.26	0.03	0.17	0.00	3.97	0.36	0.11	0.71
	Total	1.15	0.78	0.05	0.42	0.04	7.22	0.83	0.34	1.44
Pear	Vicar roots	1.48	0.33	0.02	0.24	0.73	1.44	0.28	0.05	0.63
Pear	Vicar branches	0.90	0.60	0.02	0.31	0.00	1.61	0.31	0.07	0.96
Pear	Vicar trunk	0.18	0.62	0.02	0.40	0.00	2.87	0.66	0.06	0.54
	Total	2.56	1.55	0.06	0.95	0.73	5.92	1.25	0.18	2.13
Pear	Duchess de Bordeaux roots	2.11	0.37	0.01	0.21	0.08	1.95	0.34	0.11	0.36
Pear	Duchess de Bordeaux branches	0.20	0.54	0.04	0.19	0.00	2.89	0.61	0.07	0.26
Pear	Duchess de Bordeaux trunk	0.35	0.69	0.01	0.38	0.00	3.90	0.58	0.12	0.74
	Total	2.66	1.60	0.06	0.78	0.08	8.74	1.53	0.30	1.36
Pear	Russian 508 roots	0.81	0.53	0.01	0.27	0.03	1.20	0.34	0.14	0.35
Pear	Russian 508 branches	0.02	0.01	0.00	0.04	0.00	0.60	0.12	0.00	0.05
Pear	Russian 508 trunk	0.18	0.41	0.01	0.17	0.03	1.75	0.42	0.12	0.10
	Total	1.01	0.95	0.02	0.48	0.06	3.55	0.88	0.26	0.50
Pear	Russian 358 roots	0.68	0.10	0.01	0.91	0.02	1.20	0.18	0.02	0.11
Pear	Russian 358 branches	0.03	0.09	0.01	0.06	0.00	0.37	0.07	0.01	0.12
Pear	Russian 358 trunk	0.99	0.22	0.01	0.11	0.00	1.20	0.23	0.08	0.51
	Total	1.70	0.41	0.03	1.08	0.02	2.77	0.48	0.11	0.74

AMOUNT OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS — (*Continued*).

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Pear	Refreshing Russian roots	0.53	0.26	0.01	0.27	0.04	0.98	0.31	0.15	0.72
Pear	Refreshing Russian branches	0.02	0.09	0.00	0.02	0.00	0.29	0.08	0.05	0.15
Pear	Refreshing Russian trunk	0.09	0.28	0.01	0.24	0.00	1.18	0.44	0.05	0.66
	Total	0.64	0.63	0.02	0.53	0.04	2.45	0.83	0.25	1.53
Pear........	Howell roots	0.32	0.45	0.03	0.50	0.26	5.03	0.55	0.34	0.65
Pear........	Howell branches	0.32	0.28	0.02	0.19	0.00	2.38	0.52	0.44	0.64
Pear........	Howell trunk	0.38	0.41	0.03	0.30	0.02	4.67	0.67	0.34	0.70
	Total........................	1.02	1.14	0.08	0.99	0.28	12.08	1.74	1.12	1.99
Pear........	Doyenné d'Été roots................	3.21	0.75	0.03	0.80	0.26	4.26	0.78	1.11	1.13
Pear........	Doyenné d'Été branches	0.37	0.59	0.03	0.18	0.00	3.79	0.61	0.72	0.88
Pear........	Doyenné d'Été trunk	0.56	0.79	0.04	0.45	0.02	6.57	0.82	1.20	1.33
	Total..............	4.14	2.13	0.10	1.43	0.28	14.62	2.21	3.03	3.34
Pear........	Flemish Beauty roots..............	1.48	0.26	0.01	0.20	1.10	1.28	0.15	0.11	0.43
Pear........	Flemish Beauty branches	0.20	0.26	0.02	0.24	0.00	2.67	0.44	0.42	0.62
Pear........	Flemish Beauty trunk	0.55	0.52	0.04	0.49	0.05	5.74	0.92	1.01	1.04
	Total........................	2.23	1.04	0.07	0.93	0.15	9.69	1.51	1.54	2.09

Quince	Missouri Mammoth roots	0.56	0.20	0.06	0.12	0.00	1.78	0.25	0.25	0.20
Quince	Missouri Mammoth branches	0.08	0.14	0.01	0.07	0.00	0.73	0.14	0.03	0.08
Quince	Missouri Mammoth trunk	0.08	0.16	0.01	0.07	0.00	1.45	0.22	0.03	0.10
	Total	0.72	0.50	0.08	0.26	0.00	3.96	0.61	0.31	0.38
Quince	Orange roots	3.17	0.78	0.03	0.48	0.19	4.56	1.01	0.09	0.23
Quince	Orange branches	0.18	0.38	0.02	0.02	0.00	2.17	0.37	0.03	0.05
Quince	Orange trunk	0.42	0.42	0.02	0.19	0.00	2.93	0.45	0.07	0.49
	Total	3.77	1.58	0.07	0.69	0.19	9.66	1.83	0.19	0.77
Peach	Honest John roots	0.30	0.22	0.01	0.04	0.00	0.50	0.11	0.01	0.07
Peach	Honest John branches	0.05	0.12	0.00	0.07	0.00	1.22	0.15	0.00	0.10
Peach	Honest John trunk	0.07	0.10	0.00	0.05	0.00	0.71	0.07	0.01	0.01
	Total	0.42	0.44	0.01	0.16	0.00	2.43	0.33	0.02	0.18
Peach	Red Roman roots	0.56	0.40	0.01	0.14	0.02	0.92	0.28	0.03	0.41
Peach	Red Roman branches	0.10	0.29	0.01	0.15	0.00	1.74	0.26	0.02	0.36
Peach	Red Roman trunk	0.13	0.22	0.00	0.08	0.00	0.84	0.16	0.02	0.28
	Total	0.79	0.91	0.02	0.37	0.02	3.50	0.70	0.07	1.05
Peach	Large Early York roots	0.28	0.19	0.00	0.04	0.00	0.50	0.16	0.03	0.18
Peach	Large Early York branches	0.05	0.11	0.01	0.06	0.00	0.81	0.14	0.01	0.07
Peach	Large Early York trunk	0.09	0.11	0.00	0.04	0.00	0.76	0.11	0.04	0.16
	Total	0.42	0.41	0.01	0.14	0.00	2.07	0.41	0.08	0.41

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS—(*Continued*).

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Peach	Heath Cling roots	0.99	0.39	0.01	0.14	0.03	1.08	0.28	0.09	0.21
Peach	Heath Cling branches............	0.07	0.29	0.01	0.12	0.00	1.55	0.24	0.04	0.23
Peach	Heath Cling trunk..............	0.10	0.20	0.01	0.11	0.00	0.80	0.17	0.02	0.04
	Total........................	1.16	0.88	0.03	0.37	0.03	3.43	0.69	0.15	0.48
Peach	Stump roots	0.60	0.15	0.00	0.05	0.02	0.41	0.12	0.03	0.14
Peach	Stump branches.................	0.07	0.21	0.01	0.09	0.00	1.13	0.18	0.05	0.25
Peach	Stump trunk....................	0.08	0.12	0.00	0.08	0.00	0.80	0.15	0.02	0.10
	Total........................	0.75	0.48	0.01	0.22	0.02	2.34	0.45	0.10	0.49
Peach	Stevens' Rareripe roots	0.36	0.21	0.07	0.06	0.01	0.47	0.16	0.04	0.22
Peach	Stevens' Rareripe branches	0.05	0.08	0.00	0.04	0.01	0.50	0.07	0.08	0.07
Peach	Stevens' Rareripe trunk............	0.23	0.20	0.01	0.05	0.01	0.81	0.17	0.05	0.28
	Total........................	0.64	0.49	0.08	0.15	0.03	1.78	0.40	0.17	0.57
Peach	Salway, roots..................	0.97	0.21	0.01	0.10	0.04	1.00	0.25	0.03	0.23
Peach	Salway, branches	0.06	0.09	0.00	0.07	0.00	0.76	0.14	0.01	0.14
Peach	Salway, trunk	0.95	0.05	0.00	0.04	0.00	0.47	0.11	0.02	0.19
	Total........................	1.98	0.35	0.01	0.21	0.04	2.23	0.50	0.06	0.56

Peach	Early Rivers, roots	0.88	0.19	0.01	0.08	0.01	0.65	0.28	0.09	0.31
Peach	Early Rivers, branches	0.06	0.08	0.01	0.05	0.00	0.74	0.12	0.03	0.18
Peach	Early Rivers, trunk	0.64	0.91	0.00	0.07	0.02	0.30	0.09	0.03	0.18
	Total	1.58	1.18	0.02	0.20	0.03	1.69	0.49	0.15	0.67
Plum	Coe's Golden, roots	2.36	0.53	0.01	0.19	0.06	2.90	0.56	0.12	0.48
Plum	Coe's Golden, branches	0.05	0.12	0.01	0.08	0.00	0.93	0.13	0.10	0.22
Plum	Coe's Golden, trunk	0.39	0.22	0.01	0.14	0.01	2.58	0.28	0.12	0.48
	Total	2.80	0.87	0.03	0.41	0.07	6.41	0.97	0.34	1.18
Plum	Gueii, roots	2.31	0.91	0.02	0.34	0.12	3.65	0.47	0.15	0.58
Plum	Gueii, branches	0.33	0.76	0.03	0.39	0.00	3.51	0.46	0.40	0.66
Plum	Gueii, trunk	0.20	0.29	0.02	0.17	0.00	1.57	0.20	0.09	0.44
	Total	2.84	1.96	0.07	0.90	0.12	8.73	1.13	0.64	1.68
Plum	Smith's Orleans, roots	2.62	0.81	0.01	0.24	0.13	1.99	0.67	0.13	0.78
Plum	Smith's Orleans, branches	0.07	0.24	0.02	0.12	0.00	1.52	0.32	0.08	0.44
Plum	Smith's Orleans, trunk	0.23	0.13	0.02	0.24	0.00	2.82	0.51	0.13	0.80
	Total	2.92	1.18	0.05	0.60	0.13	6.33	1.50	0.34	2.02
Plum	Peter's Yellow Gage, roots	1.43	0.54	0.01	0.15	0.06	1.49	0.40	0.06	0.52
Plum	Peter's Yellow Gage, branches	0.17	0.45	0.02	0.19	0.00	2.07	0.43	0.51	0.53
Plum	Peter's Yellow Gage, trunk	0.22	0.32	0.03	0.14	0.00	1.73	0.39	0.09	0.68
	Total	1.82	1.31	0.06	0.48	0.06	5.29	1.22	0.66	1.73

AMOUNT OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS — (*Concluded*).

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	Mg O.	Na_2O.	K_2O.
Cherry......	Napoleon Bigarreau roots	2.68	0.49	0.02	0.34	0.19	1.88	0.39	0.31	0.55
Cherry......	Napoleon Bigarreau branches.......	0.09	0.28	0.01	0.21	0.00	1.86	0.30	0.25	0.22
Cherry......	Napoleon Bigarreau trunk	0.55	0.36	0.02	0.24	0.08	2.63	0.37	0.21	0.31
	Total.......................	3.32	1.13	0.05	0.79	0.27	6.37	1.06	0.77	1.08
Cherry......	Yellow Spanish roots	3.94	1.05	0.03	0.70	0.27	2.76	0.65	0.90	0.67
Cherry......	Yellow Spanish branches...........	0.18	0.50	0.02	0.19	0.00	2.92	0.56	0.39	0.64
Cherry......	Yellow Spanish trunk	0.43	0.36	0.01	0.28	0.06	2.78	0.41	0.36	0.54
	Total...........	4.55	1.91	0.06	1.17	0.33	8.46	1.62	1.65	1.85
Cherry......	Windsor roots	3.87	0.81	0.03	0.44	0.29	2.16	0.49	0.63	0.62
Cherry......	Windsor branches.	0.48	0.61	0.04	0.26	0.15	4.53	0.71	0.45	1.07
Cherry......	Windsor trunk	0.47	0.36	0.02	0.23	0.06	2.50	0.54	0.69	0.67
	Total.......................	4.82	1.78	0.09	0.93	0.50	9.19	1.74	1.77	2.36
Cherry......	Rockport Bigarreau roots	4.58	0.74	0.06	0.33	0.31	3.43	0.61	0.54	0.78
Cherry......	Rockport Bigarreau branches.......	0.25	0.29	0.02	0.11	0.04	3.46	0.55	0.85	0.60
Cherry......	Rockport Bigarreau trunk	0.33	0.26	0.02	0.21	0.03	3.39	0.41	0.36	0.58
	Total........	5.16	1.29	0.10	0.65	0.38	10.28	1.57	1.75	1.96
Grape vine ..	Mixed vines	0.48	0.36	0.01	0.30	0.01	1.73	0.50	0.23	0.97

AMOUNT OF ASH CONSTITUENTS IN EACH TREE IN GRAMS.

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.	Weight, green tree.	Total ash.	Ash in 2,000 pounds.
Apples	Haas	1.96	1.26	.08	.80	.29	5.78	1.39	.47	.97	713.0	13.00	36.5
Apples	Golden Sweet	1.42	.60	.04	.22	.13	3.42	.53	.45	.43	587.0	7.24	24.7
Apples	Hurlburt	4.63	.89	.14	1.55	.45	10.78	2.32	1.61	1.90	1545.0	24.27	31.4
	Average	2.67	.92	.09	.86	.29	6.66	1.41	.84	1.10	948.0	14.84	30.9
Crab apple	Hyslop	1.15	.78	.05	.42	.04	7.22	.83	.34	1.44	873.0	13.80	31.6
Crab apple	Orange	2.20	.84	.05	.53	.05	9.70	.93	.18	1.00	895.0	21.77	48.6
	Average	1.68	.81	.05	.48	.05	8.46	.88	.26	1.22	884.0	17.79	40.1
Pear	Vicar	2.56	1.55	.06	.95	.73	5.94	1.25	.18	2.13	1336.0	20.95	30.7
Pear	Duchess de Bordeaux	2.66	1.60	.06	.78	.08	8.74	1.53	.30	1.36	1394.0	23.76	34.1
Pear	Russian 508	1.01	.95	.02	.48	.06	3.55	.88	.26	.50	559.0	10.90	39.0
Pear	Russian 358	1.70	.41	.03	1.08	.02	2.77	.48	.11	.74	425.0	7.26	34.2
Pear	Refreshing Russian	.64	.63	.02	.53	.04	2.45	.83	.25	1.53	530.0	8.43	31.8
Pear	Howell	1.02	1.14	.08	.99	.28	12.08	1.74	1.12	1.99	1316.0	29.24	44.4
Pear	Doyenné d'Été	4.14	2.13	.10	1.43	.28	14.62	2.21	3.03	3.34	1923.0	41.33	43.0
Pear	Flemish Beauty	2.23	1.04	.07	.93	.15	9.69	1.51	1.54	2.09	1525.0	24.03	31.5
	Average	2.00	1.18	.06	.90	.21	7.48	1.30	.85	1.71	1126.0	20.74	36.1
Quince	Missouri Mammoth	.72	.50	.08	.26	.00	3.96	.61	.31	.38	324.0	7.99	49.3
Quince	Orange	3.77	1.58	.07	.69	.19	9.66	1.83	.19	.77	1053.0	26.92	51.1
	Average	2.25	1.04	.08	.48	.10	6.81	1.22	.25	.58	689.0	17.46	50.2
Peach	Honest John	.42	.44	.01	.16	.00	2.43	.33	.02	.18	247.0	5.16	41.8
Peach	Red Roman	.79	.91	.02	.37	.02	3.50	.70	.07	1.05	586.0	10.05	34.3
Peach	Large Early York	.42	.41	.01	.14	.00	2.07	.41	.08	.41	347.0	5.17	29.8
Peach	Heath Cling	1.16	.88	.03	.37	.03	3.43	.69	.15	.48	608.0	9.48	31.2
Peach	Stump	.75	.48	.01	.22	.02	2.34	.45	.10	.49	331.0	5.95	36.0
Peach	Stevens' Rareripe	.64	.49	.08	.15	.03	1.78	.40	.17	.57	464.0	5.10	22.0
Peach	Salway	1.98	.35	.01	.21	.04	2.23	.50	.06	.56	394.0	6.15	31.2
Peach	Early Rivers	1.58	1.18	.02	.20	.03	1.69	.49	.15	.67	307.0	5.65	36.8
	Average	.97	.64	.02	.23	.02	2.48	.50	.10	.55	411.0	6.59	32.9

AMOUNT OF ASH CONSTITUENTS IN EACH TREE IN GRAMS — (*Concluded*).

		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.	Weight, green tree.	Total ash.	Ash in 2,000 pounds.
Plum	Coe's Golden	2.80	.87	.03	.41	.07	6.41	.97	.34	1.18	848.0	16.65	39.3
Plum	Gueii	2.84	1.96	.07	.90	.12	8.73	1.13	.64	1.68	1165.0	21.85	37.5
Plum	Smith's Orleans	2.92	1.18	.05	.60	.13	6.33	1.50	.34	2.02	1139.0	19.28	33.9
Plum	Peters' Yellow Gage	1.32	1.31	.06	.48	.06	5.29	1.22	.66	1.73	1194.0	17.48	29.3
	Average	2.59	1.33	.05	.60	.10	6.69	1.21	.50	1.65	1037.0	18.82	35.0
Cherry	Napoleon Bigarreau	3.32	1.13	.05	.79	.27	6.37	1.06	.77	1.08	1143.0	19.18	33.6
Cherry	Yellow Spanish	4.55	1.91	.06	1.17	.33	8.46	1.62	1.65	1.85	1558.0	25.97	33.3
Cherry	Windsor	4.82	1.78	.09	.93	.50	9.19	1.74	1.77	2.36	2105.0	29.68	28.2
Cherry	Rockport Bigarreau	5.16	1.29	.10	.65	.38	10.28	1.57	1.75	1.96	1786.0	28.79	32.2
	Average	4.46	1.53	.08	.89	.37	8.58	1.50	1.49	1.81	1648.0	25.91	31.8
Grapes	Mixed vines	.48	.36	.01	.30	.01	1.73	.50	.23	.97	337.0	5.36	31.8

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS.

Variety.	NAME OF TREE.	Roots.								
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas	1.80	0.63	0.02	0.34	0.29	2.22	0.62	0.32	0.36
Apple	Golden Sweet	1.20	0.33	0.02	0.12	0.13	1.17	0.21	0.17	0.09
Apple	Hurlburt	4.07	0.64	0.04	0.95	0.42	3.86	1.60	1.11	1.52
	Average	2.36	0.53	0.03	0.47	0.28	2.42	0.81	0.53	0.66
Crab apple	Hyslop	0.98	0.34	0.01	0.22	0.04	1.96	0.30	0.14	0.48
Crab apple	Orange	1.93	0.29	0.02	0.23	0.05	2.85	0.46	0.05	0.19
	Average	1.45	0.31	0.01	0.22	0.04	2.40	0.38	0.09	0.33
Pear	Vicar	1.48	0.33	0.02	0.24	0.73	1.44	0.28	0.05	0.63
Pear	Duchess de Bordeaux	2.11	0.37	0.01	0.21	0.08	1.95	0.34	0.11	0.36
Pear	Russian 508	0.81	0.53	0.01	0.27	0.03	1.20	0.34	0.14	0.35
Pear	Russian 358	0.68	0.10	0.01	0.91	0.02	1.20	0.18	0.02	0.11
Pear	Refreshing Russian	0.53	0.26	0.01	0.27	0.04	0.98	0.31	0.15	0.72
Pear	Howell	0.32	0.45	0.03	0.50	0.26	5.03	0.55	0 34	0.65
Pear	Doyenné d' Été	3.21	0.75	0.03	0.80	0.26	4.26	0.78	1.11	1.13
Pear	Flemish Beauty	1.48	0.26	0.01	0.20	0.10	1.28	0.15	0.11	0.43
	Average	1.33	0.38	0.02	0.43	0.19	2.17	0.37	0.25	0.55
Quince	Missouri Mammoth	0.56	0.20	0.06	0.12	0.00	1.78	0.25	0.25	0.20
Quince	Orange	3.17	0.78	0.03	0.48	0.19	4.56	1.01	0.09	0.23
	Average	1.86	0.49	0.04	0.30	0.09	3.17	0.63	0.17	0.21

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS.—(*Continued*).

Variety.	NAME OF TREE.	BRANCHES.								
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas	0.06	0.33	0.04	0.09	0.00	1.37	0.31	0.08	0.27
Apple	Golden Sweet	0.05	0.12	0.01	0.06	0.00	0.85	0.17	0.15	0.07
Apple	Hurlburt	0.11	0.20	0.03	0.16	0.03	1.83	0.13	0.22	0.23
	Average	0.07	0.22	0.03	0.10	0.01	1.35	0.20	0.15	0.19
Crab apple	Hyslop	0.11	0.18	0.01	0.03	0.00	1.29	0.17	0.09	0.25
Crab apple	Orange	0.08	0.23	0.01	0.09	0.00	1.53	0.15	0.22	0.17
	Average	0.09	0.20	0.01	0.06	0.00	1.41	0.16	0.10	0.21
Pear	Vicar	0.90	0.60	0.02	0.31	0.00	1.61	0.31	0.07	0.96
Pear	Duchess de Bordeaux	0.20	0.54	0.04	0.19	0.00	2.89	0.61	0.07	0.26
Pear	Russian 508	0.02	0.01	0.00	0.04	0.00	0.60	0.12	0.00	0.05
Pear	Russian 358	0.03	0.09	0.01	0.06	0.00	0.37	0.07	0.01	0.12
Pear	Refreshing Russian	0.02	0.09	0.00	0.02	0.00	0.29	0.08	0.05	0.15
Pear	Howell	0.32	0.28	0.02	0.19	0.00	2.38	0.52	0.44	0.64
Pear	Doyenné d' Eté	0.37	0.59	0.03	0.18	0.00	3.79	0.61	0.72	0.88
Pear	Flemish Beauty	0.20	0.26	0.02	0.24	0.00	2.67	0.44	0.42	0.62
	Average	0.26	0.31	0.02	0.15	0.00	1.83	0.35	0.22	0.46
Quince	Missouri Mammoth	0.08	0.14	0.01	0.07	0.00	0.73	0.14	0.03	0.08
Quince	Orange	0.18	0.38	0.02	0.02	0.00	2.17	0.37	0.03	0.05
	Average	0.13	0.26	0.01	0.04	0.00	1.45	0.25	0.03	0.06

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS — (*Continued*).

Variety.	NAME OF TREE.	TRUNKS.								
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Apple	Haas	0.10	0.30	0.02	0.37	0.00	2.19	0.46	0.07	0.34
Apple	Golden Sweet	0.17	0.15	0.01	0.04	0.00	1.40	0.15	0.13	0.27
Apple	Hurlburt	0.45	0.05	0.07	0.44	0.00	5.09	0.59	0.28	0.15
	Average	0.24	0.17	0.03	0.28	0.00	2.89	0.40	0.16	0.25
Crab apple	Hyslop	0.06	0.26	0.03	0.17	0.00	3.97	0.36	0.11	0.71
Crab apple	Orange	0.19	0.32	0.02	0.21	0.00	5.32	0.32	0.01	0.64
	Average	0.12	0.29	0.02	0.19	0.00	4.64	0.34	0.06	0.67
Pear	Vicar	0.18	0.62	0.02	0.40	0.00	2.87	0.66	0.06	0.54
Pear	Duchess de Bordeaux	0.35	0.69	0.01	0.38	0.00	3.90	0.58	0.12	0.74
Pear	Russian 508	0.18	0.41	0.01	0.17	0.03	1.75	0.42	0.12	0.10
Pear	Russian 358	0.99	0.22	0.01	0.11	0.00	1.20	0.23	0.08	0.51
Pear	Refreshing Russian	0.09	0.28	0.01	0.24	0.00	1.18	0.44	0.05	0.66
Pear	Howell	0.38	0.41	0.03	0.30	0.02	4.67	0.67	0.34	0.79
Pear	Doyenné d' Été	0.56	0.79	0.04	0.45	0.02	6.57	0.82	1.20	1.33
Pear	Flemish Beauty	0.55	0.52	0.04	0.49	0.05	5.74	0.92	1.01	1.04
	Average	0.41	0.49	0.02	0.32	0.02	3.48	0.59	0.37	0.70
Quince	Missouri Mammoth	0.08	0.16	0.01	0.07	0.00	1.45	0.22	0.03	0.10
Quince	Orange	0.42	0.42	0.02	0.19	0.00	2.93	0.45	0.07	0.49
	Average	0.25	0.29	0.01	0.13	0.00	2.19	0.33	0.05	0.29

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS — (*Continued*).

Variety.	NAME OF TREE.	Roots.								
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Peach	Honest John	0.30	0.22	0.01	0.04	0.00	0.50	0.11	0.01	0.07
Peach	Red Roman	0.56	0.40	0.01	0.14	0.02	0.92	0.28	0.03	0.41
Peach	Large Early York	0.28	0.19	0.00	0.04	0.00	0.50	0.16	0.03	0.18
Peach	Heath Cling	0.99	0.39	0.01	0.14	0.03	1.08	0.28	0.09	0.21
Peach	Stump	0.60	0.15	0.00	0.05	0.02	0.41	0.12	0.03	0.14
Peach	Stevens' Rareripe	0.36	0.21	0.07	0.06	0.01	0.47	0.16	0.04	0.22
Peach	Salway	0.97	0.21	0.01	0.10	0.04	1.00	0.25	0.03	0.23
Peach	Early Rivers	0.88	0.19	0.01	0.08	0.01	0.65	0.28	0.09	0.31
	Average	0.62	0.25	0.02	0.08	0.02	0.69	0.21	0.04	0.22
Plum	Coe's Golden	2.36	0.53	0.01	0.19	0.06	2.90	0.56	0.12	0.48
Plum	Gueii	2.31	0.91	0.02	0.34	0.12	3.65	0.47	0.15	0.58
Plum	Smith's Orleans	2.62	0.81	0.01	0.24	0.13	1.99	0.67	0.13	0.78
Plum	Peter's Yellow Gage	1.43	0.54	0.01	0.15	0.06	1.49	0.40	0.06	0.52
	Average	2.18	0.70	0.01	0.23	0.09	2.51	0.53	0.12	0.59
Cherry	Napoleon Bigarreau	2.68	0.49	0.02	0.34	0.19	1.88	0.39	0.31	0.55
Cherry	Yellow Spanish	3.94	1.05	0.03	0.70	0.27	2.76	0.65	0.90	0.67
Cherry	Windsor	3.87	0.81	0.03	0.44	0.29	2.16	0.49	0.63	0.62
Cherry	Rockport Bigarreau	4.58	0.74	0.06	0.33	0.31	3.43	0.61	0.54	0.78
	Average	3.77	0.77	0.04	0.45	0.27	2.56	0.54	0.60	0.66
Grapes	Mixed vines	....	....	....	....	....	....	....	....	.....

Amounts of Different Constituents in the Ash of Nursery Stock in Grams—(*Continued*).

Variety.	Name of Tree.	Branches.								
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Peach	Honest John	0.05	0.12	0.00	0.07	0.00	1.22	0.15	0.00	0.10
Peach	Red Roman	0.10	0.29	0.01	0.15	0.00	1.74	0.26	0.02	0.36
Peach	Large Early York	0.05	0.11	0.01	0.06	0.00	0.81	0.14	0.01	0.07
Peach	Heath Cling	0.07	0.29	0.01	0.12	0.00	1.55	0.24	0.04	0.23
Peach	Stump	0.07	0.21	0.01	0.09	0.00	1.13	0.18	0.05	0.25
Peach	Stevens' Rareripe	0.05	0.08	0.00	0.04	0.01	0.50	0.07	0.08	0.07
Peach	Salway	0.05	0.09	0.00	0.07	0.00	0.76	0.14	0.01	0.14
Peach	Early River	0.06	0.08	0.01	0.05	0.00	0.74	0.12	0.03	0.18
	Average	0.06	0.16	0.01	0.08	0.00	1.06	0.16	0.03	0.18
Plum	Coe's Golden	0.05	0.12	0.01	0.08	0.00	0.93	0.13	0.10	0.22
Plum	Gueii	0.33	0.76	0.03	0.39	0.00	3.51	0.46	0.40	0.66
Plum	Smith's Orleans	0.07	0.24	0.02	0.12	0.00	1.52	0.32	0.08	0.44
Plum	Peter's Yellow Gage	0.17	0.45	0.02	0.19	0.00	2.07	0.43	0.51	0.53
	Average	0.16	0.39	0.02	0.20	0.00	2.01	0.34	0.27	0.46
Cherry	Napoleon Bigarreau	0.09	0.28	0.01	0.21	0.00	1.86	0.30	0.25	0.22
Cherry	Yellow Spanish	0.18	0.50	0.02	0.19	0.00	2.92	0.56	0.39	0.64
Cherry	Windsor	0.48	0.61	0.04	0.26	0.15	4.53	0.71	0.45	1.07
Cherry	Rockport Bigarreau	0.25	0.29	0.02	0.11	0.04	3.46	0.55	0.85	0.60
	Average	0.25	0.42	0.02	0.19	0.05	3.19	0.53	0.49	0.63
Grapes	Mixed vines	0.48	0.36	0.01	0.30	0.01	1.73	0.50	0.23	0.97

AMOUNTS OF DIFFERENT CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS — (*Concluded*).

Variety.	NAME OF TREE.	TRUNKS.								
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe O_3.	CaO.	MgO.	Na_2O.	K_2O.
Peach	Honest John	0.07	0.10	0.00	0.05	0.00	0.71	0.07	0.01	0.01
Peach	Red Roman	0.13	0.22	0.00	0.08	0.00	0.84	0.16	0.02	0.28
Peach	Large Early York	0.09	0.11	0.00	0.04	0.00	0.76	0.11	0.04	0.16
Peach	Heath Cling	0.10	0.20	0.01	0.11	0.00	0.80	0.17	0.02	0.04
Peach	Stump	0.08	0.12	0.00	0.08	0.00	0.80	0.15	0.02	0.10
Peach	Stevens' Rareripe	0.23	0.20	0.01	0.05	0.01	0.81	0.17	0.05	0.28
Peach	Salway	0.95	0.05	0.00	0.04	0.00	0.47	0.11	0.02	0.19
Peach	Early Rivers	0.64	0.91	0.00	0.07	0.02	0.30	0.09	0.03	0.18
	Average	0.29	0.24	0 00	0.07	0.00	0.69	0.13	0.03	0.16
Plum	Coe's Golden	0.39	0.22	0.01	0.14	0.01	2.58	0.28	0.12	0.48
Plum	Gueii	0.20	0.29	0.02	0.17	0.00	1.57	0.20	0.09	0.44
Plum	Smith's Orleans	0.23	0.13	0.02	0.24	0.00	2.82	0.51	0.13	0.80
Plum	Peter's Yellow Gage	0.22	0.32	0.03	0.14	0.00	1.73	0.39	0.09	0.68
	Average	0.26	0.24	0.02	0.17	0.00	2.18	0.35	0.11	0.60
Cherry	Napoleon Bigarreau	0.55	0.36	0.02	0.24	0.08	2.63	0.37	0.21	0.31
Cherry	Yellow Spanish	0.43	0.36	0.01	0.28	0.06	2.78	0.41	0.36	0.54
Cherry	Windsor	0.47	0.36	0.02	0.23	0.06	2.50	0.54	0.69	0.67
Cherry	Rockport Bigarreau	0.33	0.26	0.02	0.21	0.03	3.39	0.41	0.36	0.58
	Average	0.45	0.35	0.02	0.24	0.06	2.83	0.43	0.41	0.53
Grapes	Mixed vines	....	....	....	....	....	...	....	....	.....

AVERAGES OF CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS.

		Roots.								
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Trees non-pitted	Apples	2.36	0.53	0.03	0.47	0.28	2.42	0.81	0.53	0.66
	Crab apples	1.45	0.31	0.01	0.22	0.04	2.40	0.38	0.09	0.33
	Pears	1.33	0.38	0.02	0.43	0.19	2.17	0.37	0.25	0.55
	Quinces	1.86	0.49	0.04	0.30	0.09	3.17	0.63	0.17	0.21
Grand average		1.75	0.43	0.03	0.36	0.15	2.54	0.55	0.26	0.44
Trees-pitted	Peaches	0.62	0.25	0.02	0.08	0.02	0.69	0.21	0.04	0.22
	Plums	2.18	0.70	0.01	0.23	0.09	2.51	0.53	0.12	0.59
	Cherries	3.77	0.77	0.04	0.45	0.27	2.56	0.54	0.60	0.66
Grand average		2.19	0.57	0.02	0.25	0.13	1.92	0.43	0.25	0.49

AVERAGES OF CONSTITUENTS IN THE ASH OF NURSERY STOCK IN GRAMS — (*Continued*).

		Branches.								
		SiO_2.	P_2O_5.	Cl	SO_3	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O
Trees non-pitted.	Apples	0.07	0.22	0.03	0.10	0.01	1.35	0.20	0.15	0.19
	Crab apples	0.09	0.20	0.01	0.06	0.00	1.41	0.16	0.10	0.21
	Pears	0.26	0.31	0.02	0.15	0.00	1.83	0.35	0.22	0.46
	Quinces	0.13	0.26	0.01	0.04	0.00	1.45	0.25	0.03	0.06
Grand average		0.14	0.25	0.02	0.09	0.00	1.51	0.24	0.13	0.23
Trees pitted	Peaches	0.06	0.16	0.01	0.08	0.00	1.06	0.16	0.03	0.18
	Plums	0.16	0.39	0.02	0.20	0.00	2.01	0.34	0.27	0.46
	Cherries	0.25	0.42	0.02	0.19	0.05	3.19	0.53	0.49	0.63
Grand average		0.16	0.32	0.02	0.16	0.02	2.09	0.34	0.26	0.42

Averages of Constituents in the Ash of Nursery Stock in Grams — (*Concluded*).

		Trunks.							
		SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Trees non-pitted	Apples	0.24	0.17	0.03	0.28	0.00	2.89	0.40	0.16	0.25
	Crab apples	0.12	0.29	0.02	0.19	0.00	4.64	0.34	0.06	0.67
	Pears	0.41	0.49	0.02	0.32	0.02	3.48	0.59	0.37	0.70
	Quinces	0.25	0.29	0.01	0.13	0.00	2.19	0.33	0.05	0.29
Grand average		0.26	0.31	0.02	0.23	0.01	3.30	0.42	0.16	0.48
Trees-pitted	Peaches	0.29	0.24	0.00	0.07	0.00	0.69	0.13	0.03	0.16
	Plumbs	0.26	0.24	0.02	0.17	0.00	2.18	5	0.11	0.60
	Cherries	0.45	0.35	0.02	0.24	0.06	2.83	0.43	0.41	0.53
Grand average		0.33	0.28	0.01	0.16	0.02	1.90	0.30	0.18	0.43

AVERAGE DRY WEIGHT OF ROOTS, BRANCHES AND TRUNKS OF TREES IN GRAMS.

NON-PITTED.	Roots.	Branches.	Trunks.	PITTED.	Roots.	Branches.	Trunks.
Apples	199.1	79.5	260.3	Peaches	88.0	48.4	82.7
Crab apples	165.7	82.4	246.5	Plums	185.4	151.3	237.1
Pears	179.8	97.6	269.1	Cherries	309.1	206.2	448.0
Quinces	173.8	80.1	240.1				
	178.6	84.9	254.0		194.2	135.6	255.9

AVERAGE PER CENT. OF ASH CONSTITUENTS IN DRY ROOTS, BRANCHES AND TRUNKS.

NON-PITTED.	SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.
Per cent. in dry roots	.979	.241	.017	.202	.084	1.422	.308	.146	.246
Per cent. in dry branches	.165	.294	.024	.106	.000	1.778	.282	.153	.271
Per cent. in dry trunks	.102	.122	.008	.091	.004	1.299	.165	.063	.189
Pitted:									
Per cent. in dry roots	1.129	.294	.010	.129	.067	.990	.222	.129	.253
Per cent. in dry branches	.118	.236	.015	.118	.015	1.541	.251	.200	.310
Per cent. in dry trunks	.129	.109	.004	.063	.008	.742	.117	.070	.168

Average Grams of Ash in Roots, Branches and Trunk.

	SiO_2.	P_2O_5.	Cl.	SO_3.	Fe_2O_3.	Ca O.	MgO.	Na_2O.	K_2O.
Average grams ash in roots	1.965	0 499	0.025	0.309	0.141	2.248	0.495	0.256	0.466
Average grams ash in branches.	0.156	0.293	0.022	0.124	0.008	1.832	0.294	0.195	0.320
Average grams ash in trunk....	0.029	0.029	0.015	0.020	0.015	2.602	0.072	0.034	0.091
Average grams ash in tree.	2.150	0.821	0.062	0.453	0.164	6.682	0.860	0.485	0.877
Pounds in 10,890 trees = 1 acre.	51.63	19.71	1.49	10.88	3.93	160.09	20.60	11.62	21.01

Average Results.

Average weight of green tree (32.6 oz.), grams	970.30
Average per cent. of water in tree	46.27
Average per cent. of dry matter in tree	53.73
Average per cent. ash in green tree	1.80
Average per cent. ash in dry tree	3.35
Average per cent. ash in dry roots	3.90
Average per cent. ash in dry trunks	2.57
Average per cent. ash in dry branches	4.17
Per cent. of total ash in roots	40.20
Per cent. of total ash in trunks	34.70
Per cent. of total ash in branches	25.10
Per cent. of total dry matter in roots	34.50
Per cent. of total dry matter in trunks	45.20
Per cent. of total dry matter in branches	20.20

Average weight of the seven varieties of these green trees was 970.3 grams each. With rows four feet apart and trees one foot apart in row there would be on an acre 10,890 trees, weighing 23,299 pounds, or over eleven tons. The average of the thirty-one trees gives 1.80 per cent. of ash in the green tree, therefore there would be 419.4 pounds of ash removed by an average acre of nursery stock.

Quantitative analyses have been given of the ash of these trees, and the average of these, which do not widely differ in composition, shows that there is taken from the soil in eleven tons of nursery stock the following mineral constituents, each having been determined except the carbonic acid of the ash:

Pounds of Mineral Matter Removed by Eleven Tons of Nursery Stock.

	Pounds.
Silicic acid	51.63
Phosphoric acid	19.71
Sulphuric acid	10.88
Chlorine	1.49
Carbonic acid*	147.40

* Estimated.

	Pounds.
Ferric oxide	3.93
Lime	160.09
Magnesia	20.60
Soda	11.62
Potash	21.01
Total	448.36

For the purpose of comparison the following table is presented giving the number of pounds of the several mineral constituents removed by a ton of the grain and of the straw of each of our principal cereals, from which it will be seen that since, upon an average, it requires from three to four years to grow the crop of nursery stock, the cereals make a far greater demand upon the soil than does the growing of nursery stock, and it is a matter of common observation that the removal of a crop of trees leaves the soil in excellent condition for the growth of the cereals.

ASH IN 2,000 POUNDS OF GRAIN AND STRAW — POUNDS.

	SiO_2.	P_2O_5.	SO_3.	Cl.	Fe_2O_3.	MgO.	CaO.	K_2O.	Na_2O.
Wheat grain	.8	18.4	.2	.2	.3	4.9	1.3	12.5	1.3
Rye grain	1.0	18.2	1.0	.4	.4	4.6	1.6	11.5	1.7
Barley grain	14.2	16.4	1.0	.6	.4	4.1	1.2	10.6	1.8
Oats grain	30.6	14.1	1.0	.3	.3	4.8	2.4	10.3	1.7
Maize grain	.6	12.7	.3	.1	.9	4.2	.8	7.7	.4
Wheat straw	74.6	5.7	2.7	2.9	.8	2.7	6.3	12.4	1.7
Rye straw	61.2	5.5	2.0	2.0	.8	3.0	8.2	16.0	2.7
Barley straw	56.3	4.7	3.9	3.9	1.5	2.5	8.0	22.5	4.3
Oats straw	51.5	4.3	3.4	8.4	1.7	4.0	7.7	21.3	6.7
Maize straw	31.7	9.1	5.7	5.7	2.6	6.3	11.9	38.9	1.4

For the purpose of learning the practical experience of those engaged in growing nursery stock a circular letter was addressed to several of our leading nurserymen, containing the following questions:

1. Do you know from experience or observation the effect of following one lot of nursery stock with another upon the same land?

2. Can stock of pitted fruits be grown successfully immediately after a crop of non-pitted fruit stock, or vice versa?

3. Can wheat, oats or barley be relied upon as a good crop following nursery stock?

The replies to the above questions were practically uniform, the testimony being that a crop of nursery stock was exhausting to the soil, so that if followed directly with successive crops of trees, the resulting crops were less thrifty and became steadily poorer and poorer, and this result followed so invariably that the plan is abandoned. Pear trees are reported as especially exhausting to the soil. It is found that if, during an interval of a few years, other crops were grown, the soil became in condition to grow again a successful crop of trees, having recovered apparently from its exhaustion. Several nurserymen testify that a crop of ornamental trees can follow fruit trees with good results.

The replies to the second query were generally, that, while a crop of stone fruits could successfully follow a crop of seed fruits, the reverse was not the case.

In reply to the third question there was an invariable "yes," and this appears to be a matter beyond controversy, so far as personal experience and common observation goes.

It is impossible to question the facts which are matters of almost universal experience with our most intelligent nurserymen, and yet their almost unanimous explanation that these facts are result of soil exhaustion appears to conflict with the testimony that excellent grain crops invariably follow upon land from which a heavy crop of nursery stock has been just removed, since, as is well known, the grain crops make a heavy demand upon the land and of the same constituents which we find present in the ash of nursery stock.

The explanation may perhaps be found in the fact, that, while grain crops derive their nourishment largely from the surface soil, owing to their comparatively shallow distribution of roots, nursery stock, on the other hand draws largely upon the subsoil, where comparatively a more limited amount of such available food exists, and that the growth of such a crop results, therefore, in a comparative, and as the testimony of many of the nurserymen indicates, a temporary exhaustion of the subsoil, while the superficial surface soil, through the thorough cultivation which attends the growing of nursery stock, actually becomes richer through the constantly increasing amount of available food, both mineral and organic, which accumulates during the three or four years during which the crop of nursery stock is reaching a marketable size.

It will be seen that generally the testimony of the nurserymen indicates that while a crop of stone fruits could successfully follow a crop of seed fruits, the reverse is not found to be the case, and this may be due to the fact that as generally the size attained by the latter trees is larger, the demand upon the soil is greater in proportion, and this change is equivalent to following with a crop requiring less plant food for its development. In the case of the stock furnished for this experiment there were fifteen seed fruits and sixteen stone fruits, and the average amount of ash found in the trees of seed fruits was thirty-five per cent. greater than the ash found in stone fruits.

There is another question which may be of importance in connection with this matter which deserves more than a passing consideration, especially since it may have a very wide influence in connection with the successful production of many of our crops. In our discussion of the importance of sufficient supplies of plant food, we may omit to give any weight to what we may term the excreta which are produced in the development of the plant and which may, and perhaps do, in many cases so change the character of the soil in which such plants grow as to render it unfit for the further cultivation, at least in immediate succession of such plants, as well also of other plants to which the soil has been rendered, in some way as yet not understood, unwholesome and obnoxious. Horticulturists are familiar with many illustrations which may be thus and only in such way explained, and it is to be hoped that this field of investigation shall in the near future receive greater attention, since, so far as I know it has as yet received little attention, and is not unlikely to throw light upon many obscure points in connection with our agricultural experience.

Commercial Fertilizers.

During the past year there have been analyzed 247 different brands of fertilizers, the samples of which have been taken by an agent of the station.

Besides these official samples, analyses have been made, so far as it has been possible to do so, of unofficial samples, sent in by different parties throughout the State, of fertilizers, marls, ashes and so forth, but, owing to the difficulty in securing a fair sample, unless one is informed as to the proper method of procedure, as also owing to the fact that such unofficial samples do not, in case such samples are not found to be up to the guaranteed composition, offer the proper evidence desirable to warrant a prosecution of the parties selling such inferior products, it is very desirable that the work of analysis at the station should be confined to those samples only, collected by our duly appointed and well-instructed agents, through whom it is intended to secure carefully selected specimens of every brand of fertilizer offered for sale in any portion of the State.

Thus far the analyses made appear to show not infrequent failures upon the part of manufactures and dealers to comply strictly with the requirements of the law, occasionally fertilizers being found for sale containing no guaranteed composition upon the packages as the law directs; many samples also are found where a deficiency in one constituent appears to have been made good in an increase of another beyond the amount guaranteed.

It is hoped that all those knowing of the neglect of manufacturers or dealers to comply with any of the requirements of our fertilizer law will at once give full information of such fact to the Director of this Station, who is charged with the enforcement of the provisions of this excellent law.

The following is a correct copy of the law:

COPY OF THE NEW YORK STATE FERTILIZER LAW.

Chapter 437.

AN ACT for the protection and education of farmers and manufacturers in the purchase and sale of fertilizers.

APPROVED by the Governor May 24, 1890. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. All commercial fertilizers which shall be offered for sale, to be used in this state, shall be accompanied by an analysis stating the percentages contained therein of nitrogen or its equivalent ammonia, of soluble and available phosphoric acid, the available phosphoric acid either to be soluble in water or in a neutral solution of citrate of ammonia as determined by the methods agreed upon by the American Society of Agricultural Chemists, and of potash soluble in distilled water. A legible statement of the analysis of the goods shall be printed on, or attached to each package of fertilizer offered for sale for use in the state; and where fertilizers are sold in bulk, to be used in this state, an analysis shall accompany the same, with an affidavit that it is a true representation of the contents of the article or articles.

§ 2. Manufacturers residing in this state, and agents or sellers of fertilizers made by persons residing outside the limits of this state, shall between the first and twentieth days of July, in each year, furnish to the Director of the New York State Agricultural Experiment Station, at Geneva, a list of the commercial fertilizers they manufacture or offer for sale for use in this state, with the names or brands by which they are known on the market, and the several percentages of nitrogen or its equivalent of ammonia, of phosphoric acid soluble and available, and of potash, either single or combined, contained in said fertilizer, as called for in section one of this act. Whenever any fertilizer or fertilizing ingredients are shipped or sold in bulk, for use by farmers in this state, a statement must be sent to the Director of the New York State Agricultural Experiment Station, at Geneva, giving the name of the goods so shipped, and accompanied with an affidavit from the seller, giving the analysis of such percentage guaranteed.

§ 3. Whenever a correct chemical analysis of any fertilizer offered for sale in this state shall show a deficiency of not more than one-third of one per centum of nitrogen or its equivalent of ammonia, or one-half of one per centum of soluble or available phosphoric acid and one-half of one per centum of potash soluble in distilled water, such statements shall not be deemed false within the meaning of this act. This act shall apply to all articles of fertilizers offered or exposed for sale for use in the state of New York, the selling price of which is ten dollars per ton or higher, and of which they are part or parcel, and of any element into which they enter as fertilizing materials, among which may be enumerated nitrate of soda, sulphate of ammonia, dissolved bone black and bone black undissolved, any phosphate rock, treated or untreated with sulphuric or other acids, ashes from whatever source obtained, potash, salts of all kinds, fish scrap, dried or undried, also all combinations of phosphoric acid, nitrogen or potash, from whatever source obtained, as well as all and every article that is or may be combined for fertilizing purposes.

§ 4. All manufacturers or dealers exposing or offering for sale in this state, fertilizers containing roasted leather or any other form of inert nitrogenous matter shall, in legible print, state the fact on the package in which the fertilizers are exposed or offered for sale.

§ 5. Every person, firm or corporation, violating any of the provisions of this act, shall, upon conviction thereof, for the first offense be punished by a fine of not less than fifty dollars, nor more than two hundred dollars, and for the second offense by double the amount, in the discretion of the court; such fines to be paid to the officer whose duty it is to enforce the provisions of this act, to be used by him for that purpose, and to be accounted for to the comptroller.

§ 6. The Director of the New York State Agricultural Experiment Station at Geneva is charged with the enforcement of the provisions of this act, and shall prosecute in the name of the people, for violation thereof; and for that purpose he may employ agents, counsel, chemists and experts, and the court of special sessions shall have concurrent jurisdiction to hear and determine charges for violating the provisions of this act committed in their respective counties, subject to the power of removal provided in chapter one of title six of the Code of Criminal Procedure.

§ 7. And the said Director of the New York State Agricultural Experiment Station at Geneva, or his duly authorized agents, shall have full access, egress and ingress to all places of business, factories, buildings, cars, vessels, or other places where any manufactured fertilizer is sold, offered for sale or manufactured. Such Director shall also have power to open any package, barrel or other thing containing manufactured fertilizer, and may take therefrom sufficient samples; and whenever any such fertilizer is so taken for samples, it may be divided into different portions and one or more portions sealed in such a way that it can not be opened without, upon examination, giving evidence of having been opened to the person sealing the same, and delivered to the person from whom said sample is taken, or any other person that may be agreed upon, by the said Director or his agents who take the same and the person from whom it is taken, which portion so delivered may upon consent of the parties be delivered to a chemist for the purpose of being analyzed other than the chemist employed by said Director.

§ 8. The sum of twenty thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of any money in the treasury not otherwise appropriated, to be used by said Director of the New York State Agricultural Experiment Station at Geneva, as shall be authorized by the board of control thereof, in enforcing the provisions of this act. Said sum shall be paid to said Director by the treasurer upon the warrant of the comptroller, upon vouchers to be approved by the comptroller, in such sums and at such times as said Director may require, who shall file a statements for what purposes he desires the same.

§ 9. Agents, representatives or sellers of manufactured fertilizers or fertilizing material made or owned by parties outside of this state, and offered for sale for use in this state, shall conform to the provisions of this act, and shall be subject to its penalties, and in all particulars shall take the place of their non-resident principals.

§ 10. Chapter two hundred and twenty-two of the laws of eighteen hundred and seventy-eight is hereby repealed.

§ 11. This act shall take effect immediately.

STATE OF NEW YORK, } *ss.:*
OFFICE OF SECRETARY OF STATE. }

I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom and of the whole of said original law.

FRANK RICE,
Secretary of State.

Of the 247 samples analyzed, thirty-two give only a certain and definite percentage of each constituent guaranteed to be present, and 215 give a minimum and maximum amount, though it must not be forgotten that such guarantee is misleading generally to the buyer, since obviously the guarantee in fact extends only to the minimum amount guaranteed, and when, therefore, a manufacturer guarantees, for example, two or three per cent. of nitrogen, four to five per cent. of potash, or ten to twelve per cent. of available phosphoric acid, such guarantee legally would be only for two per cent of nitrogen, four per cent. of potash and ten per cent. of available phosphoric acid, instead of the mean amounts in each case.

It is interesting to observe that in the thirty-two samples in which a definite amount of each constituent was guaranteed the average quantity guaranteed and found was as follows:

	Nitrogen, per cent.	Available phosphoric acid, per cent.	Potash, per cent
Guaranteed	2.785	8.638	5.040
Found	3.171	9.450	5.373

or an excess of 13.9 per cent. of nitrogen, of 9.4 per cent. of available phosphoric acid, and of 6.7 per cent. of potash over the guaranteed amount, which is certainly a very creditable showing.

Of the 215 samples where minimum and maximum amounts were given as guaranteed, the average results are as follows:

	Nitrogen, per cent.	Available phosphoric acid, per cent.	Potash, per cent.
Maximum guaranteed	1.984	8.446	3.044
Minimum guaranteed	2.960	10.600	3.980
Found	2.251	9.339	3.371

or an excess of 13.4 per cent. of nitrogen, of 10.6 per cent. of available phosphoric acid, and of 10.7 per cent. of potash over the minimum amount guaranteed; while the maximum amounts guaranteed were 19.6 per cent. of nitrogen, 13.5 per cent. of available phosphoric acid and 18.0 per cent. of potash, greater than the actual amounts of each of these constituents found to be present.

For the details of this branch of the work of the Station reference is made to the report of the Chemist and the several bulletins giving results of analysis.

It appears that it has been the custom of many dealers, especially of those selling ashes, to make sales upon prices subject to the analysis of the station, and it is obvious that it is practically impossible for the Station to undertake such work, nor is it contemplated by the law that work of such character should be done at the expense of the State. All fertilizers sold or offered for sale within the State at a price of ten dollars or more per ton must be sold upon a guaranteed analysis, and the packages containing such products must have the guaranteed analysis plainly printed upon such packages, but it is not required that these analyses are to be made at the expense of the State, the law requiring only that samples shall, so far as is practicable, be taken of such fertilizing materials, and analyses be made of them to determine whether these products are found up to their guaranteed composition within the limits prescribed by law.

The amount of analytical work involved in carrying out the provisions of this law is so great that it is practically impossible to do any work which is unofficial and of the general nature of private work, as analyses of individual samples of fertilizers, of muck, marls, minerals or mineral waters, adulterated foods, suspected cases of poisoning and so forth, except so far as such analyses may partake of a public nature.

The Commercial Valuation of Fertilizers.

The Station is frequently in receipt of letters asking for a money valuation upon a certain fertilizer, the analysis of which is properly guaranteed and upon inspection found to contain the amount of each constituent as guaranteed.

The fertilizer law of this State, as will be seen, neither requires such valuation to be made nor does it forbid such valuation, and we have published from time to time the scale of prices per pound for each of the constituents in the various forms in which these constituents are found for sale in the leading markets of the country, so that the analysis of any fertilizer being given, it is only necessary to multiply the per cent. of each constituent found present by twenty to learn the number of pounds of such constituent present in a ton (2,000 pounds) of the fertilizer, and then to multiply by the prices per pound and add the results together to obtain what may be called the net valuation per ton of such fertilizer; but to this net valuation should be added a sum sufficient to defray cost of manufacture, of bags or barrels, of freight to consumer, and a reasonable profit, in order to determine what would be a fair price for such fertilizer when delivered to the purchaser and consumer.

The above appears to be a very simple matter, but in practice is very difficult to accomplish in a way to do equal justice to manufacturers and consumers and for the following reasons:

The costs of manufacture and for freight differ greatly, although there appears no good reason why the farmer should pay for the differences which may arise in these ways between the cost of two brands of fertilizers equal in other respects. The main trouble arises from ignorance generally as to the exact form in which the several constituents are present in a certain fertilizer, e. g., whether the nitrogen present is in the form of nitrates, ammonia salts, fish, pomace, horn, leather, hair, or in any other of the many forms in which this element is found in combination.

There can be no question that the chemist is able to fix a perfectly fair valuation upon the nitrogen in either of the above or in other forms, since he has access to the current market quotations for these as for other products, but it is often difficult, if not now and then impossible, at the present, for him to determine the form in which this element is present in the product under analysis.

While, therefore, it is easy upon analysis of any given fertilizer to calculate the minimum valuation commercially of the constituents present, such valuation would, in the great majority of cases, be obviously unfair to the manufacturer, but it is equally obvious that the manufacturer has it in his power to secure full justice to himself in this matter of valuation if he will, and in the following way: At present, the law, while permitting the sale of anything which may be placed upon the market as a fertilizer, trusting to the general intelligence of the purchaser to protect him from what is worthless, it specially provides that in case leather or other inert forms of nitrogen compounds are used as a constituent of any fertilizer, such fact must be declared by the manufacturer using such material.

It will be observed that there is no restriction upon the sale of leather or other inert forms of nitrogenous matter, nor upon the price which may be demanded for the same, and it would appear that without in any way attempting to limit the sale or control the prices of the other constituents used in the manufacture of commercial fertilizers, it might be reasonably demanded that those offering such products for sale in the state should be compelled to state the character and constituents of their several products, since it is notoriously true that of the several nitrogenous compounds present in fertilizers the nitrogen in some is as fairly worth seventeen cents per pound as it is in another form worth seven cents per pound, or in certain other forms scarcely worth one cent per pound.

What is true of nitrogen is somewhat true in the case of phosphoric acid and potash, but not to an equal degree; but there exists a widespread preference upon the part of the farmers for soluble and available phosphoric acid derived from bone rather than from South Carolina or other mineral phosphates, as is evidenced by the very common practice of fertilizer manufacturers to calculate the phosphoric acid in their product as equivalent to so much bone-phosphate, often in cases where all of it is obtained from other phosphates than bone.

The objection often, and perhaps always, made to the suggestion that the source of the several constituents should be stated by the manufacturers of fertilizers, is, that unscrupulous persons would not hesitate to state that the best raw materials were used in their products, and such objection is perhaps likely for a time to prove true, but there can be little doubt that in the end the honest manufacturers will find, as is ever the case, that established reputation for integrity and fair dealing is quite as valuable in their business as in any other, and besides it would prove a comparatively easy matter to trace to their destination suspected material, and to devise speedy methods by which its character could be detected in the manufactured products, even if such means are not already in the hands of the analytical chemist. At least it seems that less injustice would result from the plan suggested than now, when as will be seen by looking over the published analyses, two fertilizers have the same guaranteed and found analyses, and are presumptively therefore, of equal value, when if the character of the several compounds from which they are made was known, great differences in their commercial and crop-producing values might clearly appear.

Commercial Fertilizers Sold in New York State.

While it is well known that the aggregate consumption of commercial fertilizers in the State reaches large proportions, no serious effort to determine, even approximately, the extent of the sales has been made until last year, the results having been given in the tenth annual report. While the excellence of barnyard manure is everywhere admitted, chemical manure is found to supplement it most completely, and where there is a choice of purchasing between the two, there are many who buy the latter as being the cheapest. It is believed to be of public interest to determine the amount of those sales not only, but so far as possible the character of the fertilizers sold. A circular letter was addressed to the various manufacturers doing business in this State, requesting information as to the aggregate of their sales and also the quality of the fertilizers sold, in order that information might be obtained as to the relative consumption of phosphoric acid, potash and nitrogen compounds. It is not intended, of course, to make public the details of individual business, but to secure such general information concerning this trade as would appear to be of value to both manufacturers and consumers of these products. Nearly every one of the manufacturers addressed promptly responded to the circular asking for information.

The same circular was sent out this year and while generally the replies were prompt, in several cases no replies were received, and in such cases, indicated by a star, the amounts reported the previous year have been given for this year also. A list of these manufacturers is given for the purpose of showing how exhaustive and reliable the statistics collected are, and the aggregate of the sales reported, given in the table following, is about 92,020:

Names of Fertilizer Manufacturers who have Reported their Sales for the Year Ending November 1, 1891.

Allentown Manufacturing Co., Allentown, Penn.
Armour & Co., Chicago, Ill.
H. J. Baker & Brother, 215 Pearl street, New York, N. Y.
Bowker Fertilizer Co., 43 Chatham street, Boston, Mass.
Bradley Fertilizer Co., Boston, Mass.*
Brown & Gilman, 10 S. Delaware avenue, Philadelphia, Penn.
E. B. Chapin, Rochester, N. Y.*
Chemical Company of Canton, Baltimore, Md.
Chesapeake Guano Co., Baltimore, Md.
Cleveland Dryer Co., Cleveland, Ohio.
E. Frank Coe, 16 Burling slip, New York, N. Y.*
Peter Cooper's Glue Factory, 17 Burling slip, New York, N. Y.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.
E. A. Cross, North Parma, N. Y.
L. B. Darling Fertilizer Co., Pawtucket, R. I.
J. H. Devins, Utica, N. Y.

L. Eggers' Sons, Novelty Bone Works, West Troy, N. Y.

Ellsworth, Tuthill & Co., Promised Land, Suffolk Co., N. Y.

W. S. Farmer & Co., Baltimore, Md.

Farmers' Fertilizer Co., Syracuse, N. Y.

George B. Forrester, 169 Front street, New York, N. Y.*

Hallock & Duryee Fertilizer Co., Mattituck, Suffolk Co., N. Y.

Listers' Agricultural Chemical Works, Newark, N. J.

Lorentz & Rittler, Baltimore, Md.*

Frederick Ludlam, 108 Water street, New York, N. Y.*

Mapes Formula and Peruvian Guano Co., 158 Front street, New York, N. Y.

Michigan Carbon Works, Detroit, Mich.

Milsom Rendering and Fertilizer Co., Buffalo, N. Y.

L. Mittenmaier, Rome, N. Y.

Moller & Co., Bone Works, Maspeth, Queens Co., N. Y.*

Northwestern Fertilizing Co., Union Stock Yards, Chicago, Ill.

Preston Fertilizer Co., Green Point, Kings Co., N. Y.

John S. Reese & Co., Baltimore, Md.*

Rochester Fertilizer Co., 398 E. Main street, Rochester, N. Y.

Scott Fertilizer Co., Elkton, Md.

Sheldon Brothers, Weedsport, N. Y.*

Springfield Fertilizer Co., Springfield, Ohio.

H. Stappenbeck, Utica, N. Y.

Sterling Oil Co., Greenport, Suffolk Co., N. Y.

Richard H. Stone, Trumansburgh, N. Y.

I. P. Thomas & Son Co., 2 S. Delaware avenue, Philadelphia, Penn.

George F. Tuthill & Co., Greenport, Suffolk Co., N. Y.

Walker Fertilizer Co., Clifton Springs, N. Y.

Walker, Stratman & Co., Pittsburg, Penn.

Zell, Guano Co., Baltimore, Md.

Isaac C. Hendrickson, Jamaica, N. Y.

Mitchell Fertilizer Co., Tremley, N. J.

J. E. Phelps, Jamaica, N. Y.

Rogers & Hubbard Co., Middletown, Conn.

Samson Fertilizer & Chemical Co., North East, Penn.

Lucien Sanderson, New Haven, Conn.

Aggregate Amounts of Fertilizers Reported as Sold in this State During the Year Ending November 1, 1892.

	Tons.
Complete manuring for spring use	38,415.40
Complete manuring for fall use	20,562.25
Ammoniated superphosphates without potash, including dissolved bone, etc., for spring use	588.30
Ammoniated superphosphates without potash including dissolved bone, etc., for fall use	423.00
Ground bone for spring use	1,767.40
Ground bone for fall use	1,047.00
Kainit, for spring use	396 00
Kainit, for fall use	186.00
Muriate of potash, for spring use	357.00
Muriate of potash, for fall use	122.00
Nitrogenous matter:	
(a) Ammonium sulphate, for spring use	180.00
Ammonium sulphate, for fall use	55.00
(b) Sodium nitrate, for spring use	111.00
Sodium nitrate, for fall use	40.00
(c) Blood, ammonite, etc., for spring use	1,178.50
Blood, ammonite, etc., for fall use	1,003.25
Plain superphosphates, including both dissolved bone black and S. C. acid phosphates for spring use	1,003.00
Plain superphosphates, including both dissolved bone black and S. C. acid phosphates for fall use	915.00
	68,350.10
Unclassified	23,670.00
Total sales reported	92,020.10

In the preceding pages brief mention has been made of some of the work which has been done at the Station by the several members of the staff, but for full details of this work reference must be had to the reports of those to whom the various branches of this work has been assigned, which reports are included in this volume, and I have no doubt that this work will commend itself to the farmers of the State as of great value.

It will be seen that, in the aggregate, an amazing amount of work has been performed, and while less may appear to have sufficed from which, in many cases, conclusive results might have been drawn, it has seemed wise that, in most of the investigations, the conclusions should be established by such an accumulation of testimony as to leave no room for reasonable doubt.

I desire to acknowledge the uniform faithfulness and zeal with which the work of the Station has been performed by the several employes in whatever capacity engaged, since, as is obvious, to them largely is the credit due that so much has been accomplished, even though, in many cases, full credit for such work can not personally appear in the pages of this report.

Newspapers and Periodicals Presented to the Station.

Agricultural Epitomist, Indianapolis, Ind.
Albany Weekly Journal, Albany, N. Y.
American Agriculturist, New York, N. Y.
American Cultivator, Boston, Mass.
American Dairyman, New York, N. Y.
American Grange Bulletin, Cincinnati, Ohio.
American Grocer, New York, N. Y.
American Stock-Keeper, Boston, Mass.
Baltimore Weekly Sun, Baltimore, Md.
Canadian Entomologist, Fort Hope, Canada.
Canadian Horticulturist, Grimsby, Ontario, Canada.
Chautauqua Farmer, Dunkirk, N. Y.
Cultivator and Country Gentleman, Albany, N. Y.
Detroit Free Press, Detroit, Mich.
Every Week, Angelica, N. Y.
Farmers' Advocate, London, Canada.
Farm and Fireside, Philadelphia, Penn.
Farm and Home, Springfield, Mass.
Farmers' Home, Dayton, Ohio.
Farm Journal, Philadelphia, Penn.
Farm Life, Rochester, N. Y.
Farm, Stock and Home, Minneapolis, Minn.
Gardening, Chicago, Ill.

German Agricultural and Horticultural Journal, New York, N. Y.

Grange Visitor, Lansing, Mich.

Hoard's Dairyman, Fort Atkinson, Wis.

Holstein-Friesian Register, Boston, Mass.

Horticultural Art Journal, Rochester, N. Y.

Husbandman, Binghamton, N. Y.

Industrial American, Lexington, Ky.

Jersey Bulletin, Indianapolis, Ind.

Ladies' Home Companion, Philadelphia, Penn.

Louisiana Planter and Sugar Manufacturer, New Orleans, La.

Maritime Agriculturist, St. John, N. B.

Maryland Farmer, Baltimore, Md.

Mirror and Farmer, Manchester, N. H.

Monthly Weather Review, Washington, D. C.

Nebraska Bee-Keeper, York, Neb.

Nebraska Farmer, Lincoln, Neb.

New England Farmer, Boston, Mass.

Northwestern Farmer, St. Paul, Minn.

Orange County Farmer, Port Jervis, N. Y.

Orange Judd Farmer, Chicago, Ill.

Orchard and Garden, Little Silver, N. J.

Pharmaceutical Era, Detroit, Mich.

Poultry Monthly, Albany, N. Y.

Practical Farmer, Philadelphia, Penn.

Rural New Yorker, New York, N. Y.

Southern Cultivator, Atlanta, Ga.

Sugar Beet, Philadelphia, Penn.

Sugar Bowl and Farm Journal, New Orleans, La.

Vick's Illustrated Monthly Magazine, Rochester, N. Y.

Western Plowman, Moline, Ill.

World, New York, N. Y.

Gifts to the Station.

April 19. E. Smith & Sons, Geneva, N. Y., one tree each of Languedoc and Nonpareil almonds.

February 27. Chauncey Sheffield, Geneva, N. Y., cions of Arctic and Fishkill apples.

March 1. P. B. Crandall, Ithaca, N. Y, cions of seedling apple No. 25.

March 5. Maurice Stone & Wellington, Fonthill, Canada, cions of the Baxter apple.

March 7. John Wragg, Waukee, Iowa, cions of Chisman apple.

March 8. R. G. Chase & Co., Geneva, N. Y., cions of Boiken and Winter Citron apples.

March 8. P. J. Berckmans, Augusta, Ga., cions of Hargrove, Pine Stump, Thornton and Haywood apples.

March 9. Downing & Morris, Clinton, Ind., twenty root grafts of Wabash Red apple.

March 10. T. V. Munson, Denison, Texas, twenty cions each of Shirley and Rutledge apples.

March 10. William Parry, Parry, N. J., cions of Parlin apple.

March 12. James S. Lord, Linden, N. Y., cions of a seedling apple.

March 12. Thomas W. Bowman, Rochester, N. Y., cions of Zubec Winter Sweet apple.

March 14. L. T. Sanders, Plain Dealing, Bossier Parish, La., twenty cions and two trees of Talbot Pippin apple.

March 14. A. E. Taylor, Baloit, Kansas, cions of Taylor's seedling apple.

March 14. Samuel C. Moon, Morrisville, Penn., cions of Brandywine apple.

March 18. Chase Brothers Company, Rochester, N. Y., cions of Dudley Winter, Excelsior and Martha apples.

March 18. C. G. Patten, Charles City, Iowa, cions of Alden, Arthur, Fameuse No. 1, Howard's Best, Iowa Beauty, Melinda and Patten's Greening apples.

March 22. G. C. Brackett, Lawrence, Kansas, cions of Axident, Fraker and Manwaring apples.

March 22. W. & T. Smith, Geneva, N. Y., cions of Walker Beauty apple.

March 25. M. Butterfield, Lees Summit, Mo., cions of Florence and Gano apples.

March 28. W. M. Samuels & Co., Clinton, Ky., cions of Aiken, Baptist, Jones Seedling, Paragon, Pickett and Watwood apples.

March 30. Uriah Mellott, Rays Hill, Penn., cions of the Mellott apple.

April 4. W. & T. Smith, Geneva, N. Y., cions of Gladstone, Tom Putt, Herefordshire, Beefing, Queen Muscatel Bushy, Sankermanky and Charlomof apples.

April 9. M. F. Pierson, Seneca Castle, N. Y., cions of Kirkland apple.

April 19. L. W. Carr, Erie, Penn., cions of Walker Beauty apple.

April 19. J. Cole Doughty, Lake City, Minn., two trees each of Thompson's Seedling, apple Nos. 24, 29 and 38; also two trees of Okabena apple.

April 19. Greening Brothers, Monroe, Mich., three trees of Winter Banana apple.

April 20. D. G. Edmeston, Adrian, Mich., cions of Oakland apple.

April 20. E. L. Smith, South Schodack, N. Y., cions of late-keeping apple Schodack.

April 23. Frank Ford & Son, Ravenna, O., cions of Colton apple.

April 23. Ellwanger & Barry, Rochester, N. Y., cions of Palmer Greening apple.

April 28. J. S. Ford, Pittsford, N. Y., cions of Deacon apple, and two trees of Deacon Jones apple.

April 28. W. B. Cole, Painesville, O., cions of the Madge apple.

April 29. Van Dusen Nursery Co., Geneva, N. Y., cions of Starbuck apple.

May 5. Josiah Shull, Ilion, N. Y., cions of an old, unknown variety of apple.

April 19. E. Smith & Sons, Geneva, N. Y., one tree each of De Coulange, Kashia, Oulen's Early, Smith's Early and Smith's Triumph apricots.

April 22. Hoopes Brothers & Thomas, West Chester, Penn., two Shense apricot trees.

April 25. R. G. Chase & Co., Geneva, N. Y., two Harris apricot trees.

May 16. Mark W. Johnson Seed Co., Atlanta, Ga., one packet of Jackson Wonder bean.

April 2. W. H. Phillips, Staunton, Ind., six plants of Woodland blackberry.

April 8. W. N. Scarff, New Carlisle, O., three Fruitland blackberry plants.

April 13. A. C. Maxwell, Chanute, Kan., six Maxwell's Early blackberry plants.

April 19. S. R. Alexander, Bellefontaine, O., six Reyner blackberry plants.

April 23. F. Ford & Son, Ravenna, O., six Ford's No. 1 blackberry plants.

April 23. Ellwanger & Barry, Rochester, N. Y., six Early King blackberry plants.

April 25. Cleveland Nursery Co., Rio Vista, Va., six Thompson's Early Mammoth blackberry plants.

May 16. Samuel Wilson, Mechanicsville, Penn., seven Washington Climer and Erie blackberry plants.

May 20. H. A. Hannum, Cazenovia, N. Y., one bone mill.

February 29. Floyd Q. White, Yorktown, N. Y., cions of Osceola and Mohansic cherries.

April 5. W. & T. Smith, Geneva, N. Y., two trees of Auburn Duke cherry.

April 5. Heikes Nursery Co., Dayton, O., two trees of Ida cherry.

April 8. Charles E. Pennock, Fort Collins, Col., two seeds of Improved Dwarf Rocky Mountain cherry, and three seeds of Nebraska Sand cherry.

April 25. R. G. Chase & Co., Geneva, N. Y., cions of Youngken Golden cherry.

May 4. Van Dusen Nursery Co., Geneva, N. Y., two Ostheime cherry trees.

May 16. Samuel Wilson, Mechanicsville, Penn., two Early May Pride cherry trees.

January 18. H. E. Van Deman, Pomologist of Department of Agriculture, Washington, D. C., one package of chestnuts for seed.

March 10. Wiliam Parry, Parry, N. J., one tree each of Japan Giant, Early Reliance, Advance and Success chestnuts, and two trees of Pedigree Japan Mammoth chestnut.

March 14. Samuel C. Moon, Morrisville, Penn., two trees of Numbo chestnut.

December 24. Charles E. Pennock, Fort Collins, Col., one package of native Clematis seed (ligustiafolia).

May 16. George W. Dunham, Schaghticoke, N. Y., seed of Dunham's Hybrid corn.

April 19. J. Cole Doughty, Lake City, Minn., two North Star current bushes.

April 23. D. S. Marvin, Watertown, N. Y., one seedling white currant bush.

April 25. E. Moody & Sons, Lockport, N. Y., five North Star currant bushes.

May 9. H. S. Anderson, Union Springs, N. Y., five Eclipse currant bushes.

November 25. Storrs & Harrison Co., Painesville, O., one Garfield currant bush.

March 10. William Parry, Parry, N. J., one trifoliate orange, five Albino dewberry, two Buffalo berry and two High Bush cranberry.

March 10. William Parry, Parry, N. J., two each of Eleagnus edulis, E. longipes, E. augustifolia and E. pungens.

March 15. B. E. Fernow, Chief of Forestry Division, Department of Agriculture, Washington, D. C., seeds of Lawson's cypress, Sitka spruce, black pine, lodge pole pine and western white pine.

October 6. George Stanton, Summit Station, Onondaga county, N. Y., ginseng seed.

April 8. J. T. Thompson, Oneida, N. Y., cuttings of yellow gooseberry seedlings.

April 11. Marcus D. Dubois, Newburgh, N. Y., seedlings gooseberry cuttings.

April 13. Phil Strubler, Napierville, Ill., two Strubler's No. 1 gooseberry.

April 19. C. S. Curtice, Portland, N. Y., five Red Jacket gooseberry plants.

April 23. Ellwanger & Barry, Rochester, N. Y., three Columbus gooseberry plants.

April 29. L. W. Carr, Saratoga Springs, N. Y., five plants each of Lancashire, Largo, White Eagle and Yellow Sulphur gooseberry plants.

May 9. H. S. Anderson, Union Springs, N. Y., five Frontenac gooseberry plants.

October 25. Phil Strubler, Napierville, Ill., two plants each of Nos. 2, 4, 5, 6, 7 and 10 gooseberries.

March 1. P. B. Crandall, Ithaca, N. Y., cuttings of seedling grape, No. 16 Lain.

March 7. T. S. Hubbard Co., Fredonia, N. Y., two vines each of Berckmans, Oneida and Victoria grapes.

March 10. T. V. Munson, Denison, Texas, fourteen grape vines, namely: Rommel, Red Bird, America, Brilliant, Carman, Big Red and Big B con, two of each.

April 5. A. V. Gerbig, Archbald, Penn., cuttings of Nos. 2 and 10 grape.

April 6. S. R. Alexander, Bellefontaine, O., one Alexander winter grape.

April 8. E. C. Peirson, Waterloo, N. Y., two Cortland grape vines.

April 8. J. T. Thompson, Oneida, N. Y., four seedling grape vines.

April 11. George S. Josselyn, Fredonia, N. Y., two vines each of Esther and Rockwood grapes.

April 14. United States Department of Agriculture, Washington, D. C., cuttings of Bertha, Dr. Warder, Emma, Illinois City, Marie Louise and Theophile grapes.

April 14. H. Lerch, Lockport, N. Y., three Chautauqua grape vines.

April 19. C. S. Curtice, Portland, N. Y., two Early Ohio grape vines.

April 20. D. G. Edmeston, Adrian, Mich., two Edmeston No. 1 grape vines.

April 23. D. S. Marvin, Watertown, N. Y., one seedling white grape vine.

April 25. N. M. Chandler, Ottawa, Kan., three Chandler grape vines, No. 1.

May 9. D. W. Babcock, Dansville, N. Y., two vines each of Livingston and Wheaton grapes.

May 9. H. S. Anderson, Union Springs, N. Y., three Cayuga grape vines.

May 16. Samuel Wilson, Mechanicsville, Penn., two Lutie grape vines.

October 19. Josiah Shull, Ilion, N. Y., one grape vine.

November 2. T. C. Maxwell & Brother, Geneva, N. Y., several volumes of Holstein-Friesian Herd Book.

March 10. T. V. Munson, Denison Texas, two Victoria Everbearing mulberry trees.

March 10. G. C. Bracket, Lawrence, Kan., cions of Measers Weeping Russian mulberry.

May 4. Jerome B. Rice, Cambridge, N. Y., sample of Rices Globe Shaped Early Red Onion.

March 9. Downing & Morris, Clinton, Ind., three trees of Kibby Golden Peach.

March 14. E. T. Daniels, Kiona, Kan., two Marcella peach trees.

March 14. A. T. Sanders, Plain Dealing, Bossier Parish, La., two Late Beauty peach trees.

March 18. Chase Brothers Company, Rochester, N. Y., two trees each of Ostrander's Early and Late peaches.

March 28. W. M. Samuels & Co., Clinton, Ky., two trees each of Sneed and Captain Edes peaches.

April 5. G. H. & J. H. Hale, South Glastonbury, Conn., two Crosby peach trees.

April 13. Julius Harris, Ridgeway, Orleans Co., N. Y., two Surprise peach trees.

April 19. Greening Brothers, Monroe, Mich., two New Prolific peach trees.

April 22. Hoopes Brothers & Thomas, West Chester, Penn., two trees each of American Apricot, G. & A. and Butters Late peaches.

April 23. S. R. Moore, Zanesville, O., two unnamed seedling peach trees.

April 26. Josiah Shull, Ilion, N. Y., some unnamed seedling peach cions.

April 28. J. S. Ford, Pittsford, N. Y., two Ford's Choice peach trees.

April 28. W. B. Cole, Painesville, O., two trees each of Early Champion, St. Maries and Woodman's Choice peaches.

April 30. L. M. Macumber, North Ferrisburg, Vt., two dormant buds of an early Japanese peach.

May 4. Van Dusen Nursery Co., Geneva, N. Y., two trees each of Atlanta and Globe peaches.

May 5. Warren Hartle, Covington, O., one tree each of Midseason Favorite and Christmas Seedling peaches.

May 11. Henry Lutts, Youngstown, Niagara county, N. Y., two trees each of Captain Eads and Pratt peaches.

March 8. S. D. Willard, Geneva, N. Y., cions of Vermont Beauty pear.

March 8. P. J. Berckmans, Augusta, Ga., two Reliance pear trees.

March 10. William Parry, Parry, N. J., one Lincoln Coreless pear tree.

March 10. G. C. Brackett, Lawrence, Kan., cions of Ayers No. 1 pear.

March 14. Samuel C. Moon, Morrisville, Penn., cions of Miriam pear.

March 15. O. H. Ayer, Lawrence, Kan., cions of Nos. 1 and 2 pears.

April 5. W. & T. Smith, Geneva, N. Y., two trees of President Dronard pear.

April 5. Maurice Stone & Wellington, Fonthill, Ontario, Canada, two trees of Ritson pear.

April 22. Hoopes Brothers & Thomas, West Chester, Penn., two Dewey's Premium pear trees.

April 23. Ellwanger & Barry, Rochester, N. Y., one tree each of B. S. Fox, Col. Wilder, Lucy Duke and Patrick Barry pears.

April 25. R. G. Chase & Co., Geneva, N. Y., two Clapp's Beauty No. 64 pear trees.

April 25. Josiah G. Youngken, Richlandtown, Penn., one tree each of Old Crassane, Philadelphia, Queen of the Low Countries, Red Garden (Youngken's), Winter Seckel (Youngken), and Youngken's Favorite pear trees.

May 9. H. S. Anderson, Union Springs, N. Y., three Dr. Farley pear trees.

August 14. Josiah Shull, Ilion, N. Y., cions of a seedling pear.

September 3. J. K. Adams, South Canterbury, Conn., cions of Kinsman pear.

March 14. L. T. Sanders, Plain Dealing, Bossier Parish, La., two Ruby plum trees.

April 5. W. & T. Smith, Geneva, N. Y., two trees each of Smith's Prune, Frogmore, Damson and King of Damson plums.

April 5. Morris, Stone & Wellington, Welland, Ontario, Canada, one tree of Saunders' plum.

April 9. M. F. Pierson, Seneca Castle, N. Y., cions of Miller's Superb plum.

April 9. E. Cornwell, Middleburgh, N. Y., two trees of Middleburgh plum.

April 13. J. Wragg & Son, Waukee, Ia., two Stoddard plum trees.

April 19. L. W. Carr, Erie, Penn., two Transparent plum trees.

April 19. E. Smith & Sons, Geneva, N. Y., the following named varieties of plums, one tree each: Blackman, Precoce De Bergthold and Seedlings Nos. 1 and 2.

April 20. Jay Wood, Knowlesville, N. Y., two Reed plum trees.

April 22. Hoopes Brothers & Thomas, West Chester, Penn., two Dunlap plum trees.

April 25. R. G. Chase & Co., Geneva, N. Y., two trees each of Arch Duke and Monarch plums.

May 2. S. D. Willard, Geneva, N. Y., two trees each of Arch Duke, Field and Prince of Wales plum trees.

May 4. Van Dusen Nursery Co., Geneva, N. Y., two Kelsey Japan plum trees.

May 11. Henry Lutts, Youngstown, Niagara county, N. Y., two trees each of Bougoume, Chabot, Hytankis, Lincoln and Yellow Japan plums.

May 30. H. S. Anderson, Union Springs, N. Y., two trees of Oswego plum and two Prune D'Agen.

May 14. John Fraser, Salem, N. Y., two potatoes of the Fraser potato.

May 21. George K. Higbie & Co., Rochester, N. Y., one tuber of a seedling potato.

May 26. C. E. Angell & Co., Oshkosh, Wis., one tuber each of Nos. 27 and 101 potatoes.

February 10. H. E. Van Deman, Pomologist of Department of Agriculture, Washington, D. C., cions of Van Deman and Santa Rosa quinces.

May 4. Van Dusen Nursery Co., Geneva, N. Y., two trees each of Sweet Winter and Champion quinces.

April 14. R. S. Edwards, Highlands, Jefferson county, Col., six Pride of Kent raspberry plants.

April 14. C. H. Manwaring, Lawrence, Kan., six plants of seedling blackcap.

April 19. S. R. Alexander, Bellefontaine, O., six Success blackberry plants.

April 23. Ellwanger & Barry, Rochester, N. Y., two Superlative raspberry plants.

April 25. R. D. McGeehon, Atlantic, Ia., twelve Older raspberry plants.

April 25. Cleveland Nursery Co., Rio Vista, Va., six American E. B. raspberry plants.

May 2. R. Johnston, Shortsville, N. Y., six Winona raspberry plants.

May 9. D. W. Babcock, Dansville, N. Y., six Babcock No. 1 raspberry plants.

May 12. Coe & Converse, Fort Atkinson, Wis., six plants of Older raspberry.

March 10. G. C. Brackett, Lawrence, Kansas, cuttings of Rocky Mountain Spirea.

February 29. Dr. E. W. Hilgard, Berkeley, Cal., seeds of Rumex hymenosepalum.

March 4. Charles S. Lindly, Emporia, O., twenty-five plants of Everbearing strawberry.

March 19. T. G. Michel, Judsonia, Ark., plants of Arkansaw Traveler.

April 4. F. W. P. Scharsky & Son, Princeton, Ill., twenty-four plants of Princeton Chief strawberry.

April 5. G. H. & J. H. Hale, South Glastonbury, Conn., twenty-four plants each of Swindle, Southard's Early and Gen. Putnam strawberries.

April 9. McMath Brothers, Onley, Va., twenty-five Accomac strawberry plants.

April 11. W. F. Allen, Jr., Salisbury, Md., twenty-five plants each of Allen's No. 1 and No. 3 strawberries.

April 13. R. D. Cole, Bridgeton, N. J., twelve Gaudy Bell strawberry plants.

April 13. William Parry, Parry, N. J., twenty-five Leader strawberry plants.

April 13. Samuel Kinsey & Co., Kinsey, O., twenty-five Dayton strawberry plants.

April 14. R. S. Edwards, Highlands, Jefferson county, Col., twenty-five Edwards' Favorite strawberry plants.

April 19. M. F. H. Smeltzer, Van Buren, Ark., twenty-five Smeltzer Early No. 2 strawberry plants.

April 22. George W. Townsend, Gordon, O., twenty-five No. 20 strawberry plants.

April 23. T. J. Dwyer, Cornwall, N. Y., twenty-five E. P. Toe strawberry plants.

April 23. S. R. Moore, Zanesville, O., twenty-five Muskingum strawberry plants.

April 23. Ellwanger & Barry, Rochester, N. Y., twenty-five plants each of Galerson and Laxton's Captain strawberry plants, and six Latest of All strawberry plants.

April 23. George Q. Dow, North Epping, N. H., six Yankee Doodle strawberry plants.

April 25. C. P. Bauer, Judsonia, Ark., some plants of the West Lawn strawberry.

April 25. R. D. McGeehon, Atlantic, Ia., twenty-five Sandoval strawberry plants.

April 25. Cleveland Nursery Co., six plants each of Bell and Thompson's No. 9 strawberries, and twelve plants of the Thompson's No. 40 strawberry.

April 25. D. Brandt, Bremen, O., twenty-four plants each of Triomphe De Gand, Annie Forest, Dew, Early Idaho and Oregon Ever Bearing strawberries.

April 26. Stayman & Black, Leavenworth Kan., six plants each of the following varieties of strawberries: Primate, Magnate, Glenfield, Cycloma, Cheyenne, Pawnee and Stayman's No. 3.

April 29. B. L. Carr, Saratoga Springs, N. Y., six plants of Wilton and twelve plants of Herberts' strawberries.

May 2. R. Johnston, Shortsville, N. Y., twenty-five Princess strawberry plants.

May 2. Slaymaker & Son, Dover, Del., twenty-five plants each of Accomac, Advance and Clarks' Early strawberries.

May 5. B. O. Curtis, Paris, Ill., twenty-five plants each of Nos. 15 and 154 strawberries.

May 7. W. C. Holcomb, Mecca, O., twenty-five Holcombs seedling strawberry plants.

May 9. Prof. E. S. Goff, Madison, Wis., four Alabama and twelve D. & D. strawberry plants.

May 11. S. E. Hall, Cherry Valley, Ill., twelve plants each of Custer & Halls' Seedling strawberry plants.

May 12. Coe & Converse, Fort Atkinson, Wis., twenty-five plants of Smith Seedling strawberry.

May 14. Pheneas Crosby, Clinton, Wis., twenty-five plants each of Nos. 10, 27 and 91 strawberries.

May 16. Charles S. Pratt, Reading, Mass., twelve Sunnyside strawberry plants.

May 27. Clark Hewett, Waupun, Wis., twelve Kincks Seedling strawberry plants.

October 24. S. L. Watkins, Placerville, Cal., twenty-nine strawberry plants of the following named varieties: Honey, Green Alpine, Linia Alpine, Red and Gold Alpine, and F. Chilinses.

February 24. Joseph Harris Co., Moreton Farm, N. Y., one packet of Potomac tomato seed.

March 4. Joseph Harris, Moreton Farm, N. Y., Potomac, Ignotum, Dwarf Champion and Early Ruby tomato seed.

February 20. W. Atlee Burpee & Co., Philadelphia, Penn., fifty-eight packets of vegetable seeds for testing.

February 27. Peter Henderson & Co., New York, N. Y., eight packets of vegetable seeds for testing.

February 29. Joel Horner, Delair, N. J., five packets of vegetable seeds.

April 25. R. G. Chase & Co., Geneva, N. Y., five Japanese Wineberry plants.

March 4. T. J. Townsend, Painted Post, N. Y., one Townsend wire stretcher.

Report of the First Assistant.*

The work in charge of the first assistant during the past year has been, besides some necessary routine and various incidental work connected with general station management, similar to that of the preceding year.

Experiments with poultry have been made, including some feeding experiments with capons, some with laying hens, and a continuation of some breeding experiments in relation to egg production.

Feeding experiments with swine have been continued during the year. Experiments with several lots of pigs with which the sow was fed much longer than is usual, were made, continuing from the birth of the pigs until they were ready for market; also several other feeding experiments with sows which had lost from 100 to 150 pounds, by suckling pigs. Some feeding trials with wet food contrasted with dry food, and some with sorghum and with beets in large proportion contrasted with rations nearly all of grain were made.

The rations have been arranged for the cattle under investigation and the feeding, etc., superintended. The rations at all times varied but little in proportions of constituents from those generally considered to give the best results. The grain foods were such as, among those usually to be obtained, were thought best to supplement the forage and coarse fodders at different times available. A detailed discussion of the rations fed and the results accompanying them will be reserved for future reports or for bulletins. Record of amounts of different foods consumed by the different animals will be found elsewhere in this report where the results of certain investigations with the dairy cattle are discussed.

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* William P. Wheeler.

Observations on the few varieties of sorghum found suitable for this State, and on some new varieties, were continued.

Records of results from the several strips in the field treated with different crude chemicals were made.

Poultry.

In the line of poultry work quite a number of feeding experiments with capons have been made, and as enough experiments have been finished to justify some conclusions the results have been arranged in bulletin form. The bulletin includes data obtained during the first month or more of the year following that for which this report is made, but this report not being called to press until these additional data are prepared, they are here included, making the results more complete.

The much higher prices at which capons are quoted compared with those of the average of poultry have led to many inquiries being made during the past few years in regard to the profit in growing them for the market. When we remember that beef cattle have been fed in this State during recent years at very small profit and that often to find any profit in producing pork it has been necessary to take into account the advantage of using skim milk, etc., and to consider the manurial value of the grain fed, we may find it well worth while to learn the cost of any possible animal product of the farm that will command a good price in the market.

Not many data are available in regard to the subject. But a small proportion of the recent information contained in the poultry and agricultural papers seems to have come from disinterested sources and the larger part therefore whether exaggerated or not is naturally received by many with suspicion. In order to obtain information in regard to the probable advantage of growing capons several experiments have been made at this Station during the past two years.

In this bulletin are recorded the results obtained in feeding several lots of capons for the months during which they are usually grown, beginning in August and September when young cockerels are old enough for caponizing and continuing until

February, at which time the birds are so nearly mature and the growth becomes so slow that it is only a question of holding them longer or not for higher prices.

In the feeding trials skim-milk has been as profitably fed to capons as to young chicks. With every lot, sweet skim-milk has been fed during nearly all the time in place of water and has much of the time constituted about sixty per cent. of the total food. Of the water free substance consumed the skim-milk has supplied from nine to nineteen per cent., generally from twelve to fifteen per cent.

During the fall of 1891 and winter following, two lots of capons were fed for periods of several months and several smaller lots for shorter periods of from four to six weeks. Record of feeding was not begun with these birds until after they had been caponized and recovered from the operation. During last fall and winter four lots of capons and also one lot of cockerels were fed for periods of five months. These records of feeding include the time at which the birds were caponized and account for any loss of weight or smaller gain during certain periods in consequence.

Fowls of several breeds and a few crosses, have been used: Light Brahma, Buff Cochin, Plymouth Rock, Black Langshan, Indian Game, Indian Game — Light Brahma cross, Indian Game — Buff Cochin cross and W. P. Rock — Black Minorca cross.

The cockerels were caponized at an average weight of 3.8 pounds. The average weight of those caponized at smallest size (B. P. Rocks) was 2.7 pounds, and of those at largest (the Light Brahma) 4.8 pounds, when the operation was performed. While the former recovered from the operation much more rapidly, the latter made, after recovery, much the more rapid and profitable growth.

The average loss in weight from the thirty-six hours' fasting and operation was 11.2 per cent. Within five days thereafter the birds had generally recovered the weight lost, so that seven days from the time of the removal found the cockerels back in the pen as capons at the same weight (the average showed a slight increase of three-tenths per cent.) with but the additional cost for food of that consumed during the five days.

The special feeding of the separate lots was not begun until they had attained the weight of from two to four pounds. In calculating the total cost per fowl the cost assumed up to these weights is the average cost found in feeding thirty chicks of both sexes from hatching up to the same average weight. These chicks, as also all used in experiments, were hatched after the usual farm methods by hens and were kept with hens for several weeks. The recorded cost of food, therefore, for the chicks during the first six or seven weeks after hatching is considerably more than that necessary for those kept in brooders as it includes the cost of food consumed by the hen.

The cost of the chick when hatched and on an average about one-tenth pound in weight, is taken at five cents, enough to cover the cost of eggs and of food for setting hen. (Chicks can, however, be hatched at time of year when those to make capons are hatched at somewhat less cost.) This is added to the total cost of food consumed per fowl up to any weight to find the cost per fowl at such weight as given in the tabulated results following. The total cost given is, therefore, that for food and hatching alone. No account is taken of the labor or use of buildings, land, etc., as the proportion would vary much where many or few capons were grown and in regard to location, etc. No allowance is made for value of the manure produced. (This, however, is much less valuable than many seem to think.) Neither is any account taken of the cost of marketing.

There is also a certain per cent. of loss from various diseases, accidents, etc., among the fowls at all ages, which it is important should not be forgotten in making estimates of profit, but as this varies so much with the character of the stock and their quarters, care, etc., there can hardly be any average assumed; but it is safe to say that with favorable conditions and careful attention a loss with young chicks or older birds of five per cent. can be expected.

No bird among those grown at this Station has died during two years past directly on account of the operation. (The loss of one, some weeks after caponizing, was due more to an oversight in after treatment than to the direct effect of the operation itself.) But in order to make sure of killing no birds it is occasionally necessary to leave some with almost the assurance of their developing into slips. Even the most expert professional operators expect to kill a few birds.

The excess that the average market prices show over the cost for food, however, is enough to promise a fair profit, over an ordinary per cent. of loss, for any reasonable investment of labor, etc. The cost of caponizing where the services of any expert operator can be obtained is but a few cents per fowl (sometimes as low as four cents). After a fall in the high broiler prices of Spring and early Summer it will probably be found more profitable to caponize the surplus cockerels than to market them, especially where cheap skim-milk and grain is to be turned into a market product. For while often the per cent. of profit over the cost of food in selling at broiler age is greatest, the actual difference per fowl in market price over cost of food is greater with the capon, providing the latter is sold before growth has ceased. After caponizing the labor in caring for and feeding is but little more than in feeding cattle or pigs, and the proportion of labor to produce 100 pounds of capons is, therefore, less than in production of 100 pounds of broilers as the latter have most of the time been with the hen or brooders.

As it was not possible to hatch and grow all the chicks caponized and fed, no attempt was made in these trials at any direct comparison of the breeds used, as they were not strictly comparable, being hatched at different times and not being fed exactly alike when small chicks. Most of these used were hatched and grown at this Station, but the Plymouth Rock and Black Langshan and one lot of Light Brahma chicks were purchased. The cross bred birds used were from fair stock and the chicks were in vigor and health perhaps somewhat better than the average. The Buff Cochins used were a little above the average in all but fancy points and were exceptionally vigorous and healthy. The Plymouth Rocks were from well-known stock and were vigorous and healthy looking chicks and an even lot, but in rapidity of growth and in size attained were hardly up to the average of the best of the breed. The lot of Langshans was an uneven one from stock of several breeders of good repute, but in vigor and size most of the birds were below the average of the breed. The lot of Light Brahmas was a fairly good one, and although rather late hatched for the breed, made the most profitable and rapid growth.

In the first season's feeding there was fed skim-milk (both Cooley and Separator) wheat, corn meal, alfalfa forage, dry bone and mixed grain No. 22, which was made of five parts wheat bran, one part N. P. linseed meal, one part wheat middlings and four parts ground oats by weight. There was fed the second season skim-milk, wheat, corn, alfalfa forage, beets, corn silage and two grain mixtures, No. 1, containing, by weight, five parts corn meal and one part each of ground oats, wheat bran, wheat middlings, and N. P. linseed meal, and No. 2, which contained the same as No. 1, except that two parts of O. P. linseed meal were substituted for the one part N. P.

The ratio of protein to non-nitrogenous constituents in the ration was about such as is generally found to give good results, and was usually that of about 1:4 or 1:5. The foods used showed composition by analysis as follows:

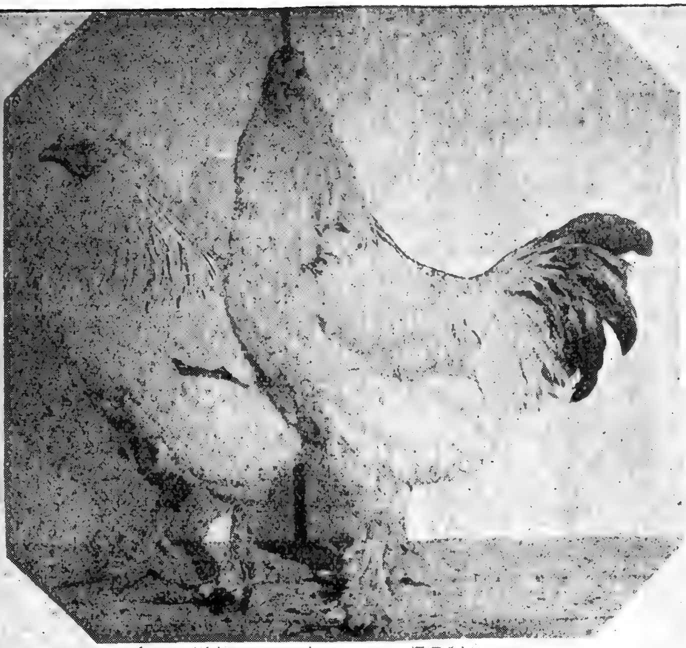
Average per cent. of moisture.	FOODS.	Composition of Water-free Substance.					
		Per cent. of ash.	Per cent. of fats.	Per cent. of crude fibre.	Per cent. total pro-tein.	Per cent. of true albu-minoids.	Per cent. of N.-free extract.
	For 1891-'92.						
10.8 } 14.0 }	Mixed grain No. 22	4.7	4.6	8.8	17.6	16.3	64.3
12.8	Wheat bran	5.7	3.3	8.1	16.8	16.5	66.1
10.2 } 17.2 }	Corn meal	1.6	4.9	2.2	12.0	....	79.3
12.3	Wheat	1.9	1.9	2.2	11.8	....	82.2
75.4	Alfalfa forage	11.2	3.5	25.4	20.4	16.8	39.5
?	Dry bone	70.0	?	....	18.8	....	....
	For 1892-'93.						
13.3	Mixed grain No. 1	3.0	5.4	4.0	15.6	15.4	72.0
15.3	Mixed grain No. 2	3.0	4.4	4.8	17.3	16.3	70.5
13.2	Wheat	2.2	2.3	2.0	13.3	12.6	80.2
14.7	Corn	1.8	6.6	1.6	11.6	10.1	78.4
79.0	Alfalfa forage	12.0	6.8	23.4	20.1	....	37.7
85.0	Beets	10.8	2.5	6.7	12.6	....	67.4
76.0	Corn silage	4.4	5.5	19.6	10.1	6.7	60.4
		Composition of Fresh Substance.					
		Per cent. ash.	Per cent. fat.		Per cent. casein.	Per cent. sugar.	
89.5	Skim-milk, 1891-'92 (Cooley)	.7	.5	....	3.9	5.4	....
89.9	Skim-milk, 1891-'92 (Separator)	.8	.1	....	3.1	6.1	....
89.0	Skim-milk, 1892-'93 (Cooley)	.7	1.1	....	3.8	5.4	....

Calculations of the value of the food consumed were made at the following prices.—In 1891;—Mixture No. 22, at twenty-three dollars per ton; wheat, at one dollar per bushel; corn meal, at twenty-two dollars per ton; wheat bran, at twenty dollars per ton; skim-milk, at twenty-five cents per 100 pounds; alfalfa forage, at two dollars per ton; and dry bone, at two cents per pound. In 1892;—ground oats, at twenty-six dollars per ton; wheat bran, at eighteen dollars per ton; wheat middlings, at twenty dollars per ton; corn meal, at twenty-four dollars per ton; linseed meal, N. P., at thirty dollars per ton; linseed meal, O. P., at twenty-eight dollars per ton; corn, at sixty cents per bushel; wheat, at eighty cents per bushel; skim-milk, at twenty-four cents per 100 pounds; alfalfa forage, beets and corn silage, each three dollars and twenty cents per ton.

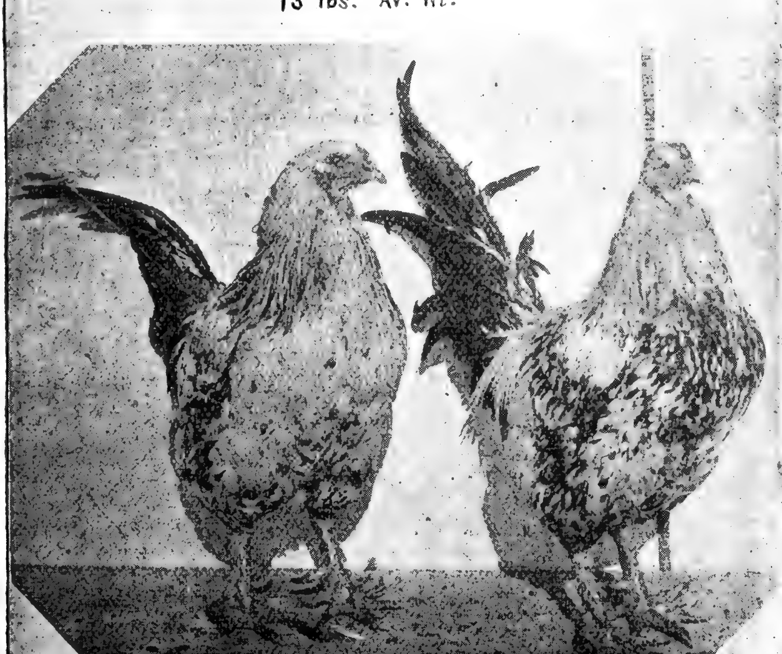
The pens in which the lots of capons were fed had about ten by twelve feet floor space with open yards, which were covered with coal ashes, attached about eleven by twenty feet. In each of these pens about fifteen to twenty fowls were kept when small, unless fewer for any lot were available, and when nearly grown from eight to twelve. After winter weather had commenced the capons were kept inside and but very seldom allowed in the yards. Until in December, however, they had the run of the open yard so that they were more than half grown when close confinement indoors began.

They were weighed once a week and oftener at about time of caponizing. Some occasionally at time of weighing were removed on account of symptoms of disease, the indications of being slips, for exhibition, or for dissection, etc. The results of feeding were averaged for periods of one week, but as the growth is shown as well with average results arranged for periods of two weeks they are so given in tabulated form.

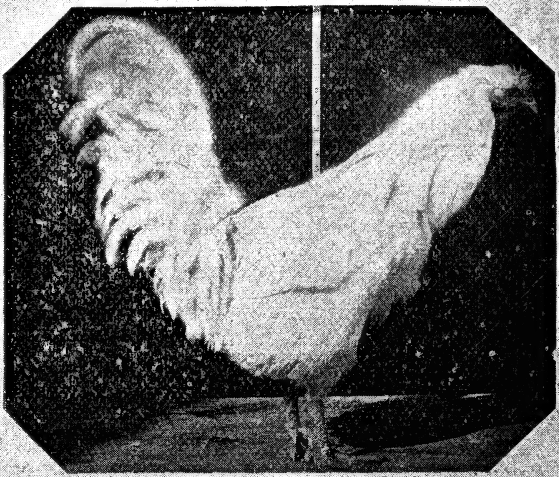
In estimating the market value per fowl at the different weights, the market price prevailing at the time of year when the fowls had on the average attained to the weights are taken. The market quotations were the average of those contained in The American Grocer and the Cultivator and Country Gentleman, and during the latter part of the season in the New York Weekly



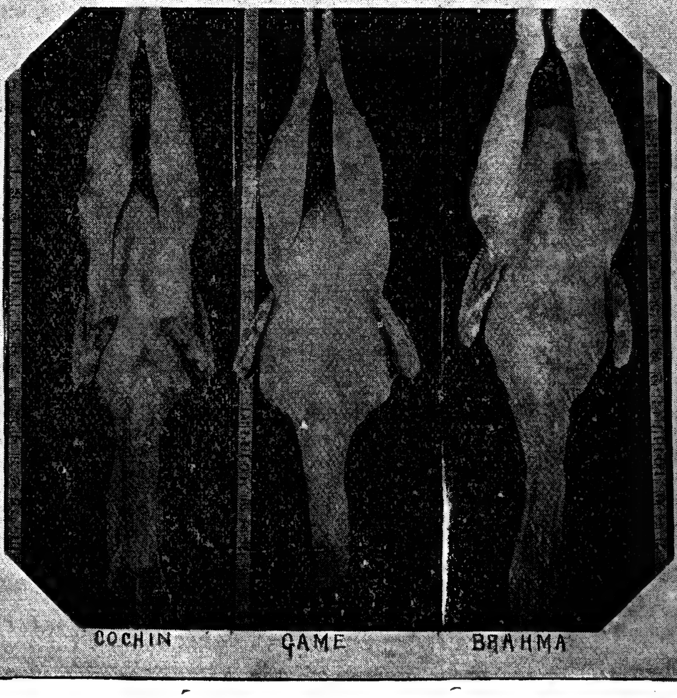
CAPONS, LIGHT BRAHMA
13 lbs. Av. Wt.



CAPONS, IN. GAME – LIGHT BRAHMA CROSS
12½ lbs. Av. Wt.



WHITE PLYMOUTH ROCK CAPON
11 lbs.



COCHIN GAME BRAHMA

Sun. These are less than those obtained by some producers, but probably fairly represent what can be expected in most seasons. Where market quotations for live weight were not given, the prices for dressed weight were reduced to correspond.*

As the demand for capons does not come from those who are looking for the cheapest possible animal food it is evident that effort should be made by any grower toward improvement in quality and the most successful and profitable competition will probably be in this direction.

It is better, of course, to use only the larger breeds for capons, and the Brahmas and Cochins are among the best, but while these breeds furnish poultry of superior size and excellent quality there is compared to the game an undesirable deficiency of breast development which is plainly noticeable in the dressed fowl. The accompanying plate taken from photographs shows the difference in appearance of the dressed fowls which were fair specimens of the breeds, Buff Cochin, Indian Game and Light Brahmas. At the New York Poultry Show in 1892 the first prize was given by a competent judge to a capon eight and one-half months old of Indian Game—Buff Cochin cross over capons young and old of Light Brahma, Black Langshan and two or three other breeds and crosses. The plates which were taken from photographs show mature specimens of Indian Game—Buff Cochin cross and Indian Game—Light Brahma cross. A cross of the Indian Game gives nearly as large fowls as the pure breed with much of the game shape. This cross can probably be used with advantage, for the Indian Game while larger than the pit game has little of the fighting spirit of the latter and having yellow skin and legs will not interfere with the common prejudice in that direction. It is not probable, however, that did such prejudice exist in a market demanding the best of capons, it would be hard to overcome where good fowls of such breeds as the Dorking, Houdan, La Fleche and Langshan were to be had.

* The average loss in weight in dressing thirty fowls for market was found to be eleven per cent. of the fasted live weight and about fifteen per cent. of the not-fasted live weight. Not often does much variation occur in the per cent. of weight lost in dressing for market. The smallest loss among thirty fowls being 6.4 per cent. and the greatest 15.2, nearly all, however, being very close to the average of eleven per cent.

To show the general proportionate increase of cost per fowl as the weight increases the average results from several lots of capons are arranged in a chart. The results from one lot of cockerels fed are also plotted on the same chart for comparison (see Chart II, opposite). The broken and dotted lines show at intersections with the vertical and horizontal lines the average total cost per fowl, for food and hatching at different weights for each lot fed. The tendency toward an upward curve shown by each line indicates the greater proportionate cost of any increase in weight as the fowls approach maturity. The growth made by the cockerels (Buff Cochins) corresponded quite closely with that made by capons of the larger breeds and the cost was similar as indicated by the unbroken black line. At weights attained by the capons a few weeks after caponizing the cost per fowl was less with the cockerels than with any lot of capons.

The accompanying tables give the results obtained with several lots calculated to the average per day per fowl, generally in periods of two weeks. The results for the first week with the Light Brahmas and Plymouth Rocks are averaged alone as these lots were fed but one week before some in each were caponized. The results from lots "E" and "F" which were fed but a short time are averaged for periods of three weeks.

With the Plymouth Rocks during the first five weeks skim-milk formed over sixty-three per cent. of the total food and supplied over eighteen and one-half per cent. of the water-free food. As the weather grew cooler less milk was taken, but the average proportion consumed during the next four months was over fifty per cent. of the total food. The skim-milk consumed by the Langshans during the first five weeks was about fifty-nine per cent. of the total food and about sixteen per cent. of the water-free food, and during the rest of the time, except the last two weeks, it constituted nearly fifty per cent. of the total food. With the Light Brahmas skim-milk, during the first five weeks, formed sixty-one per cent. of the total food and supplied over seventeen per cent. of the water-free food and for the rest of the time,

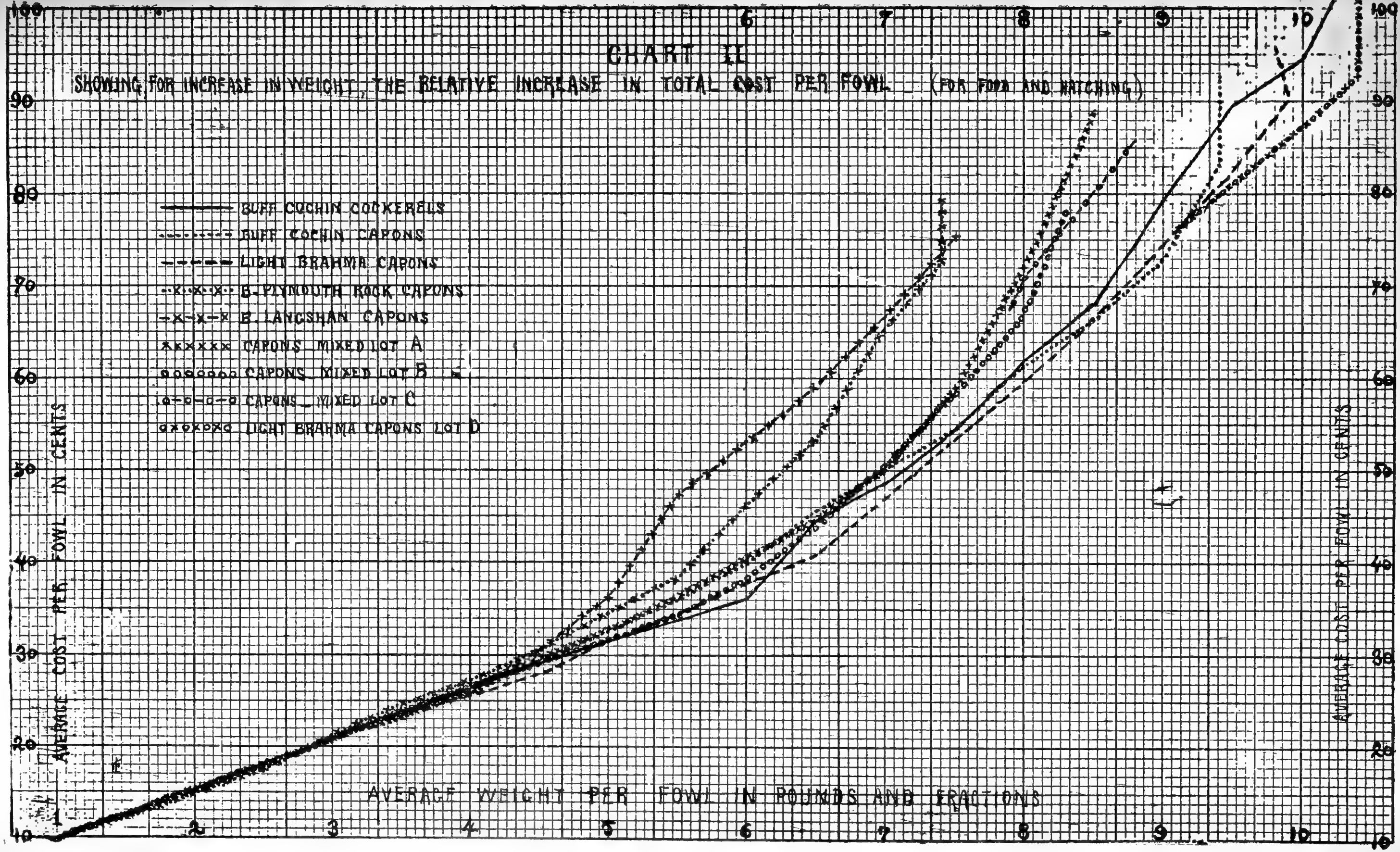
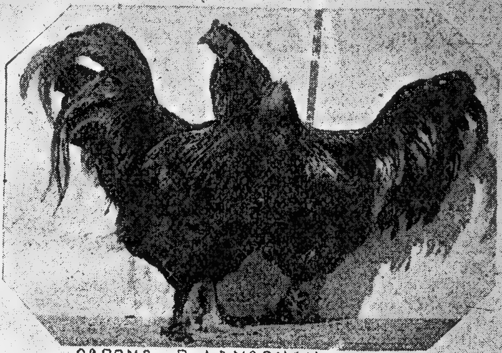


CHART II
SHOWING FOR INCREASE IN WEIGHT, THE RELATIVE INCREASE IN TOTAL COST PER FOWL _ (FOR FOOD AND HATCHING)
BUFF COCHIN COCKERELS
BUFF COCHIN CAPONS
LIGHT BRAHMA CAPONS
B. PLYMOUTH ROCK CAPONS
B. LANGSHAN CAPONS
CAPONS MIXED LOT A
CAPONS MIXED LOT B
CAPONS MIXED LOT C
LIGHT BRAHMA CAPONS LOT D
AVERAGE COST PER FOWL IN CENTS
AVERAGE WEIGHT PER FOWL IN POUNDS AND FRACTIONS
AVERAGE COST PER FOWL IN CENTS
10
20
30
40
50
60
70
80
90
100
2
3
4
5
6
7
8
9
10



CAPONS, B. LANGSHAN. 1½ Yrs.

YOUNG CAPONS — LIGHT BRAHMA
10. lbs. 9 Months.

GROUP of CAPONS — BLACK LANGSHAN. YOUNG AND OLD except the last two weeks, was over fifty-one per cent. of the total food. The capons in lot "C" were of Indian Game-Buff Cochin cross removed from another lot with which they had been fed until in December. With them skim-milk constituted fifty-eight per cent. of the total food and over twelve per cent. of the water-free food during the few weeks that they were fed. The Light Brahma capons in lot "D" which also were fed until December in a mixed lot, had fifty-four per cent. of their ration skim-milk. With the smaller lots designated "E," "F," "G" and "H," the rations contained also a large proportion of skim-milk, varying at different times from forty-two to sixty-nine per cent., and, except with lot "E," generally being over sixty per cent. of the total food.

The gain or loss for lot "G" during the four weeks recorded is so small that the ration fed may be considered as entirely a maintenance ration, and gives the amount of water-free food per day for each one pound of live weight fed as approximately one-half ounce. The cost of this ration per day for each 100 pounds live weight of fowls fed would be five cents.

The B. P. Rock cockerels were caponized at the average weight of 2.7 pounds, and lost from fasting and the operation ten per cent. but gained during the week in which they were caponized 6.6 per cent. The B. Langshan capons were caponized at the average weight of 3.9 pounds and lost 12.2 per cent., but lost during the week only an average of .5 per cent. The Lt. Brahmas were caponized at average weight of 4.8 pounds and lost 11.9 per cent., the loss for the week being 8.7 per cent.

In the tables containing the average results for periods of two weeks the figures giving the "ratio of protein to total carbohydrates in food" are not intended for the usually given "nutritive ratios," and no attempt was made at determining the digestibility of these foods with fowls. The ratio simply gives the proportion, in the total ration, of crude protein to the total carbohydrates, the fats not multiplied.

The figures under the headings "Pounds of water-free food for each one pound gain in weight" and "Cost of food for each one pound gain in weight," give the proportionate results actually obtained. Unless the growth, however, during the period was normal or in total amount approximated or exceeded one pound average gain, the figures do not, of course, give the cost of any whole pound gain made by the fowl at any time. From the total food consumed per fowl up to different weights the cost per fowl for food is calculated, the cost for hatchings added, and the results compared with the market prices obtainable as given in the accompanying tables.

B. Plymouth Rock Capons.

Number of fowls in pen.	Period.	Average weight per fowl at beginning.	Average Per Day Per Fowl.										Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
			Gain or loss in weight.	Mixed grain consumed, No. 1.	Wheat consumed.	Corn consumed.	Skim-milk consumed.	Alfalfa forage consumed	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.				
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cts.	Ozs.	Cts.
18..	August 23 to August 30	1.92	.71	1.17	.74	....	3.33	.11	5.35	2.04	1:4.1	.20	2.87	4.48	.99	.10
18..	August 30 to September 12	2.23	.71	1.45	1.07	....	4.49	.11	7.12	2.70	1:4.1	.27	3.80	6.08	1.05	.12
18..	September 12 to September 26	2.87	.64	1.95	.95	....	5.52	.11	8.53	3.14	1:4.0	.30	4.91	7.52	.98	.09
18..	September 26 to October 10	3.13	.98	2.19	1.33	....	4.38	.11	8.01	3.55	1:4.4	.34	3.62	5.60	.92	.09
18..	October 10 to October 24	4.29	.74	2.01	1.75	....	5.59	.11	9.46	3.89	1:4.3	.38	5.26	8.16	.84	.08
18..	October 24 to November 7	4.93	.93	2.49	1.70	....	5.38	.11	9.68	4.25	1:4.4	.40	4.57	6.88	.80	.08
18..	November 7 to November 21	5.71	.38	2.90	1.78	....	4.79	.11	9.58	4.60	1:4.5	.43	12.11	18.08	.79	.07
18..	November 21 to December 5	5.99	.41	2.31	1.73	.19	3.83	Beets. .22	8.28	4.11	1:5.5	.38	10.02	14.88	.66	.06
16..	December 5 to December 19	6.52	.41	2.16	1.63	.56	4.49	.25	9.09	4.29	1:4.7	.41	10.46	16.00	.64	.06
14..	December 19 to January 2	6.89	—.03	No. 2 1.37	....	2.31	3.86	Corn silage. .21	7.95	3.60	1:4.9	.31	——	——	.53	.05
13..	January 2 to January 16	6.95	.32	1.86	....	1.72	4.60	.23	8.41	3.62	1:4.4	.33	11.31	16.48	.51	.05
11..	January 16 to January 30	7.22	.15	2.27	....	1.99	4.62	.27	9.15	4.19	1:4.5	.37	27.93	39.52	.58	.05
10..	January 30 to February 13	7.44	—.04	2.16	....	2.42	.42	.30	5.30	4.01	1:5.5	.33	——	——	.54	.04

BLACK LANGSHAN CAPONS.

Number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	AVERAGE PER DAY PER FOWL. Gain or loss in weight.	Mixed grain consumed, No. 1.	Wheat consumed.	Corn consumed.	Skim-milk consumed.	Alfalfa forage consumed.	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.	Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cts.	Ozs.	Cts.
15..	September 26 to October 10	3.11	.97	1.72	1.14	....	3.89	.13	6.88	2.94	1:4.3	.27	3.03	4.48	.79	.07
15..	October 10 to October 24	3.96	.59	1.59	1.78	....	6.19	.13	9.69	3.63	1:4.2	.36	6.15	9.76	.87	.09
15..	October 24 to November 7	4.47	.65	2.49	1.87	....	5.56	.13	10.05	4.42	1:4.4	.42	6.80	10.40	.93	.09
15..	November 7 to November 21	5.04	.39	2.97	2.05	....	5.69	.13	10.84	5.01	1:4.5	.48	12.85	19.68	.96	.09
								Beets.								
15..	November 21 to December 5	5.38	.18	2.61	1.83	....	3.65	.27	8.36	4.29	1:4.8	.39	23.83	34.72	.77	.07
14..	December 5 to December 19	5.53	.78	1.99	1.98	.50	4.73	.29	9.49	4.44	1:4.9	.41	5.69	8.48	.75	.07
				No. 2				Corn silage.								
11..	December 19 to January 2	6.23	.43	1.62	....	2.49	3.67	.27	8.05	3.95	1:5.0	.35	9.19	12.96	.61	.05
9..	January 2 to January 16	6.70	.40	1.74	....	2.44	3.63	.33	8.14	4.03	1:4.9	.34	10.07	13.60	.59	.05
8..	January 16 to January 30	6.99	.31	2.37	....	2.46	3.64	.37	8.84	4.60	1:4.9	.39	14.84	20.16	.65	.05
7..	January 30 to February 13	7.48	.08	2.54	....	2.67	.39	.43	5.83	4.57	1:5.5	.38	......	......	.61	.05

PLYMOUTH ROCK CAPONS — AVERAGE PER FOWL.

At average weight per fowl of—	Total cost at weight.	Total cost per pound, live weight, at weight.	Market price per pound at weight.	Market value of fowl at prices quoted.	Cost of food consumed, per cent. of market value.	Market value per cent. of value of food consumed.
Pounds.	Cents.	Cents.	Cents.	Cents.	Per cent.	Per cent.
1.0	9.8	9.8	18.0	18.0	54.4	183.8
1.5	12.4	8.3	18.0	27.0	45.9	217.7
2.0	15.1	7.5	18.0	36.0	41.9	238.4
2.5	17.6	7.0	15.0	37.5	46.9	213.1
3.0	21.0	7.0	15.0	45.0	46.7	214.3
3.5	24.7	7.1	14.0	49.0	50.4	198.4
4.0	27.3	6.8	14.0	56.0	48.7	205.1
4.5	30.6	6.8	13.0	58.5	52.3	191.2
5.0	34.7	6.9	14.5	72.5	47.9	208.9
5.5	38.5	7.0	14.5	79.7	48.3	207.0
6.0	46.3	7.7	15.0	90.0	51.4	194.4
6.5	53.5	8.2	16.0	104.0	51.4	194.4
7.0	65.2	9.3	17.0	119.0	54.8	182.5
7.4	72.8	9.9	17.0	127.5	57.1	175.1
7.4	79.3	10.7	17.0	127.5	62.2	160.8

BLACK LANGSHAN CAPONS — AVERAGE PER FOWL.

At average weight per fowl at—	Total cost at weight.	Total cost per pound, live weight, at weight.	Market price per pound at weight.	Market value of fowl at prices quoted.	Cost of food consumed, per cent. of market value.	Market value per cent. of value of food consumed.
Pounds.	Cents.	Cents.	Cents.	Cents.	Per cent.	Per cent.
1.0	10.0	10.0	18.0	18.0	55.6	180.0
1.5	12.6	8.4	18.0	27.0	46.7	214.3
2.0	15.3	7.6	18.0	36.0	42.5	235.3
2.5	18.2	7.3	15.0	37.5	48.5	206.0
3.0	20.9	7.0	15.0	45.0	46.4	215.3
3.5	23.3	6.7	14.0	49.0	47.6	210.3
4.0	25.8	6.4	14.0	56.0	46.1	217.1
4.5	30.4	6.8	13.0	58.5	52.0	192.4
5.0	36.2	7.2	14.5	72.5	49.9	200.3
5.5	47.4	8.6	14.5	79.7	59.5	168.1
6.0	53.0	8.8	15.0	90.0	58.9	169.8
6.5	59.0	9.1	16.0	104.0	56.7	176.3
7.0	66.6	9.5	17.0	119.0	56.0	178.7
7.5	75.5	10.1	17.0	127.5	59.2	168.9

LIGHT BRAHMA CAPONS.

Number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	AVERAGE PER DAY PER FOWL.										Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live-weight of fowls fed.	Cost of food per day for each one pound live-weight of fowls fed.
			Gain or loss in weight.	Mixed grain consumed, No. 1.	Wheat consumed.	Corn consumed.	Skim-milk consumed.	Alfalfa forage consumed.	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.				
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cts.	Ozs.	Cts.
10..	October 3 to October 10.............	3.48	1.53	1.90	1.37	....	6.47	.20	9.94	3.59	1:4.0	.35	2.35	3.68	.94	.09
9..	October 10 to October 24.............	4.39	.94	1.72	2.34	....	6.98	.22	11.26	4.34	1:4.3	.42	4.63	7.20	.94	.09
9..	October 24 to November 7.............	5.21	1.42	3.31	2.01	....	7.75	.22	13.29	5.51	1:4.3	.53	3.88	5.92	.97	.09
9..	November 7 to November 21.............	6.45	.88	3.88	2.94	....	8.84	.22	15.88	6.93	1:4.4	.66	7.87	12.00	1.01	.10
8..	November 21 to December 5.............	7.47	.77	3.20	3.28	....	6.77	Beets. .50	13.75	6.43	1:4.6	.62	8.35	12.96	.79	.08
8..	December 5 to December 19.............	8.15	.71	3.49	2.47	.62	7.66	.50	14.74	6.61	1:4.6	.63	9.31	14.24	.78	.07
8..	December 19 to January 2.............	8.77	.76	No. 2 2.82	....	3.19	5.93	Corn silage. .37	12.31	5.98	1:4.8	.51	7.87	10.72	.67	.06
8..	January 2 to January 16.............	9.29	.36	2.87	....	2.79	6.32	.37	12.35	5.59	1:4.6	.50	15.53	22.24	.59	.05
8..	January 16 to January 30.............	9.61	.37	2.95	....	2.30	6.04	.37	11.66	5.21	1:4.5	.46	14.08	19.84	.54	.05
8..	January 30 to February 13.............	9.94	—.14	2.66	....	2.01	.59	.37	5.63	5.11	1:5.3	.34	......	......	.52	.03

CROSS-BRED CAPONS (LOT C).

Number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	Average Per Day Per Fowl.									Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight fowls fed.
			Gain or loss in weight.	Mixed grain No. 22 consumed.	Corn meal consumed.	Wheat consumed.	Skim-milk consumed.	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.				
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cents.	Ozs.	Cents.
8	December 17 to December 31	7.87	.22	1.60	1.55	1.38	5.60	10.13	4.48	1:5.7	.45	20.36	32.80	.56	.06
8	December 31 to January 14	8.06	.47	1.54	1.64	1.30	6.68	11.16	4.53	1:4.7	.46	9.64	15.68	.55	.06
8	January 14 to January 28	8.48	.41	1.07	.75	2.69	6.47	10.98	4.58	1:5.0	.51	11.17	19.83	.53	.06

LIGHT BRAHMA CAPONS (LOT D).

Number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	ANERAGE PER DAY PER FOWL.									Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
			Gain or loss in weight.	Mixed grain consumed.	Corn meal consumed.	Wheat consumed.	Skim-milk consumed.	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.				
		Lbs.	Lbs.	Ozs.	Ozs.	Ozs	Ozs	Ozs.	Ozs.		Cts.	Lbs.	Cts.	Ozs.	Cts.
6	December 17 to December 31	9.09	+.69	2.31	1.92	1.50	6.55	12.28	5.61	1:4.8	.56	8.13	12.96	.60	.06
6	December 31 to January 14	9.70	.79	1.99	2.11	1.63	7.54	13.27	5.70	1:4.9	.58	7.22	11.68	.57	.06
6	Januuary 14 to January 28	10.39	.05	1.32	1.50	3.16	6.98	12.96	5.90	1:5.2	.64	......	......	.57	.06

LIGHT BRAHMA CAPONS — AVERAGE PER FOWL.

At average weight per fowl of —	Total cost at weight.	Total cost per pound live weight, at weight.	Market price per pound at weight.	Market value of fowl at prices quoted.	Cost of food consumed, per cent. of market value.	Market value. per cent. of value of food consumed.
Pounds.	Cents.	Cents.	Cents.	Cents.	Per cent.	Per cent.
1.0	10.0	10.0	18.0	18.0	55.6	180.0
1.5	12.6	8.4	18.0	27.0	46.7	214.3
2.0	15.3	7.6	18.0	36.0	42.5	235.3
2.5	18.2	7.3	15.0	37.5	48.5	206.0
3.0	20.9	7.0	15.0	45.0	46.4	215.3
3.5	23.6	6.7	14.0	49.0	48.2	207.6
4.0	25.5	6.4	14.0	56.0	45.5	219.6
4.5	28.0	6.2	13.0	58.5	47.9	208.9
5.0	31.5	6.3	14.5	72.5	43.4	230.2
5.5	34.8	6.3	14.5	79.7	43.7	229.0
6.0	37.9	6.3	15.0	90.0	42.1	237.5
6.5	40.8	6.3	16.0	104.0	39.2	254.9
7.0	47.0	6.7	17.0	119.0	39.5	253.2
7.5	53.2	7.1	17.0	127.5	41.7	239.7
8.0	59.8	7.5	18.6	148.8	40.2	248.8
8.5	66.6	7.8	18.6	158.1	42.1	237.4
9.0	74.5	8.3	18.6	167.4	44.5	224.7
9.5	82.6	8.7	19.0	180.5	45.8	218.5
9.9	90.2	9.1	19.0	188.1	48.0	208.5
9.8	95.5	9.7	19.0	186.2	51.3	190.8

CROSS-BRED CAPONS. LOT C — AVERAGE PER FOWL.

At average weight per fowl of —	Total cost at weight.	Total cost per lb. live weight at weight.	Market price per lb. at weight.	Market value of fowl at prices quoted.	Cost of food consumed, per cent. of market value.	Market value per cent. of value of food consumed.
Pounds.	Cents.	Cents.	Cents.	Cents.	Per cent.	Per cent.
7.9	67.6	8.6	18.6	146.9	46.0	317.3
8.0	70.9	8.9	18.6	148.8	47.6	209.9
8.5	80.3	9.4	18.6	154.4	52.0	192.3
8.8	86.0	9.8	18.6	163.7	52.5	199.3

LIGHT BRAHMA CAPONS. LOT D—AVERAGE PER FOWL.

At average weight per fowl of—	Total cost at weight.	Total cost per lb. live weight at weight.	Market price per lb. at weight.	Market value at prices quoted.	Cost of food per cent. of market value.	Market value per cent. of cost of food consumed.
Pounds.	Cents.	Cents.	Cents.	Cents.	Per cent.	Per cent.
9.1	76.3	8.4	18.6	169.3	45.1	221.9
9.4	81.3	8.6	19.0	180.5	45.0	222.0
10.0	87.3	8.7	19.0	190.0	45.9	217.6
10.4	93.0	8.9	19.0	197.6	47.1	212.5
10.4	100.8	9.6	19.0	197.6	51.0	196.0

MIXED LOT CAPONS (E).

Number fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	AVERAGE PER DAY PER FOWL. Gain or loss in weight.	Corn meal consumed.	Wheat consumed.	Skim-milk consumed.	Total food.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats.	Total cost of food.	Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cents.	Lbs.	Cents.	Ozs.	Cents.
6	December 17 to January 7	6.88	+0.48	2.93	1.68	4.94	9.55	4.47	1:5.8	0.45	9.31	15.24	0.62	0.06
6	January 7 to January 28	7.50	+0.43	2.78	2.69	4.21	9.68	5.16	1:6.1	0.54	12.00	20.25	0.66	0.07

LOT SLIPS (F).

Number fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	Average per day per fowl: Gain or loss in weight.	Average per day per fowl: Corn meal consumed.	Average per day per fowl: Wheat consumed.	Average per day per fowl: Skim-milk consumed.	Average per day per fowl: Total food.	Average per day per fowl: Total water-free food consumed.	Average per day per fowl: Ratio of protein to total carbohydrates and fats.	Average per day per fowl: Total cost of food.	Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cents.	Lbs.	Cents.	Ozs.	Cents.
5	December 17 to January 7	6.96	+0.42	2.75	1.89	4.69	9.33	4.47	1:5.9	0.46	10.64	17.56	0.62	0.06
4	January 7 to January 28	7.45	+0.39	2.24	1.90	3.26	8.40	3.91	1:6.1	0.40	10.03	16.15	0.51	0.06

MIXED LOT CAPONS (G).

Number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	Average Per Day Per Fowl.								Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
			Gain or loss in weight.	Corn meal consumed.	Wheat consumed.	Skim-milk consumed.	Total food.	Water-free food consumed.	Ratio of protein to total carbohydrates and fats.	Total cost of food.		
		Pounds.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.		Cents.	Ounces.	Cents.
5	November 19 to December 3	7.29	+0.03	1.83	1.60	4.69	8.12	3.43	1:5.6	0.37	0.47	0.05
5	December 3 to December 17	7.31	−0.09	1.96	1.49	6.09	9.54	3.60	1:5.3	0.39	0.50	0.05

MIXED LOT CAPONS (H).

Number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	Average Per Day Per Fowl.								Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live-weight of fowls fed.
			Gain or loss in weight.	Corn meal consumed.	Wheat consumed.	Skim-milk consumed.	Total food.	Water-free food consumed.	Ratio of protein to total carbohydrates and fats.	Total cost of food.				
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cents.	Lbs.	Cents.	Ozs.	Cents.
4	November 19 to December 3	7.17	+0.25	3.02	1.64	6.36	11.02	4.65	1:5.6	0.48	18.60	32.00	0.64	0.07
4	December 3 to December 17	7.38	+0.11	2.07	1.41	7.14	10.62	3.72	1:5.1	0.40	......	......	0.50	0.05

Cockerels and Capons.

One lot of cockerels was fed at the same time with these lots of capons. These cockerels, Buff Cochins, were entirely comparable with the lot of the same breed selected for caponizing, being of the same parentage, age and previous treatment, with the exception that, as no pen large enough was available at the time the lot for caponizing was separated, the cockerels were allowed to run for a few weeks longer before special feeding began. The feeding trial with the capons began in August and with the cockerels in September.

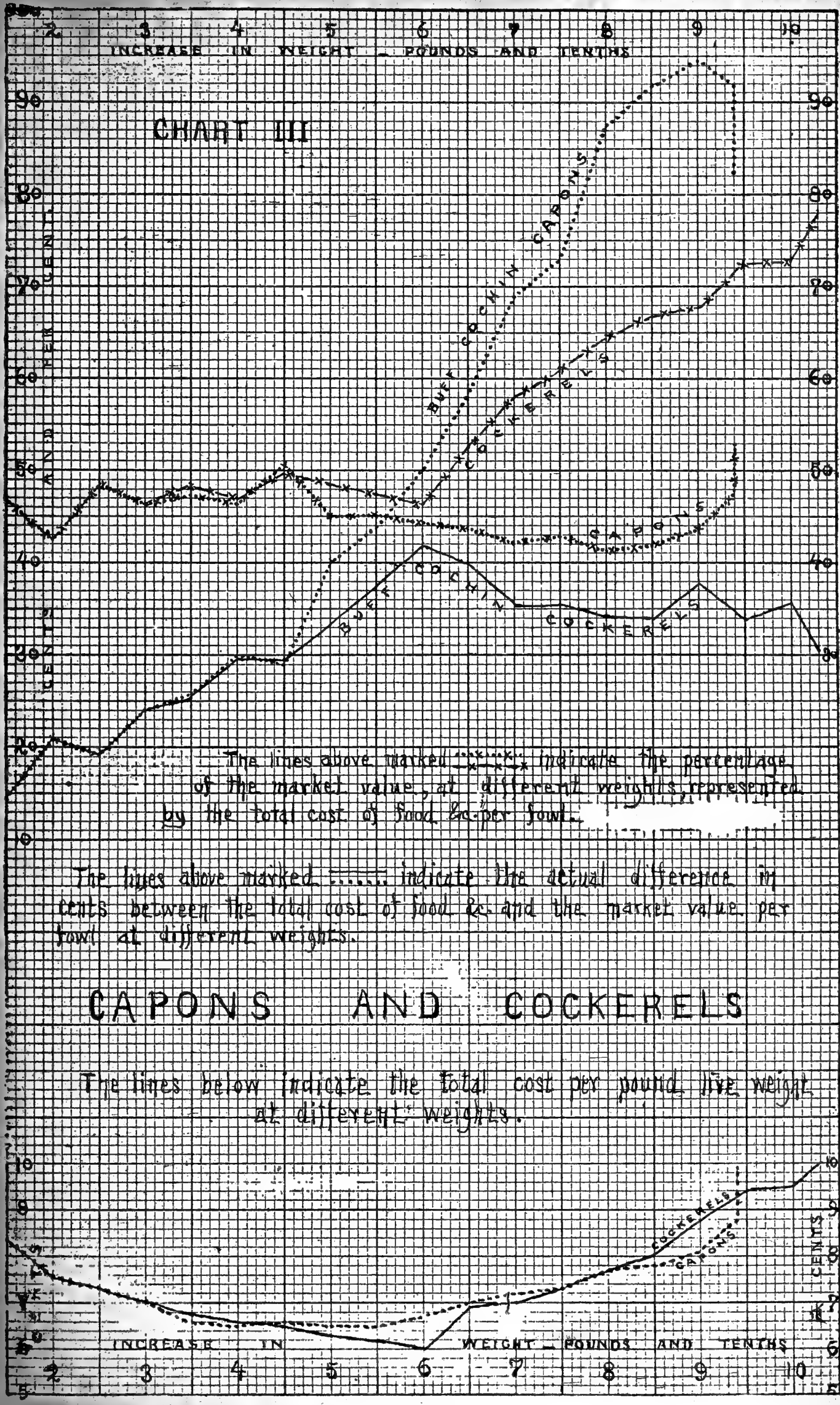
The proportion of skim-milk in the ration was about the same for each during all the time after special feeding of the cockerels began, except the last two weeks. With the cockerels during eighteen weeks the skim-milk supplied over forty-nine per cent. of the total food and eleven and one-half per cent. of the water-free food, and with the capons during the same time over forty-seven per cent. of the total food and nearly eleven per cent. of the water-free food. The ratio of protein to total carbohydrates was nearly the same in each ration.

The growth made by the cockerels was more rapid than that of the capons, but much less regular. Although on September twenty-sixth the cockerels averaged nearly six-tenths of a pound lighter than the capons, they averaged on February thirteenth nearly nine-tenths of a pound heavier. The cockerels consumed more food, however, than the capons, so that at nine pounds average weight the cockerels had cost seven-tenths of a cent per pound live weight more than the capons. At the average weight of six pounds, a few weeks after the operation of caponizing, the cockerels had cost less, having cost at this weight six cents per pound, and the capons having cost six and seven-tenths cents per pound live weight.

The Cochins were caponized at the average weight of 4.3 pounds. The loss from fasting and the operation was 10.8 per cent., but during the week in which caponizing was done the average gain was 1.8 per cent.

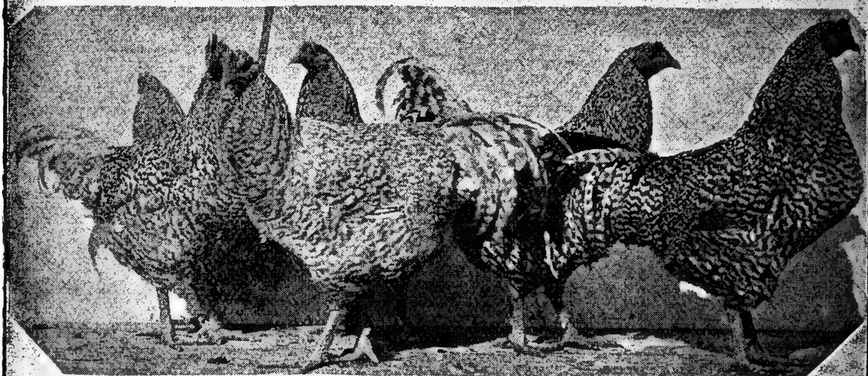
The following tables give the results of feeding for the Buff Cochins, cockerels and capons, but for a brief way of comparison some of the results are shown in a chart. (Chart III, opposite.) The lines on the chart show the relation existing between the cost of food per fowl and the market price, throughout their growth. The more abrupt changes in the directions of the lines are due more to the changes in the market prices at different times in the year and for fowls of different weights than to any great fluctuation from an even rate of growth. It will be noticed that with the cockerels the lowest rate which the cost of food (and hatching) bore to the market value, after the average weight of two pounds, when it was 42.5 per cent., was at the weight of six pounds, when it represented 46.3 per cent., about the same as at three pounds average weight. The actual difference in cents between the market value and the cost for food was also much greater at six pounds average weight than at any other.

With the lot for capons the per cent. which the cost of food (hatching included) was of the market value varied little after they had really become capons, being most of the time between forty and forty-five per cent., at some times a little lower than at broiler weight of two pounds. The actual amount in cents, however, which the market value exceeded the cost for food, rapidly and quite regularly increased up to nine pounds average weight. The difference between the market value and the cost for food and hatching was at two pounds 20.7 cents, and at nine pounds average weight it was, for the cockerels, 37.7 cents, and for the capons, 94.4 cents, per fowl.



INCREASE IN WEIGHT – POUNDS AND TENTHS
CHART III
PER CENT. AND CENTS
BUFF COCHIN CAPONS
COCKERELS
CAPONS
BUFF COCHIN COCKERELS
The lines above marked ×—×—× indicate the percentage of the market value, at different weights, represented by the total cost of food &c. per fowl.
The lines above marked ...... indicate the actual difference in cents between the total cost of food &c. and the market value per fowl at different weights.
CAPONS AND COCKERELS
The lines below indicate the total cost per pound live weight at different weights.
COCKERELS
CAPONS
CENTS
INCREASE IN WEIGHT – POUNDS AND TENTHS

YOUNG CAPONS — BUFF COCHIN



YOUNG CAPONS — BARRED PLYMOUTH ROCK

Buff Cochin Capons.

Average number of fowls in pen.	Period.	Average weight per fowl at beginning of period.	Average per day per fowl: Gain or loss in weight.	Mixed grain consumed, No. 1.	Wheat consumed.	Corn consumed.	Skim-milk consumed.	Alfalfa forage consumed.	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.	Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cents.	Oz.	Cents.
20	August 23 to August 30	3.16	+1.07	1.39	1.51	....	4.56	.10	7.56	3.03	1:4.3	.30	2.83	4.48	.89	.09
20	August 30 to September 12	3.69	+ .75	1.61	1.55	....	5.11	.10	8.37	3.33	1:4.2	.33	4.44	7.04	.83	.08
20	September 12 to September 26	4.34	+1.04	2.11	1.76	....	5.92	.10	9.89	4.03	1:4.3	.41	3.87	6.24	.83	.08
19	September 26 to October 10	5.37	+ .87	2.56	1.96	....	4.68	.10	9.30	4.45	1:4.6	.42	5 11	7 68	.78	.07
19	October 10 to October 24	6.14	+ .53	2.06	2.42	....	5.72	.10	10.30	4.54	1:4.5	.44	8.57	13.28	.71	.07
19	October 24 to November 7	6.60	+ .97	2.75	2.12	....	5.46	.10	10.43	4.84	1:5.0	.46	5.00	7.52	.69	.07
19	November 7 to November 21	7.44	+ .39	1.99	2.17	....	4.83	.10	9.09	4.16	1:4.5	.40	10.67	16.48	.55	.05
								Beets.								
19	November 21 to December 5	7.78	+ .69	2.55	2.09	.21	4.16	.21	9.22	4.69	1:4.7	.43	6.80	9.92	.57	.05
18.5	December 5 to December 19	8.39	+ .47	2.52	2.21	.76	4.08	.22	9.79	5.23	1:5.0	.48	11.13	16.32	.61	.06
				No. 2.				Corn silage.								
16	December 19 to January 2	8.85	+ .25	2.10	....	2.70	3.59	.19	8.58	4.52	1:5.0	.39	18.08	24.96	.51	.04
16	January 2 to January 16	9.07	+ .27	2.52	....	2.39	3.86	.19	8.96	4.64	1:4.8	.41	17.19	24.32	.52	.05
14	January 16 to January 30	9.12	+ .33	2.67	....	2.08	3.91	.21	8.87	4.51	1:4.7	.40	13.67	19.36	.48	.04
13.5	Jauuary 30 to February 13	9.41	— .31	2.27	....	2.25	.38	.22	5.12	3.93	1:5.5	.33	......	......	.42	.04

BUFF COCHIN COCKERELS.

Average number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	Average Per Day Per Fowl. Gain in weight.	Mixed grain consumed, No. 1.	Wheat consumed.	Corn consumed.	Skim-milk consumed.	Alfalfa forage consumed.	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.	Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
		Lbs.	Ozs.	Ozs	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cents.	Oz.	Cents.
12	September 26 to October 10	4.79	1.57	2.47	2.02	....	5.22	.17	9.68	4.50	1:4.6	.43	2.87	4.32	.83	.08
12	October 10 to October 24	6.17	.15	2.25	2.48	....	6.67	.17	11.57	4.87	1:4.4	.48	32.47	51.20	.78	.08
12	October 24 to November 7	6.31	1.13	2.94	2.68	....	6.77	.17	12.56	5.66	1:4.5	.54	5.01	7.68	.83	.08
12	November 7 to November 21	7.29	.40	2.66	3.19	....	5.86	.17	11.88	5.76	1:4.4	.55	14.40	21.92	.77	.07
11	November 21 to December 5	7.66	.59	2.80	2.86	.27	4.80	Beets. .36	11.09	5.72	1:4.7	.54	9.69	14.40	.71	.07
11	December 5 to December 19	8.27	.65	2.42	2.55	.68	5.97	.36	11.98	5.60	1:4.7	.53	8.62	13.12	.65	.06
11	December 19 to January 2	8.84	.03	No. 2. 2.00	....	2.53	4.21	Corn silage. .27	9.01	4.37	1:4.8	.39	......	......	.50	.04
9	January 2 to January 16	9.16	.04	2.57	....	2.82	4.70	.33	10.42	5.19	1:4.8	.45	......	......	.56	.05
7	January 16 to January 30	9.37	.85	2.98	....	3.21	5.36	.43	11.98	5.95	1:4.8	.52	7.00	9.76	.60	.05
6.5	January 30 to February 13	10.11	.08	2.86	....	4.12	.64	.46	8.08	6.11	1:5.7	.50	76.37	......	.60	.05

BUFF COCHIN CAPONS — AVERAGE PER FOWL.

At average weight per fowl of—	Total cost at weight.	Total cost per pound, live weight, at weight.	Market price per pound at weight.	Market value of prices quoted.	Cost of food consumed, per cent. of market value.	Market value, per cent. of cost of food consumed.
Pounds.	Cents.	Cents.	Cents.	Cents.	Per cent.	Per cent.
1.0	10.0	10.0	18.0	18.0	55.6	180.0
1.5	12.6	8.4	18.0	27.0	46.7	214.3
2.0	15.3	7.6	18.0	36.0	42.5	235.3
2.5	18.2	7.3	15.0	37.5	48.5	206.0
3.0	20.9	7.0	15.0	45.0	46.4	215.3
3.5	23.2	6.6	14.0	49.0	47.3	212.9
4.0	26.0	6.5	14.0	56.0	46.4	215.4
4.5	29.5	6.6	13.0	58.5	50.4	198.3
5.0	32.6	6.5	14.5	72.5	45.0	222.4
5.5	36.0	6.5	14.5	79.7	45.1	221.4
6.0	40.0	6.7	15.0	90.0	44.4	225.0
6.5	45.6	7.0	16.0	104.0	43.8	228.1
7.0	50.1	7.2	17.0	119.0	42.1	237.5
7.5	54.6	7.3	17.0	127.5	42.8	230.7
8.0	61.3	7.7	18.6	148.8	41.2	242.7
8.5	66.3	7.8	18.6	158.1	41.9	238.5
9.0	73.0	8.1	18.6	167.4	43.6	229.3
9.4	83.0	8.8	18.6	174.8	47.6	210.6
9.4	92.7	9.9	18.6	174.8	53.0	188.6

UFF COCHIN COCKERELS — AVERAGE PER FOWL.

1	10.0	10.0	18.0	18.0	55.6	180.0
1.5	12.6	8.4	18.0	27.0	46.7	214.3
2.0	15.3	7.6	18.0	36.0	42.5	235.3
2.5	18.2	7.3	15.0	37.5	48.5	206.0
3.0	20.9	7.0	15.0	45.0	46.4	215.3
3.5	23.7	6.8	14.0	49.0	48.4	206.8
4.0	26.4	6.6	14.0	56.0	47.1	212.1
4.5	29.1	6.5	13.0	58.5	49.7	201.0
5.0	31.6	6.3	13.0	65.0	48.6	205.7
5.5	33.9	6.2	13.0	71.5	47.4	210.9
6.0	36.1	6.0	13.0	78.0	46.3	216.1
6.5	44.6	6.9	13.0	84.5	52.8	189.5
7.0	48.7	7.0	12.0	84.0	58.0	172.5
7.5	54.6	7.3	12.0	90.0	60.7	164.8
8.0	61.8	7.7	12.0	96.0	64.4	155.3
8.5	68.0	8.0	12.0	102.0	66.7	150.0
9.0	79.3	8.8	13.0	117.0	67.8	147.5
9.5	89.6	9.4	13.0	123.5	72.6	137.8
10.0	94.5	9.5	13.0	130.0	72.7	137.6
10.3	103.5	10.0	13.0	133.9	77.9	129.4

Rations Containing Different Proportions of Total Protein.

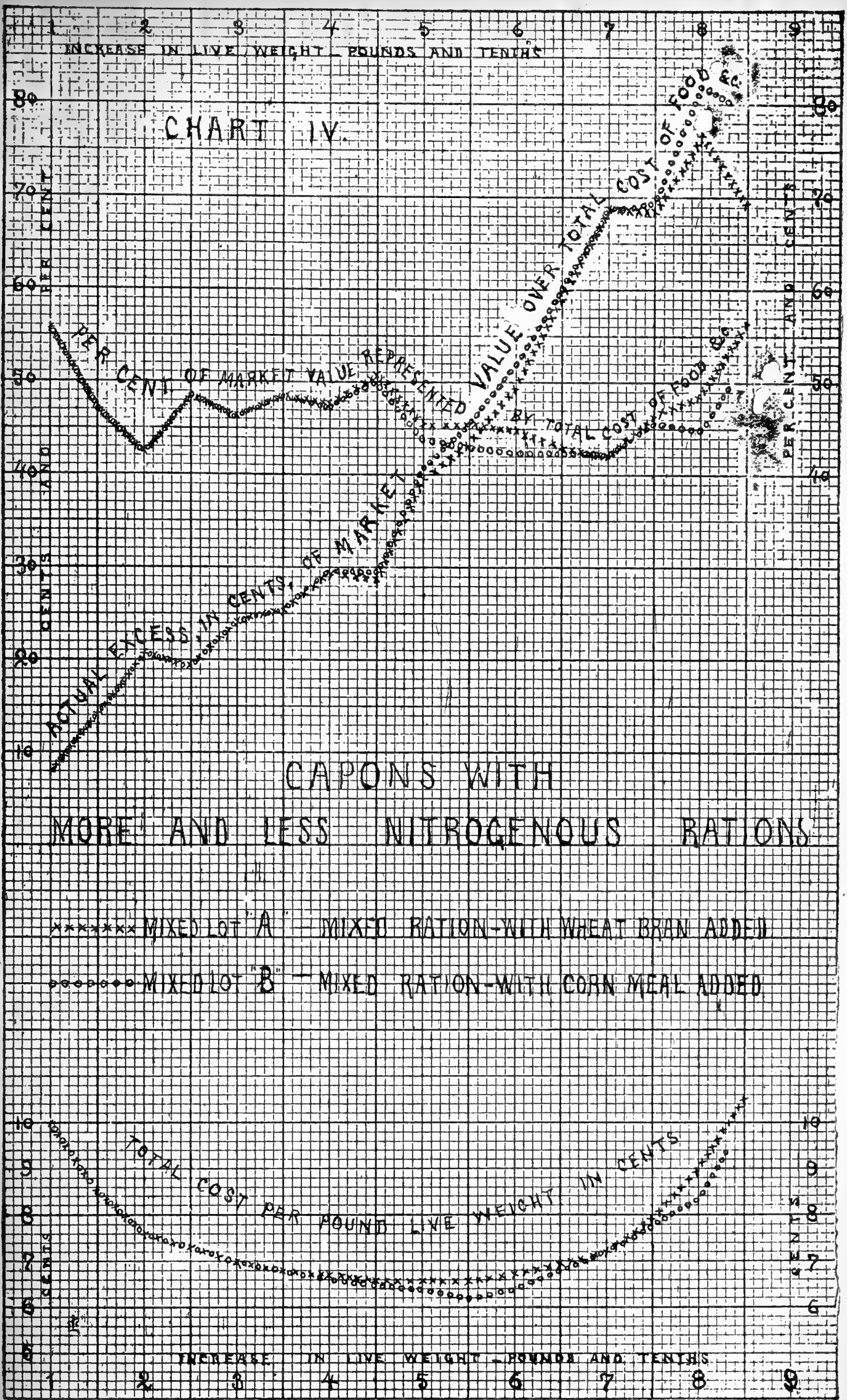
Two mixed lots of capons were fed to observe the effects of rations differing somewhat in the proportion of nitrogenous constituents. Lot "A" had a mixed ration with wheat bran added— and lot "B" had a similar ration with corn meal added in place of wheat bran.

The fowls in the lots contrasted were entirely comparable being selected from the same lots of chicks, and alike in condition and development. Each lot was composed of Light Brahmas, Indian Games, and Indian Game—Light Brahma, Indian Game—Buff Cochin and W. P. Rock—B. Minorca crosses. Feeding was not begun with these two lots until some time after the birds had been caponized.

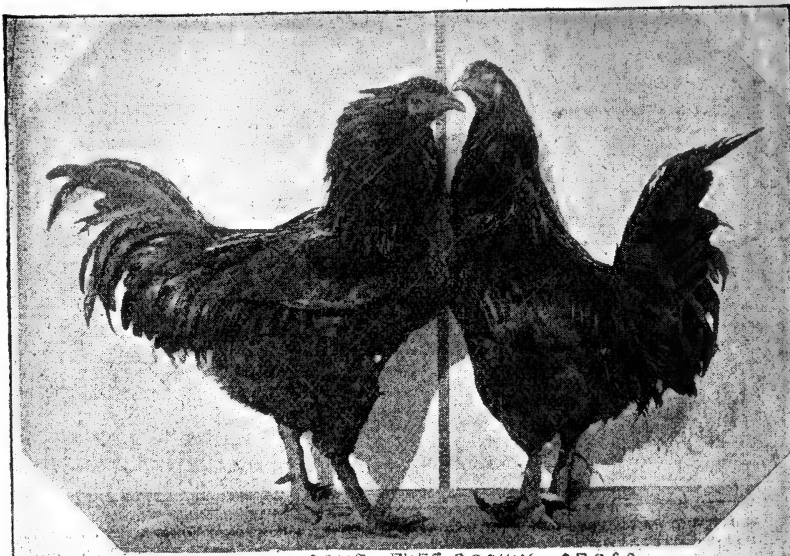
Sweet skim-milk was fed instead of water. With lot "A" skim-milk constituted an average of 64.6 per cent. of the total food and 18.3 per cent. of the water-free food and with lot "B" an average of 54.1 per cent. of the total food and 12.2 per cent. of the water-free food. In the ration for lot "A" wheat bran constituted on the average 26.5 per cent. of the total grain food and with lot "B" corn meal constituted 34.8 per cent. of the total grain food. The ratio of protein to total carbohydrates in the wheat bran ration was that of 1:3.6 and in the corn meal ration that of 1:4.4. With the fats multiplied, the ratios would be those of 1:3.8 and 1:4.8 respectively.

There was not any great difference in growth made, although the total gain in weight made by lot "A" slightly exceeded that made by lot "B" during the trial. The gain made by lot "B" was, however, somewhat the more profitable, although the corn meal cost twenty-two dollars per ton and the wheat bran twenty dollars per ton. During most of the time that the feeding lasted the capons in lot "B" could have been sold at a little better profit than those in lot "A"—but on the whole the difference was of little consequence. The gains made by each lot were profitable at the prices quoted.

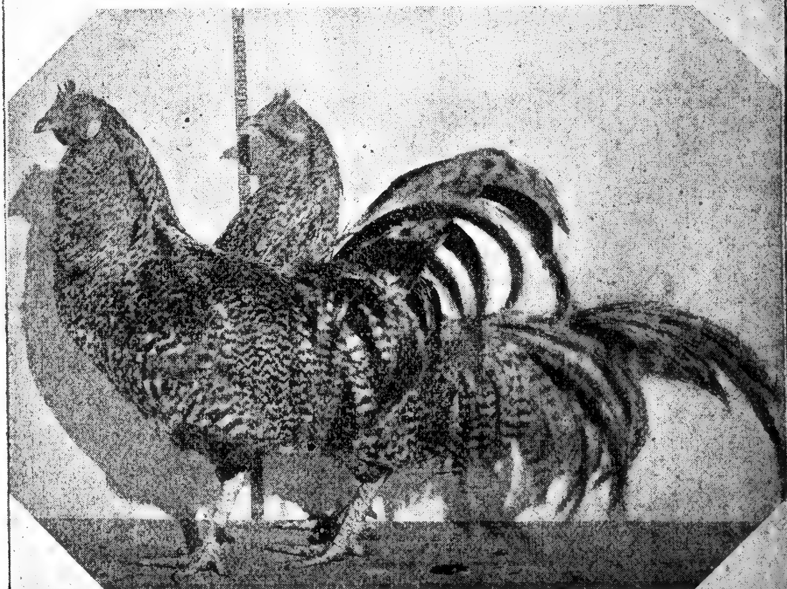
The results of this feeding experiment are given in the following tables and shown in comparison on chart IV, opposite. As



INCREASE IN LIVE WEIGHT _ POUNDS AND TENTHS
CHART IV.
PER CENT
CENTS AND PER CENT
PER CENT AND CENTS
PER CENT OF MARKET VALUE REPRESENTED BY TOTAL COST OF FOOD &C.
VALUE OVER TOTAL COST OF FOOD &C.
ACTUAL EXCESS IN CENTS, OF MARKET
CAPONS WITH
MORE AND LESS NITROGENOUS RATIONS
×××××× MIXED LOT "A" — MIXED RATION-WITH WHEAT BRAN ADDED
ooooooo MIXED LOT "B" — MIXED RATION-WITH CORN MEAL ADDED
TOTAL COST PER POUND LIVE WEIGHT IN CENTS
CENTS
INCREASE IN LIVE WEIGHT _ POUNDS AND TENTHS



CAPONS, IN. GAME-BUFF COCHIN CROSS
11 lbs. Av. Wt.



CAPONS, W. P. ROCK-B. MINORCA CROSS
9 lbs. Av. Wt.

plainly shown on the chart, the total cost per pound live weight gradually and quite rapidly increased after 5.5 pounds average weight, but the market value increased also enough to make the greatest difference over the cost of food at the average weight of eight pounds for each lot. Only once with each lot of capons did the per cent. of market value represented by the cost of food fall below that for two-pound chicks.

MIXED LOT CAPONS (A).

Average number of fowls in pen.	PERIOD.	Average weight per fowl at beginning of period.	AVERAGE PER DAY PER FOWL.											Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
			Gain in weight.	Mixed grain No. 22 consumed.	Wheat bran consumed.	Wheat consumed.	Skim-milk consumed.	Dry bone consumed.	Alfalfa forage consumed.	Total food consumed.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats in food.	Total cost of food.				
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cts.	Ozs.	Cts.
13	September 17 to October 1	4.77	1.00	2.12	1.06	1.20	7.54	0.07	0.23	12.22	4.74	1:3.5	0.47	4.74	7.52	0.91	0.09
13	October 1 to October 15	5.65	1.03	1.99	1.08	1.57	11.28	0.18	0.23	16.33	5.47	1:3.3	0.57	5.31	8.80	0.90	0.09
13	October 15 to October 29	6.55	0.79	2.89	1.59	1.04	11.08	0.22	0.23	17.05	6.22	1:3.6	0.62	7.87	12.48	0.90	0.09
12	October 29 to November 19	7.25	0.40	2.62	1.58	1.25	9.64	0.07	......	15.56	5.80	1:3.8	0.57	14.50	22.72	0.77	0.08
8	November 19 to December 3	8.10	0.19	2.22	1.06	1.46	8.53	0.12	......	13.39	5.12	1:3.8	0.53	26.91	44.64	0.62	0.06
7.5	December 3 to December 17	8.27	0.21	1.40	1.09	1.15	8.33	0.10	......	12.07	4.12	1:3.7	0.43	19.62	32.80	0.49	0.05

Mixed Lot Capons (B).

Number of fowls in pen.	Period.	Average weight per fowl at beginning of period.	Average Per Day Per Fowl.											Pounds of water-free food for each one pound gain in weight.	Cost of food for each one pound gain in weight.	Water-free food per day for each one pound live weight of fowls fed.	Cost of food per day for each one pound live weight of fowls fed.
			Gain in weight.	Mixed grain No. 22 consumed.	Corn meal consumed.	Wheat consumed.	Skim-milk consumed.	Dry bone consumed.	Alfalfa forage consumed.	Total food.	Total water-free food consumed.	Ratio of protein to total carbohydrates and fats.	Total cost of food.				
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Cts.	Lbs.	Cents.	Ozs.	Cents.
13	September 17 to October 1.......	4.74	1.20	2.02	1.48	.68	4.91	.06	.23	9.38	4.34	1:4.2	.40	3.60	5.38	.82	.08
13	October 1 to October 15.......	5.79	.75	1.79	1.36	1.75	6.60	.13	.23	11.86	5.20	1:4.2	.53	6.93	11.23	.85	.09
13	October 15 to October 29.......	6.44	.64	2.20	2.09	.75	6.51	.12	.23	11 90	5.30	1:4.4	.51	8.28	12.71	.79	.07
13	October 29 to November 19.......	7.00	.53	2.22	1.70	1.18	6.55	.08	......	11.72	5.23	1:4.5	.51	9.87	15.41	.71	.07
8	November 19 to December 3.......	7.95	.23	1.58	1.54	1.30	5.99	.12	......	10.53	4.59	1:4.6	.46	19.96	32.24	.57	.06
8	December 3 to December 17.......	8.16	.15	2.06	1.74	.90	4.56	.13	......	9.39	4.70	1:4.6	.45	31.33	47.91	.57	.05

MIXED LOT CAPONS, A — AVERAGE PER FOWL.

At average weight per fowl of—	Total cost at weight.	Total cost per pound, live weight, at weight.	Market price per pound at weight.	Market value of fowl at prices quoted.	Cost of food consumed, per cent. of market value.	Market value per cent. of value of food consumed.
Pounds.	Cents.	Cents.	Cents.	Cents.	Per cent.	Per cent.
1.0	10.0	10.0	18.0	18.0	55.6	180.0
1.5	12.7	8.5	18.0	27.0	47.0	212.6
2.0	15.3	7.6	18.0	36.0	42.5	235.3
2.5	18.2	7.3	15.0	37.5	48.5	206.0
3.0	20.9	7.0	15.0	45.0	46.4	215.3
3.5	23.7	6.8	14.0	49.0	48.4	209.8
4.0	26.7	6.7	14.0	56.0	47.7	209.7
4.5	29.7	6.6	13.0	58.5	50.8	197.0
5.0	32.8	6.6	14.5	72.5	45.2	221.0
5.5	36.3	6.6	14.5	79.7	45.5	219.6
6.0	40.4	6.7	15.0	90.0	44.9	222.8
6.5	44.8	6.9	16.0	104.0	43.1	232.1
7.0	50.1	7.2	17.0	119.0	42.1	237.5
7.5	59.0	7.9	17.0	127.5	46.3	216.1
8.0	72.2	9.0	18.6	148.8	48.5	206.1
8.5	89.0	10.5	18.6	158.1	56.3	177.6

MIXED LOT CAPONS, B — AVERAGE PER FOWL.

At average weight per fowl of—	Total cost at weight.	Total cost per pound, live weight, at weight.	Market price per pound at weight.	Market value of fowl at prices quoted.	Cost of food consumed, per cent. of market value.	Market value per cent. of value of food consumed.
Pounds.	Cents.	Cents	Cents.	Cents.	Per cent.	Per cent.
1.0	10.0	10.0	18.0	18.0	55.6	180.0
1.5	12.7	8.5	18.0	27.0	47.0	212.6
2.0	15.3	7.6	18.0	36.0	42.5	235.3
2.5	18.2	7.3	15.0	37.5	48.5	206.0
3.0	20.9	7.0	15.0	45.0	46.4	215.3
3.5	23.7	6.8	14.0	49.0	48.4	206.8
4.0	26.5	6.6	14.0	56.0	47.3	211.3
4.5	29.2	6.5	13.0	58.5	49.9	200.3
5.0	31.8	6.4	14.5	72.5	43.9	228.0
5.5	34.3	6.2	14.5	79.7	43.0	232.4
6.0	38.2	6.4	15.0	90.0	42.4	235.2
6.5	44.0	6.8	16.0	104.0	42.3	236.4
7.0	50.6	7.2	17.0	119.0	42.5	235.2
7.5	58.2	7.8	17.0	127.5	45.6	219.1
8.0	66.8	8.3	18.6	148.8	44.9	222.8
8.3	78.0	9.4	18.6	158.1	49.3	202.7

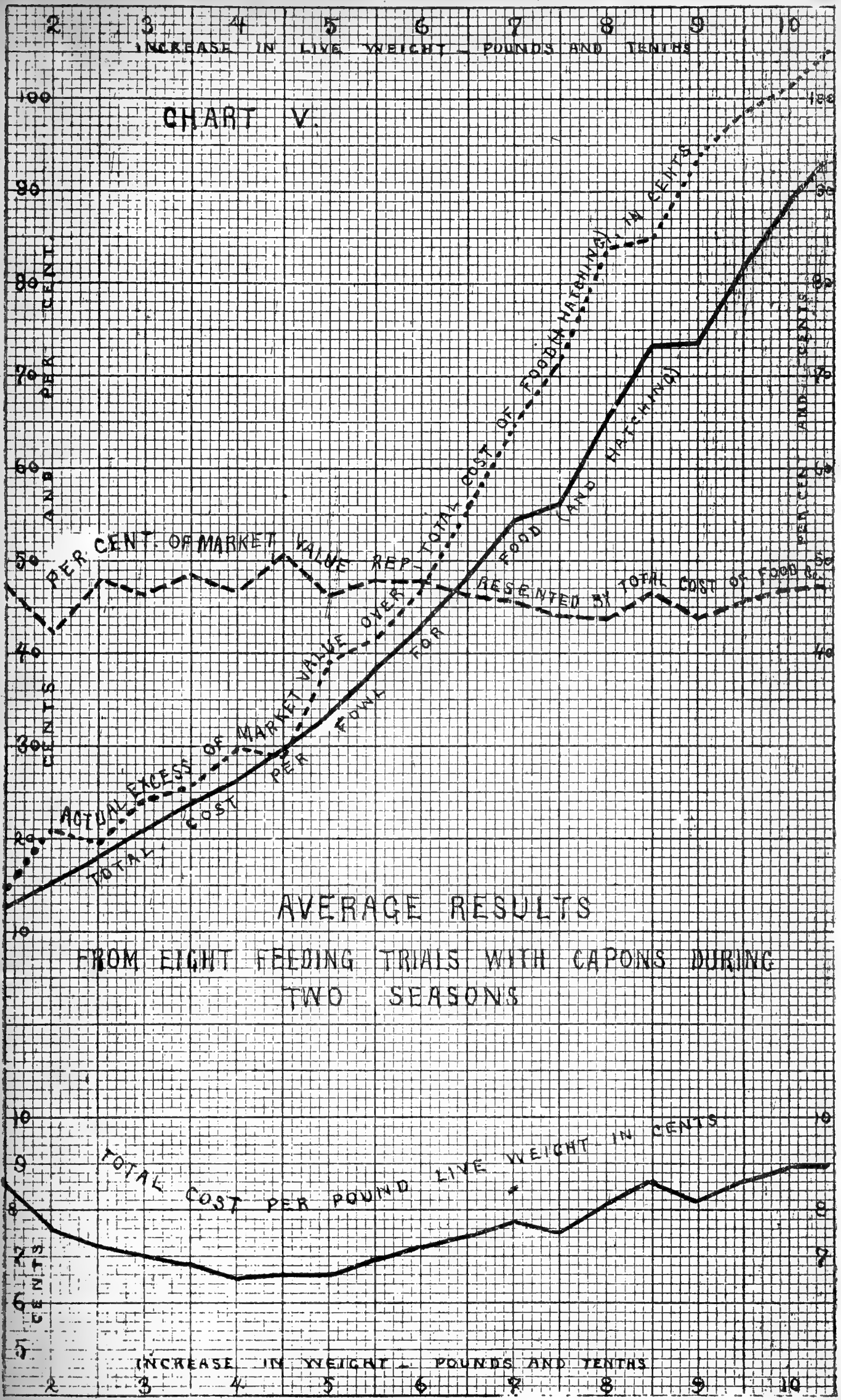


CHART V.
INCREASE IN LIVE WEIGHT — POUNDS AND TENTHS
CENTS AND PER CENT
PER CENT AND CENTS
PER CENT OF MARKET VALUE REPRESENTED BY TOTAL COST OF FOOD &c.
TOTAL COST OF FOOD (HATCHING) IN CENTS
ACTUAL EXCESS OF MARKET VALUE OVER TOTAL COST OF FOOD (AND HATCHING)
TOTAL COST PER FOWL FOR FOOD (AND HATCHING)
AVERAGE RESULTS
FROM EIGHT FEEDING TRIALS WITH CAPONS DURING TWO SEASONS
TOTAL COST PER POUND LIVE WEIGHT IN CENTS
CENTS
INCREASE IN WEIGHT — POUNDS AND TENTHS

Average Results from Several Lots of Capons.

The average results from the eight lots of capons for which records were kept during the longest time, are arranged in the form of the accompanying chart as a convenient way of showing them. (See chart V, opposite.)

It will be observed that at no time did the per cent. of market value represented by the total cost of food (and hatching) fall below that of chicks at broiler age. Although the total cost per fowls for food increased more rapidly than the weight, the actual excess in cents of the market value over the cost also increased rapidly and quite regularly, so that the greatest difference in amount per fowl occurred at the higher weights, although the per cent. excess over cost for food was less.

The total cost per pound live weight was lowest at about four pounds average weight and increased thereafter with the weight. The lines showing the increase in total cost per fowl and change in cost per pound live weight would be less irregular if only the results from fowls which naturally attain the higher weights were averaged. The breaks in the gradual curves of these lines are caused by dropping at certain weights from the averages the results from those fowls which normally will not reach the higher weights given except by very slow and unprofitable increase.

General Observations.

While capons continue to command so much higher prices than the average of poultry of the same weights it will probably be found more profitable to caponize surplus cockerels of the larger breeds after the high broiler prices of spring and early summer have dropped—especially where cheap food is available. With the fancier, of course, whose time is occupied in the production of breeding and exhibition stock, the earlier the surplus chicks are disposed of, the better.

The labor required in feeding capons is less than with young chicks. The cost of caponizing is small where expert services can be obtained and an expert should be employed where possible. The methods of operation can be learned from the printed instructions accompanying several of the different sets of instruments advertised and sold, but anyone endeavoring to teach himself should operate on several dead cockerels before attempting to operate on a live one.

The largest breeds will be found the most profitable for capons, and it is useless to caponize cockerels of the smaller breeds.

Skim-milk can be profitably fed to capons and, if sweet, in large quantities. If sour, very little should be fed. It is very important that the dishes from which milk is fed should be cleaned often and scalded occasionally.

A variety of food should be given to capons as well as to other fowls, and rations somewhat similar to those fed in these experiments will give good results. With equally good lots of birds, rations differing somewhat (but not excessively) in the proportion of nitrogenous to non-nitrogenous constituents will not make much difference in the growth. Of the rations fed to lots "A" and "B" in the experiments recorded, either fairly good, that for lot "B" containing corn meal will in general be found to give better results, as it did to a certain extent in this trial.

The cost of feeding capons after they have nearly reached their full size is approximately five cents per day for each 100 pounds live weight. The advisability of holding those of middle-weight breeds after reaching seven to eight pounds weight or the larger breeds after reaching nine to ten pounds weight will depend upon the prices to be obtained.

The results from feeding four pens of laying pullets during eight and nine months are here reported, as they give some data in regard to the question of the relative egg-production of hens kept without and with male birds. The pens, for convenience, were numbered 5, 6, 7 and 8. Pen 5 contained, during most of the time, seven pullets and cockerel, and pen 7, most of the time, eight pullets, without a male. Pens 6 and 8 each contained eight pullets part of the time and ten pullets most of the time, and with pen 6 a cockerel was also kept.

The pullets in pens 5 and 7 were Indian Game-Buff Cochin cross, and in pens 6 and 8 were Black Minorcas and Light Brahmas. The Light Brahmas and the pullets of Indian Game-Buff Cochin cross were selected from a lot of chicks hatched and grown to supply cockerels for caponizing. The Minorcas and Light Brahmas were from high grade stock so far as "standard" requirements are concerned, but were not very good layers. The egg yields, however, are only comparable among these four pens of fowls, which were in the same house and received similar rations and treatment. The somewhat close confinement necessary in any trial where a careful account of the food is kept of course always makes the conditions more or less unfavorable for the largest egg production. No attempt was made to force laying, and broody fowls were allowed to sit at will, there being plenty of nest boxes in each pen. About the same number became broody in pens having male birds as in those without. Some from pens 5 and 7 were removed long enough to hatch eggs, but were fed while out of the pen the same as those remaining, and were returned to the same pens from which they were taken.

All these pullets were separated from all male birds when immature and some months before any began laying. Those in pens 7 and 8 were kept away from males thereafter and during the time for which these records are given. Male birds were put with the pullets of pens 5 and 6 nearly two months before any of them began laying. The pullets in pens 5 and 7 were from the same lot of chicks and were under exactly the same conditions up to the time of selection for this trial. Those in pen 6 were also from the same lot of chicks as those in pen 8, and had been under the same conditions.

Some of the pullets in pen 7 began laying about a month earlier than any in pen 5, and some of those in pen 8 from one to two months sooner than any in pen 6. The records given in accompanying tables include the larger part of the laying season and show what differences there were in results.

The pullets in pen No. 7 layed about twenty-two per cent. more eggs than those in pen 5 (thirty-four per cent. more fowl, cockerel in pen 5 counted), and although the consumption of food was somewhat greater per fowl for pen 7, the cost of eggs produced was nearly thirty per cent. less than for pen 5. During the first three months for which records are given, pen No. 8 also produced thirty-two per cent. more eggs per fowl than pen 6. After this the yield fell below that for pen 6 — owing, doubtless, to the confirmed habit of "feather eating," which had been, purposely allowed to develop unchecked in pen 8 (reference to this will be found later). The total yield for the eight months, however, was about the same, calculated to the average per fowl, for pens 6 and 8, slightly in favor of pen 8. The consumption of food was enough greater in pen 8, to make the cost of eggs produced slightly exceed that for pen 6.

These fowls were fed mixed grain, wheat, fresh bone, corn silage and alfalfa forage. Oyster shells were kept in the pens and a box of dust. Coal ashes were in the yards, and fresh water at all times available. The mixed grain until June sixteenth, consisted of two parts corn meal, two parts ground oats, one part wheat middlings, one part linseed meal (O. P.) — After June sixteenth, the mixed grain was composed of one part each of corn meal, linseed meal (O. P.), wheat bran, wheat middlings, ground oats, cottonseed meal, gluten meal and crude gluten (high grade). To every twenty pounds of this mixed grain, one ounce of salt was added and thoroughly mixed. This was a very highly nitrogenous mixture and was fed so soon as warm weather began, with the expectation that it might assist rapid and early molting which it probably did as most of the fowls had new feathers by September. The average per cent. of moisture for each food was: Mixture No. 1, 12.9 per cent.; mixture No. 2, 10.5 per cent.; wheat, 12.0 per cent.; corn silage, 70.0 per cent.; alfalfa forage, 78.2 per cent., and fresh cut bone, 29.7 per cent.; up to March twenty-fourth, 40.3 per cent.; March to July, and 32.6 per cent. after July. The composition of the water-free substance for each food is shown in the following small table. The succeeding tables show the results of feeding for each pen calculated to the average per fowl for periods of twenty-eight days, except the last period, which is fourteen days.

COMPOSITION OF WATER-FREE SUBSTANCE.

FOOD.	Per cent. of ash.	Per cent. of fats.	Per cent. of fibre.	Per cent. of crude protein.	Per cent. of nitrogen-free extract.
Wheat	2.17	2.28	2.03	13.31	80.21
Mixture No. 1	2.71	5.75	5.56	16.62	69.36
Mixture No. 2	3.24	4.64	7.26	28.75	56.11
Corn silage	4.01	5.02	18.54	8.77	63.66
Alfalfa forage	10.00	6.74	26.80	16.56	39.90
Fresh bone	34.62	31.19	......	31.28	?2.90

PEN NO. 5 — AVERAGE PER FOWL.

Number of fowls.	PERIOD.	Average weight at beginning.		Gain or loss in weight	Total mixed grain per day. No. 1.	Total wheat per day.	Total fresh bone per day.	Total corn silage per day.	Total alfalfa forage per day.	Crude protein in food per day.	Crude fats in food per day.	Carbohydrates in food per day.	Proportion of protein to total carbohydrates (fats added).
		Lbs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Oz s.	
8[illegible]	December 31 to January 28	5	9.9	+ 2.3	1.17	2.11	.25	.13	......	.47	.16	2.22	1:5.1
9	January 28 to February 25	5	12.1	+ 3.8	1.32	1.95	.25	.11	......	.48	.16	2.20	1:4.9
9[illegible]	February 25 to March 24	5	15.9	+ 6.6	1.51	2.48	.25	.11	......	.57	.18	2.69	1:5.0
9	March 24 to April 21	6	6.4	−10.4	1.38	2,06	.25	.20	......	.49	.16	2.32	1:5.1
7	April 21 to May 19	6	1.4	− 2.9	1.78	2.34	,25	.42	......	.59	.19	2.81	1:5.1
5	May 19 to June 16	6	6.6	−12.6	1.09	2.34	.25	......	.47	.50	.15	2.35	1:5.0
7	June 16 to July 14	5	3.9	+10.7	No. 2. 1.19	1.96	.15	......	.55	.58	.13	2.02	1:3.7
7	July 14 to August 11	5	14.6	+ 3.4	1.48	1.63	.14	......	.57	.62	.13	1.94	1:3.3
8	August 11 to September 8	5	15.0	+ 1.0	1.53	1.79	.14	......	.50	.65	.14	2.08	1:3.4
8	September 8 to September 22	6	0.0	+ 8.4	1.87	1.87	.14	......	.50	.75	.15	2.31	1:3.3

PEN NO. 5 — AVERAGE PER FOWL.

PERIOD.	Total food per day.	Total water-free food per day.	Total food per day for each one pound live weight fed.	Water-free food per day for each one pound live weight fed.	Ratio of protein to total carbohydrate fats multiplied	Pounds of water-free food to produce one pound of eggs.	Total number eggs for period.	Total weight eggs for period.	Per Laying Hen. Total number eggs for period.	Per Laying Hen. Total weight of eggs for period
	Ozs.	Ozs.	Ozs.	Ozs.		Lbs.		Ozs.		Ozs.
December 31 to January 28	3.65	3.09	0.64	0.54	1:5.5	13.68	3.12	6.33	3.57	7.23
January 28 to February 25	3.63	3.08	0.62	0.52	1:5.3	11.80	3.55	7.31	4.00	8.22
February 25 to March 24	4.35	3.71	0.71	0.61	1:5.4	8.39	5.00	10.29	5.62	11.58
March 24 to April 21	3.89	3.22	0.64	0.53	1:5.4	4.06	10.33	22.21	11.62	24.98
April 21 to May 19	4.79	3.89	0.77	0.63	1:5.5	8.32	11.73	26.14	14.12	31.46
May 19 to June 16	4.15	3.26	0.69	0.54	1:5.3	4.46	9.60	20.50	12.00	25.62
June 16 to July 14	3.85	2.99	0.69	0.54	1:3.9	5.98	6.29	14.00	7.33	16.33
July 14 to August 11	3.82	2.97	0.64	0.49	1:3.6	15.46	5.10	10.77	6.00	12.56
August 11 to September 8	3.96	3.16	0.66	0.53	1:3.6	25.04	3.49	7.04	4.00	8.06
September 8 to September 22	4.38	3.53	0.70	0.56	1:3.5	13.77	1.75	3.59	2.00	4.11

PEN NO. 6 — AVERAGE PER FOWI.

Number of fowls.	PERIOD.	Average weight at beginning.		Gain or loss in weight.	Total mixed grain per day, No. 1.	Total wheat per day.	Total fresh bone per day.	Total corn silage per day.	Total alfalfa forage per day.	Crude protein in food per day.	Crude fats in food per day.	Carbohydrates in food per day.	Proportion of protein to total carbohydrates (fats added).
		Lbs	Ozs	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs	
9	January 28 to February 25	5	2.3	+9.0	1.35	1.95	.25	.11	......	.48	.16	2.22	1:5.0
11	February 25 to March 24	5	8.2	+3.8	1.28	2.16	.25	.09	......	.49	.16	2.31	1:5.0
11	March 24 to April 21	5	12.	—5 1	1.22	1.96	.25	.16	......	.46	.15	2.15	1:5.0
11	April 21 to May 19	5	11.3	—7.7	1.43	1.71	.25	.29	......	.46	.15	2.13	1:5.0
11	May 19 to June 16	5	3.5	—1.0	1.02	1.87	.25	......	.36	.43	.14	1.97	1:4.9
11	June 16 to July 14	5	2.5	—1.8	No. 2. 1.42	2.07	.16	......	.36	.56	.12	1.64	1:3.1
11	July 14 to August 11	5	.7	—9.9	1.41	1.42	.14	......	.36	.55	.12	1.63	1:3.2
11	August 11 to September 8	4	13.1	+4.4	1.80	1.49	.14	......	.36	.69	.14	2.08	1:3.2
11	September 8 to September 22	5	1.5	+4.0	2.16	1.45	.14	......	.36	.82	.16	2.48	1:3.2

PEN NO. 6 — AVERAGE PER FOWL.

PERIOD.	Total food per day.	Total water-free food per day.	Total food per day for each one pound live weight fed.	Water-free food per day for each one pound live weight fed.	Ratio of protein to total carbohydrates, fats multiplied.	Pounds of water-free food to produce one pound of eggs.	Total number eggs for period.	Total weight eggs for period.	Per Laying Hen. Total number eggs for period.	Per Laying Hen. Total weight of eggs for period.
	Ozs.	Ozs.	Ozs.	Ozs.		Lbs		Ozs.		Ozs.
January 28 to February 25	3.66	3.11	.67	.57	1:5.3	69.11	.55	1.25	.62	1.41
February 25 to March 24	3.78	3.21	.67	.57	1:5.4	31.78	1.27	2.83	1.40	3.11
March 24 to April 21	3.59	2.98	.64	.53	1:5.4	5.79	6.27	14.42	6.90	15.86
April 21 to May 19	3.68	2.98	.67	.55	1:5.3	3.78	9.54	22.06	10.50	24.26
May 19 to June 16	3.50	2.77	.67	.53	1:5.3	3.32	10.64	23.34	11.70	25.68
June 16 to July 14	4.01	2.56	.79	.50	1:3.4	3.12	10.09	22.99	11.10	25.29
July 14 to August 11	3.34	2.54	.68	.52	1:3.4	13.65	4.64	10.43	5.10	11.47
August 11 to September 8	3.80	3.20	.77	.65	1:3.4	9.73	7.91	18.45	8.70	20.30
September 8 to September 22	4.12	3.80	.79	.73	1:3.4	7.14	3.18	7.45	3.50	8.20

Pen No. 7 — Average Per Fowl.

Number of fowls.	PERIOD.	Average weight at beginning.	Gain or loss in weight.	Total mixed grain per day, No. 1.	Total wheat per day.	Total fresh bone per day.	Total corn silage per day.	Total alfalfa forage per day.	Crude protein in food per day.	Crude fats in food per day.	Carbohydrates in food per day.	Proportion of protein to total carbohydrates (fats added).
		Lbs Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs	
7	December 31 to January 28	5 12.6	—2.4	1.19	2.14	0.25	0.14	......	0.48	0.16	2.26	1:5.3
8	January 28 to February 25	5 9.1	+6.6	1.55	2.08	0.25	0.13	......	0.53	0.18	2.43	1:4.9
8	February 25 to March 24	5 15.8	—1.1	1.36	2.37	0.25	0.13	......	0.53	0.17	2.52	1:5.1
8	March 24 to April 21	5 14.6	—5.8	1.50	2.06	0.25	0.22	......	0.51	0.16	2.40	1:5.0
6½	April 21 to May 19	5 8.9	—1.7	1.79	2.09	0.25	0.43	......	0.56	0.18	2.64	1:5.0
4	May 19 to June 16	6 1.8	—6.5	1.52	2.57	0.25	......	0.50	0.59	0.18	2.77	1:5.0
8	June 16 to July 14	5 7.3	+1.5	No. 2. 0.90	1.84	0.16	......	0.50	0.49	0.11	1.79	1:3.9
8	July 14 to August 11	5 8.8	+2.3	1.41	1.50	0.14	......	0.50	0.60	0.13	1.84	1:3.3
8	August 11 to September 8	5 11.3	+0.7	1.85	1.59	0.14	......	0.50	0.64	0.15	1.95	1:3.3
8	September 8 to September 22	5 12.0	+7.4	2.27	1.49	0.14	......	0.50	0.60	0.16	1.83	1:3.3

PEN No. 7 — AVERAGE PER FOWL.

PERIOD.	Total food per day.	Total water-free food per day.	Total food per day for each one pound live weight fed.	Water-free food per day for each one pound live weight fed.	Ratio of protein to total carbohydrates, fats multiplied.	Pounds of water-free food to produce one pound of eggs.	Total number of eggs for period.	Total weight of eggs for period.
	Ozs.	Ozs.	Ozs	Ozs.		Lbs.		Ozs.
December 31 to January 28	3.72	3.14	.65	.55	1:5.4	5.23	8.86	16.79
January 28 to February 25	4.00	3.39	.69	.59	1:5.3	6.79	6.75	13.98
February 25 to March 24	4.10	3.48	.67	.58	1:5.4	6.55	7.50	14.86
March 24 to April 21	4.03	3.34	.70	.58	1:5.4	4 09	11.00	22.84
April 21 to May 19	4.56	3.68	.75	.61	1:5.4	3.23	14.95	31.00
May 19 to June 16	4.84	3.84	.82	.65	1:5.3	3.25	16.25	33.12
June 16 to July 14	3.39	2.62	.62	.48	1:4.1	3.61	9.87	20.30
July 14 to August 11	3.55	2.78	.63	.49	1:3.5	22.78	3.24	6.84
August 11 to September 8	4.08	3.25	.70	.56	1:3.5	10.55	8.37	17.28
September 8 to September 22	4.40	3.54	.74	.60	1:3.6	7.50	3.25	6.62

Pen No. 8 — Average Per Fowl.

Number of fowls.	Period.	Average weight at beginning. Lbs.	Average weight at beginning. Ozs.	Gain or loss in weight. Ozs.	Total mixed grain per day, No. 1. Ozs.	Total wheat per day. Ozs.	Total fresh bone per day. Ozs	Total corn silage per day. Ozs.	Total Alfalfa forage per day. Ozs.	Crude protein in food per day Ozs.	Crude fats in food per day. Ozs.	Carbohydrates in food per day. Ozs.	Proportion of protein to total carbohydrates (fats added).
8	January 28 to February 25	5	15.5	+ 8.0	1.59	2.21	.25	.25	......	.55	.18	2.56	1:5.0
10	February 25 to March 24	6	2.6	+ 2.0	1.46	2.41	.25	.10	......	.55	.18	2.60	1:5.1
10	March 24 to April 21	6	4.6	—12.8	1.68	2.12	.25	.18	......	.54	.17	2.55	1:5.0
10	April 21 to May 19	5	7.8	— 5.7	1.41	1.35	.25	.31	......	.42	.15	1.87	1:4.8
10	May 19 to June 16	5	2.1	— 6.5	1.05	2.00	.25	......	.40	.45	.14	2.09	1:5.0
10	June 16 to July 14	4	11.6	+ 6.8	No. 2. 1.59	2.14	.16	......	.40	.70	.14	2.34	1:3.5
10	July 14 to August 11	5	2.4	— .6	1.36	1.48	.14	......	.40	.57	.12	1.76	1:3.3
10	August 11 to September 8	5	1.8	+ .4	1.92	1.71	.14	......	.40	.74	.15	2.21	1:3.2
10	September 8 to September 22	5	2.2	+ 4.4	2.19	1.64	.14	......	.40	.80	.16	2.29	1:3.1

PEN NO 8 — AVERAGE PER FOWL.

PERIOD.	Total food per day.	Total water-free food per day.	Total food per day for each one pound live weight fed.	Water-free food per day for each one pound live weight fed.	Ratio of protein to total carbohydrates, fats multiplied.	Pounds of water-free food to produce one pound of eggs.	Total number of eggs for period.	Total weight of eggs for period.
	Ozs.	Ozs.	Ozs.	Ozs.		Lbs.		Ozs.
Jauuary 28 to February 25	4.30	3.57	.69	.57	1:5.4	54.09	.87	1.84
February 25 to March 24	4.22	3.60	.68	.58	1:5.4	14.34	3.20	7.04
March 24 to April 21	4.23	3.53	.72	.60	1:5.4	5.37	8.00	18.41
April 21 to May 19	3.32	2.66	.63	.50	1:5.2	3.38	9.70	22.00
May 19 to June 16	3.70	2.92	.75	.59	1:5.3	3.99	8.40	20.46
June 16 to July 14	4.29	3.48	.87	.70	1:3.8	4.92	8.40	19.79
July 14 to August 11	3.38	2.70	.66	.53	1:3.5	6.31	5.20	11.97
August 11 to September 8	4.17	3.40	.81	.66	1:3.4	6.36	6.40	14.96
September 8 to September 22	4.37	3.58	.79	.65	1:3.3	5.97	3.60	8.40

Observations on Feather-Eating.

During the winter the vice or habit of "feather-eating" made its appearance in pen No. 8, and at first only one or two of the fowls were inclined to this. As the ration at this time was such as never appeared to be unfavorable to other fowls and contained an average of one-fourth ounce of fresh cut bone and meat per day per fowl, the habit was allowed to develop and no attempt was made for some time to check its spread until after a few weeks every fowl in the pen had acquired the habit or was suffering very conspicuously from it. After this habit had been very seriously prevalent for some weeks, vaseline or lard (sometimes one, and sometimes the other), in which had been mixed powdered aloes, was applied to the old feathers near the spots which had been picked bare, and on the new feathers which appeared. After continuing this treatment for some time the habit apparently disappeared so that the birds were enabled to grow a full coat of new feathers. No change of any consequence was made in the food, etc., and the suppression of the habit was probably due to the disagreeable taste of the aloes.*

The means taken to discourage this habit necessitated frequent handling of the fowls and would not pay with ordinary stock. It would be more economical to kill the birds first affected.

It does not seem probable that a ration deficient in some constituent is always the cause of this trouble, for in this case four pens of fowls were fed alike and the habit developed in only one and was afterward suppressed in this pen without any radical change in the food. The habit appeared, developed, and had begun to disappear during the few months, in which almost no change was made in the composition of the ration. During this time quite a liberal amount of fresh cut bone, containing considerable lean meat, was fed. Before this even a larger proportion of fresh bone had been fed.

The most apparent cause for the development of this habit was idleness, to some extent consequent upon the confinement of the fowls, although they all spent a fair proportion of time scratching for their grain in the straw which covered the floor of the pen.

* An extract of aloes would probably be better where grease on the feathers is objectionable.

This habit, however, which may sometimes be a "symptom" of disease, is more often, perhaps, induced by improper food, lack of animal food, or lack of variety in the ration. Laying hens fed at this station about two months almost exclusively upon Indian corn and corn meal, picked not only the feathers but flesh from each other, so that two were killed. This same trouble has been seen elsewhere when birds were closely confined, with little chance or inducement for exercise and no change in food. A pen of young capons and "slips" was fed for about two months exclusively on corn and corn meal (plenty of fresh water being at all times available) and these birds picked nearly all the smaller feathers from each other. An entirely similar pen, fed at the same time a mixed grain ration, continued in perfect plumage.

General Observations.

A pen of pullets kept without a male produced eggs at about thirty per cent. less cost than an exactly similar pen with which a cockerel was kept.

Another pen without a male gave during the first three months about the same proportionate excess of product over an exactly similar pen with which a cockerel was kept. After the development of the feather-eating habit, the egg product diminished, but during eight months the total egg yields for each pen were very nearly alike.

In each of the two pens without male birds some pullets had begun to lay from one to two months earlier than any in the corresponding pens in which male birds were kept.

While "feather eating" usually appears after feeding for any length of time an unvaried ration, deficient in some constituent, more especially nitrogenous matter, the habit has developed from idleness or some unknown cause among fowls having a ration which gave satisfactory results with other similar pens of fowls fed at the same time. While the habit of "feather-eating" can be cured sometimes by a needed change of food, and sometimes by methods similar to that mentioned in this bulletin, no method which necessitates frequent handling of fowls will be an economical one with ordinary stock.

This vice is very uncommon among fowls that have exercise and a variety of food, and it is most economical to prevent its appearance by careful feeding, but as the spread is rapid even under a ration which does not ordinarily seem to encourage its development, the vice should be stamped out by the death or removal of the first offender.

Swine.

Among the many kinds of forage and coarse foods recommended as food for hogs, the only kinds tried at this station that gave profitable results, when fed in large quantities, were sorghum and beets. Some short feeding trials made in preceding years gave such promising results that other feeding experiments with these foods were made during the past year. Twenty pigs were used in these experiments — two lots of ten each. There were seven sows and three barrows in each lot, and the lots were also alike so far as breeds are concerned, there being in each lot pigs of Poland China, Berkshire, Duroc Jersey and Chester white breeds and of Berkshire-Cheshire cross.

During the first period lot A was fed a limited amount of linseed meal and a large proportion of sorghum, and lot B corn meal with the linseed meal, and a small proportion of sorghum. During the second period lot B had the large amount of sorghum and lot A the small amount. In the third and fourth periods when beets were fed instead of sorghum, the lots were contrasted in the same way. A moderate amount of skim-milk was fed throughout the experiment.

In feeding sorghum the entire mature plant, except the roots, was fed as cut in the field. The seed was eaten and the stalks and leaves thoroughly chewed over, but only a part beside the juice eaten. The pigs were given about all they could thus utilize. In several trials it was found that about forty-nine per cent. (48.9 per cent.) of the sorghum weighed out was eaten and this factor is used in order to fill out the amount of food consumed in the tabulated results given, but this approximate quantity is not important as the principal information sought in these trials was whether the sorghum was profitably fed, and the amount necessary to be fed to the pigs gives the cost of the ration. The beets were fed as stored, for winter, without the tops, and were eaten without waste.

In calculating the cost of the rations fed sorghum is rated at two dollars per ton, beets at three dollars per ton, linseed meal at twenty-eight dollars per ton, corn meal at twenty-four dollars per ton, and skim-milk at twenty-four cents per 100 pounds. The pigs which were fed in these experiments when afterwards killed lost, on the average, 23.5 per cent. in dressing, and the cost per pound, dressed weight, is estimated on this basis.

At the higher prices of pork prevailing during these few months and later, all of the rations gave profitable results. During the first period the gain made by lot A, for which 67 per cent. of the total food was sorghum, was much less profitable than that made by lot B, having only 12.1 per cent. of the total food sorghum. During the second period the gain made by the lot having the most sorghum, constituting 55.8 per cent. of the total food, was somewhat better than during the first period, but much less profitable than that made by the lot having only 9.6 per cent. of the total food sorghum, this lot making also a more profitable gain than that made by the corresponding lot in the first period. During both the third and fourth periods the lot having beets enough to constitute 50.8 per cent. and 50.2 per cent. of the total food and 37.9 and 38.2 per cent. of the water-free food made more profitable gains than those having but a small proportion of beets in their ration, constituting for the respective periods 12.9 per cent. and 9.2 per cent. of the total food, and 4.7 and 3.6 per cent. of the water-free food. With beets rated at two dollars per ton, as they sometimes are, the difference is still greater, and the increase in weight made at less cost per pound than is usual with the grain foods ordinarily used.

With the sorghum rated at one dollar per ton the cost of gain made during the first period was about the same for each lot, but during the second period still somewhat greater for the lot having the large amount of sorghum.

The results obtained from the two lots of pigs during the four periods, calculated to the average per day for each 100 pounds live weight fed, are given in the following table:

SORGHUM AND BEETS — AVERAGE PER DAY PER 100 POUNDS LIVE WEIGHT FED.

Average weight of pig at beginning.	Days in period.	Lot number.	PERIOD.	Gain in weight.	Total sorghum fed.	Total sorghum consumed. (Approximate.)	Total beets consumed.	Total linseed meal. (N. P.)	Total corn meal.	Total skim-milk.	Total water.	Total food.	Total water-free food.	Water-free food for one pound gain in weight.	Total cost of food.	Cost of food for one pound gain in weight.	Cost of food for one pound dressed weight. (Estimated.)	Nutritive ratio.
Lbs.				Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cts.	Cts.	Cts.	
43.2	28	A	September 28 to October 26	.57	13.01	*6.36	....	1.02	....	2.11	7.83	*9.49	*3.26	*5.72	3.24	5.68	7.42	.....
42.9	28	B	September 28 to October 26	.90	1.35	.66	....	.91	1.85	2.02	9.36	*5.44	*2.90	*3.22	4.11	4.57	5.97	.....
50.8	35	A	October 26 to November 30...........	1.18	1.56	*.76	....	.86	2.00	4.25	7.90	*7.87	*3.26	*2.08	4.78	4.05	5.29	.....
55.3	35	B	October 26 to November 30...........	.71	13.92	*6.81	....	1.01	....	4.39	6.99	*12.21	*3.65	*5.14	3.85	5.42	7.08	.....
77.4	28	A	November 30 to December 28.........	.76	......	....	5.48	.98	....	4.33	6.01	10.79	2.19	2.88	3.23	4.25	5.55	1:2.1
70.7	28	B	November 30 to December 28.........	1.04	......	....	.97	.87	2.09	3.57	6.94	7.50	3.17	3.05	4.75	4.57	5.97	1:3.9
95.5	28	A	December 28 to January 25...........	.83	......	....	.74	.89	1.89	4.51	4.21	8.03	3.09	3.72	4.71	5.67	7.41	1:3.6
94.9	28	B	December 28 to January 25...........	.67	......	....	5.76	1.01	....	4.70	4.39	11.47	2.28	3.40	3.40	5.08	6.64	1:2.3

* Approximate.

Feeding Experiments with Swine.

Some feeding experiments with pigs have been made in which several lots of pigs have been fed from birth, keeping the mother with them so long as she would give milk. The data derived from these experiments, so far as they relate to the time that pigs can profitably be fed with the sow, will be of more definite value in connection with the results of other feeding trials to be reported later. But as the results from three lots of pigs of three breeds which were fed alike for some months after separation from the sow will give additional information to that obtained in other feeding trials where the breeds are contrasted, they are here reported. These lots of pigs were all farrowed during the same week and were from mature and healthy stock of three breeds, Poland China, Duroc and Berkshire. The pigs were fed with the sow during the first fourteen weeks.

The results of feeding are for convenience of comparison calculated to the average per day for each 100 pounds of live weight fed and are arranged in periods of five weeks each except the first period of four weeks. Skim-milk, which at the price it is usually rated forms one of the cheapest foods, was not used in these trials, and as grain alone was fed the cost of growth is correspondingly high. During the first period wheat bran alone was fed, during the second equal parts of wheat bran and ground oats and during the third equal parts of bran, middlings and ground oats. During the fourth period, the first after the sow was removed, the pigs were fed the same as for the third. For the fifth and sixth periods "mixture No. 3," containing six parts wheat middlings, two parts wheat bran, four parts corn meal and one part cottonseed meal was fed, and during the last two periods "mixture No. 4" was fed, this mixture consisting of four parts wheat middlings, two parts wheat bran, six parts corn meal, and one part cottonseed meal. In calculating the cost of the food, wheat bran is rated at eighteen dollars per ton, corn meal at twenty-four dollars, wheat middlings at twenty dollars, ground oats at twenty-six dollars, and cottonseed meal at thirty dollars per ton.

The gross cost of production of live weight for the whole trial, not counting the value of weight lost by the sow, was for the Poland Chinas, 4.0 cents; for the Durocs, 5.1 cents, and for the Berkshires, 5.4 cents per pound.* For the twenty-five weeks after removal of the sow, the Poland Chinas cost 3.91 cents per pound gain; the Berkshires, 5.13 cents, and the Durocs, 5.57 cents; the Poland Chinas, costing 23.8 per cent. less than the Berkshires and 29.8 per cent. less than the Durocs. These pigs at the close of this trial ran from 116 pounds in weight to 165 pounds, and after being used in another feeding trial were killed, when six Poland Chinas lost on the average by dressing 19.5 per cent.; four Durocs, 23.7 per cent., and four Berkshires, 25.6 per cent. of their live weight.

At the high prices of grain and the average price, for the few years past, of pork, the Poland Chinas were the only pigs to make a fairly profitable gain; but at the higher prices of pork recently prevailing, the gain made by each was a profitable one. In this trial record was not made of the food necessary for the sows to recover the weight lost, but in another trial the average cost of food to restore the weight lost by these same sows in suckling pigs was 6.37 cents per pound. By considering the weight lost at this value the gains made by any lot during any of the first three periods were not profitable. The gain made by the pigs during the third period, on this basis, however, was less expensive than that during the first.

The condensed results for these three lots of pigs are given in the following tables:

* In a later trial with pigs from these same sows when skim-milk was fed, the gross cost of increase in weight of the pigs for the first ten weeks was for the Durocs 3.2 cents per pound. for the Poland Chinas 3.7 cents per pound and for the Berkshires 4.0 cents per pound, the Durocs making this time much the more profitable growth. Valuing the weight lost by each sow at the cost of restoring it, the net cost per pound gain for the time that the sow was fed with the pigs was 5.47 cents for the Durocs, 6.50 cents for the Poland Chinas, and 6.78 cents for the Berkshires

POLAND-CHINA PIGS, SOW FED WITH PIGS FOR FIRST NINETY-EIGHT DAYS.

Average per day per 100 pounds live-weight fed.

Days in period.	Number of pigs.	Average weight per pig at beginning.	PERIOD.	Gain in weight, pigs.	Loss or gain in weight, sow.	Salt.	Total wheat bran.	Total ground oats.	Total wheat middlings.	Total mixed grain.	Nutritive ratio of ration.	Total water-free food.	Water-free food for one pound gain, loss in weight of sow subtracted.	Total cost of food per day.	Gross cost of food for one pound gain in weight of pigs.
		Lbs.		Lbs.	Lbs.	Oz.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs	Lbs.	Cents.	Cents.
28	8	3.6	September 7 to October 5	+.64	—.64	......	1.64	......	......	1.64	1:4.0	1.42	....	1.28	2.00
35	6	12.9	October 5 to November 9	+.55	—.27	......	1.29	1.29	......	2.59	1:4.8	2.34	8.36	2.57	4.67
35	6	25.0	November 9 to December 14	.53	—.14	......	1.07	1.07	1.07	3.20	1:4.9	2.79	7.15	2.98	5.43
35	6	38.0	December 14 to January 18	.65	......	.....	......	......	......	4.05	1:4.9	3.54	5.45	3.79	5.68
35	6	47.7	January 18 to February 22	1.17	......	.09	......	......	......	3.90	1:4.9	3.34	2.85	3.61	3.09
35	6	72.4	February 22 to March 28	.84	......	.20	......	......	......	3.19	1:4.9	2.77	3.30	2.99	3.44
35	6	97.3	March 28 to May 2	.66	......	.28	......	......	......	2.80	1:5.3	2.43	3.68	2.70	4.09
35	6	122.8	May 2 to June 6	.67	......	.28	......	......	......	2.59	1:5.3	2.28	3.40	2.53	3.78

DUROC PIGS — SOW FED WITH PIGS FOR FIRST NINETY-EIGHT DAYS.

Average per day per 100 pounds live weight fed.

Days in period.	Number of pigs.	Average weight per pig at beginning.	PERIOD.	Gain in weight, pigs.	Loss or gain in weight, sow.	Salt.	Total wheat bran.	Total ground oats.	Total wheat middlings.	Total mixed grain.	Nutritive ratio of ration.	Total water-free food.	Water-free food for one pound gain, loss in weight of sow subtracted.	Total cost of food per day.	Gross cost of food for one pound gain in weight of pigs.
		Lbs.		Lbs.	Lbs.	Ozs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Cents.	Cents.
28	6	2.7	September 3 to October 1	.62	—.61	......	1.59	......	......	1.59	1:4.0	1.38	....	1.43	2.31
35	6	13.6	October 1 to November 5	.54	—.28	......	1.27	1.27	......	2.55	1:4.8	2.23	8.58	2.80	5.18
35	6	25.8	November 5 to December 10	.72	—.07	......	1.25	1.25	1.25	3.74	1:4.9	3.26	5.01	4.00	5.56
35	6	45.0	December 10 to January 14	.54	......	......	......	......	......	3.82	1:4.9	3.37	6.24	4.09	7.57
35	6	56.2	January 14 to February 18	1.05	......	.12	......	......	......	3.24	1:4.9	2.78	2.65	3.50	3.33
35	6	81.5	February 18 to March 24	.26	......	.20	......	......	......	2.47	1:4.9	2.01	7.73	2.67	10.27
35	4	89.3	March 24 to April 28	.12	......	.29	......	......	......	1.37	1:5.3	1.18	9.83	1.52	12.67
35	2	134.7	April 28 to June 2	.58	......	.27	......	......	......	2.22	1:5.3	1.93	3.33	2.46	4.24

BERKSHIRE PIGS — SOW FED WITH PIGS FOR FIRST NINETY-NINE DAYS.

Average per day per 100 pounds live weight fed.

Days in period.	Number of pigs.	Average weight per pig at beginning.	PERIOD.	Gain in weight, pigs.	Loss or gain in weight, sow.	Salt.	Total wheat bran.	Total ground oats.	Total wheat middlings.	Total mixed grain.	Nutritive ratio of ration.	Total water-free food.	Water-free food for one pound gain, loss in weight of sow subtracted.	Total cost of food per day.	Gross cost of food for one pound gain in weight of pigs.
		Lbs.		Lbs.	Lbs.	Ozs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Cts.	Cts.
29	8	2.7	September 1 to September 30	.74	—.65	......	2.42	......	......	2.42	1:4.0	2.09	....	2.18	2.95
35	6	10.3	September 30 to November 4	.51	—.13	......	1.73	1.73	......	3.46	1:4.8	3.02	7.95	3.81	7.47
35	6	18.3	November 4 to December 9	.56	+.02	......	1.49	1.49	1.49	4.46	1:4.9	3.90	6.72	4.77	8.52
35	6	28.5	December 9 to January 13	.57	......	.00	......	......	......	4.49	1:4.9	3.92	6.88	4.80	8.42
35	6	34.8	January 13 to February 17	1.16	......	.09	......	......	......	4.31	1:4.9	3.69	3.18	4.65	4.01
35	6	52.7	February 17 to March 23	.76	......	.22	......	......	......	3.67	1:4.9	3.19	4.20	3.96	5.21
35	4	68.9	March 23 to April 27	.63	......	.22	......	......	......	3.07	1:5.3	2.67	4.24	3.41	5.41
35	4	86.0	April 27 to June 1	.84	......	.27	......	......	......	3.13	1:5.3	2.72	3.24	3.47	4.13

Sorghum.

Fifteen varieties of sorghum were grown for comparison in 1892. Eight of these were from seed selected at this Station in 1891, the seed of one, "Early Minnesota," was received from S. H. Kenney, and all other seed was received from the Department of Agriculture Washington, D. C. One row only about sixty-six feet long of each of these varieties was grown. In the field larger areas of a few varieties were grown, the better of which were Early Minnesota, Early Amber and Early Orange, and two other unrecognized varieties. Some of this sorghum was used in feeding experiments made with pigs, and the result obtained will be found among the records of pig feeding.

Of the varieties tested only those numbered 6, 9, 10, 11, 12 and 72 in the list are of value for syrup production in this State. The yield of seed from any variety it was not possible to determine on account of English sparrows.

The average of observations made upon the growth, maturity and size of the different varieties will be found in the following table. The results also of examination of the juices from individual canes of several varieties follow the tabulated form. And the average results from the mixed juices of several mature or nearly mature canes of each of the earlier varieties are also given:

Row No. 3—"Degenerated White African."

Date.	Number of canes.	Weight of cane.	Per cent. of juice expressed.	Specific gravity of juice.	Per cent. of cane sugar in juice.	Maturity of seed.
		Oz.				
October 5	2	47.25	*45.0	1.073	10.75	In milk.
October 5	1	27.00	*51.9	1.067	10.51	In dough.
October 5	1	30.00	60.0	1 069	10.78	In soft dough.
October 6	1	28.25	60.0	1.072	12.21	In soft dough.
October 5	1	23.50	54.7	1.072	11.83	In dough.
October 7	1	37.75	61.2	1.071	10.44	In milk.
October 7	1	32.25	62.7	1.070	10.21	In soft dough.

Row No. 6—"Black Sorghum" (Var. Bicolor).

October 5	1	26.75	52.3	1.066	10.60	In hard dough.
October 5	1	26.75	55.1	1.065	12.10	In hard dough.
October 5	1	28.00	54.4	1.074	13.76	In dough.
October 5	1	33.50	?	1.071	12.50	In dough
October 5	1	31.50	61.3	1.063	10.87	In dough.
October 7	1	22.25	61.8	1.062	10.84	In hard dough.
October 7	1	33.25	58.8	1.069	12.36	In dough.
October 10	1	32.25	57.3	1.067	11.68	In milk.
October 10	1	31.00	60.6	1.072	12.45	In milk.
October 10	1	26.25	60.7	1.063	11.30	In hard dough.

Row No. 7—"Collier's Sorghum" (Probably Undendebule).

October 5	1	37.00	*52.0	1.064	10.50	In soft dough.
October 5	1	32.00	*51.6	1.072	12.50	In soft dough.
October 5	1	37.50	58.4	1.069	11.33	In bloom.
October 5	1	47.00	44.1	1.076	13.90	In dough.
October 5	1	31.75	50.9	1.067	10.60	In soft dough.
October 7	1	32.25	57.1	1.067	11.84	After bloom.

Row No. 8—"Jyangentombi" (Not True to Name).

October 11	....	37.50	47.4	1.069	12.45	In milk.

Row No. 9—"Boomvana or Early Amber."

October 5	2	32.50	*9.2	1.057	9.04	Ripe.
October 6	1	19.00	*53.9	1.066	11.04	In hard dough.
October 6	2	35.00	56.2	1.057	10.61	Ripe.
October 6	2	37.25	58.0	1.064	8.78	Ripe.
October 7	2	37.25	63.8	1.067	11.56	Ripe.
October 7	2	44.25	62.9	1.063	10.50	In hard dough.
October 7	1	21.50	56.5	1.074	13.44	Ripe.
October 10	2	37.25	60.5	1.075	13.76	Ripe.
October 10	1	20.75	57.4	1.074	12.77	Ripe.
October 10	2	32.25	58.2	1.077	14 00	Ripe.
October 10	1	18.75	62.0	1.054	8.70	Ripe.
October 10	1	20.75	60.7	1.063	10.07	Ripe.
October 10	....	131.00	59.7	1.062	10.41	In dough.

Row No. 10—"Koombana."

October 5	1	25.50	*56.7	1.057	8.09	Ripe.
October 5	1	20.00	*51.0	1.068	12.04	Ripe.
October 5	1	24.00	51.4	1.067	11.01	In hard dough.
October 5	1	31.25	57.3	1.061	9.04	In hard dough.
October 7	1	31.75	50.0	1.065	7.37	In milk.
October 7	1	29.75	64.9	1.054	6.92	Ripe.
October 7	1	21.25	62.1	1.068	11.74	Ripe.
October 10	1	34.75	55.8	1.063	9.10	Ripe.

ROW NO. 11 — "POOTUNG SORGHUM."

DATE.	Number of canes.	Weight of canes.	Per cent. of juice expressed.	Specific gravity of juice.	Per cent. of cane sugar in juice.	Maturity of seed.
October 5	1	24.25	*58.8	1.045	3.69	Ripe.
October 5	1	23.00	*53.3	1.071	11.53	Ripe.
October 5	1	27.50	60.0	1.053	6.46	Ripe.
October 5	1	21.50	61.7	1.048	5.33	Ripe.
October 7	1	41.50	64.7	1.066	8.73	In milk.
October 7	1	28.50	58.2	1.046	3.69	Ripe.
October 7	1	23.75	54.2	1.073	13.25	In milk.
October 10	1	38.75	59.4	1.061	10.04	In bloom.
October 10	1	33.75	56.2	1.077	12.74	In dough.
October 10	1	31.25	60.5	1.060	6.69	In milk.
October 10	1	20.75	59.7	1.068	9.85	Ripe.

ROW NO. 12 — "EARLY MINNESOTA." (FROM S. H. KENNEY.)

October 5	2	19.00	*46.1	1.049	6.46	Ripe.
October 5	2	15.50	*48.4	1.067	11.30	Ripe.
October 5	2	25.25	56.3	1.071	12.10	Ripe.
October 6	3	36.25	51.1	1.076	13.46	Ripe.
October 7	2	22.75	58.3	1.067	11.90	Ripe.
October 7	2	22.75	56.1	1.074	13.16	Ripe.
October 7	2	19.50	51.6	1.075	13.09	Ripe.
October 10	1	18.50	57.7	1.071	13.00	Ripe.
October 10	2	20.75	58.8	1.070	12.24	Ripe.
October 10	2	18.25	53.2	1.073	13.16	Ripe.

ROW NO. 13 — "UBEHLANA"? (FROM DEP'T OF A.)

October 11	10	53.00	?	1.061	8.59	Bloom.

ROW NO. 14 — "PLANTER'S FRIEND." (FROM DEP'T OF A.)

October 11	10	30.00	61.1	1.071	10.51	In bloom.

ROW NO. 15 — "MCLEAN'S." (FROM DEP'T OF A.)

October 11	10	38.00	62.5	1.058	9.70	In soft dough.

ROW NO. 16 — "COLEMAN'S CANE." (FROM DEP'T OF A.)

October 11	10	40.00	59.2	1.068	11.56	In bloom.

ROW NO. 17 — "COLEMAN'S RED." (FROM DEP'T OF A.)

October 11	10	36.50	58.9	1.066	12.39	In bloom.

ROW NO. 20 — SELECTION BY STATION.

October 5	1	24.75	*50.4	1.055	6.85	In milk.
October 5	1	31.25	57.1	1.069	11.21	In dough.
October 5	2	22.25	41.4	1.067	10.24	In dough.
October 7	1	42.50	55.1	1.054	8.05	In bloom.
October 7	1	23.50	42.3	1.053	8.53	In dough.
October 7	1	39.00	50.8	1.057	6.46	In milk.
October 10	1	37.25	46.1	1.071	11.87	In dough.
October 10	1	29.00	47.6	1.056	7.55	In bloom.
October 10	1	32.50	42.6	1.064	10.47	In milk.

ROW NO. 72 — "EARLY CANE." (KENNEY'S.)

DATE.	Number of canes.	Weight of cane.	Per cent. of juice expressed.	Specific gravity of juice.	Per cent. of cane sugar in juice.	Maturity of seed.
October 5	2	30.75	*44.7	1.047	5.72	Ripe.
October 6	1	29.50	*46.4	1.058	9.31	In hard dough.
October 6	1	28.25	60.7	1.052	8.08	Ripe.
October 6	1	22.00	62.1	1.063	9.37	Ripe
October 6	1	38.25	58.9	1.063	10.18	In dough.
October 7	1	29.25	57.3	1.063	10.44	In dough.
October 7	1	21.25	62.9	1.061	9.17	Ripe.
October 7	1	26.00	60.5	1.064	10.24	In bloom.
October 10	1	24.75	58.2	1.058	6.95	Ripe.
October 10	1	28.00	61.0	1.071	11.61	In hard dough.
October 10	1	26.25	59.5	1.058	7.38	Ripe.
October 10	....	164.25	48.3	1.058	8.99	In dough.
October 10	1	26.25	58.2	1.065	10.47	Ripe.

AVERAGE ROW NO. 3 — MATURE OR NEARLY MATURE CANES.

NUMBER OF ANALYSES.	Number canes.	Average weight of cane, ounces.	Per cent. of juice expressed.	Specific gravity of juice.	Per cent. of cane sugar in juice.	Maturity of seed.
5	5	28.20	57.9	1.070	11.11	In dough.
AVERAGE ROW NO. 6 — MATURE OR NEARLY MATURE CANES.						
8	8	28.53	57.8	1.067	11.79	In dough.
AVERAGE ROW NO. 7 — MATURE OR NEARLY MATURE CANES.						
4	4	36.44	49.7	1.070	11.87	In dough.
AVERAGE ROW NO. 9 — MATURE OR NEARLY MATURE CANES.						
10	16	17.58	54.3	1.066	11.27	Ripe.
AVERAGE ROW NO. 10 — MATURE OR NEARLY MATURE CANES.						
5	5	26.25	58.1	1.062	9.58	Ripe.
AVERAGE ROW NO. 11 — MATURE OR NEARLY MATURE CANES.						
6	6	24.25	58.6	1.055	6.76	Ripe.
AVERAGE ROW NO. 12 — MATURE OR NEARLY MATURE CANES.						
10	20	10.92	53.8	1.070	11.99	Ripe.
AVERAGE ROW NO. 20 — MATURE OR NEARLY MATURE CANES.						
5	5	28.56	46.7	1.065	10.46	In dough.
AVERAGE ROW NO. 72 — MATURE OR NEARLY MATURE CANES.						
7	8	22.44	58.0	1.058	8.16	Ripe.

REPORT OF THE CHEMIST.*

The following statement indicates, in outline, the various subjects considered in this report:

1. Summary of laboratory work.
II. Arrangement of chemical work.
III. Bulletins and addresses.
IV. Character and extent of experiments made in the manufacture of cheese during the season of 1892.
V. Tabulated analyses of milk, whey and cheese.
VI. Summary of results relating to conditions of manufacture of cheese.
VII. A study of the composition of milk.
VIII. A study of the composition of whey.
IX. A study of the composition of cheese.
X. Loss of milk-constituents in cheese-making.
XI. Influence of composition of milk on composition of cheese.
XII. Influence of composition of milk on yield of cheese.
XIII. Influence of skimming milk and adding cream upon losses in cheese-making, composition and yield of cheese.
XIV. Comparison of Cheddar and stirred-curd processes of cheese-making.
XV. Effects of using high temperature in heating curd upon cheese-making.
XVI. Effects of using different amounts of rennet upon cheese-making.
XVII. Effects of cutting curd in hard and in soft condition upon cheese-making.
XVIII. Effects of cutting curd coarse upon cheese-making.
XIX. Effects of tainted milk upon cheese-making.

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* L. L. Van Slyke, Ph. D.

XX. Effects of retaining natural gases in milk upon cheese-making.
XXI. Effects of exposing milk to foul odors upon cheese-making.
XXII. Effects of aerating milk by separator upon cheese-making.
XXIII. General summary of results of investigation of cheese.
XXIV. Comparison of dairy breeds of cattle with reference to the production of butter.
XXV. Trade values of fertilizing ingredients for 1892.
XXVI. Tabulated results of analyses of commercial fertilizers in New York State for the spring of 1892.
XXVII. Tabulated results of analyses of commercial fertilizers in New York State for the fall of 1892.

I. SUMMARY OF LABORATORY WORK.

While a statement of the number of determinations of different kinds does not include an account of all kinds of laboratory work and does not, therefore, necessarily convey an accurate idea in regard to the whole amount of laboratory work done, nevertheless, it serves to give fairly adequate information in regard to the extent, character and variety of the chemical and allied work. It will be noticed that our chemical work has been mainly confined to two lines, investigations connected with dairy problems and analysis of fertilizers.

TABULATED STATEMENT OF LABORATORY WORK FOR THE YEAR.

	In milk.	In skim-milk.	In buttermilk.	In butter.	In cheese.	In whey.	In cattle foods.	In fertilizers.	In ash of plants.	In soils.	In plants and fruits.	Totals.
Determinations of nitrogen	2,524	......	......	......	684	426	248	400	......	....	....	4,282
Determinations of fat (Babcock test)	1,888	599	590	......	......	....	....	......	......	....	....	3,077
Determinations of fat (ether-extract)	321	......	......	590	366	318	124	......	......	....	....	1,719
Determinations of water	2,094	7	......	......	366	318	137	......	37	10	96	3,065
Determinations of ash	888	7	......	......	......	....	124	......	115	....	96	1,230
Determinations of crude fiber	......	......	......	......	......	....	124	......	......	....	....	124
Determinations of sugar and starch	......	......	......	......	......	....	372	......	......	....	111	483
Determinations of phosphoric acid	......	......	......	......	......	....	....	1,200	60	....	....	1,260
Determinations of potash	......	......	......	......	......	....	....	460	60	....	....	510
Determinations of copper	......	......	......	......	......	....	....	......	142	30	....	172
Determinations of iron, sodium, etc	......	......	......	......	......	....	....	......	480	....	....	480
Microscopical examinations	569	......	......	......	......	....	....	......	......	....	....	569
Miscellaneous determinations	......	......	......	......	......	....	....	......	......	....	....	282
Grand total	......	......	......	......	......	....	....	......	......	....	....	17,253

II. ARRANGEMENT OF CHEMICAL WORK.

The chemist gives such general and special supervision to all the different lines of work as they may require. The work done in the way of preparing bulletins and giving addresses is given below under a special head.

The present arrangement of chemical work among the assistant chemists is as follows:

Mr. C. G. Jenter has special charge of the analysis of butter, of cattle foods and similar materials, of the determination of copper in plants, soils, etc., and of miscellaneous analytical work.

Mr. A. L. Knisely has special charge of the analysis of milk, whey and cheese and of the microscopical examinations of milk. He has also done considerable work in relation to methods of separating and determining the different classes of nitrogen compounds in milk, whey and cheese.

Mr. W. B. Cady has special charge of all nitrogen determinations and also assists in analysis of dairy products.

Messrs. B. L. Murray, A. D. Cook and J. T. Sheedy give their entire time to the analysis of commercial fertilizers and fertilizing materials.

Mr. John Collins and Mr. James Horth are laboratory assistants, attending to various kinds of routine, mechanical work. Mr. Collins also has charge of the determination of fat in milk, skim-milk, etc., by the Babcock test.

Mr. A. H. Horton and R. D. Newton have charge of keeping the records connected with the investigation of dairy breeds of cattle, which require numerous and extended calculations.

III. BULLETINS AND ADDRESSES.

During the year the chemist has prepared the following station bulletins:

Bulletin No. 41.—New series.—April, 1892 (twelve pages). The portion relating to "Analyses of materials used in spraying plants."

Bulletin No. 42.—New series.—May, 1892 (twenty pages). Analyses of commercial fertilizers.

Bulletin No. 43.—New series.—June, 1892 (fifty-three pages). Experiments in the manufacture of cheese during May.

Bulletin No. 45.—New series.—August, 1892 (thirty-six pages). Experiments in the manufacture of cheese during June.

Bulletin No. 46.—New series.—September, 1892 (fifty-eight pages). Experiments in the manufacture of cheese during July and August.

Bulletin No. 47.—New series.—November, 1892 (sixty-four pages). Experiments in the manufacture of cheese during September and October.

During the year, the chemist has given the following addresses:

"Results of Analyses of Materials used in Spraying," in January, 1892, at Rochester, before the annual convention of the Western New York Horticultural Society.

"Commercial Fertilizers," in January and February, at farmers' institutes, held in the following places: Batavia, Genesee county; Lyons, Wayne county; Perry, Wyoming county; Geneva, Ontario county; Albion, Orleans county.

"Some Old Mistakes and Some New Facts about Milk and Cheese," in December, 1892, at Cobleskill, N. Y., before the annual convention of the New York State Dairymen's Association.

The chemist also was appointed "Reporter on Nitrogen," for 1892, by the Association of Official Agricultural Chemists, and made his report at the annual meeting of the association held in August, 1892, at Washington.

IV. CHARACTER AND EXTENT OF EXPERIMENTS MADE IN THE MANUFACTURE OF CHEESE DURING THE SEASON OF 1892.

In Bulletins 43, 45, 46 and 47, issued from June to November, we have described all the details of the experiments made in the manufacture of cheese during the season of 1892 and have given the detailed results secured. The work of each month has, thus far, been considered by itself, but it is highly important to study the results of the season's experiments as a whole and also to compare the results of each month with those of the other months. It is designed to make this summary as complete as possible in itself, so that reference to the previous bulletins will be necessary only when the details of individual experiments are desired.

In Bulletin 37, in which were given the results of our first eight preliminary experiments in cheese-making, begun in the fall of 1891, we made the following statement: "While, in most respects, fairly definite results were obtained, it must be kept in mind that the experiments so far are few in number and can scarcely justify any broad conclusions. The results of this first series of experiments should be looked upon mainly as valuable suggestions for future work; and, if the results of several series of investigations, made under varying conditions, agree, then we may be able to state definite general conclusions, which may be regarded as established facts." The results of the work done during the season of 1892 have fully justified the caution contained in the above statement. Some of the results of our first experiments have been confirmed, while others have been greatly modified by our later, more extended investigation. In our first series of experiments, most of the milk used was not normal, having been partially skimmed or having contained added cream. Our work this past season has fully shown the fallacy of comparing results obtained with abnormal milk and those secured with normal milk and of drawing from such comparisons conclusions that are expected to apply to normal milk. Moreover, some of the statements made in giving the results of each month separately needed modification when we came to study the results of the season's work as a whole. While some of the results reached may be regarded as sufficient to form the basis

NOTE.— This Station has had the co-operation of the New York State Dairy Commission in carrying on this investigation. The Station Chemist has had charge of the work on the part of the Station; he has planned the experiments in their details, has personally prepared the bulletins describing the experiments and their results, and has had immediate direction and supervision of the analytical work, the details of which have been faithfully attended to by his assistants. The operation of manufacturing cheese has been performed by the following cheese-making experts of the Dairy Commission: Messrs. Geo. A. Smith, W. W. Hall, M. T. Morgan, H. A. Rees and John H. Berry.

for definite and positive conclusions, others must be subjected to future, more extended study, before we can accept them as representing established facts.

I. Points Investigated.

In each of the 106 experiments, we have made special study of the following points:

1. The loss of fat in the process of cheese-making and its relation to the amount of fat in the milk.

2. The loss of casein and albumen in the process of cheese-making.

3. The relation of casein to albumen in milk.

4. The relation of fat to casein and albumen in milk.

5. The relation of fat in milk to composition of cheese. Does milk containing a certain per cent. of fat always make cheese containing a uniform per cent. of fat?

6. The relation of casein and albumen in milk to composition of cheese.

7. The relation of fat in milk to yield of cheese. How much cheese should be made for each pound of fat in normal milk? Is there any definite relation?

8. The relation of casein and albumen in milk to yield of cheese.

9. The relation of fat to solids not fat in cheese.

10. The relation of fat to casein and albumen in cheese.

11. Is it possible to establish such definite relations between the composition of milk and the composition of the corresponding cheese, that, from knowing the composition of one, we can tell the composition of the other with a fair degree of accuracy?

In addition to the foregoing points of study, there were made special experiments for the purpose of securing information regarding other facts.

12. The influence of the removal of fat from normal milk upon the composition of milk and the composition, yield and quality of cheese was studied in seven experiments.

13. The influence of the addition of fat to normal milk upon the composition of milk and the composition, yield and quality of cheese was studied in three experiments.

14. In twenty experiments, a special comparative study was made of the Cheddar and stirred-curd processes.

15. In two experiments, the use of a temperature of 106 degrees F. was employed and its effects studied.

16. In ten experiments, the effects of using amounts of rennet more or less above the usual amount were observed.

17. In nineteen experiments, a study was made of the result of cutting curd in hard and soft condition.

18. In two experiments, a comparison was made between the effects of cutting curd in fine and coarse condition.

19. In fifteen experiments, the influence of using tainted milk upon cheese-making was studied.

20. In three experiments, the milk was shut up warm in cans and cooled down, being held over night before making into cheese. The effects of this treatment were carefully noted.

21. In three experiments, the milk was exposed over night to foul odors and then made into cheese.

22. In three experiments, both taint and acid were developed in the milk before it was made into cheese.

23. In three experiments, the milk was aerated by being passed through a De Laval Baby No. 2 separator, the cream and skim milk being mixed together again before making into cheese; and, in two other experiments, the milk was aerated by an ordinary aerator.

24. A comparative study has been made of the composition of the milk, whey and cheese for the different months, in order to note changes of composition taking place during the factory season, and the effect of such changes upon the quantity and quality of cheese.

25. A few of the October cheeses were made with special reference to studying the chemical changes that take place in the process of ripening. These cheeses will be kept as long as practicable and analyzed from time to time.

2. Extent of Investigation.

We have made experiments from three to five days in each month, from May to October, in five different cheese factories, located in Oneida, Oswego, Jefferson and St. Lawrence counties, making an average of ten experiments in each factory. In addition, we have made experiments at this Station from two to eight days in each month for the same period of time. In all, we have made 106 experiments, and, in this work, have used over 200,000 pounds of milk, representing the product of not less than 1,500 different cows. The results may, therefore, be claimed to represent the average conditions that prevail in New York State more closely than any other data now existing.

3. NUMBER OF EXPERIMENTS MADE DURING THE SEASON OF 1892

	May.	June.	July.	August.	September.	October.	Totals for season.
Factory experiments	6	10	8	7	11	8	56
Station experiments.......	8	8	4	10	10	16	50
Total	14	18	12	17	21	24	106

4. POUNDS OF MILK USED IN EXPERIMENTS.

	May.	June.	July.	August.	September.	October.	Total for season.
Factory experiments:							
Least	3,307	4,394	4,083	3,712	3,758	2,903	....
Greatest	3,583	4,640	5,097	4,322	4,159	3,749	....
Average	3,429	4,509	4,591	4,050	3,994	3,240	....
Total	20,573	45,058	36,726	28,348	43,932	25,917	200,554
Station experiments:							
Least	250	250	250	230	250	229	....
Greatest	300	250	250	250	250	271	....
Average	275	250	250	243	250	250	....
Total	2,200	2,000	1,000	2,430	2,500	4,000	14,130
Total of all experiments	22,773	47,058	37,726	30,778	46,432	29,917	214,684

If we assume that each cow averaged twenty pounds of milk per day during the season, the amount of milk used represents over 20,000 individual milkings and our average analyses may, therefore, be regarded as representing the average of that number of analyses, although we made actual analysis of only about 100 samples.

5. POUNDS OF WHEY MADE IN EXPERIMENTS.

	May.	June.	July.	August.	September.	October.	Totals for season.
Factory experiments:							
Least	3,015.0	3,990.8	3,687.0	3,334.0	3,375.0	2,541.0	
Greatest	3,277.0	4,127.5	4,581.0	3,885.0	3,750.0	3,322.0	
Average	3,129.0	4,062.4	4,133.7	3,644.0	3,598.3	2,857.0	
Total	18,772.0	40,591.5	33,068.0	25,505.0	39,579.0	22,853.0	180,369
Station experiments:							
Least	224.5	222.4	224.2	205.5	220.1	206.1	
Greatest	266.8	227.4	228.0	222.7	223.4	232.6	
Average	243.8	224.4	225.7	216.5	222.6	221.5	
Total	1,950.8	1,795.4	902.8	2,165.3	2,225.8	3,554.0	12,584
Totals of all experiments	20,722.8	42,387.0	33,970.8	27,670.3	41,804.8	26,397.0	192,953

6. POUNDS OF CHEESE MADE IN EXPERIMENTS.

	May.	June.	July.	August.	September.	October.	Totals for season.
Factory experiments:							
Least	292.0	403.25	396.0	378.0	383.0	362.0	
Greatest	306.0	512.50	516.0	437.0	409.0	427.0	
Average	300.0	446.65	457.25	406.0	395.7	383.0	
Total	1,801.0	4,466.50	3,658.0	2,843.0	4,353.0	3,064.0	20,185.5
Station experiments:							
Least	25.47	22.60	22.00	24.50	26.60	22.90	
Greatest	33.18	27.60	25.75	27.25	29.90	38.40	
Average	31.15	25.57	24.30	26.50	27.42	28.50	
Total	249.21	204.55	97.20	264.75	274.20	456.00	1,545.9
Totals for all experiments	2,050.21	4,671.05	3,755.20	3,107.75	4,627.20	3,520.00	21,731.4

7. Amount of Analytical Work Required by the Investigation and Extent of Data Furnished.

In order to insure the greatest possible accuracy, every analytical determination was performed three times; so that, in making analyses of the milk used in 106 experiments, an amount of analytical work was done that was equivalent to the analysis of 318 samples of milk. The same was true of the whey and cheese. The table below gives the number of different determinations as they were made each month.

	May.	June.	July.	August.	September.	October.	Total for season.
Direct determinations:							
Total solids	126	162	108	153	189	216	954
Fat	126	162	108	153	189	216	954
Casein and albumen	126	162	108	153	189	216	954
Casein	98	126	86	132	126	144	712
Total number of direct determinations	476	612	410	591	693	792	3,574
Indirect determinations:							
Water	42	54	36	51	63	72	318
Albumen	42	54	36	34	42	48	256
Sugar, ash, etc	42	54	36	51	63	72	318
Total number of indirect determinations	126	162	108	136	168	192	892
Total number of direct and indirect determinations	602	774	518	727	861	984	4,466

In addition to the numerical data furnished directly by chemical analysis, there have been presented other data derived from these, the presentation of which was required for an intelligent discussion of the various points to which attention was called. These derived numerical data aggregate somewhat over 2,600 in number. Still further, various data have been presented in regard to the conditions of manufacture and these have amounted to about 1,600 in number. These numbers serve to indicate, to some extent, the very large amount of detailed work that this investigation has necessitated.

8. Explanations Connected with the Following Table Containing Analyses of Milk, Whey and Cheese.

The analyses contained in the following table are arranged according to the per cent. of fat in the milk; the data are obtained by averaging all the milks containing the same amount of fat without regard to time or place of production. The amount of whey is obtained by the method previously used; that is, the amount of green cheese made is taken from 100 pounds of milk and the difference represents the whey. A different method from that previously employed is here used to determine the composition of the cheese. Hitherto the results obtained from actual analysis have been given; the results contained in this table are not merely the averages of the individual analyses previously presented, but they are obtained by subtracting the constituents found in the whey made from 100 pounds of milk from the constituents found in 100 pounds of milk. The remainder should give the amount of each constituent found in the cheese made from 100 pounds of milk. From these data the composition of the cheese is readily calculated. The results obtained by this method agree fairly well with those obtained by actual analysis; of the two methods, that used here gives more uniform and consistent results, since it is a matter of great difficulty to secure for analysis a thoroughly representative sample of cheese.

V. AVERAGE OF ANALYSES OF MILK, WHEY AND CHEESE.

Numbers of experiments included in averages.		Composition Expressed in Parts per Hundred. Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.	From One Hundred Pounds of Milk. Pounds.	Pounds of water.	Pounds of solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
1, 3	Milk	88.40	11.60	3.05	2.64	1.98	0.66	5.91	100	88.40	11.60	3.05	2.64	1.98	0.66	5.91
	Whey	93.13	6.87	0.28	0.69	......	....	5.90	91.50	85.21	6.29	0.26	0.63	....	....	5.40
	Green cheese	37.53	62.47	32.82	23.65	22.45	1.20	6.00	8.50	3.19	5.31	2.79	2.01	1.91	0.10	0.51
5	Milk	87.81	12.19	3.10	2.72	2.06	0.66	6.37	100	87.81	12.19	3.10	2.72	2.06	0.66	6.37
	Whey	92.60	7.40	0.33	0.71	......	....	6.36	91.38	84.62	6.76	0.30	0.65	....	....	5.81
	Green cheese	37.00	63.00	32.48	24.00	22.35	1.65	6.52	8.62	3.19	5.43	2.80	2.07	1.93	0.14	0.56
4	Milk	87.97	12.03	3.30	2.63	2.03	0.60	6.10	100	87.97	12.03	3.30	2.63	2.03	0.60	6.10
	Whey	92.83	7.17	0.36	0.71	......	....	6.10	90.95	84.43	6.52	0.33	0.64	....	....	5.55
	Green cheese	39.12	60.88	32.82	22.00	21.11	0.89	6.06	9.05	3.54	5.51	2.97	1.99	1.91	0.08	0.55
2, 6	Milk	87.94	12.06	3.35	2.65	1.97	0.68	6.06	100	87.94	12.06	3.35	2.65	1.97	0.68	6.06
	Whey	92.82	7.18	0.34	0.72	......	....	6.12	90.87	84.35	6.52	0.31	0.65	....	....	5.56
	Green cheese	39.32	60.68	33.30	21.90	20.32	1.58	5.48	9.13	3.59	5.54	3.04	2.00	1.86	0.14	0.50
21	Milk	87.52	12.48	3.45	3.20	2.43	0.77	5.83	100	87.52	12.48	3.45	3.20	2.43	0.77	5.83
	Whey	92.93	7.07	0.23	0.88	......	....	5.96	90.32	83.93	6.39	0.21	0.79	....	....	5.39
	Green cheese	37.09	62.91	33.47	24.90	23.57	1.33	4.54	9.68	3.59	6.09	3.24	2.41	3.28	0.13	0.44
15, 18, 38, 40, 47	Milk	87.52	12.48	3.50	3.14	2.47	0.67	5.84	100	87.52	12.48	3.50	3.14	2.47	0.67	5.84
	Whey	93.02	6.98	0.38	0.81	......	....	5.79	90.14	83.85	6.29	0.34	0.73	....	....	5.22
	Green cheese	37.22	62.78	32.05	24.44	23.03	1.41	6.29	9.86	3.67	6.19	3.16	2.41	2.27	0.14	0.62
64	Milk	87.80	12.20	3.55	3.09	2.51	0.58	5.56	100	87.80	12.20	3.55	3.09	2.51	0.58	5.56
	Whey	93.27	6.73	0.40	0.81	......	....	5.52	90.35	84.27	6.08	0.36	0.73	....	....	4.99
	Green cheese	36.58	63.42	33.05	24.46	22.29	2.17	5.94	9.65	3.53	6.12	3.19	2.36	2.15	0.21	0.57
16, 17, 19, 36, 39, 46	Milk	87.45	12.55	3.60	3.15	2.44	0.71	5.80	100	87.45	12.55	3.60	3.15	2.44	0.71	5.80
	Whey	93.04	6.96	0.32	0.83	......	....	5.81	90.23	83.95	6.28	0.29	0.75	....	....	5.24
	Green cheese	35.82	64.18	33.88	24.56	22.93	1.63	5.74	9.77	3.50	6.27	3.31	2.40	2.24	0.16	0.56

22, 34	Milk	87.38	12.62	3.65	3.15	2.47	0.68	5.82	100	87.38	12.62	3.65	3.15	2.47	0.68	5.82
	Whey	93.05	6.95	0.30	0.86	......	....	5.79	89.66	83.43	6.23	0.27	0.77	....	....	5.19
	Green cheese	38.20	61.80	32.70	23.00	21.98	1.02	6.10	10.34	3.95	6.39	3.38	2.38	2.27	0.11	0.63
20, 33, 35, 66	Milk	87.46	12.54	3.70	3.13	2.49	0.64	5.71	100	87.46	12.54	3.70	3.13	2.49	0.64	5.71
	Whey	93.17	6.83	0.32	0.85	......	....	5.66	90.10	83.94	6.16	0.29	0.77	....	....	5.10
	Green cheese	35.56	64.44	34.44	23.84	22.32	1.52	6.16	9.90	3.52	6.38	3.41	2.36	2.21	0.15	0.61
37, 50, 62	Milk	87.41	12.59	3.75	3.06	2.48	0.58	5.78	100	87.41	12.59	3.75	3.06	2.48	0.58	5.78
	Whey	93.18	6.82	0.34	0.83	......	....	5.65	89.95	83.82	6.13	0.31	0.75	....	....	5.07
	Green cheese	35.72	64.28	34.23	23.00	21.38	1.62	7.05	10.05	3.59	6.46	3.44	2.31	2.15	0.16	0.71
41, 42, 45, 63, 67, 70	Milk	87.54	12.46	3.80	3.08	2.46	0.62	5.58	100	87.54	12.46	3.80	3.08	2.46	0.62	5.58
	Whey	93.19	6.81	0.44	0.82	......	....	5.55	90.19	84.05	6.14	0.40	0.74	....	....	5.00
	Green cheese	35.58	64.42	34.66	23.85	22.07	1.78	5.91	9.81	3.49	6.32	3.40	2.34	2.17	0.17	0.58
51, 69, 72, 80, 82	Milk	87.34	12.66	3.85	3.18	2.53	0.65	5.63	100	87.34	12.66	3.85	3.18	2.53	0.65	5.63
	Whey	93.16	6.84	0.37	0.86	......	....	5.61	89.64	83.51	6.13	0.33	0.77	....	....	5.03
	Green cheese	36.97	63.03	33.98	23.26	21.16	2.10	5.79	10.36	3.83	6.53	3.52	2.41	2.19	0.22	0.60
27, 28, 43, 49, 68, 71, 81, 93, 94.	Milk	87.41	12.59	3.90	3.18	2.56	0.62	5.51	100	87.41	12.59	3.90	3.18	2.56	0.62	5.51
	Whey	93.23	6.77	0.36	0.83	......	....	5.58	89.71	83.64	6.07	0.32	0.74	....	....	5.01
	Green cheese	36.64	63.36	34.80	23.71	22.33	1.38	4.85	10.29	3.77	6.52	3.58	2.44	2.30	0.14	0.50
31, 32, 52, 53, 56, 65	Milk	87.29	12.71	3.95	3.22	2.49	0.73	5.54	100	87.29	12.71	3.95	3.22	2.49	0.73	5.54
	Whey	93.10	6.90	0.34	0.88	......	....	5.68	89.56	83.38	6.18	0.30	0.79	....	....	5.09
	Green cheese	37.45	62.55	34.96	23.28	22.14	1.14	4.31	10.44	3.91	6.53	3.65	2.43	2.31	0.12	0.45
25, 26, 48, 54, 55, 58, 59, 77, 78, 85, 91, 104	Milk	87.00	13.00	4.00	3.29	2.68	0.61	5.71	100	87.00	13.00	4.00	3.29	2.68	0.61	5.71
	Whey	93.04	6.96	0.30	0.87	......	....	5.79	88.82	82.64	6.18	0.27	0.77	....	....	5.14
	Green cheese	39.00	61.00	33.36	22.54	21.21	1.33	5.10	11.18	4.36	6.82	3.73	2.52	2.37	0.15	0.57
83, 95, 105, 106	Milk	86.91	13.09	4.05	3.45	2.77	0.68	5.59	100	86.91	13.09	4.05	3.45	2.77	0.68	5.59
	Whey	93.17	6.83	0.37	0.87	......	....	5.59	88.48	82.44	6.04	0.33	0.77	....	....	4.94
	Green cheese	38.80	61.20	32.30	23.27	22.20	1.07	5.63	11.52	4.47	7.05	3.72	2.68	2.57	0.11	0.65
30, 60, 61, 76, 87, 89, 96, 98.	Milk	86.92	13.08	4.10	3.36	2.68	0.68	5.62	100	86.92	13.08	4.10	3.36	2.68	0.68	5.62
	Whey	93.18	6.82	0.35	0.89	......	....	5.58	88.82	82.76	6.06	0.31	0.79	....	....	4.96
	Green cheese	37.21	62.79	33.90	23.00	21.50	1.50	5.89	11.18	4.16	7.02	3.79	2.57	2.40	0.17	0.66
11, 79, 84, 86, 99	Milk	86.59	13.41	4.15	3.48	2.76	0.72	5.78	100	86.59	13.41	4.15	3.48	2.76	0.72	5.78
	Whey	93.04	6.96	0.35	0.91	......	....	5.70	88.36	82.21	6.15	0.31	0.80	....	....	5.04
	Green cheese	37.63	62.37	33.09	23.00	22.00	1.00	6.37	11.64	4.38	7.26	3.34	2.68	2.56	0.12	0.74
9, 12	Milk	86.16	13.84	4.20	3.38	2.62	0.76	6.26	100	86.16	13.84	4.20	3.38	2.62	0.76	6.26
	Whey	92.50	7.50	0.34	0.89	......	....	6.27	89.00	82.33	6.67	0.30	0.79	....	....	5.58
	Green cheese	34.82	65.18	35.45	23.64	22.41	1.23	6.09	11.00	3.83	7.17	3.90	2.59	2.45	0.14	0.68

V. Averages of Analyses of Milk, Whey and Cheese — (*Concluded*).

Numbers of experiments included in averages		Composition Expressed in Parts per Hundred.							From One Hundred Pounds of Milk.							
		Per cent. water.	Per cent of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
74, 88	Milk	86.53	13.47	4.25	3.48	......	0.73	5.74	100	86.53	13.47	4.25	3.48	2.75	0.73	5.74
	Whey	93.28	6.72	0.32	0.94	......	....	5.46	88.60	82.65	5.95	0.28	0.83	....	....	4.84
	Green cheese	34.00	66.00	34.82	23.25	21.99	1.26	7.93	11.40	3.88	7.52	3.97	2.65	2.51	0.14	0.90
13, 14, 73	Milk	86.61	13.39	4.30	3.44	2.64	0.80	5.65	100	86.61	13.39	4.30	3.44	2.64	0.80	5.65
	Whey	92.91	7.09	0.31	0.90	......	....	5.88	88.85	82.55	6.30	0.28	0.80	....	....	5.22
	Green cheese	36.40	63.60	36.05	23.68	22.89	0.79	3.87	11.15	4.06	7.09	4.02	2.64	2.55	0.09	0.43
90, 97	Milk	86.31	13.69	4.35	3.59	2.90	0.69	5.75	100	86.31	13.69	4.35	3.59	2.90	0.69	5.75
	Whey	93.00	7.00	0.35	0.94	......	....	5.71	88.30	82.12	6.18	0.31	0.83	....	....	5.04
	Green cheese	35.81	64.19	34.53	23.59	21.79	1.80	6.07	11.70	4.19	7.51	4.04	2.76	2.55	0.21	0.71
10, 75, 103	Milk	86.54	13.46	4.40	3.46	2.71	0.75	5.60	100	86.54	13.46	4.40	3.46	2.71	0.75	5.60
	Whey	92.96	7.04	0.40	0.88	......	....	5.76	88.40	82.18	6.22	0.35	0.78	....	....	5.09
	Green cheese	37.59	62.41	34.91	23.10	22.10	1.00	4.40	11.60	4.36	7.24	4.05	2.68	2.56	0.12	0.51
102 (fat two-fifths removed).	Milk	88.17	11.83	2.40	3.47	2.90	0.57	5.96	100	88.17	11.83	2.40	3.47	2.90	0.57	5.96
	Whey	93.12	6.88	0.18	0.80	......	....	5.90	90.00	83.81	6.19	0.16	0.72	....	....	5.31
	Green cheese	43.60	56.40	22.40	27.50	26.30	1.20	6.50	10.00	4.36	5.64	2.24	2.75	2.63	0.12	0.65
44 (fat one-fourth removed).	Milk	88.30	11.70	2.90	3.21	2.57	0.64	5.59	100	88.30	11.70	2.90	3.21	2.57	0.64	5.59
	Whey	93.04	6.96	0.27	0.84	......	....	5.85	90.65	84.34	6.31	0.24	0.76	....	....	5.31
	Green cheese	42.35	57.65	28.45	26.20	25.13	1.07	3.00	9.35	3.96	5.39	2.66	2.45	2.35	0.10	0.28
24 (fat one-fifth removed).	Milk	88.25	11.75	2.95	3.26	2.50	0.76	5.54	100	88.25	11.75	2.95	3.26	2.50	0.76	5.54
	Whey	93.18	6.82	0.29	0.88	......	....	5.65	90.90	84.70	6.20	0.26	0.80	....	....	5.14
	Green cheese	39.00	61.00	29.55	27.03	26.26	0.77	4.42	9.10	3.55	5.55	2.69	2.46	2.39	0.07	0.40
29 (fat one-fifth removed).	Milk	88.25	11.75	3.20	3.21	2.41	0.80	5.34	100	88.25	11.75	3.20	3.21	2.41	0.80	5.34
	Whey	93.20	6.80	0.29	0.85	......	....	5.66	90.59	84.43	6.16	0.26	0.77	....	....	5.13
	Green cheese	40.60	59.40	31.24	25.93	25.24	0.69	2.23	9.41	3.82	5.59	2.94	2.44	2.37	0.07	0.21

57 (fat one-sixth removed).	Milk	87.77	12.23	3.25	3.27	2.60	0.67	5.71	100	87.77	12.23	3.25	3.27	2.60	0.67	5.71
	Whey	93.10	6.90	0.25	0.90	......	....	5.75	90.20	88.98	6.22	0.23	0.81	....	....	5.18
	Green cheese	38.67	61.33	30.82	25.10	23.88	1.22	5.41	9.80	3.79	6.01	3.02	2.46	2.34	0.12	0.53
7 (fat one-fourth removed).	Milk	86.97	13.03	3.55	3.46	2.69	0.77	6.01	100	86.97	13.03	3.55	3.46	2.69	0.77	6.01
	Whey	92.74	7.26	0.23	0.93	......	....	6.10	89.80	83.28	6.52	0.21	0.84	....	....	5.48
	Green cheese	36.18	63.82	32.84	25.69	24.51	1.18	5.29	10.20	3.69	6.51	3.35	2.62	2.50	0.12	0.53
100 (fat one-tenth removed).	Milk	86.92	13.08	3.80	3.48	2.81	0.67	5.80	100	86.92	13.08	3.80	3.48	2.81	0.67	5.80
	Whey	92.98	7.02	0.30	0.84	......	....	5.88	88.53	82.32	6.21	0.27	0.74	....	....	5.20
	Green cheese	40.10	59.90	30.78	23.90	23.00	0.90	5.22	11.47	4.60	6.87	3.53	2.74	2.64	0.10	0.60
23 (cream taken from 24 added).	Milk	86.81	13.19	4.22	3.30	2.57	0.73	5.67	100	86.81	13.19	4.22	3.30	2.57	0.73	5.67
	Whey	92.87	7.13	0.30	0.88	.....	....	5.95	88.90	82.56	6.34	0.27	0.78	....	....	5.29
	Green cheese	38.29	61.71	35.59	22.70	20.99	1.71	3.42	11.10	4.25	6.85	3.95	2.52	2.33	0.19	0.38
101 (cream taken from 102 added).	Milk	85.35	14.65	5.70	3.32	2.80	0.52	5.63	100	85.35	14.65	5.70	3.32	2.80	0.52	5.63
	Whey	92.95	7.05	0.49	0.79	......	....	5.77	85.84	79.78	6.06	0.42	0.68	....	....	4.96
	Green cheese	39.34	60.66	37.29	18.64	18.00	0.64	4.73	14.16	5.57	8.59	5.28	2.64	2.55	0.09	0.67
8 (cream taken from 7 added).	Milk	84.74	15.26	6.00	3.46	2.73	0.73	5.80	100	84.74	15.26	6.00	3.46	2.73	0.73	5.80
	Whey	92.76	7.24	0.39	0.92	......	....	5.93	86.70	80.42	6.28	0.34	0.80	....	....	5.14
	Green cheese	32.50	67.50	42.56	20.00	18.80	1.20	4.94	13.30	4.32	8.98	5.66	2.66	2.50	0.16	0.66

VI. SUMMARY OF RESULTS RELATING TO CONDITIONS OF MANUFACTURE.

While we can not draw any definite general conclusions from a study of the conditions of manufacture in respect to many important points, it is a matter of interest to consider briefly some of the more prominent facts observed. We shall present, in tabulated form, an outline of the data secured during the season in regard to the following points:

1. Ounces of rennet-extract used for 1,000 pounds of milk.
2. Temperature of milk when rennet was added.
3. Time required for rennet to coagulate the milk completely.
4. Temperature to which curd was heated after being cut.
5. Time from cutting curd to drawing whey.
6. Time from drawing whey to putting to press.
7. Time consumed in the whole operation of cheese-making.

1. OUNCES OF RENNET USED FOR ONE THOUSAND POUNDS OF MILK.

	May.	June.	July.	August	September.	October.	Average for season.
Factory experiments:							
Least	4	2	3	2	3	3	....
Greatest	4	4	6	5	6	6	....
Average	4	2¼	3⅜	3	3⅜	3¾	3⅓
Station experiments:							
Least	1¾	2½	2¾	3	3	3	....
Greatest	8	3	4	6	3	9	....
Average	3½	2¾	3½	3½	3	3½	3⅓

The rennet-extract used in all the station experiments and in most of the factory experiments was Hansen's. The average amount used for ordinary work was about three ounces for each 1,000 pounds of milk. The amount of rennet used varied from one and three-fourths to nine ounces for 1,000 pounds of milk. The effect of using different amounts of rennet upon the other conditions of manufacture and upon the losses, the yield and quality of cheese will be considered later by itself under a special subdivision.

2. Temperature of Milk When Rennet Was Added:

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiment:							
Lowest temperature	82° F	84° F	82° F	84° F	83° F	86° F	....
Highest temperature	85°	86°	84°	84°	84° F	90°	....
Average temperature	83½°	84¼°	83¼°	84°	83¾°	87°	84¼° F
Station experiments:							
Lowest temperature	82° F	83° F	82° F	82° F	85° F	84° F	....
Highest temperature	84°	88°	84°	86°	88°	88°	....
Average temperature	83½°	84½°	83°	83°	86°	85½°	84¼° F

It will be seen that the average temperature of the milk, when the rennet was added, was very near 84 degrees F., varying from 82 degrees F. to 90 degrees F. There was a tendency to use a somewhat higher temperature as the season drew near the end. Taking the averages for each month, the extreme variation was from 83 degrees F. to 87 degrees F., a range of 4 degrees. In our work next season, we shall take the precaution to furnish every worker with a thermometer that has been carefully standardized. We can then rely fully upon all the data that refer to temperature.

3. TIME REQUIRED FOR RENNET TO COAGULATE THE MILK COMPLETELY.

	May.	June.	July.	August.	September.	October.	Average for season.
	Min.	Min.	Min.	Min.	Min.	Min.	Min.
Factory experiments:							
Shortest time	19	15	18	15	14	14	....
Longest time	26	40	40	40	28	28	....
Average time	23	26	28	26	23	23	25
Station experiments:							
Shortest time	13	11	3	11	9	9	....
Longest time	32	25	11	35	30	30	....
Average time	21	18	7	20	23	23	19

The time required for the rennet to completely coagulate the milk varied, in all the work, from three to forty minutes. The time required for coagulation depended mainly upon two conditions — (1) the amount of rennet extract used, and (2) the degree of "ripeness" or acidity of the milk. The range of temperature employed was probably not such as to affect noticeably the average time of coagulation. The time was more uniform in the factory experiments, because larger amounts of milk were used and the amount of rennet used was more uniform. In the July station experiments tainted milk was used. There is much special study needed in connection with the conditions under which rennet-extract coagulates milk.

4. TEMPERATURE TO WHICH CURD WAS HEATED AFTER BEING CUT.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Lowest temperature	98° F.	97° F.	98° F.	98° F.	98° F.	100° F.	....
Highest temperature	98°	106°	98°	100°	98°	100°	....
Average temperature	98°	99°	98°	98½°	98°	100°	98½° F.
Station experiments:							
Lowest temperature	98° F.	97° F.	99° F.	98° F.	100° F.	97° F.	....
Highest temperature	99°	106°	99°	102°	101°	100°	....
Average temperature	98¾°	99°	99°	99°	100½°	99°	99° F.

The extreme variation in temperature used in heating the curd was from 97 degrees F. to 106 degrees F., the latter temperature being used in only a few special experiments. The monthly average of temperature shows a variation from 98 degrees F. to 100 1-2 degrees F., the average of all being pretty near 99 degrees F. The effects resulting from the use of a temperature of 106 degrees F. upon the loss of milk constituents, the yield and quality of cheese will be noticed more in detail later.

5 TIME FROM CUTTING CURD TO DRAWING WHEY.

	May.		June.		July.		August.		September.		October.		Average for season.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Factory experiments:														
Least	2	12	1	50	1	57	1	23	2	44	2	00	....	....
Greatest	4	17	3	00	2	57	3	00	4	25	3	42	....	....
Average	3	28	2	29	2	17	2	6	3	28	2	39	2	45
Station experiments:														
Least	1	31	1	23	1	00	1	33	0	34	0	32	....	....
Greatest	2	5	2	20	1	4	3	8	3	35	2	16	....	....
Average	1	53	1	37	1	1	2	10	2	29	1	43	1	49

We notice the following points of interest:

1. The curd in the May factory experiments required a much longer time than the average for the expulsion of moisture.

2. In September, when the cows of the factory at which the work was done were feeding largely on the soured refuse of a corn-canning factory, there was a tendency to floating curd and a slower expulsion of moisture.

3. In some of the station experiments, the milk was tainted and also rather acid; in these cases, the whey was taken from the curd more quickly than in working with normal milk.

4. The factory experiments took about one hour longer for this stage of the work, owing to the much larger quantities of milk used.

6. TIME FROM DRAWING WHEY TO PUTTING TO PRESS.

	May.		June.		July.		August.		September.		October.		Average for season.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Factory experiments:														
Least	1	00	1	50	2	5	2	15	2	15	2	15	....	....
Greatest	2	00	3	50	2	50	4	40	4	20	3	50	....	....
Average	1	33	3	15	2	25	3	00	3	9	2	52	2	42
Station experiments:														
Least	1	25	1	42	2	00	1	10	1	25	1	15	....	....
Greatest	1	55	2	45	2	40	2	35	2	20	3	10	....	....
Average	1	38	2	22	2	20	1	46	2	00	2	30	2	6

7. TIME CONSUMED IN THE WHOLE OPERATION OF CHEESE MAKING.

	May.		June.		July.		August.		September.		October.		Average for season.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Factory experiments:														
Least	5	5	6	40	6	20	6	00	7	28	7	17	....	....
Greatest	8	40	9	7	8	40	9	40	9	20	9	20	....	....
Average	7	8	7	45	7	15	7	15	8	30	8	10	7	40
Station experiments:														
Least	6	00	4	15	3	20	4	10	3	00	5	5	....	....
Greatest	7	00	5	40	4	30	6	55	7	45	7	35	....	....
Average	6	24	5	00	3	50	5	20	6	20	6	00	5	30

Except for the difference noticed in the July work, the cause of which has been previously given, the shorter time required for cheese-making in the station experiments was due to the smaller amount of milk used in the latter. It is interesting to notice that in September, when the amount of fat lost in the factory experiments was greatest at any time during the season, the time occupied by the operation of cheese-making was greatest. This may, of course, have been purely accidental.

VII. A STUDY OF THE COMPOSITION OF MILK.

The data which have been accumulated during the past season in connection with this investigation afford abundant material for studying the composition of milk, whey and cheese, and also the variations in composition which occur with the advance of the season. While chemical and dairy literature contains many analyses of the milk of individual cows, we have nowhere been able to find analyses based upon the mixed milk of large numbers of cows and covering an extended period of time. Our data furnish us the most satisfactory means we have yet met with for determining the average composition of the milk of our dairy cows in New York State; and the same is true of the whey and cheese. We hope our future work will so enlarge the number of data that we can before long speak with full positiveness in regard to the composition of the dairy products of our State.

We shall take up this study of the composition of milk under the following heads:

1. Pounds of solids in 100 pounds of milk.
2. Pounds of fat in 100 pounds of milk.
3. Pounds of casein and albumen in 100 pounds of milk.
4. Pounds of casein in 100 pounds of milk.
5. Pounds of albumen in 100 pounds of milk.
6. Relation of casein to albumen in normal milk.
7. Relation of fat to casein and albumen in normal milk.
8. Relation of fat to casein an normal milk.
9. Relation of fat to casein and albumen and to casein in skimmed milk and in milk containing added cream.

10. General summary.

In studying the composition of milk in the succeeding pages, it will be well to keep in mind the following facts:

(1.) The factory-milk represents the mixed morning and evening milk from numerous herds of cows.

(2.) The factory-milk of May and September came from the same herds of cows.

(3.) The factory-milk of the other months represents, in every case, a different factory and different cows from those of the other months.

(4.) It is the rule in the case of the factory-cows, to commence the lactation period in the spring; and, hence, our factory data represent in reality, the changes due to advance of the period of lactation, modified, to some extent, by special conditions, such as food, weather, etc.

(5.) About one-half of the milk used in the station experiments came from our station-herd, representing several different breeds, in every stage of lactation. The rest of the milk was obtained from different sources. The data obtained from the station-experiments in regard to the composition of the milk do not, therefore, illustrate in such marked degree as do the factory-experiments the changes due to advance of lactation.

1. Pounds of Solids in One Hundred Pounds of Normal Milk.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	11.47	12.41	12.47	12.35	12.20	13.19	....
Greatest	12.48	12.65	12.73	12.96	12.76	13.91	....
Average	11.92	12.53	12.60	12.69	12.55	13.58	12.64
Station experiments:							
Least	13.51	12.41	12.24	12.77	12.52	12.60	....
Greatest	13.91	13.26	12.52	12.93	13.16	13.50	....
Average	13.71	12.74	12.33	12.85	12.83	13.08	12.92
Average of all experiments	12.09	12.54	12.59	12.70	12.56	13.51	12.66

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The factory-milk illustrates very well the fact that the solids in the milk increase as the season advances, and that, therefore, the amount of constituents that produce cheese increases. In other words, the cheese-producing power of milk increases as the season advances. We shall study later the relation of milk-solids to the yield of cheese and the general loss of milk-solids in cheese-making.

The milk-solids in the factory-milk varied, during the season, from 11.47 to 12.91 pounds in 100 pounds of milk and averaged 12.64 pounds. In the station-milk, the variation during the season ranged from 12.24 to 13.91 pounds, and the average was 12.92 pounds in 100 pounds of milk. The average of all the milk for the season was 12.66 pounds.

2. Pounds of Fat in One Hundred Pounds of Normal Milk.

	May.	June.	July.	August.	September.	October.	Average for season,
Factory experiments:							
Least	3.04	3.45	3.50	3.50	3.55	4.05	....
Greatest	3.37	3.70	3.75	4.00	3.95	4.35	....
Average	3.20	3.58	3.63	3.77	3.81	4.14	3.69
Station experiments:							
Least	4.15	3.90	3.80	3.95	3.85	3.90	....
Greatest	4.38	4.10	3.90	4.10	4.40	4.40	....
Average	4.25	3.98	3.83	4.00	4.08	4.04	4.03
Average of all experiments	3.30	3.60	3.64	3.79	3.82	4.13	3.70

In the factory-milk, the fat varied from 3.04 pounds to 4.35 pounds in 100 pounds of milk and averaged 3.69 pounds during the season. In the station-milk, the fat varied from 3.80 pounds to 4.40 pounds in 100 pounds of milk and averaged 4.03 pounds for the season. The season's average of all the milk was 3.70 pounds.

The increase of fat during the advance of the period of lactation is well illustrated in the factory-milk.

3. POUNDS OF CASEIN AND ALBUMEN IN ONE HUNDRED POUNDS OF NORMAL MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	2.53	3.20	3.03	3.00	3.07	3.56	....
Greatest	2.78	3.30	3.10	3.09	3.22	3.76	....
Average	2.65	3.25	3.08	3.04	3.12	3.66	3.13
Station experiments:							
Least	3.35	3.14	3.08	3.17	3.14	3.25	....
Greatest	3.50	3.23	3.23	3.29	3.40	3.56	....
Average	3.45	3.19	3.15	3.24	3.26	3.37	3.28
Average of all experiments	2.73	3.24	3.09	3.06	3.13	3.62	3.14

In the factory-milk, the casein and albumen varied, during the season, from 2.53 pounds to 3.76 pounds, and averaged 3.13 pounds in 100 pounds of milk. In the station-milk, the variation ranged from 3.08 pounds to 3.56 pounds, and averaged 3.28 pounds in 100 pounds of milk for the season. The average of all the experiments for the season was 3.14 pounds.

Many analyses of milk which have been published represent the casein and albumen as being equal to or greater in amount than the fat. When we come to consider the composition of milk with reference to cheese-making, it is highly important to learn what relation to each other these compounds have in the milk. We will, therefore, a little later consider this question at some length as viewed in the light of the facts furnished by this season's work.

4. POUNDS OF CASEIN IN ONE HUNDRED POUNDS OF NORMAL MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	1.93	2.36	2.47	2.45	2.47	2.72	....
Greatest	2.06	2.57	2.54	2.49	2.61	3.00	....
Average	2.00	2.44	2.51	2.46	2.53	2.88	2.47
Station experiments:							
Least	2.60	2.41	2.39	2.49	2.49	2.64	....
Greatest	2.73	2.60	2.62	2.60	2.64	2.96	....
Average	2.68	2.48	2.49	2.53	2.56	2.76	2.58
Average of all experiments	2.07	2.44	2.51	2.47	2.54	2.86	2.48

In the factory-milk, the casein varied, during the season, from 1.93 pounds to 3.00 pounds, and averaged 2.47 pounds in 100 pounds of milk. In the station-milk, the casein varied from 2.39 to 2.96 pounds, and averaged 2.58 pounds in 100 pounds of milk. The average for all the milk during the season was 2.48 pounds. In the factory-milk, there was a gradual increase of casein as the season advanced.

5. POUNDS OF ALBUMEN IN ONE HUNDRED POUNDS OF NORMAL MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	0.60	0.73	0.56	0.55	0.57	0.71	....
Greatest	0.77	0.87	0.60	0.63	0.64	0.86	....
Average	0.65	0.81	0.57	0.58	0.59	0.78	0.66
Station experiments:							
Least	0.68	0.63	0.61	0.63	0.59	0.57	....
Greatest	0.82	0.80	0.69	0.80	0.82	0.67	....
Average	0.77	0.71	0.66	0.71	0.70	0.61	0.70
Average of all experiments	0.66	0.80	0.58	0.59	0.59	0.76	0.66

In the factory-milk, the albumen varied, during the season, from 0.55 pounds to 86 pounds and averaged 0.66 pounds in 100 pounds of milk. In the station-milk, the albumen varied from 0.57 pounds to 0.82 pounds and averaged 0.70 pounds. The average for all the milk during the season was 0.66 pounds. There appears to be considerable variation in the amount of albumen, but the point of special importance and interest is to see how this variation is related to the amount of casein in the milk; and we will take up this subject next.

6. Relation of Casein to Albumen in Normal Milk.

Blyth * says in regard to the amount of albumen in milk and the relation of casein to albumen in milk: "The amount of albumen in milk is really fairly constant, and averages 0.7 per cent. In healthy cows it is a very constant quantity, the chief deviation occurring directly after calving, when the amount may rise as high as 3 per cent., but this is always accompanied by a corresponding rise in the casein. According to the author's experience, the quantity of the latter being five times that of the albumen; so that if either the amount of casein or albumen is known, the one may be calculated from the other with great accuracy." The foregoing statement has been quite generally accepted as authoratitive. The author does not state the extent of the work upon which he bases his general conclusions, nor does he say anything about the source of the milk examined by him. The results secured in our work do not agree with the statements of Blyth, as an examination of the tables presented below will indicate. The first table gives the extreme and average results for each month during the season in regard to the relation of casein and albumen. The second table gives the extreme and average results in regard to the amount of casein and of albumen and their relation in milk; the third table gives similar data in detail for milks varying in fat from about 3 to nearly 4.5 pounds of fat in 100 pounds of milk. The figures in these tables represent the averages of about 100 samples of mixed milk and, as previously stated, they also represent the averages of over 20,000 milkings.

* Foods: Composition and Analysis, 2d ed., p. 208.

TABLE SHOWING POUNDS OF CASEIN FOR ONE POUND OF ALBUMEN IN NORMAL MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	2.6	2.7	4.1	3.9	3.9	3.2	......
Greatest	3.4	3.5	4.5	4.5	4.6	4.2	......
Average	3.1	3.0	4.4	4.2	4.3	3.7	3.74
Station experiments:							
Least	3.2	3.0	3.5	3.1	3.1	4.1	......
Greatest	4.0	4.1	4.3	4.0	4.3	4.9	......
Average	3.5	3.6	3.8	3.6	3.7	4.5	3.78
Average of all experiments	3.14	3.05	4.33	4.20	4.30	3.76	3.76

An examination of the above table, together with the three tables preceding this, enable us to make the following statements:

(1.) The amount of casein and albumen during the whole season varied from 2.53 pounds to 3.76 pounds in 100 pounds of milk, and averaged 3.14 pounds.

(2.) The amount of casein during the whole season varied from 1.93 pounds to 3.00 pounds and averaged 2.48 pounds in 100 pounds of milk.

(3.) The amount of albumen during the whole season varied from 0.55 pounds to 0.86 pounds, and averaged 0.66 pounds in 100 pounds of milk.

(4.) There were for each pound of albumen in the milk from 2.6 pounds to 4.9 pounds of casein, with an average of 3.76 pounds. The tendency was for the albumen to diminish, relative to the casein, as the season advanced.

These statements are presented in summary form as follows:

SUMMARY OF RESULTS FOR THE WHOLE SEASON.

	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of casein for one pound of albumen in milk.
Least	2.53	1.93	0.55	2.6
Greatest......................	3.76	3.00	0.86	4.9
Average.......................	3.14	2.48	0.66	3.76

We will now take up two of Blyth's statements and see how they agree with our facts.

(1.) "The amount of albumen in milk is really fairly constant and averages 0.7 per cent. In healthy cows it is a very constant quantity." Our results show that the average amount of albumen in normal milk is not far from 0.7 per cent., viz.: 0.66 per cent., but a detailed study shows very wide variations; and the deviations would, of course, have been very much greater, if we could have made analysis of the milk of the individual cows, whose mixed milk was used in our work.

(2.) "The albumen preserves a very constant relation to the casein, the quantity of the latter being five times that of the albumen; so that, if either the amount of casein or albumen is known, the one may be calculated from the other with great accuracy." Our results show that the relation of albumen to casein is very variable instead of constant, and, in no single instance, did any sample of the mixed normal milk contain as much as five parts of casein for one of albumen, the highest being 4.9, while the average was 3.76 parts of casein for one of albumen. If it were true that normal milk contains five parts of casein for one of albumen, the casein in our milk would have varied from 2.75 to 4.30 per cent., and averaged 3.35 per cent., while it actually varied from 1.83 to 3.00 per cent., and averaged 2.48 per cent. Again, on the basis of Blyth's statement, the total amount of casein and albumen in the milk would have varied from 3.30 to 5.16 per cent., with an average of 4.02 per cent., while it actually varied from 2.53 to 3.76 per cent. and averaged 3.14 per cent.

The relation of casein to albumen in milk is one of interest from a scientific standpoint and is of practical importance in connection with cheese-making, since the albumen mostly passes into the whey with the present processes used in cheese-making. We are making a study of this relation in connection with the individuals of our different breeds undergoing experiment at this Station, and, so far as our results go, they confirm the results secured in the past season's work in the investigation of cheese.

In the table given below, there are presented data giving the amount of casein and of albumen and their relation in normal milk, arranged in the order of the fat content of the milk, which ranged from about 3 to nearly 4.5 per cent.

TABLE SHOWING RELATION OF CASEIN TO ALBUMEN IN MILK.

Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of albumen in 100 pounds of milk.	Pounds of casein for 100 pounds of casein and albumen.	Pounds of albumen for 100 pounds of casein and albumen.	Pounds of casein for one pound of albumen in milk.
2.64	1.98	0.66	75.00	25.00	3.00
2.72	2.06	0.66	75.74	24.26	3.12
2.63	2.03	0.60	77.19	22.81	3.38
2.65	1.97	0.68	74.34	25.66	2.90
3.20	2.43	0.77	75.94	24.06	3.16
3.14	2.47	0.67	78.66	21.34	3.70
3.09	2.51	0.58	81.23	18.77	4.33
3.15	2.44	0.71	77.46	22.54	3.44
3.15	2.47	0.68	78.41	21.59	3.63
3.13	2.49	0.64	79.55	20.45	3.90
3.06	2.48	0.58	81.05	18.95	4.28
3.08	2.46	0.62	79.90	20.10	3.97
3.18	2.53	0.65	79.56	20.44	3.90
3.18	2.56	0.62	80.50	19.50	4.13
3.22	2.49	0.73	77.33	22.67	3.41
3.29	2.68	0.61	81.46	18.54	4.40
3.45	2.77	0.68	30.29	19.81	4.07
3.36	2.68	0.68	79.76	20.24	3.94
3.48	2.76	0.72	79.31	20.69	3.83
3.38	2.62	0.76	77.52	22.48	3.45
3.48	2.75	0.73	79.02	20.98	3.77
3.44	2.64	0.80	76.74	23.26	3.30
3.59	2.90	0.69	80.78	19.22	4.20
3.46	2.71	0.75	78.33	21.67	3.60

7. Relation of Fat to Casein and Albumen and to Casein in Normal Milk.

An examination of many individual analyses and averages of analyses of milk, especially as reported by German, French and English authorities, would make it appear that average milk contains about as much casein and albumen as fat, if not considerably more. Blyth* gives the following amounts of fat, casein and albumen as representing for these constituents the "average composition of healthy cow's milk":

Fat, per cent		3.50
Casein, per cent	3.98	4.75
Albumen, per cent	0.77	

* Foods: Composition and Analysis, 2d ed. p. 214.

König† gives the following averages:

	354 analyses.		455 analyses.		809 analyses.	
Fat, per cent		3.62		3.74		3.69
Casein, per cent	3.18 }	3.66	2.89 }	3.44	3.02 }	3.55
Albumen, per cent	0.48 }		0.55 }		0.53 }	

In our work this past season we have not found a single instance in which the normal mixed milk of herds contained more casein and albumen than fat; and, moreover, we have not found a single instance in which the milk contained as much casein and albumen as fat. In our investigation of breeds, we have found only one individual that regularly gave milk containing more casein and albumen than fat. Some other individuals, when twelve months or more along in lactation, were found to give milk of similar composition.

The data secured this past season should be sufficient to afford us a fair basis for ascertaining the relation of fat to casein and albumen in average normal milk, as we find it in New York State. The table presented below contains a summary of the season's results as applied to the relation of fat to casein and albumen in normal milk:

	Pounds of fat in 100 pounds of milk.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of fat for one pound of casein and albumen in milk.	Pounds of casein in 100 pounds of milk.	Pounds of fat for one pound of casein in milk.
Least	3.04	2.53	1.07	1.93	1.35
Greatest	4.40	3.76	1.33	3.00	1.74
Average	3.70	3.14	1.18	2.48	1.50

The table below gives in greater detail data showing the relation of fat to casein in normal milk, in partially skimmed milk and in milk to which cream has been added.

† Zusammensetzung der menschlichen Nahrungs und Genussmittel—3d ed. pp. 277, 295.

TABLE SHOWING RELATION OF FAT TO CASEIN AND TO CASEIN AND ALBUMEN IN MILK.

Pounds of fat in 100 pounds of milk.	Pounds of casein and albumen in 100 pounds of milk	Pounds of fat for one pound of casein and albumen in milk.	Pounds of casein in 100 pounds of milk.	Pounds of fat for one pound of casein.	Increase of fat in milk.	Increase of casein and albumen in milk.	Increase of casein in milk.
3.05	2.64	1.16	1.98	1.54	.....	.....	.....
3.10	2.72	1.14	2.06	1.50	0.05	0.08	0.08
3.30	2.63	1.25	2.03	1.62	0.25	0.00	0.05
3.35	2.65	1.26	1.97	1.70	0.30	0.00	0.00
3.45	3.20	1.08	2.43	1.42	0.40	0.56	0.45
3.50	3.14	1.11	2.47	1.42	0.45	0.50	0.49
3.55	3.09	1.15	2.51	1.41	0.50	0.45	0.53
3.60	3.15	1.14	2.44	1.48	0.55	0.51	0.46
3.65	3.15	1.16	2.47	1.48	0.60	0.51	0.49
3.70	3.13	1.18	2.49	1.50	0.65	0.49	0.51
3.75	3.06	1.23	2.48	1.51	0.70	0.42	0.50
3.80	3.08	1.23	2.46	1.54	0.75	0.44	0.48
3.85	3.18	1.21	2.53	1.52	0.80	0.54	0.55
3.90	3.18	1.23	2.56	1.52	0.85	0.54	0.58
3.95	3.22	1.23	2.49	1.58	0.90	0.58	0.51
4.00	3.29	1.22	2.68	1.50	0.95	0.65	0.70
4.05	3.45	1.17	2.77	1.46	1.00	0.81	0.79
4.10	3.36	1.22	2.68	1.53	1.05	0.72	0.70
4.15	3.48	1.20	2.76	1.50	1.10	0.84	0.78
4.20	3.38	1.24	2.62	1.60	1.15	0.74	0.64
4.25	3.48	1.22	2.75	1.55	1.20	0.84	0.77
4.30	3.44	1.25	2.64	1.63	1.25	0.80	0.66
4.35	3.59	1.21	2.90	1.50	1.30	0.95	0.92
4.40	3.46	1.27	2.71	1.62	1.35	0.82	0.73
2.40*	3.47	0.70	2.90	0.83	.....	.....	.....
2.90*	3.21	0.90	2.57	1.13	.....	.....	.....
2.95*	3.26	0.90	2.50	1.18	.....	.....	.....
3.20*	3.21	1.00	2.41	1.33	.....	.....	.....
3.25*	3.27	1.00	2.60	1.25	.....	.....	.....
3.56*	3.46	1.03	2.69	1.32	.....	.....	.....
3.80*	3.48	1.09	2.81	1.35	.....	.....	.....
4.22†	3.30	1.28	2.57	1.64	.....	.....	.....
5.70†	3.32	1.71	2.80	2.04	.....	.....	.....
6.00†	3.46	1.73	2.73	2.20	.....	.....	.....

A study of the tables above suggests the following points of interest:

(1st.) In normal milk, which contained fat varying from 3.04 to 4.40 per cent., the casein and albumen varied from 2.53 to 3.76

* Milk partially skimmed. † Cream added.

per cent. The fat averaged 3.70 per cent., and the casein and albumen 3.14 per cent.

(2d.) In no case, did normal milk during the season contain less than 1.07 pounds of fat for one pound of casein and albumen or more than 1.33 pounds of fat for one pound of casein and albumen; while the average of all was 1.18 pounds of fat for one pound of casein and albumen in milk. Taking the summary in the table above, we find the limits of variation between 1.08 and 1.27 pounds of fat for one pound of casein and albumen in milk.

(3d.) Arranging the individual results of the season's work as below, we can see how the variations were distributed:

POUNDS OF FAT FOR ONE POUND OF CASEIN AND ALBUMEN IN NORMAL MILK.

	Below 1.05.	Between 1.05 and 1.10.	Between 1.10 and 1.15.	Between 1.15 and 1.20.	Between 1.20 and 1.25.	Between 1.25 and 1.30.	Between 1.30 and 1.35.	Above 1.35.
Number of samples of milk	0	3	14	16	44	15	4	0

(4th.) It appears from our results that, in case of mixed milk of herds of cows, the amount of fat seldom falls below 1.10 pounds for each pound of casein and albumen. Our previous study of the individuals of various breeds confirms this statement.

(5th.) In normal milk, which contained fat varying from 3.04 to 4.40 per cent., the casein varied from 1.93 to 3.00 per cent. The fat averaged 37.0 per cent., and the casein, 2.48 per cent.

(6th.) In no case, did the normal milk during the season contain less than 1.35 pounds of fat for one pound of casein or more than 1.74 pounds of fat for one pound of casein, while the average of all was 1.50 pounds of fat for one pound of casein Taking the summary in the table above, we find the limits of variation between 1.41 and 1.70 pounds of fat for one pound of casein and albumen in milk.

(7th.) Arranging the individual results of the season's work as below, we can see how the variations were distributed.

POUNDS OF FAT FOR ONE POUND OF CASEIN IN NORMAL MILK.

	No. of samples of milk.
Below 1.35	0
Between 1.35 and 1.40	2
Between 1.40 and 1.45	14
Between 1.45 and 1.50	14
Between 1.50 and 1.55	30
Between 1.55 and 1.60	15
Between 1.60 and 1.65	16
Between 1.65 and 1.70	3
Between 1.70 and 1.75	3
Above 1.75	0

(8th.) It appears from our results that, in case of mixed milk of herds of cows, the amount of fat seldom falls below 1.40 pounds for each pound of casein.

(9th.) In the last three columns of the large table above, data are given which show (1) to what extent the casein and albumen increase in normal milk, when the fat increases, and (2) to what extent the casein alone increases when the fat increases.

It has been generally held that the casein and albumen of normal milk do not increase as rapidly as the fat; in other words, that milk, rich in fat, contains less casein and albumen in proportion to its fat than does milk poorer in fat. Averaging all the data secured in the season's work, we find that when the fat in the milk increased one pound, the casein and albumen increased 0.7 pounds. This would indicate that the fat actually increases more rapidly in amount than do the casein and albumen, but this statement does not show whether the relative increase is greater.

In order to illustrate, we will compare two normal milks containing three and four per cent. of fat respectively. According to our data these milks will contain casein and albumen as follows:

	No. 1.	No. 2.
Pounds of fat in 100 pounds of milk.............	3	4
Pounds of casein and albumen in 100 pounds of milk..................................	2.65	3.35
Pounds of fat for one pound of casein and albumen	1.13	1.18

The fat in milk No. 1 increases one pound or one-third of itself when it increases from three to four pounds, as in No. 2. At the same time, the casein and albumen increase from 2.65 to 3.35 pounds, an increase of 0.70 of one pound, which is an increase of only a little over one-fourth of itself, instead of one-third of itself as in case of the fat. In our work, the general rule appears to have held good, viz., that the milk richer in fat contains somewhat less casein and albumen in proportion to its fat than does milk less rich in fat, or, stated another way, there was more fat for a pound of casein and albumen in the richer milk than in the poorer milk. However, there was much variation from the general rule in individual cases. According to data secured in our work connected with the investigation of breeds of dairy animals, the general rule appears to be considerably influenced and modified by advance of lactation; so much so that as the period of lactation advances, the casein and albumen increased proportionally with greater rapidity than the fat. (See Tenth Annual Report, p. 387 and p. 106.)

The question arises, does this same general relation hold good between the fat and casein, leaving the albumen out of consideration? This is of special interest in connection with cheese-making, since only the casein enters into the manufacture of cheese. As the average of our season's results, we found the following:

When the fat increased one pound, the casein increased two-thirds of one pound. On the face of it, this statement would seem to indicate that the casein followed the same general rule as the casein and albumen, taken together, as regards relation to fat in milk.

But a closer examination of the data gives us a different interpretation of the facts. To illustrate as before, we will compare two normal milks, containing 3 and 4 per cent. of fat respectively. According to our data, these milks will contain casein as follows:

	Pounds of fat in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of fat for one pound of casein.
No. 1	3	2	1.50
No. 2	4	2.67	1.50

The fat in milk No. 1 increases one pound or one-third of itself, when it increases from three to four pounds, as in No. 2. At the same time the casein increases from two pounds in No. 1 to 2.67 pounds in No. 2, an increase of two-thirds of one pound, which is exactly one-third of two pounds, the amount of casein in No. 1. The fat increases one-third of itself and, at the same time, the casein increases one-third of itself, or in exactly the same proportion as the fat. In No. 1 the casein is two-thirds of the amount of fat; in No. 2 the casein is also two-thirds of the fat in amount. Hence, the casein increased in just the same proportion as the fat. Our results show, therefore, that while the relation of the fat to casein in normal milk varied within certain limits, normal factory-milk, containing fat ranging from 3 to 4.4 per cent. contained, on an average, 1.5 pounds of fat for one pound of casein, or the casein averaged two-thirds of the amount of fat in normal factory-milk. It remains to be seen whether more extended work during another season will fully confirm these results or whether we shall need to modify the above statement. But other facts appear to point to the same conclusions.

8. Relation of Fat to Casein and Albumen and to Casein in Skimmed Milk and in Milk Containing Added Cream.

In the table below, we give data showing the relation of fat to casein and albumen and to casein in milk which has had removed varying proportions of fat. Under "(a) normal milk," is given the amount of fat, casein, etc., in the milk before the fat was removed; under "(a) skim-milk" are given the same data in regard to the milk after the fat was removed; and throughout the table the "normal milk" and "skim-milk" under the same letter refer to one and the same milk before and after skimming.

KIND OF MILK.	Pounds of fat in 100 lbs.	Amount of fat removed from 100 lbs. of normal milk.	Per cent. of fat in normal milk removed.	Pounds of casein and albumen in 100 lbs.	Pounds of fat for one pound of casein and albumen.	Pounds of casein in 100 lbs.	Pounds of fat for one pound of casein.
Normal milk (a)	4.05	1.65	40.75	3.45	1.17	2.88	1.41
Skim-milk (a)	2.40			3.47	0.70	2.90	0.83
Normal milk (b)	3.90	1.00	25.65	3.23	1.21	2.62	1.49
Skim-milk (b)	2.90			3.21	0.90	2.57	1.13
Normal milk (c)	4.10	0.90	22.00	3.18	1.29	2.44	1.68
Skim-milk (c)	3.20			3.21	1.00	2.41	1.33
Normal milk (d)	3.60	0.65	18.00	3.28	1.10	2.53	1.42
Skim-milk (d)	2.95			3.26	0.90	2.50	1.18
Normal milk (e)	3.95	0.70	17.70	3.25	1.22	2.53	1.56
Skim-milk (e)	3.25			3.27	1.00	2.60	1.25
Normal milk (f)	4.15	0.35	8.55	3.36	1.20	2.85	1.46
Skim-milk (f)	3.80			3.48	1.09	2.81	1.35

A study of this table suggests the following points of interest:

(1st.) In skimming milk, little but fat is removed; the casein and albumen remain essentially undiminished in quantity. Hence the greater the amount of fat that is removed, the more casein and albumen there will be in proportion to the fat left.

(2d.) Fat was removed from the normal milks varying in quantity from 0.35 to 1.65 pounds of fat for 100 pounds of milk, which was equivalent to from 8.55 to 40.75per cent. of the fat in the milk.

(3d.) In the normal milks, there were from 1.10 to 1.34 pounds of fat for one pound of casein and albumen in the milk; while in the skim-milks there were from 0.70 to 1.09 pounds of fat for one pound of casein and albumen in the milk.

(4th.) In the normal milks, there were from 1.41 to 1.72 pounds of fat for one pound of casein in the milk; while in the skim-milks there were from 0.83 to 1.35 pounds of fat for one pound of casein in the milk.

(5th.) In no case did skim-milk contain more than 1.09 pounds of fat for one pound of casein and albumen — and this was in case of milk which had less than ten per cent. of its fat removed. In our whole season's work no normal milk was found which contained less than 1.07 pounds of fat for one pound of casein and albumen, while the average was 1.20 pounds of fat for one of albumen and casein. It therefore appears highly probable that, in case of mixed normal milk of herds of cows, there will not be less than 1.05 pounds of fat for one pound of casein and albumen, unless the milk has been skimmed.

(6th.) In no case did skim-milk contain more than 1.35 pounds of fat for one pound of casein, and this was in case of the milk which had less than ten per cent of its fat removed. In our whole season's work, no normal milk was found which contained less than 1.35 pounds of fat for one pound of casein, while the average was 1.50 pounds of fat for one pound of casein. So far as our results go, we should appear justified in saying that milk has been skimmed when it contains less than 1.30 pounds of fat for one pound of casein.

(7th.) Taking milk which contains four per cent. of fat and removing from it varying amounts of fat, we can show very clearly, as below, the effect of skimming milk upon the relation of the fat to the casein and albumen.

KIND OF MILK.	Pounds of fat in 100 pounds of milk.	Amount of fat removed from 100 pounds of normal milk.	Per cent. of fat in normal milk removed.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of fat for one pound of casein and albumen.	Pounds of casein in 100 pounds of milk.	Pounds of fat for one pound of casein.
Normal	4.00	......	......	3.30	1.21	2.67	1.50
Skim-milk	3.80	0.20	5.00	3.30	1.15	2.67	1.42
Skim-milk	3.60	0.40	10.00	3.30	1.09	2.67	1.35
Skim-milk	3.33	0.67	16.67	3.30	1.00	2.67	1.25
Skim-milk	3.20	0.80	20.00	3.30	0.97	2.67	1.20
Skim-milk	3.00	1.00	25.00	3.30	0.91	2.67	1.12
Skim-milk	2.67	1.33	33.33	3.30	0.81	2.67	1.00
Skim-milk	2.40	1.60	40.00	3.30	0.72	2.67	0.90
Skim-milk	2.00	2.00	50.00	3.30	0.60	2.67	0.75
Skim-milk	1.60	2.40	60.00	3.30	0.48	2.67	0.60
Skim-milk	1.33	2.67	66.67	3.30	0.40	2.67	0.50
Skim-milk	1.00	3.00	75.00	3.30	0.30	2.67	0.38
Skim-milk	0.80	3.20	80.00	3.30	0.24	2.67	0.30
Skim-milk	0.40	3.60	90.00	3.30	0.12	2.67	0.15
Skim-milk	0.10	3.90	97.50	3.30	0.02	2.67	0.04
Skim-milk	0.00	4.00	100.00	3.30	0.00	2.67	0.00

(8th.) In adding cream to normal milk, we add little but fat in the way of solids; the casein and albumen remain essentially the same. Hence the greater the amount of fat added, the greater will become the proportion of fat to casein and albumen. The data in the table below illustrate this statement.

KIND OF MILK.	Pounds of fat in 100 pounds.	Amount of fat added to 100 pounds of normal milk.	Per cent of fat added to normal milk.	Pounds of casein and albumen in 100 pounds.	Pounds of fat for one pound of casein and albumen.	Pounds of casein in 100 pounds.	Pounds of fat for one pound of casein.
Normal milk (a)	3.50	0.62	17.20	3.28	1.10	2.53	1.42
Normal milk and cream (a)	4.22			3.30	1.28	2.57	1.64
Normal milk (b)	4.05	1.65	40.75	3.45	1.17	2.88	1,41
Normal milk and cream (b)	5.70			3.32	1.72	2.80	2.04
Normal milk (c)	4.65	1.35	29.00	3.46	1.34	2.73	1.72
Normal milk and cream (c)	6.00			3.46	1.73	2.71	2.21

(9th.) The data presented in connection with the effects of removing fat from milk suggest a basis for determining whether milk has had any of its fat removed by skimming or other process. We shall continue our study of factory-milk another season on a still more extended scale, and if the results of this season's work are confirmed, we shall have established a natural standard by which factory-milk can be judged. So far as the results of the past season go, we should be justified in saying that milk which contains less than 1.05 pounds of fat for one pound of casein and albumen or less than 1.3 pounds of fat for one pound of casein, has had some of its fat removed.

9. General Summary of Results in Regard to Composition of Normal Milk.

(1st.) Pounds of solids in 100 pounds of milk:

The milk-solids varied during the season from 11.47 pounds to 13.91 pounds in 100 pounds of milk, and averaged 12.66 pounds.

(2d.) Pounds of fat in 100 pounds of milk:

The fat varied during the season from 3.04 pounds to 4.40 pounds in 100 pounds of milk, and averaged 3.70 pounds.

(3d.) Pounds of casein and albumen in 100 pounds of milk:

The casein and albumen varied during the season from 2.53 pounds to 3.76 pounds in 100 pounds of milk, and averaged 3.14 pounds.

(4th.) Pounds of casein in 100 pounds of milk:

The casein varied during the season from 1.93 pounds to 3.00 pounds in 100 pounds of milk, and averaged 2.48 pounds.

(5th.) Pounds of albumen in 100 pounds of milk:

The albumen varied during the season from 0.55 pounds to 0.86 pounds in 100 pounds of milk, and averaged 0.66 pounds.

(6th.) Relation of casein to albumen in normal milk:

For each pound of albumen in the milk, the casein varied from 2.6 pounds to 4.9 pounds, averaging 3.76 pounds during the season.

(7th.) Relation of fat to casein and albumen in normal milk:

a. For each pound of casein and albumen in the milk, the fat varied from 1.04 pounds to 1.33 pounds, averaging 1.20 pounds.

b. The fat in the milk increased somewhat more rapidly, as a rule, than did the casein and albumen; that is the milk rich in fat contained somewhat less casein and albumen in proportion to its fat than did the milk poorer in fat.

(8th.) Relation of fat to casein in normal milk:

a. For each pound of casein in the milk, the fat varied from 1.35 pounds to 1.74 pounds, averaging 1.50 pounds.

b. The casein in the milk increased, as a rule, in just the same proportion as the fat. The casein averaged two-thirds of the fat in amount.

(9th.) Relation of fat to casein and albumen in skim-milk:

In milk from which some of the fat had been removed, there were never more than 1.09 pounds of fat for one pound of casein and albumen, while, in most cases, there was less than one pound of fat for one pound of casein and albumen. The greater the amount of fat removed, the smaller was the amount of fat left, relative to the casein and albumen.

(10th.) Relation of fat to casein in skim-milk:

In milk, from which some of the fat had been removed, there were never more than 1.35 pounds of fat for the pound of casein, while, in most cases, there were less than 1.3 pounds of fat for one pound of casein. The greater the amount of fat removed, the smaller was the amount of fat left, relative to the casein

(11th.) Relation of fat to casein and albumen and to casein in milk to which cream has been added:

The greater the amount of fat added, the greater becomes the amount of fat relative to the casein and albumen or to the casein.

(12th.) The relation of fat to casein and albumen in milk as a basis for distinguishing normal milk from skim-milk:

The results secured indicate that, in case of mixed milk of herds of cows, the milk has been skimmed, if it contains less than 1.05 pounds of fat for one pound of casein and albumen.

(13th.) The relation of fat in milk as a basis for distinguishing normal milk from skim-milk:

According to the results secured, we should be justified in saying that, in case of mixed milk of herds of cows, the milk has been skimmed, if it contains less than 1.3 pounds of fat for one pound of casein.

(14th.) Average composition of normal milk:

The table below gives the average of results relating to the composition of the milk used in the season's work (1st) for the different months and (2d) for the season.

Table Showing Average Composition of Milk for the Season.

	Pounds of water in 100 lbs. of milk.	Pounds of total solids in 100 lbs. of milk.	Pounds of fat in 100 lbs of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of sugar, ash, etc., in 100 lbs. of milk.
Factory experiments:							
May	88.08	11.92	3.20	2.65	2.00	0.65	6.07
June	87.47	12.53	3.58	3.25	2.44	0.81	5.70
July	87.40	12.60	3.63	3.08	2.51	0.57	5.89
August	87.31	12.69	3.77	3.04	2.46	0.58	5.88
September	87.45	12.55	3.81	3.12	2.53	0.59	5.62
October	86.42	13.58	4.14	3.66	2.88	0.78	5.78
Average for season	87.36	12.64	3.69	3.13	2.47	0.66	5.82
Station experiments:							
May	86.29	13.71	4.25	3.45	2.68	0.77	6.01
June	87.26	12.74	3.98	3.19	2.48	0.71	5.57
July	87.67	12.33	3.83	3.15	2.49	0.66	5.35
August	87.15	12.85	4.00	3.24	2.53	0.71	5.61
September	87.17	12.33	4.08	3.26	2.56	0.70	5.59
October	86.92	13.08	4.04	3.37	2.76	0.61	5.67
Average for season	87.08	12.92	4.03	3.28	2.58	0.70	5.61
General average for all experiments	87.34	12.66	3.70	3.14	2.48	0.66	5.82

VIII. A STUDY OF THE COMPOSITION OF WHEY.

We shall consider the following points in connection with our study of the composition of whey:

1. Pounds of solids in 100 pounds of whey.
2. Pounds of fat in 100 pounds of whey.
3. Pounds of casein and albumen in 100 pounds of whey.
4. Pounds of casein in 100 pounds of whey.
5. Pounds of albumen in 100 pounds of whey.
6. General summary.

1. POUNDS OF SOLIDS IN ONE HUNDRED POUNDS OF WHEY.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiment:							
Least	6.61	6.82	6.78	6.78	6.43	6.62	......
Greatest	7.52	7.13	7.20	7.08	6.98	6.93	......
Average	7.11	7.01	6.92	6.91	6.69	6.84	6.91
Station experiments:							
Least	7.24	6.75	6.80	6.66	6.57	6.63	......
Greatest	7.55	7.33	7.05	7.02	6.84	7.08	......
Average	7.36	6.96	6.93	6.91	6.70	6.91	6.96
Average of all experiments	7.14	7.00	6.93	6.91	6.69	6.85	6.92

The solids in the factory-whey varied during the season from 6.43 pounds to 7.52 pounds in 100 pounds of whey, and averaged 6.91 pounds. In the station-whey the solids ranged from 6.63 pounds to 7.55 pounds, and averaged 6.96 pounds. The average of the solids in all the whey for the whole season was 6.92 pounds.

2. POUNDS OF FAT IN ONE HUNDRED POUNDS OF WHEY.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	0.23	0.23	0.23	0.29	0.33	0.30	....
Greatest	0.39	0.38	0.50	0.40	0.45	0.41	....
Average	0.32	0.30	0.35	0.35	0.39	0.35	0.34
Station experiments:							
Least	0.28	0.28	0.27	0.22	0.26	0.24	....
Greatest	0 40	0.35	0.52	0.45	0.47	0.44	....
Average	0.33	0.30	0.43	0.30	0.36	0.35	0.34
Average of all experiments	0.32	0.30	0.36	0.34	0.38	0.35	0.34

The fat in the factory-whey varied from 0.23 pounds to 0.50 pounds, and averaged for the season 0.34 pounds. In the station-whey, the fat varied from 0.22 pounds to 0.52 pounds and averaged 0.34 pounds for the season. The larger losses were generally caused by tainted milk.

3. POUNDS OF CASEIN AND ALBUMEN IN ONE HUNDRED POUNDS OF WHEY.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	0.67	0.84	0.78	0.80	0.77	0.87	....
Greatest	0.75	0.88	0.86	0.83	0.85	1.07	....
Average	0.70	0.86	0.82	0.81	0.83	1.00	0.84
Station experiments:							
Least	0.88	0.84	0.84	0.85	0.85	0.74	....
Greatest	0.94	0.88	0.87	0.91	0.94	0.85	....
Average	0.91	0.86	0.85	0.88	0.89	0.81	0.86
Average of all experiments	0.80	0.86	0.84	0.85	0.86	0.90	0.85

In the factory-whey, the casein and albumen varied, during the season, from 0.67 pounds to 1.07 pounds in 100 pounds of whey, averaging 0.84 pounds. In the station-whey, the casein and albumen varied from 0.74 pounds to 0.94 pounds and averaged 0.86 pounds. The average amount of casein and albumen in all the whey during the whole season was 0.85 pounds in 100 pounds of whey.

4. Pounds of Casein in One Hundred Pounds of Whey.

The presence of casein in the whey is due to two causes. First, it is due to the passage of very fine particles of coagulated casein through the strainer, when the whey is drawn from the curd. These minute particles can readily be seen by letting a pail of freshly-drawn whey stand until the casein settles, and then pouring off the whey, when a noticeable quantity of finely divided casein can be seen at the bottom of the pail. This passage of casein into the whey is not entirely avoidable, but it is needlessly made greater by carelessness or violence in cutting the curd and in subsequent handling, by agitation while drawing off the whey and by imperfect strainers. The amount of casein that thus passes into the whey varied from 0.04 to 0.16 pounds and averaged 0.09 pounds in 100 pounds of whey.

In addition to the casein that passes into the whey mechanically, a small quantity appears in the whey as a result of the chemical action of the rennet. According to the best light we now have upon the subject, it appears that when the casein of milk is acted upon by rennet, it is converted into two different compounds; one of these, constituting the greater portion, is insoluble and forms the solid portion of the curd proper; while the other, which is usually small in quantity, is soluble and passes into the whey along with the albumen, which it resembles in several respects. The amount of this soluble portion depends upon conditions which have not yet been carefully studied; in amount, it does not probably exceed 0.05 pounds in 100 pounds of whey. Hence, the total amount of casein, insoluble and soluble, present in the whey probably does not exceed, on an average, 0.15 pounds in 100 pounds of whey. We have as yet no method for determining the amount of soluble casein in the presence of albumen and, therefore, we can not now present definite data on this point.

5. Pounds of Albumen in One Hundred Pounds of Whey.

If 100 pounds of whey contain, on an average, 0.15 pounds casein, there will be contained in the same amount of whey from 0.52 to 0.92 pounds of albumen, with an average of 0.70 pounds.

6. General Summary of Results in Regard to Composition of Whey.

(1st.) Pounds of solids in 100 pounds of whey:

The solids in the whey varied during the season from 6.43 pounds to 7.55 pounds, and averaged 6.92 pounds in 100 pounds of whey.

(2d.) Pounds of fat in 100 pounds of whey:

The fat in 100 pounds of whey varied during the season from 0.22 pounds to 0.52 pounds, and averaged 0.34 pounds.

(3d.) Pounds of casein and albumen in 100 pounds of whey:

The casein and albumen in 100 pounds of whey varied, during the season, from 0.67 pounds to 1.07 pounds, and averaged 0.85 pounds. The casein averaged about 0.15 pounds and the albumen about 0.70 pounds, so far as could be determined.

(4th.) Average composition of whey:

TABLE SHOWING AVERAGE COMPOSITION OF WHEY FOR THE SEASON.

	Pounds of water in 100 pounds of whey.	Pounds of total solids in 100 p'nds of whey.	Pounds of fat in 100 pounds of whey	Pounds of casein and albumen in 100 p'nds of whey.	Pounds of sugar, ash, etc., in 100 pounds of whey.
Factory experiments:					
May	92.89	7.11	0.32	0.70	6.09
June	92.99	7.01	0.30	0.86	5.85
July	93.08	6.92	0.35	0.82	5.75
August	93.09	6.91	0.35	0.81	5.75
September	93.31	6.69	0.39	0.83	5.47
October	93.16	6.84	0.35	1.00	5.49
Av'ge for season	93.09	6.91	0.34	0.84	5.73
Station experiments:					
May	92.64	7.36	0.33	0.91	6.12
June	93.04	6.96	0.30	0.86	5.80
July	93.07	6.93	0.43	0.85	5.65
August	93.09	6.91	0.30	0.88	5.73
September	93.30	6.70	0.36	0.89	5.45
October	93.09	6.91	0.35	0.81	5.75
Av'ge for season	93.04	6.96	0.34	0.86	5.76
General average for all experiments	93.08	6.92	0.34	0.85	5.73

IX. A STUDY OF THE COMPOSITION OF CHEESE.

The following points will be presented in connection with our discussion of the composition of green cheese:

1. Pounds of water in 100 pounds of green cheese.
2. Pounds of solids in 100 pounds of green cheese.
3. Pounds of fat in 100 pounds of green cheese.
4. Pounds of casein and albumen in 100 pounds of green cheese.
5. Pounds of casein in 100 pounds of green cheese.
6. Pounds of soluble casein and albumen in 100 pounds of green cheese.
7. Relation of fat to casein in cheese made from normal milk.
8. Relation of fat to casein in cheese made from skimmed milk.
9. Relation of fat to casein in cheese made from milk containing added cream.
10. Relation of fat to total solids in cheese made from normal and skimmed milk.
11. Summary of results.

1. Pounds of Water in One Hundred Pounds of Green Cheese.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	36.47	35.27	33.94	33.50	34.46	36.21	......
Greatest	37.92	38.63	36.25	38.51	38.00	38.80	......
Average	37.10	36.82	34.90	35.74	36.29	37.62	36.41
Station experiments:							
Least	33.53	33.67	37.44	36.12	34.70	34.32	......
Greatest	35.55	39.66	39.35	39.77	40.60	42.90	......
Average	34.80	36.73	38.29	37.94	37.78	37.31	37.14
Average of all experiments	36.82	36.80	35.00	35.93	36.38	37.58	36.46

In the factory-cheese, the water varied during the season from 33.50 pounds to 38.80 pounds, and averaged 36.41 pounds in 100 pounds of cheese. In the station-cheese, the water varied from 33.53 pounds to 42.90 pounds and averaged 37.14 pounds. Taking all the cheese of the season, the water varied from 33.50 pounds to 42.90 pounds, and averaged 36.46 pounds in 100 pounds of cheese.

It will be noticed that there is a very much greater variation in respect to water than in any other constituent of cheese. Our season's work has shown very conclusively that it is an exceedingly difficult task to make cheese in such a way as to retain a definite amount of water. While skilled makers can, to some extent, control the amount of water in the cheese, the indications which serve to show to the maker how much water he is retaining in the curd do not appear to be reliable under many conditions. So far as our work goes, this point in cheese-making is the one most difficult to control, and one which demands special study, in order that it may be brought under better, if not complete control.

We will show later that it is a very important matter to consider the amount of water present in cheese, when we come to study the relation of cheese-yield to milk. As to the amount of water that it is desirable to retain in cheese, various circumstances must determine. The most important problem at present is how to retain just the amount of moisture that is desired, whether it be little or much.

2. POUNDS OF SOLIDS IN ONE HUNDRED POUNDS OF GREEN CHEESE.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	62.08	61.37	63.75	61.49	62.00	61.20	......
Greatest	63.53	64.73	66.06	66.50	65.54	63.79	......
Average	62.90	63.18	65.10	64.26	63.71	62.38	63.59
Station experiments:							
Least	64.45	60.34	60.65	60.23	59.40	57.10	......
Greatest	66.47	66.33	62.56	63.88	65.30	65.68	......
Average	65.20	63.27	61.71	62.08	62.22	62.69	62.86
Average of all experiments	63.18	63.20	65.00	64.07	63.62	62.42	63.54

The variation of solids is, of course, the same in amount as that of the water in cheese, the solids increasing in proportion as the water diminishes and vice versa. As this increase and decrease of solids is divided among several constituents, it is not important to discuss their variation as a whole.

3. POUNDS OF FAT IN ONE HUNDRED POUNDS OF GREEN CHEESE.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	32.44	32.72	32.12	32.67	34.52	31.90	....
Greatest	35.64	34.90	35.96	36.64	36.79	34.60	....
Average	34.00	33.80	34.19	35.14	35.63	33.03	34.30
Station experiments:							
Least	35.92	33.48	33.58	33.48	32.30	30.84	....
Greatest	37.10	36.25	34.80	35.06	37.24	36.37	....
Average	36.40	35.28	33.66	34.23	34.57	33.74	34.65
Average of all experiments	34.17	33.90	34.15	35.08	35.56	33.00	34.33

In the factory-cheese the fat varied from 32.12 pounds to 36.79 pounds, and averaged 34.30 pounds in 100 pounds of cheese. In the station-cheese the fat varied from 30.84 pounds to 37.24 pounds and averaged 34.65 pounds in 100 pounds of cheese. In all the cheese made during the season, the fat averaged 34.33 pounds in 100 pounds of cheese. It will be seen that, of the cheese-solids, the fat varies most, though the monthly average variations are not great.

The important question must soon arise in connection with buying and selling cheese, "what proportion of fat should a cheese made from normal milk contain?" If practicable, it is highly desirable to establish a standard for whole-milk cheese. As a discussion of this question involves the consideration of constituents of other than the fat, it will be postponed until later.

4. POUNDS OF CASEIN AND ALBUMEN IN ONE HUNDRED POUNDS OF GREEN CHEESE.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	23.18	23.50	23.74	23.18	23.43	23.25	....
Greatest	24.10	26.10	24.75	25.51	24.90	24.14	....
Average	23.60	25.17	24.66	24.24	24.26	23.85	24.30
Station experiments:							
Least	23.43	22.30	24.50	22.28	22.11	22.91	....
Greatest	24.19	24.51	24.81	24.27	23.96	24.76	....
Average	23.90	23.46	24.62	23.09	22.93	23.84	23.64
Average of all experiments	23.64	25.09	24.65	24.14	24.18	23.85	24.25

In the factory-cheese, the casein and albumen in 100 pounds of cheese varied from 23.18 pounds to 26.10 pounds and averaged 24.30 pounds during the season. In the station-cheese, the casein and albumen varied during the season from 22.11 pounds to 24.81 pounds, and averaged 23.64 pounds. The average amount of casein and albumen in all the cheese made during the season was 24.25 pounds in 100 pounds of cheese.

The statement that has been so commonly made to the effect that good cheese consists of one-third water, one-third fat, and one-third casein may be set down as a fiction. It would not be difficult to show that it is impossible to make a cheese of such composition from any normal factory milk that we have yet found in New York State.

5. POUNDS OF CASEIN IN ONE HUNDRED POUNDS OF GREEN CHEESE.

	May.	June.	July.	August.	Septembe .	October.	Average for season.
Factory experiments:							
Least	21.66	22.30	23.25	21.01	21.21	21.67	....
Greatest	23.24	24.37	23.86	23.61	22.97	23.27	....
Average	22.23	23.42	23.67	22.34	22.05	22.49	22.70
Station experiments:							
Least	22.50	21.20	23.41	20.67	20.78	21.29	....
Greatest	23.18	23.31	23.66	23.14	23.00	23.58	....
Average	22.80	22.39	23.53	21.63	21.74	22.83	22.49
Average of all experiments ...	22.30	23.37	23.65	22.28	22.03	22.54	22.68

It should be explained that when we speak of casein in cheese in connection with our analyses, we mean by it that portion of the nitrogen compounds that is insoluble in water. By the action of rennet or bacteria or both combined, the insoluble, tough casein as we find it in the form of cheese-curd, quite rapidly loses its toughness, becomes soft and is more or less soluble in water. The term "insoluble" or "undissolved" casein might describe this constituent which is here designated simply casein. The casein varied in all the green cheese made during the season from 20.67 pounds to 24.37 pounds, and averaged 22.68 pounds in 100 pounds of green cheese.

6. POUNDS OF ALBUMEN AND SOLUBLE CASEIN IN ONE HUNDRED POUNDS OF GREEN CHEESE.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	0.86	1.20	0.84	1.52	1.74	0.72	....
Greatest	1.65	2.32	1.15	2.66	2.66	1.77	....
Average	1.37	1.75	0.99	1.90	2.21	1.36	1.60
Station experiments:							
Least	0.63	0.58	1.03	1.07	0.96	0.41	....
Greatest	1.69	1.39	1.15	1.91	1.59	2.46	....
Average	1.10	1.07	1.09	1.46	1.19	1.01	1.15
Average of all experiments	1.34	1.72	1.00	1.86	2.15	1.31	1.57

As stated above, the insoluble casein of cheese tends to become soft quite rapidly, being converted into compounds that are more soluble in water. The portion of nitrogen compounds that thus dissolve in water is included in the above table under the terms "albumen and soluble casein." Inasmuch as the soluble casein and albumen are very much alike in their chemical properties, we have not yet been able to determine them separately, but it is highly probable that the albumen proper that is retained from the milk in the cheese does not exceed 0.10 pounds for 100 pounds of milk, and that the remainder is "soluble casein." This soluble portion of casein is very variable. It was noticed that it increased very considerably within twenty-four hours after a cheese was taken from the press. As will be seen, the amount of albumen and soluble casein varied from 0.41 pounds to 2.66 pounds, and averaged 1.57 pounds during the season.

7. Relation of Fat to Casein in Cheese Made From Normal Milk.

Since the amount of albumen in cheese is very small, we can properly speak of the nitrogen compounds in cheese as consisting of casein. We have already seen that the fat and casein in normal milk bear a fairly definite relation to each other. We will now see if any similar relation holds good for the relation of fat to casein in cheese.

TABLE SHOWING POUNDS OF FAT FOR ONE POUND OF CASEIN IN CHEESE.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	1.37	1.27	1.30	1.38	1.41	1.33	....
Greatest	1.52	1.40	1.45	1.54	1.51	1.44	....
Average	1.45	1.35	1.39	1.45	1.47	1.38	1.41
Station experiments:							
Least	1.50	1.45	1.35	1.38	1.43	1.33	....
Greatest	1.56	1.56	1.38	1.54	1.56	1.53	....
Average	1.53	1.50	1.37	1.48	1.50	1.39	1.47
Average of all experiments	1.46	1.36	1.39	1.46	1.48	1.38	1.42

GENERAL SUMMARY OF RESULTS FOR THE WHOLE SEASON.

	Pounds of fat in 100 pounds of green cheese.	Pounds of casein in 100 pounds of green cheese.	Pounds of fat for one pound of casein in cheese.
Least............	30.84	22.11	1.27
Greatest..........	37.24	26.10	1.56
Average.........	34.33	24.25	1.42

The table below gives in greater detail average data showing the relation of fat to casein in cheese made from milk that contained fat ranging from 3.05 to 4.40 per cent.

TABLE SHOWING RELATION OF FAT TO CASEIN IN CHEESE MADE FROM NORMAL MILK.

Pounds of fat in 100 pounds of milk.	Pounds of fat in 100 pounds of green cheese.	Pounds of casein in 100 pounds of green cheese.	Pounds of fat in one pound of casein in cheese.
3.05	32.82	23.65	1.39
3.10	32.48	24.00	1.35
3.30	32.82	22.00	1.49
3.35	33.30	21.90	1.52
3.45	33.47	24.90	1.34
3.50	32.05	24.44	1.31
3.55	33.05	24.46	1.35
3.60	33.88	24.56	1.38
3.65	32.70	23.00	1.42
3.70	34.44	23.84	1.45
3.75	34.23	23.00	1.49
3.80	34.66	23.85	1.45
3.85	33.98	23.26	1.46
3.90	34.80	23.71	1.47
3.95	34.96	23.28	1.50
4.00	33.36	22.54	1.48
4.05	32.30	23.27	1.39
4.10	33.90	23.00	1.48
4.15	33.00	23.00	1.43
4.20	35.45	23.64	1.50
4.25	34.82	23.25	1.50
4.30	36.05	23.68	1.52
4.35	34.53	23.59	1.46
4.40	34.91	23.10	1.51

A study of the tables above suggests the following points of interest:

(1st) In green cheese made from normal milk, which contained from 3.05 to 4.40 pounds of fat in 100 pounds of milk, the fat varied from 30.84 pounds to 37.24 pounds, and averaged 34.33 pound in 100 pounds of cheese, while the casein varied from 22.11 pounds to 26.10 pounds, and averaged 24.25 pounds.

(2d) In only one case did cheese made from normal milk contain less than 1.30 pounds of fat for one pound of casein and, in no case, more than 1.56 pounds of fat for one pound of casein, while the average of all was 1.42 pounds of fat for one pound of casein Taking the general summary above, we find the limits of variation between 1.27 and 1.56 pounds of fat for one pound of casein in cheese.

(3d) Arranging the individual results of the season's work as below, we can see how the variations were distributed:

POUNDS OF FAT FOR ONE POUND OF CASEIN IN CHEESE MADE FROM NORMAL MILK.

	No. of samples of cheese.
Below 1.27	0
Between 1.27 and 1.30	1
Between 1.30 and 1.35	6
Between 1.35 and 1.40	19
Between 1.40 and 1.45	22
Between 1.45 and 1.50	17
Between 1.50 and 1.55	26
Between 1.55 and 1.57	5
Above 1.56	0

(4th) From our results it appears that, in case of cheese made from mixed normal milk of herds of cows, the fat seldom falls below 1.30 pounds for each pound of casein, while it does not often fall below 1.35 pounds.

8. Relation of Fat to Casein in Cheese made from Skimmed Milk.

In the table below, we give data showing the relation of fat to casein in cheese made from whole milk and in cheese made from the same kind of milk after a portion of its fat had been removed:

KIND OF MILK.	Pounds of fat in 100 pounds of green cheese.	Pounds of casein in 100 pounds of green cheese.	Pounds of fat for one pound of casein in cheese.	Per cent of fat in normal milk removed.
Normal milk (a)......	33.27	24.65	1.35	....
Skim-milk (a)	22.40	27.50	0.82	40.75
Normal milk (b)......	33.61	24.81	1.35	....
Skim-milk (b)........	28.45	26.20	1.09	25.65
Normal milk (c)......	36.20	23.24	1.56	....
Skim-milk (c)........	31.24	25.93	1.20	22.00
Normal milk (d)......	33.33	25.25	1.32	....
Skim-milk (d)........	29.55	27.03	1.09	18.00
Normal milk (e)......	35.06	22.77	1.54	....
Skim-milk (e)	30.82	25.10	1.23	17.70
Normal milk (f)......	33.95	23.99	1.42	....
Skim-milk (f)	30.78	23.90	1.27	8.55

A study of the above table suggests the following statements:

(1st) Removal of fat from milk influences the composition of cheese in much the same way that it does that of milk. Skimming milk increases the amount of casein relative to the fat not only in the milk, but also in the cheese made from such skimmed milk. The greater the amount of fat removed from the normal milk, the less will become the amount of fat relative to casein in the resulting skim-milk as well as in the cheese made from such skim-milk.

(2d) Fat, varying in quantity from 0.35 pounds to 1.65 pounds for 100 pounds of milk was removed from various kinds of normal milk. The amount of fat removed was equivalent to from 8.55 to 40.75 per cent. of the fat in the milk.

(3d) In the cheese made from normal milk, there were from 1.32 to 1.56 pounds of fat for one pound of casein, while in the cheese made from the skim-milk, there were from 0.82 to 1.27 pounds of fat for one pound of casein

(4th) In no case did cheese made from skimmed milk contain as much as 1.30 pounds of fat for one pound of casein. The nearest any cheese came to this was one made from milk from which less than ten per cent. of its fat had been removed, and in this cheese there were 1.27 pounds of fat for one pound of casein In only a single instance in our entire season's work was there a cheese made from normal milk which contained less than 1.3 pounds of fat for one pound of casein, while the average was 1.42 pounds of fat for one of casein. It, therefore, appears highly probable, that in case of cheese made from the mixed normal milk of herds of cows, there will not be less than 1.30 pounds of fat for one pound of caseine, unless the cheese was made from skimmed milk. Another season we shall carry our study much farther in this line, with a view to establishing beyond doubt whether the above statement can be held as generally true or whether it must be somewhat modified.

(5th) Taking milk which contains four pounds of fat in 100 pounds of milk, and removing from it varying amounts of fat, we can show very clearly, as below, the effect of skimming milk upon the relation of the fat to the casein in the resulting cheese.

In ascertaining the composition of the cheese in the table below, it was assumed, as a result of our season's work (1st) that 8.5 per cent. of the fat in the milk is lost in manufacture, and twenty-four per cent. of the casein and albumen; (2d) that the amount of ash in the cheese made from 100 pounds of milk is constant; and (3d) that the per cent. of water in the cheese is constant, 36.5 per cent. being adopted as a standard. The assumption regarding the ash may not be absolutely true for all cases, and, in actual experience, the per cent. of water in the cheese would be increased as the milk was more completely skimmed. The amount of casein might be slightly diminished with more complete skimming. But the data are intended to show the relation of fat to casein in cheese as indicated below, and for this purpose, are, in all probability, quite as accurate as we could secure by actually doing the work.

KIND OF MILK USED FOR MAKING CHEESE.	Pounds of fat in 100 lbs. of milk.	Per cent. of fat in normal milk removed.	Pounds of fat in 100 lbs. of green cheese.	Pounds of casein in 100 lbs. of green cheese.	Pounds of fat for one lb. of casein.
Normal milk.............	4.00	......	34.37	24.41	1.41
Skim-milk	3.80	5.00	33.56	25.07	1.34
Skim-milk	3.60	10.00	32.74	25.79	1.27
Skim-milk	3.33	16.67	31.48	26.83	1.17
Skim-milk	3.20	20.00	30.84	27.37	1.13
Skim-milk	3.00	25.00	29.78	28.26	1.05
Skim-milk	2.67	33.33	27.95	29.78	0.94
Skim-milk	2.40	40.00	26.35	31.14	0.87
Skim-milk	2.00	50.00	23.55	33.47	0.70
Skim-milk	1.60	60.00	20.33	36.21	0.56
Skim-milk	1.33	66.67	17.91	38.18	0.47
Skim-milk	1.00	75.00	14.53	41.07	0.35
Skim-milk	0.80	80.00	12.05	43.12	0.28
Skim-milk	0.40	90.00	6.76	47.53	0.14
Skim-milk	0.10	97.50	1.80	51.80	0.04
Skim-milk	0.00	100.00	0.00	53.28	0.00

(6th.) The data presented in the foregoing paragraphs suggest a basis for determining whether cheese is made from whole milk or from skim-milk. If our future work confirms that done thus far we shall be able to establish a natural standard by which cheese can be judged. So far as the results of the past season go, we should be justified in saying that cheese which contains less than 1.3 pounds of fat for one pound of casein has, in all probability, been made from skimmed milk.

9. Relation of Fat to Casein in Cheese Made From Milk to Which Cream has been Added.

The effect of adding cream to normal milk is to make the amount of fat larger relative to the casein and the same effect is produced in the cheese made from such milk. Thus in cheese made from milk to which 17 per cent. of fat was added, and which then contained 4.22 per cent. of fat, there were 1.57 pounds of fat for one pound of casein; in cheese made from milk to which about 40 per cent. of fat was added and which then contained 5.70 per cent. of fat, there were two pounds of fat for one pound of casein.

10. Relation of Fat to Total Solids in Cheese Made From Normal and Skimmed Milk.

We have seen above that the relation of fat to casein in cheese probably furnishes a means of distinguishing skim-milk cheese from whole milk cheese. The question arises as to whether we can find other relations between the constituents of cheese which promise a more satisfactory basis for making such distinction. A careful study has been made of every experiment during the season of the relation existing between the fat and total solids, of the relation existing between the fat and the solids not fat, and also of the relation existing between the total solids and the solids not fat. The result of the study has not appeared to justify the publication and discussion of the data, since none of these relations appear to be so uniform and sharply defined as to permit of their use for distinguishing whole milk and skim-milk cheese. In general, it was found that in whole milk cheese, the fat always exceeded the solids not fat, but this was also found to be true of some skim-milk cheese. So far as our study goes, no relation appears to be so sensitive and so easily affected by skimming as the relation of the fat to the casein.

11. General Summary of Results in Regard to Composition of Green Cheese.

1. Pounds of water in 100 pounds of cheese:

The water in 100 pounds of cheese varied during the season from 33.50 pounds to 42.90 pounds, and averaged 36.46 pounds. It was the most variable constituent of the cheese.

2. Pounds of fat in 100 pounds of cheese:

The fat in 100 pounds of cheese varied during the season from 30.84 pounds to 37.24 pounds, and averaged 33.33 pounds.

3. Pounds of casein and albumen in 100 pounds of cheese:

The casein and albumen in 100 pounds of cheese varied during the season from 22.11 pounds to 26.10 pounds, and averaged 24.25 pounds.

4. Pounds of casein in 100 pounds of cheese:

The insoluble casein in 100 pounds of green cheese varied from 20.67 pounds to 24.37 pounds, and averaged 22.68 pounds.

5. Pounds of soluble casein and albumen in 100 pounds of cheese:

The soluble casein and albumen varied from 0.41 pounds to 2.66 pounds, and averaged 1.57 pounds in 100 pounds of green cheese. The albumen probably does not exceed 0.10 pounds in amount.

6. Relation of fat to casein in cheese made from normal milk:

For each pound of casein in the cheese, the fat varied from 1.27 pounds to 1.56 pounds, and averaged 1.42 pounds.

7. Relation of fat to casein in cheese made from skim-milk:

In cheese made from milk from which one-tenth of the fat had been removed there were never more than 1.27 pounds of fat for one pound of casein; the ratio of fat to casein decreased in proportion to the amount of fat removed.

8. Relation of fat to casein in cheese made from milk to which cream has been added:

The greater the amount of fat added, the greater became the amount of fat relative to the casein in the cheese.

9. The relation of fat to casein in cheese as a basis for distinguishing cheese made from normal milk and that made from skim-milk:

According to the results secured thus far we should be justified in saying that, in case of cheese made from the mixed milk of herds of cows, the cheese has been made from skimmed milk if it contains less than 1.30 pounds of fat for one pound of casein

10. Average composition of green cheese made from normal milk:

The table below gives the averages of results relating to the composition of green cheese made in the season's work.

TABLE SHOWING AVERAGE COMPOSITION OF GREEN CHEESE FOR THE SEASON.

	Pounds of water in 100 pounds of cheese.	Pounds of solids in 100 pounds of cheese.	Pounds of fat in 100 pounds of cheese.	Pounds of casein and albumen in 100 pounds of cheese.	Pounds of casein in 100 pounds of cheese.	Pounds of albumen and soluble casein in 100 pounds of cheese.	Pounds of sugar, ash, etc., in 100 pounds of cheese.
Factory experiments:							
May	37.10	62.90	34.00	23.60	22.23	1.37	5.30
June	36.82	63.18	33.80	25.17	23.42	1.75	4.21
July	34.90	65.10	34.19	24.66	23.67	0.99	6.25
August	35.74	64.26	35.14	24.24	22.34	1.90	4.88
September	36.29	63.71	35.63	24.26	22.05	2.21	3.82
October	37.62	62.38	33.03	23.85	22.49	1.36	5.50
Average for season	36.41	63.59	34.30	24.30	22.70	1.60	4.99
Station experiments:							
May	34.80	65.20	36.40	23.90	22.80	1.10	4.90
June	36.73	63.27	35.28	23.46	22.39	1.07	4.53
July	38.29	61.71	33.66	24.62	23.53	1.09	3.43
August	37.92	62.08	34.23	23.09	21.63	1.46	4.76
September	37.78	62.22	34.57	22.93	21.74	1.19	4.72
October	37.31	62.69	33.74	23.84	22.83	1.01	5.11
Average for season	37.14	62.86	34.65	23.64	22.49	1.15	4.57
General average for all experiments	36.46	63.54	34.33	24.25	22.68	1.57	4.96

X. LOSS OF MILK-CONSTITUENTS IN CHEESE-MAKING.

Under this general head, the following topics will be considered:

1. Amount of solids in milk lost and recovered in cheese-making.

2. Amount of fat in milk lost and recovered in cheese-making.

3. Amount of casein and albumen in milk lost and recovered in cheese-making.

1. Amount of Solids in Milk Lost and Recovered in Cheese-making.

TABLE SHOWING POUNDS OF SOLIDS IN ONE HUNDRED POUNDS OF MILK

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	11.47	12.41	12.47	12.35	12.20	13.19	......
Greatest	12.48	12.65	12.73	12.96	12.76	13.91	......
Average	11.92	12.53	12.60	12.69	12.55	13.58	12.64
Station experiments:							
Least	13.51	12.41	12.24	12.77	12.52	12.60	......
Greatest	13.91	13.26	12.52	12.93	13.16	13.50	......
Average	13.71	12.74	12.33	12.85	12.83	13.08	12.92
Average of all experiments	12.09	12.54	12.59	12.70	12.56	13.51	12.66

In the factory-milk the solids varied from 11.47 pounds to 13.91 pounds, and averaged 12.64 pounds in 100 pounds of milk. In the station-milk, the solids varied from 12.24 pounds to 13.91 pounds, and averaged 12.92 pounds in 100 pounds of milk. The average of all the milk for the season was 12.66 pounds.

Table Showing Pounds of Milk Solids in Whey Made From One Hundred Pounds of Milk.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	6.05	6.21	6.09	6.09	5.81	5.87	......
Greatest	6.83	6.40	6.48	6.36	6.28	6.09	......
Average	6.49	6.31	6.23	6.22	6.02	6.03	6.21
Station experiments:							
Least	6.47	6.08	6.13	5.90	5.84	5.91	......
Greatest	6.72	6.53	6.32	6.27	6.13	6.28	......
Average	6.53	6.23	6.23	6.15	5.97	6.13	6.21
Average of all experiments	6.50	6.30	6.23	6.21	6.00	6.05	6.21

In the factory experiments, the amount of solids in 100 pounds of milk that went into the whey varied from 5.81 pounds to 6.83 pounds, and averaged 6.21 pounds; in the station experiments, the variation was from 5.84 pounds to 6.72 pounds, and the average 6.21 pounds. The average loss of solids in the whey for 100 pounds of milk, during the season's work, was 6.21 pounds.

It will be noticed that as the season advanced the amount of solids lost decreased somewhat.

TABLE SHOWING PER CENT. OF SOLIDS IN MILK LOST IN WHEY.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	52.72	50.04	48.84	49.00	47.62	43.59	....
Greatest	54.73	50.60	50.90	50.04	49.22	45.09	....
Average	54.45	50.36	49.45	49.01	48.00	44.40	49.13
Station experiments:							
Least	47.00	48.72	50.08	46.20	44.82	45.52	....
Greatest	48.35	49.24	50.90	48.50	49.90	47.48	....
Average	47.63	48.89	50.52	47.86	46.45	46.86	48.07
Average of all experiments...	51.04	49.63	50.00	48.44	47.23	45.63	49.05

In the factory experiments, from 43.57 to 54.73 per cent. of the solids in the milk was lost in the whey, the average for the season being 49.13 per cent. In the station experiments, from 44.82 to 50.90 per cent. of the solids in the milk was lost in the whey, the average for the season being 48.07 per cent. The average of all the season's experiments was 49.05 per cent.

It will be noticed that the per cent. of milk solids lost in the whey decreased as the season advanced. This is consistent with the fact that the fat and casein increased with the advance of the season in the same proportion, while the other solids, the sugar and ash, were fairly uniform during the season, and the albumen tended to decrease.

TABLE SHOWING POUNDS OF MILK-SOLIDS RECOVERED IN CHEESE MADE FORM ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	5.31	5.96	6.28	6.21	6.08	7.18	....
Greatest	5.79	6.41	6.68	6.77	6.56	7.58	....
Average	5.43	6.22	6.37	6.47	6.53	7.55	6.43
Station experiments:							
Least	7.09	6.51	6.15	6.59	6.58	6.36	....
Greatest	7.51	6.65	6.34	6.94	7.10	7.42	....
Average	7.18	6.58	6.23	6.70	6.87	6.95	6.71
Average of all experiments	6.31	6.40	6.30	6.59	6.59	7.25	6.45

In the factory experiments, the milk-solids that were recovered in the cheese made from 100 pounds of milk varied from 5.31 pounds to 6.77 pounds, and averaged 6.43 pounds during the season. In the station-work the amount ranged from 6.15 pounds to 7.51 pounds, and averaged 6.71 pounds. The season's average for all the work was 6.45 pounds.

The amount of milk-solids retained in the cheese from 100 pounds of milk increased as the season advanced. Since the increase of solids in the milk during the season is due mainly to an increase of fat and casein which are the chief cheese-producing constituents of milk, this increase of solids retained in the cheese is a necessary consequence of the natural change in the composition of the milk, as a result of advance of lactation.

TABLE SHOWING PER CENT. OF MILK-SOLIDS RECOVERED IN CHEESE FROM ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	45.27	49.40	50.10	49.96	50.78	54.91	....
Greatest	47.28	49.96	51.16	53.00	52.38	56.43	....
Average	45.55	49.64	50.55	50.99	52.00	55.60	50.87
Station experiments:							
Least	51.65	50.76	49.10	51.50	50.10	52.52	....
Greatest	53.00	51.28	49.92	53.80	55.18	54.48	....
Average	52.37	51.11	49.48	52.14	53.55	53.14	51.93
Average of all experiments	48.96	50.37	50.00	51.56	52.77	54.37	50.95

In the factory-work the per cent. of milk-solids recovered in the cheese varied from 45.27 to 56.43 per cent., and averaged 50.87 per cent. In the station-work the variation was from 49.10 to 55.18 per cent., with an average of 51.93 per cent. during the season. The per cent. of milk-solids retained in the cheese averaged for the season's work 50.95. Owing to natural changes taking place in the composition of the milk as the season advanced, the per cent. of solids retained in the cheese increased from month to month.

The table below gives in greater detail the results embodied in the preceding tables for milk ranging from 3.05 to 4.40 pounds of fat in 100 pounds of milk.

Table Showing Amount of Milk-solids Lost and Recovered in Cheese-making.

Pounds of fat in 100 lbs. of milk.	Pounds of solids in 100 lbs. of milk.	Pounds of milk-solids lost in whey for 100 lbs. of milk.	Pounds of milk-solids recovered in cheese for 100 lbs. of milk.	Per cent. of milk-solids lost in whey.	Per cent. of milk-solids recovered in cheese.
3.05	11.60	6.29	5.31	54.22	45.78
3.10	12.03	6.52	5.51	54.20	45.80
3.30	12.06	6.52	5.54	54.06	45.94
3.35	12.19	6.76	5.43	55.45	44.55
3.45	12.20	6.08	6.12	49.84	50.16
3.50	12.46	6.14	6.32	49.28	50.72
3.55	12.48	6.39	6.09	51.20	48.80
3.60	12.48	6.29	6.19	50.40	49.60
3.65	12.54	6.16	6.38	49.12	50.88
3.70	12.55	6.28	6.27	50.00	50.00
3.75	12.59	6.13	6.46	48.65	51.35
3.80	12.59	6.07	6.52	48.21	51.79
3.85	12.62	6.23	6.39	49.36	50.64
3.90	12.66	6.13	6.53	48.42	51.58
3.95	12.71	6.18	6.53	48.62	51.38
4.00	13.00	6.18	6.82	47.55	52.45
4.05	13.08	6.06	7.02	46.33	53.67
4.10	13.09	6.04	7.05	46.15	53.85
4.15	13.39	6.30	7.09	47.05	52.95
4.20	13.41	6.15	7.26	45.86	54.14
4.25	13.46	6.22	7.24	46.21	53.79
4.30	13.47	5.95	7.52	44.17	55.83
4.35	13.69	6.18	7.51	45.14	54.86
4.40	13.84	6.67	7.17	48.92	51.08

2. Amount of Fat in Milk Lost and Recovered in Cheese-making.

Table showing pounds of fat in 100 pounds of milk.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	3.04	3.45	3.50	3.50	3.55	4.05	....
Greatest	3.37	3.70	3.75	4.00	3.95	4.35	....
Average	3.20	3.58	3.63	3.77	3.81	4.14	3.69
Station experiments:							
Least	4.15	3.90	3.80	3.95	3.85	3.90	....
Greatest	4.38	4.10	3.90	4.10	4.40	4.40	....
Average	4.25	3.98	3.33	4.00	4.08	4.04	4.03
Average of all experiments	3.30	3.60	3.64	3.79	3.82	4.13	3.70

In the factory-milk, the fat varied from 3.04 pounds to 4.35 pounds in 100 pounds of milk, and averaged 3.69 pounds during the season. In the station-milk, the amount of fat ranged from 3.80 to 4.40 pounds, and averaged 4.03 pounds. The average of all the milk for the whole season was 3.70 pounds of fat in 100 pounds of milk.

TABLE SHOWING POUNDS OF MILK-FAT LOST IN WHEY FOR ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	0.24	0.21	0.21	0.26	0.30	0.26	....
Greatest	0.34	0.34	0.45	0.37	0.41	0.35	....
Average	0.29	0.27	0.31	0.32	0.35	0.31	0.31
Station experiments:							
Least	0.25	0.25	0.34	0.21	0.23	0.21	....
Greatest	0.35	0.32	0.50	0.34	0.41	0.39	....
Average	0.29	0.27	0.39	0.27	0.32	0.31	0.31
Average for all experiments	0.29	0.27	0.32	0.31	0.34	0.31	0.31

In the factory-work, the fat lost in the whey varied from 0.21 pounds to 0.45 pounds for 100 pounds of milk, and averaged 0.31 pounds during the season. In the station-work, the fat in the whey varied from 0.21 pounds to 0.50 pounds, and averaged 0.31 pounds during the season. The average of all the season's work was 0.31 pounds of fat in the whey for 100 pounds of milk.

The largest loss of fat in the factory-work occurred in September, when the cows at the factory, where the cheese was made, were fed the soured refuse of a corn-canning factory. The largest loss of fat in the station-work occurred in July when a portion of the milk used was tainted quite seriously.

Table Showing Per Cent. of Fat in Milk Lost in Whey.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	7.87	6.09	5.68	6.93	7.69	6.12	......
Greatest	10.00	9.66	12.86	9.44	10.38	8.67	......
Average	9.06	7.53	8.54	8.50	9.19	7.50	8.40
Station experiments:							
Least	5.84	6.33	8.70	5.00	5.75	5.25	......
Greatest	8.00	8.20	13.16	10.13	9.49	9.51	......
Average	6.62	6.80	10.18	7.25	7.84	7.67	7.70
Average of all experiments	8.80	7.50	8.80	8.18	8.90	7.50	8.38

The per cent. of fat in the milk that was lost in the whey varied during the season in the factory-work from 5.68 to 12.86 per cent., and averaged 8.40 per cent.; in the station-work, the variation ranged from 5.00 to 13.16 per cent. and averaged 7.70 per cent. The average for all the season's work was 8.38 per cent.

The larger loss of fat in the September factory-work and the July station-work was due to use of tainted milk.

In general, the results show that the proportion of milk-fat lost was entirely independent of the amount of fat in the milk; the variations that occurred were due either to the condition of the milk or to some special conditions employed in manufacture.

TABLE SHOWING POUNDS OF MILK-FAT RECOVERED IN CHEESE FOR ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August	September.	October.	Average for season.
Factory experiments:							
Least	2.77	3.24	3.05	3.18	3.19	3.67	......
Greatest	3.07	3.48	3.49	3.71	3.60	4.03	......
Average	2.91	3.31	3.32	3.45	3.46	3.83	3.38
Station experiments:							
Least	3.84	3.58	3.30	3.55	3.49	3.58	......
Greatest	4.03	3.83	3.56	3.87	3.99	4.11	......
Average	3.96	3.71	3.44	3.73	3.76	3.73	3.72
Average of all experiments	3.01	3.33	3.32	3.48	3.48	3.82	3.39

The amount of fat that was recovered in the cheese for 100 pounds of milk varied, in the factory-work, from 2.77 to 4.03 pounds, and averaged 3.38 pounds during the season; in the station-work, the amount ranged from 3.30 to 4.03 pounds, and averaged 3.72 pounds. The average of the whole season's work was 3.39 pounds.

TABLE SHOWING PER CENT. OF FAT IN MILK RECOVERED IN CHEESE.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	90.00	90.34	87.14	90.56	89.62	91.33	....
Greatest	92.13	93.91	94.32	93.17	92.31	93.88	....
Average	90.94	92.46	91.46	91.50	90.81	92.50	91.60
Station experiments:							
Least	92.00	91.80	86.84	89.87	90.51	90.49	....
Greatest	94.16	93.67	91.30	95.00	94.25	94.75	....
Average	93.38	93.20	89.82	92.75	92.16	92.33	92.30
Average of all experiments	91.20	92.50	91.20	91.82	91.10	92.50	91.62

The per cent. of fat in milk that was recovered in the cheese varied, in the factory-work, from 87.14 to 94.32 per cent., and averaged 91.60 per cent.; in the station-work, the variation was from 86.84 to 95.00 per cent., with an average of 92.30 per cent. The average of all the season's work was 91.62 per cent.

The table below gives in greater detail the results embodied in the preceding tables for milk ranging from 3.05 to 4.40 pounds of fat in 100 pounds of milk:

TABLE SHOWING AMOUNT OF FAT RECOVERED AND LOST IN CHEESE-MAKING.

Pounds of fat in 100 pounds of milk.	Pounds of fat lost in whey for 100 pounds of milk.	Pounds of fat recovered in cheese for 100 pounds of milk.	Per cent. of fat in milk lost in whey.	Per cent. of fat in milk recovered in cheese.
3.05	0.26	2.79	8.52	91.48
3.10	0.30	2.80	9.68	90.32
3.30	0.33	2.97	10.00	90.00
3.35	0.31	3.04	9.25	90.75
3.45	0.21	3.24	6.09	93.90
3.50	0.34	3.16	9.71	90.39
3.55	0.36	3.19	10.14	89.86
3.60	0.29	3.31	8.06	91.94
3.65	0.27	3.38	7.40	92.60
3.70	0.29	3.41	7.84	92.16
3.75	0.31	3.44	8.27	90.73
3.80	0.40	3.40	10.53	89.47
3.85	0.33	3.52	8.57	91.43
3.90	0.32	3.58	8.21	91.79
3.95	0.30	3.65	7.60	92.40
4.00	0.27	3.73	6.75	93.25
4.05	0.33	3.72	8.15	91.85
4.10	0.31	3.79	7.56	92.44
4.15	0.31	3.84	7.47	92.53
4.20	0.30	3.90	7.14	92.86
4.25	0.28	3.97	6.59	93.41
4.30	0.28	4.02	6.50	93.50
4.35	0.31	4.04	7.13	92.87
4.40	0.35	4.05	7.95	92.05

3. Amount of Casein and Albumen in Milk Lost and Recovered in Cheese-making.

TABLE SHOWING AMOUNT OF CASEIN AND ALBUMEN IN NORMAL MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	2.53	3.20	3.03	3.00	3.07	3.56	....
Greatest	2.78	3.30	3.10	3.09	3.22	3.76	....
Average	2.65	3.25	3.08	3.04	3.12	3.66	3.13
Station experiments:							
Least	3.35	3.14	3.08	3.17	3.14	3.25	....
Greatest	3.50	3.23	3.23	3.29	3.40	3.56	....
Average	3.45	3.19	3.15	3.24	3.26	3.37	3.28
Average of all experiments	2.73	3.24	3.09	3.06	3.13	3.62	3.14

The amount of casein and albumen in 100 pounds of factory-milk varied from 2.53 pounds to 3.76 pounds, and averaged 3.13 pounds for the season; in the station milk, the season's variation ranged from 3.08 pounds to 3.56 pounds, and the average amount was 3.28 pounds. The average in all the season's milk was 3.14 pounds in 100 pounds of milk.

TABLE SHOWING POUNDS OF CASEIN AND ALBUMEN LOST IN WHEY FOR ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	0.61	0.76	0.70	0.72	0.70	0.79	....
Greatest	0.68	0.80	0.77	0.75	0.77	0.94	....
Average	0.64	0.78	0.73	0.73	0.74	0.88	0.75
Station experiments:							
Least	0.78	0.76	0.76	0.75	0.76	0.66	....
Greatest	0.84	0.79	0.78	0.80	0.83	0.74	....
Average	0.81	0.77	0.77	0.79	0.79	0.72	0.77
Average of all experiments	0.66	0.78	0.73	0.73	0.74	0.86	0.75

In the factory experiments, the amount of casein and albumen lost in the whey for 100 pounds of milk varied from 0.61 pounds to 0.94 pounds, and averaged 0.75 pounds for the season. In the station-work, the variation ranged from 0.66 pounds to 0.84 pounds, the average being 0.77 pounds. The average of the whole season's work was 0.75 pounds of casein and albumen lost in the whey for 100 pounds of milk. While individual cases showed considerable variation, it will be noticed that the monthly averages show quite marked uniformity.

TABLE SHOWING PER CENT. OF CASEIN AND ALBUMEN IN MILK LOST IN WHEY.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least........................	23.46	23.31	22.90	23.38	22.50	22.07	....
Greatest........................	24.50	24.69	24.84	24.59	24.67	25.00	....
Average........................	24.10	24.00	23.70	24.00	23.72	24.00	23.96
Station experiments:							
Least........................	23.12	23.84	23.68	23.66	22.65	20.48	....
Greatest........................	24.28	24.84	25.00	24.77	25.46	22.07	....
Average........................	23.50	24.14	24.45	24.38	24.23	21.37	23.48
Average of all experiments...	24.17	24.08	23.62	23.86	23.64	23.76	23.90

In the factory-work, the per cent. of casein and albumen in the milk that was lost in the whey varied from 22.07 to 25.00 per cent., and averaged 23.96 per cent. In the station-work, the variation ranged from 20.48 to 25.46 per cent., and the average was 23.48 per cent. The average for the whole season's work was 23.90 per cent. The uniformity of loss of casein and albumen as indicated by the percentage loss above is rather remarkable, when we consider the variety of conditions under which the cheese was made. The results show that this loss is very uniform and is quite independent of ordinary variation in conditions of manufacture.

Table Showing Amount of Casein and Albumen Recovered in Cheese for One Hundred Pounds of Milk.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	1.90	2.41	2.31	2.27	2.32	2.71	....
Greatest	2.10	2.51	2.39	2.36	2.46	2.82	....
Average	2.01	2.47	2.35	2.31	2.38	2.78	2.38
Station experiments:							
Least	2.57	2.26	2.31	2.42	2.37	2.55	....
Greatest	2.69	2.52	2.45	2.49	2.63	2.82	....
Average	2.64	2.42	2.38	2.45	2.47	2.65	2.51
Average of all experiments.	2.07	2.46	2.36	2.33	2.39	2.76	2.39

The amount of casein and albumen recovered in the cheese for 100 pounds of milk varied in the factory work from 1.90 pounds to 2.82 pounds, and averaged 2.38 pounds, while in the station-work, the variation was from 2.31 pounds to 2.82 pounds, the average being 2.51 pounds. The average of all work for the season was 2.39 pounds.

TABLE SHOWING PER CENT. OF CASEIN AND ALBUMEN IN MILK RECOVERED IN CHEESE.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	75.50	75.31	75.16	75.41	75.33	75.00	....
Greatest	76.54	76.69	77.10	76.62	77.50	77.93	....
Average	75.90	76.00	76.30	76.00	76.28	76.00	76.04
Station experiments:							
Least	75.72	75.16	75.00	75.23	74.54	77.93	....
Greatest	76.88	76.16	76.32	76.34	77.35	79.52	....
Average	76.50	75.86	75.55	75.62	75.77	78.63	76.52
Average of all experiments	75.83	75.92	76.38	76.14	76.36	76.24	76.10

The per cent. of casein and albumen in milk that was recovered in cheese varied from 75 to 77.93 per cent. and averaged 76.04 per cent. in the factory-work; in the station-work, the per cent. varied from 75 to 79.52 per cent. and averaged 76.52 per cent. In all the season's work, 76.10 per cent. of the casein and albumen in the milk was recovered in the cheese.

The table below gives in greater detail the results embodied in the preceding tables for milk, varying from 3.05 to 4.40 per cent. of fat:

TABLE SHOWING AMOUNT OF CASEIN AND ALBUMEN IN MILK LOST AND RECOVERED IN CHEESE-MAKING.

Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen lost in whey for 100 pounds of milk.	Pounds of casein and albumen recov'd in cheese for 100 lbs. of milk.	Per cent. of casein and albumen lost in whey.	Per cent. of casein and albumen recov'd in cheese.
2.64	0.63	2.01	23.86	76.14
2.72	0.65	2.07	23.90	76.10
2.63	0.64	1.99	24.34	75.66
2.65	0.65	2.00	24.53	75.47
3.20	0.79	2.41	24.69	75.31
3.14	0.73	2.41	23.25	76.75
3.09	0.73	2.36	23.62	76.38
3.15	0.75	2.40	23.81	76.19
3.15	0.77	2.38	24.44	75.56
3.13	0.77	2.36	24.60	75.40
3.06	0.75	2.31	24.51	75.49
3.08	0.74	2.34	24.03	75.97
3.18	0.77	2.41	24.21	75.79
3.18	0.74	2.44	23.27	76.73
3.22	0.79	2.43	24.54	75.46
3.29	0.77	2.52	23.40	76.60
3.45	0.77	2.68	22.32	77.68
3.36	0.79	2.57	23.51	76.49
3.48	0.80	2.68	23.00	77.00
3.38	0.79	2.59	23.38	76.92
3.48	0.83	2.65	23.85	76.15
3.44	0.80	2.64	23.26	76.74
3.59	0.83	2.76	23.12	76.88
3.46	0.78	2.68	22.54	77.46

TABLE SHOWING RELATION OF ALBUMEN IN MILK TO CASEIN AND ALBUMEN IN WHEY.

Pounds of albumen in 100 pounds of milk.	Pounds of casein and albumen in whey from 100 pounds of milk.	Amount of casein and albumen in whey in excess of albumen in milk.
0.66	0.63	....
0.66	0.65	....
0.60	0.64	0.04
0.68	0.65	....
0.77	0.79	0.02
0.67	0.73	0.06
0.58	0.73	0.15
0.71	0.75	0.04
0.68	0.77	0.09
0.64	0.77	0.13
0.58	0.75	0.17
0.62	0.74	0.12
0.65	0.77	0.12
0.62	0.74	0.12
0.73	0.79	0.06
0.61	0.77	0.16
0.68	0.77	0.09
0.68	0.79	0.11
0.72	0.80	0.08
0.76	0.79	0.03
0.73	0.83	0.10
0.80	0.80	0.00
0.69	0.83	0.14

An examination of the table above shows that, in most cases, there is a larger amount of casein and albumen in the whey, than there is of albumen in the milk. If we suppose that all the albumen of the milk goes into the whey, then the excess in the whey must be casein. On this supposition, the casein in the whey would vary, as shown in the third column of the table above, from 0.03 to 0.17 pounds, and average about 0.09 pounds for 100 pounds of milk. However, it is probable that from 0.05 to 0.10 pounds of albumen go into the cheese for 100 pounds of milk, and hence, that there are somewhat more than 0.10 pounds of casein in the whey.

4. General Summary of Results in Regard to Loss and Recovery of Milk-constituents in Cheese-making.

(1.) Amount of solids in milk lost and recovered in cheese-making:

a. The milk-solids in 100 pounds of milk varied, during the season, from 11.47 pounds to 13.91 pounds, and averaged 12.66 pounds.

b. Of the solids in 100 pounds of milk, there were lost in the whey from 5.81 pounds to 6.83 pounds, with an average of 6.21 pounds; this was equivalent to from 43.57 to 54.73 per cent. of the solids in the milk, with an average of 49.05 per cent.

c. Of the solids in 100 pounds of milk, there were recovered in the cheese from 5.31 pounds to 7.51 pounds, with an average of 6.45 pounds; this was equivalent to from 45.27 to 56.43 per cent. of the solids in the milk, with an average of 50.95 per cent.

d. The per cent. of the solids in the milk lost in the whey diminished as the season advanced, while the per cent. of milk-solids recovered in the cheese increased as the season advanced.

(2.) Amount of fat in milk lost and recovered in cheese-making:

a. The fat in 100 pounds of milk varied during the season from 3.04 to 4.40 pounds, and averaged 3.70 pounds.

b. Of the fat in 100 pounds of milk, there were lost in the whey from 0.21 to 0.50 pounds, with an average of 0.31 pounds; which was equivalent to from 5.00 to 13.16 per cent of the fat in the milk, with an average of 8.38 per cent.

c. Of the fat in 100 pounds of milk, there were recovered in the cheese from 2.77 to 4.03 pounds, with an average of 3.39 pounds; which was equivalent to from 86.84 to 95.00 per cent., with an average of 91.62 per cent.

d. The proportion of milk-fat lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

(3.) Amount of casein and albumen in milk lost and recovered in cheese-making:

a. The casein and albumen in 100 pounds of milk varied from 2.53 pounds to 3.76 pounds, and averaged 3.14 pounds during the season.

b. Of the casein and albumen in 100 pounds of milk, there were lost in the whey from 0.61 pounds to 0.94 pounds, with an average of 0.75 pounds, which was equivalent to from 20.48 to 25.00 per cent. of the casein and albumen in the milk, with an average of 23.90 per cent.

c. Of the casein and albumen in 100 pounds of milk, there were recovered in the cheese from 1.90 to 2.82 pounds, with an average of 2.39 pounds, which was equivalent to from 75 to 79.52 per cent. of the casein and albumen in the milk, with an average of 76.10 per cent.

d. The proportion of casein and albumen lost in cheese-making was for the most part, very uniform, without regard to condition of manufacture.

e. While results based on definite data can not be presented, it is probable that less than 0.10 pounds of albumen is recovered in the cheese and that somewhat more than 0.10 pounds of casein go into the whey for 100 pounds of milk.

f. The loss of casein and albumen in cheese-making was in no way influenced by the amount of fat in the milk.

TABLE GIVING GENERAL SUMMARY REGARDING LOSS OF MILK CONSTITUENTS IN CHEESE-MAKING.

	Pounds in 100 lbs. of milk.	Pounds lost in whey for 100 lbs. of milk.	Pounds recovered in cheese for 100 lbs. of milk.	Per cent. lost in whey.	Per cent recovered in cheese.
Solids in milk........	12.66	6.21	6.45	49.05	50.95
Fat in milk..........	3.70	0.31	3.39	8.38	91.62
Casein and albûmen in milk..	3.14	0.75	2.39	23.90	76.10

Table Giving Summary of Results Regarding Loss of Milk-solids in Cheese-making.

	Pounds of solids in 100 pounds of milk.	Pounds of solids lost in whey for 100 pounds of milk.	Pounds of solids recovered in cheese for 100 pounds of milk.	Per cent. of solids in milk lost in whey.	Per cent. of solids in milk recovered in cheese.
Factory experiments:					
May	11.92	6.49	5.43	54.45	45.55
June	12.53	6.31	6.22	50.36	49.64
July	12.60	6.23	6.37	49.45	50.55
August	12.69	6.22	6.47	49.01	50.99
September	12.55	6.02	6.53	48.00	52.00
October	13.58	6.03	7.55	44.40	55.60
Average for season.	12.64	6.21	6.43	49.13	50.87
Station experiments:					
May	12.82	6.53	7.18	47.63	52.37
June	12.64	6.23	6.58	48.89	51.11
July	12.47	6.23	6.23	50.52	49.48
August	12.77	6.15	6.70	47.86	52.14
September	12.69	5.96	6.87	46.45	53.55
October	13.33	6.13	6.95	46.86	53.14
Average for season.	12.92	6.21	6.71	48.07	51.93
General average for all experiments	12.66	6.21	6.57	48.60	51.40

TABLE GIVING SUMMARY OF RESULTS REGARDING LOSS OF MILK-FAT IN CHEESE-MAKING.

	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in whey for 100 lbs. of milk.	Pounds of fat recovered in cheese for 100 lbs. of milk.	Per cent. of fat in milk lost in whey.	Per cent. of fat in milk recovered in cheese.
Factory experiments:					
May	3.20	0.29	2.91	9.06	90.94
June	3.58	0.27	3.31	7.54	92.46
July	3.63	0.31	3.32	8.54	91.46
August	3.77	0.32	3.45	8.50	91.50
September	3.81	0.35	3.46	9.19	90.81
October	4.14	0.31	3.83	7.50	92.50
Average for season.	3.69	0.31	3.38	8.40	91.60
Station experiments:					
May	4.25	0.29	3.96	6.62	93.38
June	3.98	0.27	3.71	6.80	93.20
July	3.93	0.39	3.44	10.18	89.82
August	4.00	0.27	3.73	7.25	92.75
September	4.08	0.32	3.76	7.84	92.16
October	4.04	0.31	3.73	7.67	92.33
Average for season.	4.03	0.31	3.72	7.70	92.30
General average for all experiments	3.70	0.31	3.39	8.38	91.92

TABLE GIVING SUMMARY OF RESULTS REGARDING LOSS OF CASEIN AND ALBUMEN IN CHEESE-MAKING.

	Pou ds of casein and albumen in 100 pounds of milk.	Pounds of casein and albumen lost in whey for 100 pounds of milk.	Pounds of asein and albumen recovered in cheese for 100 pounds of milk.	Per cent. of casein and albumen in milk lost in whey.	Per cent. of casein and albumen in milk recovered in cheese.
Factory experiments:					
May	2.65	0.64	2.01	24.10	75.90
June	3.25	0.78	2.47	24.00	76.00
July	3.08	0.73	2.35	23.70	76.30
August	3.04	0.73	2.31	24.00	76.00
September	3.12	0.74	2.38	23.72	76.28
October	3.66	0.88	2.78	24.00	76.00
Average for season.	3.13	0.75	2.38	23.96	76.04
Station experiments:					
May	3.45	0.81	2.64	23.50	76.50
June	3.19	0.77	2.42	24.14	75.86
July	3.15	0.77	2.38	24.45	75.55
August	3.34	0.79	2.45	24.38	75.62
September	3.26	0.79	2.47	24.23	75.77
October	3.37	0.72	2.65	21.37	78.63
Average for season.	3.28	0.77	2.51	23.48	76.52
General average for all experiments	3.14	0.75	2.39	23.90	76.10

XI. INFLUENCE OF COMPOSITION OF MILK ON COMPOSITION OF CHEESE.

Under this head we shall consider the following points:

1. The influence of fat in milk on composition of cheese.

2. The influence of casein and albumen in milk on composition of cheese.

In connection with the general subject of the relation of the composition of milk to the composition of cheese, it is a matter of interest and importance to ascertain whether or not we can trace a definite relation between the amount of fat in milk and in cheese; whether, in case of factory-milk, the per cent. of fat in cheese increases when the per cent. of fat in the milk increases; whether, knowing the composition of a given milk, we can predict what amount of fat the cheese made from it will contain; or whether, knowing the composition of a cheese, we can determine the composition of the milk from which it was made.

In the tables below, the constituents of cheese are given in two forms (1st) in the green cheese, and (2d) in the dry or water-free cheese. To illustrate, 100 pounds of a certain green cheese contain 33.7 pounds of fat and 37.3 pounds of water. If the water were removed completely by drying, 100 pounds of the dried or water-free cheese would contain 53.8 pounds of fat. This method of calculating the results is made desirable where comparison of cheeses is to be made from the fact that, in curing, the cheese is steadily losing moisture, and the per cent. of fat is becoming larger, though the actual amount of fat in the cheese is the same. By calculating the fat in 100 pounds of water-free cheese, we have a uniform basis for comparing our results.

I. The Influence of Fat in Milk on Composition of Cheese.

Table Showing Relation of Fat in Milk to Fat in Cheese.

Pounds of fat in 100 pounds of milk.	Pounds of fat in 100 pounds of green cheese.	Pounds of fat in 100 pounds of green cheese for one pound of fat in milk.	Lbs. of fat in 100 pounds of water-free cheese.	Lbs. of fat in 100 pounds of water-free cheese for one pound of fat in milk.
3.05	32.82	10.76	52.54	17.23
3.10	32.48	10.45	51.56	16.63
3.30	32.82	9.95	53.90	16.33
3.35	33.30	9.94	54.88	16.38
3.45	33.47	9.70	53.20	15.42
3.50	32.05	9.16	51.05	14.60
3.55	33.05	9.31	52.11	14.70
3.60	33.88	9.41	52.79	14.66
3.65	32.70	9.00	52.91	14.50
3.70	34.44	9.31	53.45	14.45
3.75	34.23	9.13	53.25	14.20
3.80	34.66	9.12	53.80	14.16
3.85	33.98	8.83	53.90	14.00
3.90	34.80	8.92	54.92	14.08
3.95	34.96	8.85	55.88	14.15
4.00	33.36	8.34	54.70	13.68
4.05	32.30	8.00	52.78	13.03
4.10	33.90	8.27	54.00	13.17
4.15	33.00	7.96	52.91	12.75
4.20	35.45	8.44	54.39	12.95
4.25	34.82	8.19	52.75	12.40
4.30	36.05	8.38	56.68	13.18
4.35	34.53	7.94	53.79	12.37
4.40	34.91	7.93	55.93	12.71

(1st.) An examination of the second and third columns in the table above indicates much irregularity, within certain limits regarding the relation between the amount of fat in normal milk and in cheese. Taking the amount of fat in 100 pounds of green cheese, it varied from about thirty-two to thirty-six pounds, with a slight but very irregular tendency to increase when the fat in the milk increased. In order to see how this variation of fat in the green cheese was influenced by variation in the amount of water in the cheese, it will be necessary to consider the water-free cheese.

(2d.) An examination of the last two columns in the table above also shows variation and irregularity as regards the relation between the fat in the milk and in the water-free cheese. The amount of fat in 100 pounds of water-free cheese varied from 51.05 to 56.68 pounds. There is a slight but irregular tendency for the fat in the water-free cheese to increase, when the fat in the milk increases.

(3d.) So far as using our data as a basis for finding a definite relation between the amount of fat in a given milk and the amount of fat in the cheese made from the milk, no relation appears to exist, so sharp and definite that we can tell exactly what per cent. of fat cheese will contain from knowing the amount of fat in the milk from which the cheese was made, so far as normal factory-milk containing from 3 to 4.40 per cent. of fat is concerned. The water-free cheese from such milk should not contain less than fifty-one pounds of fat in 100 pounds of cheese; while 100 pounds of green cheese made from normal factory-milk should not contain less than thirty-one or thirty-two pounds of fat.

2. The Influence of Casein and Albumen in Milk on Composition of Cheese.

In the table below, data relating to the casein and albumen in the milk and in the cheese are presented similar to those presented above relating to the fat.

TABLE SHOWING RELATION OF CASEIN AND ALBUMEN IN MILK TO CASEIN AND ALBUMEN IN CHEESE.

Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein and albumen in 100 pounds of green cheese.	Pounds of casein and albumen in green cheese for one pound of fat in milk.	Pounds of casein and albumen in 100 pounds of water-free cheese.	Pounds of casein and albumen in 100 pounds of water-free cheese for one pound of casein and albumen in milk.
2.64	23.65	8.96	37.86	14.34
2.72	24.00	8.82	38.10	14.00
2.63	22.00	8.36	36.13	13.74
2.65	21.90	8.26	35.10	13.62
3.20	24.90	7.78	39.58	12.37
3.14	24.44	7.78	38.93	12.40
3.09	24.46	7.91	38.57	12.48
3.15	24.56	7.80	38.27	12.15
3.15	23.00	7.30	37.22	11.82
3.13	23.84	7.62	37.00	11.82
3.06	23.00	7.52	35.80	11.70
3.08	23.85	7.74	37.02	12.02
3.18	23.26	7.31	36.90	11.60
3.18	23.71	7.45	37.42	11.76
3.22	23.28	7.23	37.22	11.56
3.29	22.54	6.85	36.95	11.23
3.45	23.27	6.75	38.02	11.02
3.36	23.00	6.84	36.63	10.90
3.48	23.00	6.61	36.87	10.60
3.38	23.64	6.99	36.27	10.73
3.48	23.25	6.68	35.26	10.13
3.44	23.68	6.90	37.23	10.80
3.59	23.59	6.57	36.75	10.24
3.46	23.10	6.67	37.00	10.70

The casein and albumen in 100 pounds of milk varied from 2.63 to 3.69 pounds; in the green cheese, from 21.90 to 24.56 pounds; and, in the water-free cheese, from 35.26 to 39.58 pounds. There appears to be no relation between the amount of casein and albumen in milk and in cheese, so sharp and definite that we can tell from the composition of the milk how much casein and albumen a cheese will contain. One hundred pounds of green cheese made from normal factory-milk, as we have found it, should contain from 22 to 25 pounds of casein, while the water free cheese should contain from 36 to 39 pounds.

The relation of fat to casein in cheese made from normal factory-milk, we have previously discussed in full, and, as we have seen, there is a fairly uniform relation, which we hope to make use of in determining whether cheese has been made from normal or skimmed milk.

XII. INFLUENCE OF COMPOSITION OF MILK ON YIELD OF CHEESE.

Under this head, the following points will be considered:

1. Yield of green cheese from 100 pounds of milk.
2. Amount of water retained in green cheese made from 100 pounds of milk.
3. Amount of fat retained in green cheese made from 100 pounds of milk.
4. Amount of casein and albumen retained in green cheese made from 100 pounds of milk.
5. Influence of different milk-constituents in increasing yield of cheese.
6. Relation of fat in milk to yield of cheese.
7. Relation of total solids in milk to yield of cheese.
8. General summary of results.

TABLE SHOWING RELATIONS OF MILK-CONSTITUENTS TO YIELD OF CHEESE.

Pounds of fat in 100 pounds of milk.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of green cheese made from 100 lbs. of milk.	Pounds of water in cheese from 100 pounds of milk.	Pounds of fat in cheese from 100 pounds of milk.	Pounds of casein and albumen in cheese from 100 pounds of milk.	Pounds of ash, etc., in cheese from 100 pounds of milk.
3.05	2.64	8.50	3.19	2.79	2.01	0.51
3.10	2.72	8.62	3.19	2.80	2.07	0.56
3.30	2.63	9.05	3.54	2.97	1.99	0.55
3.35	2.65	9.13	3.59	3.04	2.00	0.50
3.45	3.20	9.68	3.59	3.24	2.41	0.44
3.50	3.14	9.86	3.67	3.16	2.41	0.62
3.55	3.09	9.65	3.53	3.19	2.36	0.57
3.60	3.15	9.77	3.50	3.31	2.40	0.56
3.65	3.15	10.34	3.95	3.38	2.38	0.63
3.70	3.13	9.90	3.52	3.41	2.36	0.61
3.75	3.06	10.05	3.59	3.44	2.31	0.71
3.80	3.08	9.81	3.49	3.40	2.34	0.58
3.85	3.18	10.36	3.83	3.52	2.41	0.60
3.90	3.18	10.29	3.77	3.58	2.44	0.50
3.95	3.22	10.44	3.91	3.65	2.43	0.45
4.00	3.29	11.18	4.36	3.73	2.52	0.57
4.05	3.45	11.52	4.47	3.72	2.68	0.65
4.10	3.36	11.18	4.16	3.79	2.57	0.66
4.15	3.48	11.64	4.38	3.84	2.68	0.74
4.20	3.38	11.00	3.83	3.90	2.59	0.68
4.25	3.48	11.40	3.88	3.97	2.65	0.90
4.30	3.44	11.15	4.06	4.02	2.64	0.43
4.35	3.59	11.70	4.19	4.04	2.76	0.71
4.40	3.46	11.60	4.36	4.05	2.68	0.51

I. Yield of Green Cheese from One Hundred Pounds of Milk.

Table Showing Pounds of Green Cheese Made from One Hundred Pounds of Milk.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	8.47	9.65	9.50	9.40	9.63	11.40	....
Greatest	9.13	10.38	10.29	10.60	10.29	12.28	....
Average	8.75	9.87	9.96	10.03	9.91	11.84	10.06
Station experiments:							
Least	11.00	9.82	9.90	10.60	10.44	10.60	....
Greatest	11.55	11.02	10.30	11.40	11.96	12.44	....
Average	11.21	10.40	10.03	10.96	10.96	11.28	10.94
Average of all experiments	9.00	9.93	9.97	10.10	9.97	11.76	10.12

In the factory experiments, the yield of cheese from 100 pounds of milk varied from 8.47 pounds to 12.28 pounds, and averaged 10.06 pounds during the season. In the station experiments, the yield varied from 9.90 pounds to 12.44 pounds, and averaged 10.94 pounds. The average yield from all the season's experiments was 10.12 pounds.

2. Amount of Water Retained in Cheese Made from One Hundred Pounds of Milk.

TABLE SHOWING POUNDS OF WATER IN CHEESE MADE FROM ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August.	September	October.	Average for season.
Factory experiments:							
Least	3.16	3.42	3.22	3.19	3.32	4.22	....
Greatest	3.35	4.01	3.67	3.93	3.87	4.76	....
Average	3.25	3.62	3.48	3.58	3.60	4.45	3.66
Station experiments:							
Least	3.69	3.31	3.71	3.83	3.69	3.84	....
Greatest	4.04	4.37	3.96	4.47	4.86	5.34	....
Average	3.88	3.81	3.84	4.15	4.14	4.21	4.01
Average of all experiments	3.31	3.65	3.49	3.63	3.63	4.42	3.70

The amount of water retained in the cheese made from 100 pounds of milk varied, in the factory experiments, from 3.16 pounds to 4.76 pounds, and averaged 3.66 pounds for the season. in the station experiments, the water in the cheese varied from 3.31 pounds to 5.34 pounds, and averaged 4.01 pounds. The average of the whole season's work was 3.70 pounds.

If it were possible to control absolutely the amount of moisture retained in cheese, then the cheese made from 100 pounds of milk would contain moisture in proportion to the solids contained in the cheese. The table below shows (1st) the amount of solids retained in the cheese made from 100 pounds of milk, for milk varying from 3.05 to 4.40 per cent. of fat; (2d) the amount of green cheese made from 100 pounds of milk; (3d) the amount of water in the green cheese made from 100 pounds of milk; (4th) the amount of "normal" cheese made from 100 pounds of milk; and (5th) the amount of water in "normal" cheese made from 100 pounds of milk. By "normal" cheese is meant cheese containing about 36.5 per cent. of water. This is the average per cent. of water in all the cheese made during the summer. Calculating the amount of water in cheese on this basis, we can see how much cheese would have been made from 100 pounds of milk and how much water such cheese would have retained, if it had been possible to retain exactly the same proportion of water in the cheese.

Pounds of fat in 100 lbs. of milk.	Pounds of solids in cheese made from 100 lbs. of milk.	Pounds of green cheese made from 100 lbs. of milk.	Pounds of water in green cheese made from 100 lbs. of milk.	Pounds of normal cheese made from 100 lbs. of milk.	Pounds of water in normal cheese made from 100 lbs. of milk.
3.05	5.31	8.50	3.19	8.38	3.07
3.10	5.43	8.62	3.19	8.57	3.14
3.30	5.51	9.05	3.54	8.69	3.18
3.35	5.54	9.13	3.59	8.74	3.20
3.45	6.09	9.68	3.59	9.91	3.52
3.50	6.19	9.86	3.67	9.76	3.57
3.55	6.12	9.65	3.53	9.65	3.53
3.60	6.27	9.77	3.50	9.89	3.62
3.65	6.39	10.34	3.95	10.08	3.69
3.70	6.38	9.90	3.52	10.07	3.69
3.75	6.46	10.05	3.59	10.19	3.73
3.80	6.32	9.81	3.49	9.97	3.65
3.85	6.53	10.36	3.83	10.30	3.77
3.90	6.52	10.29	3.77	10.29	3.77
3.95	6.53	10.44	3.91	10.30	3.77
4.00	6.82	11.18	4.36	10.76	3.94
4.05	7.05	11.52	4.47	11.13	4.08
4.10	7.02	11.18	4.16	11.08	4.06
4.15	7.26	11.64	4.38	11.46	4.20
4.20	7.17	11.00	3.83	11.31	4.14
4.25	7.52	11.40	3.88	11.87	4.35
4.30	7.09	11.15	4.06	11.19	4.10
4.35	7.51	11.70	4.19	11.85	4.34
4.40	7.24	11.60	4.36	11.42	4.18

3. Amount of Fat Retained in Cheese made from One Hundred Pounds of Milk.

TABLE SHOWING POUNDS OF FAT IN CHEESE MADE FROM ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	2.77	3.24	3.05	3.18	3.19	3.67	....
Greatest	3.07	3.48	3.49	3.71	3.60	4.03	....
Average	2.91	3.31	3.32	3.45	3.46	3.83	3.38
Station experiments:							
Least	3.84	3.58	3.30	3.55	3.49	3.58	....
Greatest	4.03	3.83	3.56	3.87	3.99	4.11	....
Average	3.96	3.71	3.44	3.73	3.76	3.73	3.72
Average for all experiments	3.01	3.33	3.32	3.48	3.48	3.82	3.39

The amount of fat retained in the cheese made from 100 pounds of milk varied, in the factory experiments, from 2.77 pounds to 4.03 pounds, and averaged 3.38 pounds during the season. In the station-work, the amount varied from 3.30 pounds to 4.11 pounds, and averaged 3.72 pounds. The average of the whole season's work was 3.39 pounds.

If we arrange our data as in the table below, we can see how the amount of fat retained in the cheese varied with the amount of fat in the milk.

Pounds of fat in 100 pounds of milk.	Pounds of fat in cheese made from 100 pounds of milk.	Increase of fat in 100 pounds of milk.	Increase of fat in cheese made from 100 pounds of milk.
3.05	2.79	....	....
3.10	2.80	0.05	0.01
3.30	2.97	0.25	0.18
3.35	3.04	0.30	0.25
3.45	3.24	0.40	0.35
3.50	3.16	0.45	0.37
3.55	3.19	0.50	0.40
3.60	3.31	0.55	0.52
3.65	3.38	0.60	0.59
3.70	3.41	0.65	0.62
3.75	3.44	0.70	0.65
3.80	3.40	0.75	0.61
3.85	3.52	0.80	0.73
3.90	3.58	0.85	0.79
3.95	3.65	0.90	0.86
4.00	3.73	0.95	0.94
4.05	3.72	1.00	0.93
4.10	3.79	1.05	1.00
4.15	3.84	1.10	1.05
4.20	3.90	1.15	1.11
4.25	3.97	1.20	1.18
4.30	4.02	1.25	1.23
4.35	4.04	1.30	1.25
4.40	4.05	1.35	1.26

An examination of the last two columns in the preceding table shows conclusively that when the fat in the milk increased, the amount of fat retained in the cheese closely followed the increase of fat in the milk.

4. Amount of Casein and Albumen Retained in Cheese Made from One Hundred Pounds of Milk.

TABLE SHOWING POUNDS OF CASEIN AND ALBUMEN RETAINED IN CHEESE MADE FROM ONE HUNDRED POUNDS OF MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	1.90	2.41	2.31	2.27	2.32	2.71	....
Greatest	2.10	2.51	2.39	2.36	2.46	2.82	....
Average	2.01	2.47	2.35	2.31	2.38	2.78	2.38
Station experiments:							
Least	2.57	2.36	2.31	2.42	2.37	2.55	....
Greatest	2.69	2.52	2.45	2.49	2.63	2.82	....
Average	2.64	2.42	2.38	2.45	2.47	2.65	2.51
Average of all experiments	2.07	2.46	2.36	2.33	2.39	2.76	2.39

In the factory experiments, the amount of casein and albumen retained in the cheese made from 100 pounds of milk varied from 1.90 pounds to 2.82 pounds and averaged 2.38 pounds for the season. In the station-work, the variation ranged from 2.31 pounds to 2.82 pounds, and the average was 2.51 pounds. The average amount of casein and albumen retained in the cheese made from 100 pounds of milk was 2.39 pounds for the season.

5. Influence of Different Milk-constituents in Increasing Yield of Cheese.*

In order to ascertain to what particular constitutents of the milk the increase in yield of cheese was due, we rearrange below data previously presented.

Yield of cheese from 100 pounds of milk.		Pounds of fat in cheese from 100 pounds of milk.		Pounds of casein and albumen in cheese from 100 pounds of milk.		Pounds of water, ash, etc., in cheese from 100 pounds of milk.	
Increase of yield.	Decrease of yield.	Increase of fat in cheese.	Decrease of fat in cheese.	Increase of casein and albumen in cheese.	Decrease of casein and albumen in cheese.	Increase of water, etc., in cheese.	Decrease of water, etc., in cheese.
0.12	.....	0.05	......	0.06	......	0.05	......
0.55	.....	0.18	......	......	0.02	0.39	......
0.63	.....	0.25	......	......	0.01	0.39	......
1.18	.....	0.45	......	0.40	......	0.33	......
1.36	.....	0.37	.....	0.40	......	0.59	......
1.15	.....	0.40	......	0.35	......	0.40	......
1.27	.....	0.52	......	0.39	......	0.36	......
1.84	.....	0.59	......	0.37	......	0.88	......
1.40	.....	0.62	......	0.35	......	0.43	......
1.55	.....	0.65	......	0.30	......	0.60	......
1.31	.....	0.61	......	0.33	......	0.37	......
1.86	.....	0.73	......	0.40	......	0.73	......
1.79	.....	0.79	......	0.43	......	0.57	......
1.94	.....	0.86	......	0.42	......	0.66	......
2.68	.....	0.94	......	0.51	......	1.23	......
3.02	.....	0.93	......	0.67	......	1.42	......
2.68	.....	1.00	......	0.56	......	1.12	......
3.14	.....	1.05	......	0.67	......	1.42	......
2.50	.....	1.11	......	0.58	......	0.81	......
2.90	.....	1.18	......	0.64	......	1.08	......
2.65	.....	1.23	......	0.63	......	0.79	......
3.20	.....	1.25	......	0.75	......	1.20	......
3.10	.....	1.26	......	0.67	......	1.17	......

* In some of the bulletins giving the data of each month's work, skim-milk was used as the basis of comparison in ascertaining the increase or decrease of yield of various constituents. When we come to study the season's results as a whole it can be seen that the comparison of skim-milk in this way with normal milk was misleading, since it greatly exaggerated the influence of the fat.

A careful study of the results embodied in the above table enables us to make the following summary in regard to the average of results secured in our entire season's work:

	Pounds.	Per cent.
Average increased yield of cheese	1.91	100
Average increased yield of fat in cheese..........	0.74	38.75
Average increased yield of water, ash, etc., in cheese	0.74	38.75
Average increased yield of casein and albumen in cheese	0.43	22.50

Stating the above facts in another form, we can say that whenever there was an increase of one pound of fat in the cheese, there was, on an average, also an increase of one pound of water in the cheese and of about 0.60 pounds (nine and one-half ounces) of casein and albumen.

6. Relation of Fat in Milk to Yield of Cheese.

It has been generally believed that normal milk poor in fat makes more cheese in proportion to its fat than does milk richer in fat. If we compare skim-milk with normal milk or with milk which has been enriched by addition of cream, the belief above stated is true, as all our facts go to show. But is the statement true of normal milk such as we have used in our experiments; that is, milk varying in fat content from 3.05 to 4.40 per cent? If it is true the casein and fat in normal factory-milk are present, on an average, in approximately uniform relative proportion, it would follow that the yield of cheese for a pound of fat must be fairly uniform, whether the milk contains three of four per cent. of fat, provided the amount of water retained in the cheese is fairly uniform.

POUNDS OF CHEESE MADE FOR ONE POUND OF FAT IN MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	2.60	2.61	2.64	2.53	2.52	2.77	....
Greatest	2.80	2.83	2.86	2.91	2.72	2.96	....
Average	2.73	2.76	2.74	2.66	2.60	2.86	2.73
Station experiments:							
Least	2.54	2.51	2.60	2.68	2.50	2.60	....
Greatest	2.71	2.76	2.64	2.81	2.86	3.11	....
Average	2.64	2.61	2.62	2.74	2.69	2.79	2.71
Average of all experiments	2.727	2.758	2.739	2.665	2.610	2.847	2.725

In the factory experiments, the yield of cheese for one pound of fat varied from 2.53 to 2.96 pounds, and averaged 2.73 pounds. In the station-experiments, the variation ranged from 2.50 to 3.11 pounds, and the average was 2.71 pounds. For the average of the whole season's work, each pound of fat in milk made 2.725 pounds of cheese.

In the factory experiments, we see that the averages for the months of May, June and July were very constant, although the amount of fat in the milk increased considerably. The dropping of the yield in August and September was due to the fact that tainted milk was encountered in the factories where the work was done and there was greater loss in manufacture, while the amount of water retained in the cheese was also below the average. The large yield of October was due to two facts: (1.) The amount of water retained in the cheese was above the average, and (2) the proportion of casein to fat in milk was above the average.

In order to see how much variation was caused by variation in the amount of water retained in the cheese, we present below a table giving the actual results of the work for milk ranging from 3.05 to 4.40 per cent. of fat, and also the results calculated for "normal" cheese containing 36.5 per cent. of water.

TABLE SHOWING RELATION OF FAT IN MILK TO YIELD OF GREEN CHEESE.

Pounds of fat in 100 lbs. of milk.	Pounds of cheese made from 100 lbs. of milk.	Pounds of cheese for one pound of fat in milk.	Pounds of normal cheese made from 100 lbs. of milk.	Pounds of normal cheese for one pound of fat in milk.
3.05	8.50	2.79	8.38	2.75
3.10	8.62	2.78	8.57	2.76
3.30	9.05	2.74	8.69	2.63
3.35	9.13	2.73	8.74	2.61
3.45	9.68	2.81	9.61	2.79
3.50	9.86	2.82	9.76	2.79
3.55	9.65	2.72	9.65	2.72
3.60	9.77	2.72	9.89	2.74
3.65	10.34	2.83	10.08	2.76
3.70	9.90	2.68	10.07	2.72
3.75	10.05	2.68	10.19	2.72
3.80	9.81	2.60	9.97	2.63
3.85	10.36	2.70	10.30	2.68
3.90	10.29	2.64	10.29	2.64
3.95	10.44	2.64	10.30	2.61
4.00	11.18	2.79	10.76	2.69
4.05	11.52	2.84	11.13	2.75
4.10	11.18	2.73	11.08	2.70
4.15	11.64	2.80	11.46	2.76
4.20	11.00	2.62	11.31	2.70
4.25	11.40	2.69	11.87	2.79
4.30	11.15	2.60	11.19	2.60
4.35	11.70	2.69	11.85	2.72
4.40	11.60	2.64	11.42	2.60

An examination of the above table shows that while there is considerable variation in the amount of cheese that can be made for one pound of fat in milk, that the variation is, all things considered, practically independent of the amount of fat in the milk. Our season's work appears to indicate that, taking the season right through, we can calculate the average amount of cheese that should be made from normal factory-milk containing from about 3 to 4.50 per cent. of fat by multiplying the per cent. of fat in the milk by 2.75. This statement is not to be regarded as absolute but rather as tentative, and its confirmation or modification will follow from future work. It is desirable, if possible, to establish some average relation between the amount of fat in factory-milk and the yield of cheese; since this can be used as a general indication of the skill of the cheese-maker. If, for example, it was found that a cheese-maker was making, on an average, only 2.50 or 2.60 pounds of cheese for one pound of fat in milk, it would be ground for suspicion that it was due to lack of skill, unless the results could be explained by some special conditions, such as the prevalence of tainted milk.

7. Relation of Solids in Milk to Yield of Cheese.

TABLE SHOWING POUNDS OF CHEESE MADE FOR ONE POUND OF SOLIDS IN MILK.

	May.	June.	July.	August.	September.	October.	Average for season.
Factory experiments:							
Least	0.70	0.76	0.76	0.75	0.77	0.85	......
Greatest	0.74	0.83	0.80	0.83	0.80	0.90	......
Average	0.73	0.78	0.79	0.79	0.79	0.87	0.79
Station experiments:							
Least	0.79	0.79	0.82	0.83	0.81	0.83	......
Greatest	0.85	0.82	0.89	0.88	0.92	0.95	......
Average	0.82	0.81	0.81	0.85	0.85	0.86	0.83
Average of all experiments	0.74	0.79	0.79	0.80	0.80	0.87	0.80

In the factory experiments, one pound of milk-solids made from 0.70 to 0.90 pounds of cheese, with an average of 0.79 pounds. In the station-work, one pound of milk-solids made from 0.79 to 0.95 pounds of cheese, with an average of 0.83 pounds. Averaging the results of the season's work, one pound of milk-solids made 0.80 pounds (nearly thirteen ounces) of cheese; or stated, in another way, one pound of cheese was made for 1.25 pounds of milk-solids. As we have previously seen, a little over one-half of the milk-solids are recovered in the cheese, and the portion of solids recovered retains enough water to produce the proportion of cheese above stated.

8. Summary of Results Relating to the Influence of Composition of Milk on Yield of Green Cheese.

(1st.) Yield of green cheese from 100 pounds of milk:

From 100 pounds of milk there were made from 8.47 to 12.44 pounds, with an average of 10.12 pounds for the season.

(2d.) Amount of water retained in cheese made from 100 pounds of milk:

There were retained in the cheese made from 100 pounds of milk from 3.16 to 5.34 pounds, the average for the season being 3.70 pounds.

(3d.) Amount of fat retained in cheese made from 100 pounds of milk:

The amount of fat retained in the cheese made from 100 pounds of milk varied, during the season, from 2.77 to 4.11 pounds, and averaged 3.39 pounds. The variations of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

(4th.) Amount of casein and albumen retained in the cheese made from 100 pounds of milk:

The amount of casein and albumen retained in the cheese made from 100 pounds of milk varied from 1.90 to 2.82 pounds, and averaged 2.39 pounds for the season.

(5th.) Influence of different milk-constituents in increasing yield of cheese:

For an increase of one pound of fat in the cheese, there was, on an average, an increase of one pound of water in the cheese and of about 0.60 pounds (nine and one-half ounces) of casein and albumen.

(6th.) Relation of fat in milk to yield of cheese:

Each pound of fat in milk produced from 2.50 to 3.11 pounds of cheese, the average being nearly 2.75 pounds.

(7th.) Relation of solids in milk to yield of cheese:

For each pound of solids in milk there were made from 0.70 to 0.95 pounds of cheese, the average being 0.80 pounds.

Table Giving General Summary Regarding Relation of Different Milk-constituents to Yield of Cheese.

	Pounds of green cheese made from 100 pounds of milk.	Pounds of water retained in green cheese made from 100 pounds of milk.	Pounds of fat retained in green cheese made from 100 pounds of milk.	Pounds of casein and albumen retained in green cheese made from 100 pounds of milk.	Pounds of green cheese made from one pounds of fat in milk.	Pounds of green cheese made for one pound of solids in milk.
Factory experiments:						
May	8.75	3.25	2.91	2.01	2.73	0.73
June	9.87	3.62	3.31	2.47	2.76	0.78
July	0.96	3.48	3.32	2.35	2.74	0.79
August	10.03	3.58	3.45	2.31	2.66	0.79
September	9.91	3.60	3.49	2.38	2.60	0.79
October	11.84	4.45	3.83	2.78	2.86	0.87
Average for season	10.06	3.66	3.38	2.38	2.73	0.79
Station experiments:						
May	11.21	3.88	3.96	2.64	2.64	0.82
June	10.40	3.81	3.71	2.42	2.61	0.81
July	10.03	3.84	3.44	2.38	2.62	0.81
August	10.96	4.15	3.73	2.45	2.74	0.85
September	10.96	4.14	3.76	2.47	2.69	0.85
October	11.28	4.21	3.73	2.65	2.79	0.86
Average for season	10.94	4.01	3.72	2.51	2.71	0.83
General average for all experiments	10.12	3.70	3.39	2.39	2.73	0.80

XIII. THE INFLUENCE OF SKIMMING NORMAL MILK AND ADDING CREAM TO NORMAL MILK UPON THE MANUFACTURE OF CHEESE.

We have already discussed the effect of skimming milk and adding cream to milk upon the composition of milk and also upon the composition of the cheese made from such milk. We have seen that removal of fat from normal milk produces the following effects: (1st) the milk-solids decrease in quantity; (2d) the casein and albumen increase relative to the fat, so that while in the normal mixed milk of herds of cows we found rarely less than 1.10 pounds of fat for one pound of casein, in skim-milk there was rarely as much fat as casein and albumen. Our season's work appears to justify the statement that ordinary skim-milk rarely or never contains more than 1.30 pounds of fat for one pound of casein (not including albumen). Adding cream to milk has the effect of increasing the amount of fat relative to the casein and albumen in both milk and cheese.

We will consider, in addition, the following points under this head:

1. The influence upon loss of milk-solids in cheese-making.
2. The influence upon loss of fat in cheese-making.
3. The influence upon loss of casein and albumen in cheese-making.
4. The influence upon composition of cheese.
5. The influence upon yield of cheese.
6. Summary of results.

I. The Influence of Skimming Milk and Adding Cream upon Loss of Milk-solids in Cheese-making.

TABLE SHOWING AMOUNT OF MILK-SOLIDS LOST AND RECOVERED IN CHEESE-MAKING.

Pounds of fat in 100 lbs. of milk.	Pounds of solids in 100 lbs. of milk.	Pounds of solids lost in whey for 100 lbs. of milk.	Pounds of solids recovered in cheese for 100 lbs. of milk.	Per cent. of milk-solids lost in whey.	Per cent. of milk-solids recovered in cheese.
2.40	*11.70	6.31	5.39	53.93	46.07
2.90	*11.75	6.20	5.55	52.76	47.24
2.95	*11.75	6.16	5.59	52.43	47.57
3.20	*11.83	6.19	5.64	52.32	47.68
3.25	*12.23	6.22	6.01	50.86	49.14
3.55	*13.03	6.52	6.51	50.00	50.00
3.80	*13.08	6.21	6.87	47.48	52.52
4.22	†13.19	6.34	6.85	48.07	51.93
5.70	†14.65	6.06	8.59	41.37	58.63
6.00	†15.26	6.28	8.98	41.15	58.85

The per cent. of loss of milk-solids in making skim-milk into cheese is greater than in case of normal milk, while, in making into cheese milk to which cream has been added, the per cent. of loss of milk-solids is less than in normal milk, as is shown by the following summary:

PER CENT. OF MILK-SOLIDS LOST IN WHEY.

	Normal milk.	Skim-milk.	Milk containing cream.
Least	43.59	47.48	41.15
Greatest	54.73	53.93	48.07
Average	48.60	52.03	43.35

* Partially skimmed. † Cream added.

2. The Influence of Skimming Milk and Adding Cream Upon Loss of Fat in Cheese-making.

TABLE SHOWING AMOUNT OF FAT LOST AND RECOVERED IN CHEESE-MAKING.

Pounds of fat in 100 pounds of milk.	Pounds of fat lost in whey for 100 pounds of milk.	Pounds of fat recovered in cheese for 100 pounds of milk.	Per cent. of fat in milk lost in whey.	Per cent. of fat in milk recovered in cheese.
*2.40	0.16	2.24	6.67	92.33
*2.90	0.24	2.66	8.28	91.72
*2.95	0.26	2.69	8.81	91.19
*3.25	0.23	3.02	7.08	92.92
*3.56	0.21	3.35	5.90	94.10
*3.80	0.27	3.53	7.10	92.90
†4.22	0.27	3.95	6.40	93.60
†5.70	0.42	5.28	7.37	92.63
†6.00	0.34	5.66	5.67	94.33

The following arrangement shows the per cent. of fat in milk that was lost in making normal milk into cheese and also that lost in making the corresponding skim-milk into cheese side by side with the normal milk:

	Pounds of fat in 100 pounds of normal milk.	Per cent. of fat in normal milk lost in whey.	Pounds of fat in 100 pounds of skim-milk.	Per cent. of fat in skim-milk lost in whey.
	4.15	6.50	3.80	7.10
	3.95	5.32	3.25	7.08
	3.90	8.70	2.90	8.28
	4.10	6.60	3.20	8.12
Average.....	4.03	6.78	3.29	7.65

A comparison, as above, of the loss of fat experienced in making normal milk into cheese and in making parallel experiments with the same normal milk after partial skimming shows that the average per cent. of fat lost in case of the normal milk was 6.78

* Partially skimmed. † Cream added.

per cent. of the fat in the milk, while the fat lost in case of the skim-milk amounted to 7.65 per cent. of the fat in the milk.

In the table below we give the results obtained in making experiments side by side with skim-milk and milk containing added cream. In these experiments, cream was taken from one portion of normal milk and added to another portion of the same normal milk, and the two resulting milks, one skim-milk and the other containing added cream, were made into cheese side by side under conditions as nearly alike as possible:

	Pounds of fat in 100 pounds of milk containing added cream.	Per cent. of fat in milk containing added cream lost in whey.	Pounds of fat in 100 pounds of skim-milk.	Per cent. of fat in skim-milk lost in whey.
	6.00	5.66	3.56	5.90
	5.70	7.37	2.40	6.67
	4.22	6.40	2.95	8.81
Average.....	5.31	6.48	2.97	7.13

The above results indicate that there was a smaller per cent. of loss of fat in making into cheese the milk containing added cream than there was in case of the skim-milk.

The general results of our season's work all go to show that milk rich in fat can be made into cheese more economically as regards loss of fat in manufacture than can milk poorer in fat. To what extent this is true of milk containing over 6 per cent. of fat, we can not say. As we do not meet with normal cheese factory-milk containing over 4.50 or 5 per cent. of fat, the interest that attaches to milk of extra richness, whether normal or abnormal, is not one of general practical importance.

3. The Influence of Skimming Milk and Adding Cream upon Loss of Casein and Albumen in Cheese-making.

TABLE SHOWING LOSS OF CASEIN AND ALBUMEN IN CHEESE-MAKING.

Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein and albumen lost in whey for 100 pounds of milk.	Pounds of casein and albumen recovered in cheese for 100 pounds of milk.	Per cent. of casein and albumen in milk lost in whey.	Per cent. of casein and albumen in milk recovered in cheese.
*3.47	0.72	2.75	20.75	79.25
*3.21	0.76	2.45	23.68	76.32
*3.26	0.80	2.46	24.54	75.46
*3.21	0.77	2.44	24.00	76.00
*3.27	0.81	2.46	24.77	75.23
*3.46	0.84	2.62	24.28	75.72
*3.48	0.74	2.74	21.27	78.73
†3.30	0.78	2.52	23.64	76.36
†3.32	0.68	2.64	20.48	79.52
†3.46	0.80	2.66	23.12	76.88

An examination of the above table and a comparison with our average results show that the loss of casein and albumen in cheese-making is affected little, if any, by skimming milk or adding cream.

4. The Influence of Skimming Milk and Adding Cream upon the Composition of Cheese.

This subject has been discussed already in connection with the composition of green cheese under the heads, "Relation of fat to casein in cheese made from skimmed milk," and "Relation of fat to casein in cheese made from milk to which cream has been added."

* Partially skimmed. † Cream added.

5. The Influence of Skimming Milk and Adding Cream upon the Yield of Cheese.

TABLE SHOWING RELATION OF MILK-CONSTITUENTS TO YIELD OF GREEN CHEESE.

Pounds of fat in 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of green cheese made from 100 lbs. of milk.	Pounds of water in green cheese made from 100 lbs. of milk.	Pounds of fat in green cheese made from 100 lbs. of milk.	Pounds of casein and albumen in green cheese made from 100 lbs. of milk.
*2.40	3.47	10.00	4.36	2.24	2.75
*2.90	3.21	9.35	3.96	2.66	2.45
*2.95	3.26	9.10	3.55	2.69	2.46
*3.20	3.21	9.41	3.82	2.94	2.44
*3.25	3.27	9.80	3.79	3.02	2.46
*3.55	3.46	10.20	3.69	3.35	2.62
*3.80	3.48	11.47	4.60	3.53	2.74
†4.22	3.30	11.10	4.25	3.95	2.52
†5.70	3.32	14.16	5.57	5.28	2.64
†6.00	3.46	13.30	4.32	5.66	2.66

Since the retention of water in skim-milk cheese is a consideration greatly affecting the yield, we can best study the question of yield by making comparison between the actual yield and the theoretical yield calculated on a basis of 36.5 per cent., water in the cheese, the same as we used for the whole-milk cheese.

Pounds of fat in 100 pounds of milk.	Pounds of solids in cheese made from 100 pounds of milk.	Pounds of green cheese made from 100 pounds of milk.	Pounds of water in green cheese made from 100 pounds of milk.	Pounds of cheese containing 36.5 percent water made from 100 pounds of milk.	Pounds of water in cheese containing 36.5 per cent. water made from 100 pounds of milk.
*2.40	5.64	10.00	4.36	8.90	3.26
*2.90	5.39	9.35	3.96	8.50	3.11
*2.95	5.55	9.10	3.55	8.75	3.25
*3.20	5.59	9.41	3.82	8.82	3.23
*3.25	6.01	9.80	3.79	9.48	3.47
*3.55	6.51	10.20	3.69	10.27	3.76
*3.80	6.87	11.47	4.60	10.84	3.97
†4.22	6.85	11.10	4.25	10.81	3.96
†5.70	8.59	14.16	5.57	13.55	4.96
†6.00	8.98	13.30	4.32	14.17	5.19

* Partially skimmed. † Cream added.

A comparison of the third and fifth columns in the table above shows that in almost every instance the cheese made from skim-milk gave a larger yield than there would have been if the cheese had contained the same proportion of water as cheese made from normal milk; and a comparison of the fourth and sixth columns shows that this difference of yield was due to water retained. The excess of water in the skim-milk cheese varied from 0.32 to 1.10 pounds for the cheese made from 100 pounds of milk. In the cheese made from milk containing cream, the average amount of moisture was about the same as in cheese made from normal milk, though, as will be seen, the variation of water in the individual cases was very marked. In two cases, the cheese contained less water than cheese made from normal milk; in the other case, the moisture was considerably in excess. Theoretically, the loss of yield by skimming milk should equal the amount of fat removed plus the amount of water which this fat would retain in the cheese; but, owing to the fact that an excess of water is retained, the actual difference is not usually equal to the theoretical difference.

THE INFLUENCE OF SKIMMING MILK AND ADDING CREAM UPON THE RELATION OF FAT IN MILK TO YIELD OF CHEESE.

Pounds of fat in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese for one pound of fat in milk.	Pounds of cheese containing average water made from 100 pounds of milk.	Pounds of cheese containing 36.5 per cent. water made for one pound of fat in milk.
*2.40	10.00	4.16	8.90	3.70
*2.90	9.35	3.22	8.50	2.93
*2.95	9.10	3.08	8.75	2.97
*3.20	9.41	2.94	8.82	2.75
*3.25	9.80	3.02	9.48	2.92
*3.55	10.20	2.87	10.27	2.90
*3.80	11.47	3.00	10.84	2.85
†4.22	11.10	2.63	10.81	2.56
†5.70	14.16	2.48	13.55	2.38
†6.00	13.30	2.22	14.17	2.36

* Partially skimmed. † Cream added.

The data in the table above indicate that a pound of fat in skim-milk will make more cheese than a pound of fat in normal milk, while the reverse is true of milk containing added cream. This is a necessary consequence, since, in skimming milk, little but fat in the way of solids is removed and the casein is present, relative to the fat, in larger amount than in normal milk and, in addition, the cheese made from skim-milk retains, as a rule, more water than cheese made from normal milk. Hence, in skim-milk cheese, we have for every pound of fat more casein and more water than in case of normal milk cheese. In the case of cheese made from milk containing added cream, there is less than a normal amount of casein relative to the fat.

6. Summary of Results Relating to the Influence of Skimming Normal Milk and Adding Cream to Normal Milk upon the Manufacture of Cheese.

(1st.) Loss of milk-solids:

With skim-milk, the per cent. of milk-solids lost in the whey in cheese-making was greater than with normal milk; while the loss of milk containing added cream was less than with normal milk. The per cent. of fat in the skim-milks varied from 2.40 to 3.80.

(2d.) Loss of fat:

The proportion of fat lost in case of skim-milk was greater than that lost in case of normal milk made into cheese under the same conditions; while the proportion of fat lost in case of milk containing added cream was less than in case of normal milk. The largest amount of fat in the milk containing added cream was 6 per cent.

(3d.) Loss of casein and albumen:

There was practically no difference in the results obtained, whether skim-milk, normal milk, or milk containing added cream was used.

(4th.) The composition of cheese:

Cheese made from skim-milk contains more casein and water relative to the fat than does cheese made from normal milk.

Cheese made from milk containing added cream contains less casein relative to the fat than cheese made from normal milk, and the tendency is also to a retention of less water relative to the fat.

(5th.) The yield of cheese:

When milk is skimmed, the yield of cheese from 100 pounds of milk is diminished at least by the amount of fat removed and generally somewhat more according to the amount of water retained. When cream is added to milk, the yield is increased at least by the amount of fat added and generally more, according to to the amount of water retained.

XIV. COMPARISON OF THE CHEDDAR AND STIRRED-CURD PROCESS OF CHEESE-MAKING.*

The table below gives a general summary of the results secured in making twenty comparative experiments with the Cheddar and stirred-curd processes:

	Per cent. of fat in milk lost in whey.	Per cent. of casein and albumen in milk lost in whey.	Pounds of cheese made from 100 pounds of milk.	Pounds of water retained in cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
Cheddar process:					
Least	6.12	23.31	9.60	3.22	2.53
Greatest	12.10	24.67	11.76	4.26	2.78
Average	8.25	24.01	10.13	3.67	2.66
Stirred-curd process:					
Least	6.33	23.37	9.40	3.19	2.53
Greatest	13.16	25.00	11.75	4.37	2.87
Average	8.52	24.35	10.11	3.65	2.65

The results of the season's work, when averaged, show very little difference between the results secured by the Cheddar and stirred-curd processes. On account of extra water retained, there

* For details of experiments, see Bulletins 43, 45, 46, 47, experiments, 9, 10, 19, 20, 31, 32, 35, 36 41, 42, 45, 46, 52, 53, 62, 63, 68, 69, 87, 88.

is a slight difference in favor of the Cheddar process which can be expressed by saying that, according to our results, the Cheddar process would make about two pounds more of cheese than the stirred-curd process for 10,000 pounds of milk. No difference was noticed in the quality of the cheese produced by the two processes.

XV. COMPARISON OF ORDINARY AND HIGH TEMPERATURES IN HEATING CURD.*

Two sets of experiments were made in June to compare the effect of using a temperature of 106 degrees F. in heating curd upon the loss of milk-constituents, yield and quality of cheese. The general results are stated below:

	Per cent. of fat in milk lost in whey.	Per cent. of casein and albumen in milk lost in whey.	Pounds of cheese made from 100 pounds of milk.	Pounds of water retained in cheese made from 100 pounds of milk.	Pounds of cheese made from one pound of fat in milk.
Temperature of 100°F.	6.93	24.02	9.94	3.50	2.65
Temperature of 106°F.	8.93	24.38	9.74	3.40	2.63

The results point to the conclusion that at the higher temperature, there is a slightly greater loss of milk-constituents and a somewhat decreased yield of cheese. In quality, the cheese made at the higher temperature showed imperfect flavor and lack of firmness in body.

* For details of experiments see Bulletin No. 45, experiments 17, 18, 27, 28.

XVI. EFFECTS OF USING DIFFERENT AMOUNTS OF RENNET.*

The amount of rennet extract used, was, in most cases, three and six ounces for 1,000 pounds of milk. The general results are given below:

	Per cent. of fat in milk lost in whey.	Per cent. of casein and albumen in milk lost in whey.	Pounds of cheese made from 100 pounds of milk.	Pounds of water retained in cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
Ordinary amount of rennet used:					
Least	6.09	21.45	9.68	3.51	2.62
Greatest	9.80	24.69	11.80	4.67	2.91
Average	7.74	23.48	10.76	3.98	2.74
Double amount of rennet used:					
Least	5.61	21.45	10.00	3.54	2.60
Greatest	12.86	25.00	12.10	4.60	2.87
Average	8.17	23.65	10.87	4.00	2.72

When the larger amount of rennet-extract was used, there was a slightly larger loss in manufacture and a slightly smaller yield for a pound of fat in the milk. The actual yield was a little greater when the larger amount of rennet was used, but this was due to the fact that the milk used in those experiments contained a little more fat, on the average, than the milk used in the experiments in which less rennet was used. Perhaps, the most that the results justify us in saying is that, under ordinary circumstances, the use of an extra large amount of rennet is not attended with any advantages as regards yield of cheese. The use of a large amount of rennet appeared to hasten the ripening of the cheese.

* For details of experiments, see Bulletins 43, 45, 46, 47, experiments 9, 10, 11, 12, 21, 22, 39, 40, 49, 50, 51, 60, 61, 70, 71, 72, 89, 90, 105, 106.

XVII. EFFECTS OF CUTTING CURD IN HARD AND IN SOFT CONDITION.*

When the curd was cut in "soft condition," the cutting was done very soon after the milk coagulated and considerably sooner than is done in ordinary practice; while, for "hard" cutting, the coagulation was allowed to continue for some time longer than is done by most cheese-makers. It is not possible to describe the difference more definitely. The general results secured are presented below:

	Per cent. of fat in milk lost in whey.	Per cent. of casein and albumen in milk lost in whey.	Pounds of cheese made from 100 lbs. of milk.	Pounds of water retained in cheese made from 100 lbs. of milk.	Pounds of cheese made for one pound of fat in milk.
Curd cut soft:					
Least	5.00	23.14	9.05	3.34	2.60
Greatest	10.00	24.46	11.55	4.47	2.81
Average	7.60	23.98	10.50	3.89	2.72
Curd cut hard:					
Least	5.00	23.14	9.74	3.47	2.54
Greatest	8.72	24.84	12.00	4.66	2.89
Average	7.65	24.14	10.67	3.97	2.72

The difference of loss in manufacture was slight. The hardest curd tended to retain a little more water. The results show practically no other difference.

XVIII. EFFECTS OF CUTTING CURD COARSE.§

When the curd was cut less fine than usual, the proportion of loss in manufacture was less than when cut more fine. The yield was increased by coarse cutting, owing to the retention of a larger amount of water than usual. Owing to the excess of moisture retained, the cheese made from curd cut coarse was salvy.

* For details of experiments, see Bulletins 43, 45, 46, 47, experiments 4 13, 14, 15, 16, 25, 26, 33, 34, 49, 50, 54, 55, 58, 59, 67, 68, 83, 84.

§ For details of experiments, see Bulletin No. 46. part 2, experiments 58 and 59.

	Per cent. of fat in milk lost in whey.	Per cent. of casein and albumen in milk lost in whey.	Pounds of cheese made from 100 pounds of milk.	Pounds of water retained in cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
Curd cut coarse	5.00	24.15	11.25	4.46	2.81
Curd cut ordinarily fine	8.00	24.31	10.70	4.11	2.68

XIX. THE EFFECTS OF TAINTED MILK UPON THE MANUFACTURE OF CHEESE.*

The term "tainted" is usually applied to any milk that gives off any odor other than that belonging to normal milk. In regard to cheese-making, we should make a distinction between different kinds of tainted milk. Milk may be exposed to and absorb odors which do not in any way affect the cheese-making, that is which do not cause floating curd and increased loss in manufacture, and which may produce cheese of good quality. For example, the absorption by milk of traces of such an odor as that of spirits of turpentine would in no way affect the loss of milk-consituents in cheese-making, and, under ordinary conditions, the volatile compound would be completely driven out at the temperature used in manufacture, so that the quality of the product would not necessarily be injured. On the other hand, if milk is exposed in the presence of putrefying animal matter, the absorption of odors will be accompanied by absorption of bacteria which will work such changes in the milk that, during the process of cheese-making, there will result floating curd, large losses of milk-constituents and an inferior cheese-product. In connection with cheese-making, we should, therefore, distinguish between tainted milk caused by the absorption of a mere odor and that caused by absorption of odors which are necessarily accompanied by deleterious bacteria. Of course, any abnormal odors are undesirable in milk, but there is a wide difference in respect to their

* For details, see Bulletins 46 and 47. experiments 41-45, 62-72.

source and effects, and some general distinction like the above should be recognized.

In the July experiments at the Station, a portion of the milk used was obtained some distance from the Station and the person who furnished it failed to follow the instructions given in regard to preparing the milk for shipment. The milk was put warm into imperfectly cleaned cans and was then shipped at once. In the warm weather then prevailing, seriously tainted milk was the inevitable result. In the factory experiments made in September, the work was done at a factory where the cows were liberally fed on the refuse of a corn-canning factory and this food was more or less fermented and sour. The tabulated statement below gives the average results of these experiments and also the average of the other experiments made in the same months with milk in good condition:

	Per cent. of fat in milk lost in whey	Per cent. of casein and albumen in milk lost in whey.	Pounds of cheese made from 100 pounds of milk.	Pounds of water in cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
Milk tainted.........	9.54	24.29	9.92	3.66	2.60
Milk in good condition.	8.15	23.71	10.55	3.82	2.72

Making necessary allowance for difference of fat in milk, difference in water retained in cheese, etc., the results show that the tainted milk gave, for 100 pounds of milk, about one-half pound less of cheese.

XX. EFFECTS OF SHUTTING UP WARM MILK IN CANS AND COOLING UPON MANUFACTURE OF CHEESE.*

In these experiments, about 100 pounds of night's milk were placed warm in closed cans and cooled immediately to about 50 degrees F. This was held over night and on the following morning was mixed with about 150 pounds of milk that had been kept in open vessels and similarly cooled. In each case,

* For details of experiments, see Bulletin 46, experiments 73, 77 and 91.

control experiments with milk that had been stored in open vessels and cooled were made side by side with the other experiments.

The averages of the three sets of experiments are given below:

	Per cent. of fat in milk lost in whey.	Per cent. of casein and albumen in milk lost in whey.	Pounds of cheese made from 100 pounds of milk.	Pounds of water in cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.
Milk shut up in cans..	6.65	23.30	10.88	3.96	2.69
Milk kept in open cans.	7.30	23.74	10.75	4.04	2.70

The milk that was shut up showed slightly less loss in manufacture. The yield of cheese for a pound of fat in milk shows practically no difference in the results. There was no perceptible difference in quality. The results can not be regarded as conclusive, since the work was done when the weather was cool, and the milk was produced by animals in perfect condition as regards food, care, surroundings, etc.

XXI. EFFECTS OF EXPOSING MILK TO FOUL ODORS UPON MANUFACTURE OF CHEESE.*

In one case, the milk was placed in vessels that had been imperfectly cleaned and was left exposed in the stable over night. This treatment resulted in a marked development of acid, with little taint, and the results were an increased loss of milk-constituents, a yield that was fair, owing to the large amount of water retained, and a very poor quality of cheese.

In another case, the milk was exposed in clean vessels over night to foul odors arising from excrements, and, in another case, to fumes of tobacco smoke. The weather was cool and the results did not show increased loss. Little or no taint was developed in the cheese. The results must be regarded as not conclusive for general conditions, since the weather was cool and the conditions were not all favorable for the production of bad results.

* For details of experiments, see Bulletin 47, experiments 75, 93, 95.

XXII. EFFECT OF AERATING MILK BY SEPARATOR.*

The aeration of tainted milk did not result in an increased yield of cheese, but the quality was much improved. When unaerated milk of good quality was made into cheese beside milk that had been aerated by separator, the latter made a smaller yield of cheese, but the quality was perfect.

XXIII. GENERAL SUMMARY OF THE RESULTS OF ALL THE EXPERIMENTS IN CHEESE-MAKING MADE DURING THE SEASON OF 1892.

1. *Extent of Investigation.*

1. Number of experiments made:

There were fifty experiments made at five different cheese factories and fifty-six experiments at this Station, the total number being 106.

2. Amount of milk used and of products made:

a. In all, there were used in the experiments 214,684 pounds of milk, of which 200,554 pounds were factory-milk.

b. There were produced 21,731 pounds of cheese and 192,953 pounds of whey.

3. Amount of chemical work done:

Of direct estimations, there were 3,574; of indirect estimations, 892, making a total of 4,466.

2. *Conditions of Manufacture.*

1. Amount of rennet-extract used:

The amount of rennet-extract used for 1,000 pounds of milk varied from one and three-fourths to nine ounces and averaged three and one-third ounces.

2. Temperature of milk when rennet was added:

The temperature of the milk when the rennet was added varied from 82 degrees F. to 90 degrees F. and averaged a little over 84 degrees F.

3. Time required for rennet to coagulate milk:

When the milk was in normal condition, the time of coagulation varied from eleven to forty minutes and averaged over twenty minutes.

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* For details of experiments, see Bulletin 47, experiments 80, 94, 96.

4. Temperature to which curd was heated:

The average degree of temperature to which the curd was heated after cutting was between 98 degrees and 99 degrees F.

5. Time from cutting curd to drawing whey:

The time that passed between cutting the curd and drawing the whey, varied from one to over four hours and averaged about two hours and fifteen minutes.

6. Time from drawing whey to putting in press:

The time that passed between drawing the whey and putting the curd in press varied from one to over four hours and averaged about two and one-half hours.

7. Time occupied by operation of cheese-making:

The time occupied by the whole operation of cheese-making varied from three to over nine hours and averaged nearly seven hours.

3. *The Composition of Normal Milk.*

1. Pounds of solids in 100 pounds of milk:

The milk-solids in 100 pounds of milk varied during the season from 11.47 to 13.91 pounds and averaged 12.66 pounds.

2. Pounds of fat in 100 pounds of milk:

The fat in 100 pounds of milk varied during the season from 3.04 to 4.40 pounds and averaged 3.70 pounds.

3. Pounds of casein and albumen in 100 pounds of milk:

The casein and albumen in 100 pounds of milk varied during the season from 2.53 to 3.76 pounds and averaged 3.14 pounds.

4. Pounds of casein in 100 pounds of milk:

The casein in 100 pounds of milk varied during the season from 1.93 to 3 pounds, and averaged 2.48 pounds.

5. Pounds of albumen in 100 pounds of milk:

The albumen in 100 pounds of milk varied during the season from 0.55 to 0.86 pounds, and averaged 0.66 pounds.

6. Relation of casein to albumen in normal milk:

For each pound of albumen in the milk, the casein varied during the season from 2.6 to 4.9 pounds and averaged 3.76 pounds.

7. Relation of fat to casein and albumen in normal milk:

a. For each pound of casein and albumen in the milk, the fat varied during the season from 1.07 to 1.33 pounds and averaged 1.20 pounds.

b. When the fat in the milk increased, the casein and albumen increased also but not in the same proportion, as a rule; that is, the milk rich in fat contained somewhat less casein and albumen in proportion to its fat than did the milk poorer in fat.

8. Relation of fat to casein in normal milk:

a. For each pound of casein in the milk, the fat varied from 1.35 to 1.74 pounds and averaged 1.50 pounds.

b. Taking the average of the entire season's results, the casein in the milk increased in just the same proportion as the fat, when the latter increased. The casein averaged two-thirds of the fat in amount.

9. Relation of fat to casein and albumen in skim-milk:

In milk, from which a portion of the fat had been removed, there were never more than 1.09 pounds of fat for one pound of casein and albumen, while in most cases, there was less than one pound of fat for one pound of casein and albumen. The greater the amount of fat removed from normal milk the smaller was the amount of fat left, relative to the casein and albumen.

10. Relation of fat to casein in skim-milk:

In milk, from which a portion of the fat had been removed, there were never more than 1.35 pounds of fat for one pound of casein, while, in most cases there were less than 1.3 pounds of fat for one pound of casein. The greater the amount of fat removed from normal milk, the smaller was the amount of fat left, relative to the casein.

11. Relation of fat to casein and albumen and to casein in milk containing added cream:

The greater the amount of fat added to normal milk, the greater became the amount relative to the casein and albumen together or to the casein alone.

12. The relation of fat to casein and albumen in milk as a basis for distinguishing normal milk from skim-milk:

The results secured indicate that, in the case of mixed milk of herds of cows, the milk has been skimmed, if it contains less than 1.05 pounds of fat for one pound of casein and albumen.

13. The relation of fat to casein in milk as a basis for distinguishing normal milk from skim-milk:

According to the results secured, we should be justified in saying that, in the case of mixed milk of herds of cows, the milk has been skimmed, if it contains less than 1.3 pounds of fat for one pound of casein.

4. *Composition of Whey.*

1. Pounds of solids in 100 pounds of whey:

The amount of solids in 100 pounds of whey varied during the season from 6.43 to 7.55 pounds and averaged 6.92 pounds.

2. Pounds of fat in 100 pounds of whey:

The amount of fat in 100 pounds of whey varied during the season from 0.22 to 0.52 pounds and averaged 0.34 pounds.

3. Pounds of casein and albumen in 100 pounds of whey:

The amount of casein and albumen in 100 pounds of whey varied during the season from 0.67 to 1.07 pounds, and averaged 0.85 pounds. So far as could be determined indirectly, the amount of casein in the whey averaged about 0.15 pounds and the amount of albumen about 0.70 pounds.

5. *The Composition of Green Cheese made from Normal Milk.*

1. Pounds of water in 100 pounds of green cheese:

The amount of water in 100 pounds of green cheese varied during the season from 33.50 to 42.90 pounds, and averaged 36.46 pounds. It was the most variable constituent of the cheese.

2. Pounds of fat in 100 pounds of green cheese:

The amount of fat in 100 pounds of green cheese varied during the season from 30.84 to 37.24 pounds, and averaged 34.33 pounds.

3. Pounds of casein and albumen in 100 pounds of green cheese:

The amount of casein and albumen in 100 pounds of green cheese varied during the season from 22.11 to 26.10 pounds, and averaged 24.25 pounds.

4. Pounds of casein in 100 pounds of green cheese:

The amount of casein (insoluble in water) in 100 pounds of green cheese varied during the season from 20.67 to 24.37 pounds, and averaged 22,68 pounds.

5. Pounds of soluble casein and albumen in 100 pounds of green cheese:

The amount of soluble casein and albumen in 100 pounds of green cheese varied during the season from 0.41 to 2.66 pounds, and averaged 1.57 pounds. The albumen probably did not exceed 0.10 pounds in amount.

6. Relation of fat to casein in cheese made from normal milk:

For each pound of casein in the cheese, the amount of fat varied from 1.27 to 1.56 pounds, and averaged 1.42 pounds.

7. Relation of fat to casein in cheese made from skim-milk:

In no case was the cheese made from skim-milk found to contain over 1.27 pounds of fat for one pound of casein. The ratio of fat to casein decreased from 1.27 downward in proportion to the amount of fat removed from the normal milk.

8. Relation of fat to casein in cheese made from milk containing added cream:

For each pound of casein in the cheese the amount of fat varied from 1.58 pounds upward, according to the amount of fat added to the normal milk.

9. The relation of fat to casein in cheese as a basis for distinguishing whole-milk cheese from skim-milk cheese:

According to the results secured in our season's work, we should be justified in saying that, in the case of cheese made from the mixed milk of herds of cows, the cheese has been made from skimmed milk, if it contains less than 1.30 pounds of fat for one pound of casein.

6. *Loss of Milk-Constituents in Cheese-making.*

1. Loss of milk-solids in cheese-making:

a. The amount of milk-solids in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 5.81 to 6.83 pounds, and averaged 6.21 pounds; this was equivalent to from 43.57 to 54.73 per cent. of the solids in the milk, with an average of 48.60 per cent.

b. The per cent. of the solids in the milk lost in the whey diminished as the season advanced.

2. Loss of fat in cheese-making:

a. The amount of fat in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.21 to 0.50 pounds, and averaged 0.31 pounds (nearly five ounces); this was equivalent to from 5 to 13 per cent. of the fat in the milk, with an average of 8.38 per cent.

b. The proportion of fat in milk that was lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

3. Loss of casein and albumen in cheese-making:

a. The amount of casein and albumen in 100 pounds of milk that was lost in the whey in cheese-making varied during the season from 0.61 to 0.94 pounds, and averaged 0.75 pounds (twelve ounces); this was equivalent to from 20.48 to 25 per cent. of the casein and albumen in the milk, with an average of 23.90 per cent.

b. The proportion of casein and albumen lost in cheese-making was, in general, very uniform and was little influenced by variation in the conditions of manufacture.

c. We can not state results based upon definite data, but it is probable that in 100 pounds of milk, less than 0.10 pounds of albumen is recovered in cheese and that somewhat more than 0.10 pounds of casein goes into the whey.

7. *Influence of Composition of Milk on Composition of Cheese.*

1. The influence of fat in milk on composition of cheese:

In cheese made from normal factory-milk varying from three to 4.40 per cent. of fat, there was a slight tendency for the fat to increase when the fat increased in the milk, but the increase of fat in the cheese was very irregular and slight, as compared with the increase of fat in the milk. Green cheese made from factory-milk should contain from thirty-two to thirty-six pounds of fat in 100 pounds of cheese.

2. The influence of casein and albumen in milk on composition of cheese:

Green cheese made from factory-milk should contain from twenty-two to twenty-five pounds of casein and albumen in 100 pounds of cheese. There did not appear to be any definite relation between the amount of casein and albumen in normal milk and the amount of casein and albumen in cheese made from such milk.

8. *Influence of Composition of Milk on Yield of Cheese.*

1. Yield of green cheese from 100 pounds of milk:

From 100 pounds of milk, there were made during the season from 8.47 to 12.44 pounds of green cheese, the average being 10.12 pounds.

2. Pounds of milk required to make one pound of cheese:

There were from 8.04 to 11.80 pounds of milk required to make one pound of cheese, 9.88 pounds being the average.

3. Amount of water retained in cheese made from 100 pounds of milk:

The amount of water retained in the cheese made from 100 pounds of milk varied during the season from 3.16 to 5.34 pounds and averaged 3.70 pounds.

4. Amount of fat retained in cheese made from 100 pounds of milk:

The amount of fat retained in the cheese made from 100 pounds of milk, varied during the season from 2.77 to 4.11 pounds and averaged 3.39 pounds. The variation in the amount of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

5. Amount of casein and albumen retained in cheese made from 100 pounds of milk:

The amount of casein and albumen retained in the cheese made from 100 pounds of milk varied during the season from 1.90 to 2.82 pounds and averaged 2.39 pounds.

6. Influence of different milk-constituents in increasing yield of cheese:

When there was an increase of one pound of fat in the cheese, there was, at the same time, an increase of one pound of water in the cheese and also an increase of about 0.60 pounds (nine and one-half ounces) of casein and albumen, taking the average of the season's work.

7. Relation of fat in milk to yield of green cheese:

Each pound of fat produced from 2.50 to 3.11 pounds of cheese, the average for the season being nearly 2.75 pounds.

9. *Influence of Skimming Normal Milk and Adding Cream to Normal Milk upon the Manufacture of Cheese.*

1. Loss of milk-solids:

a. The per cent. of loss of solids in making skim-milk into cheese was greater than when normal milk was used.

b. The per cent. of loss of solids in making into cheese milk containing added cream was less than when normal milk was used.

2. Loss of fat:

a. The proportion of fat in milk that was lost in making skim-milk into cheese was greater than that lost in making normal milk into cheese.

b. The proportion of fat in milk that was lost in making into cheese milk containing added cream was less that in case of normal milk.

3. Loss of casein and albumen:

The proportion of casein and albumen lost in cheese-making was practically the same, whether skim-milk, normal milk or milk containing added cream was used.

4. The composition of cheese:

a. Cheese made from skim-milk contained more casein and water relative to the fat than cheese made from normal milk.

b. Cheese made from milk containing added cream contained less casein relative to the fat than cheese made from normal milk, and there was also a tendency to retain less water relative to the fat.

5. Yield of cheese:

a. When the milk was skimmed, the yield of cheese from 100 pounds of milk was diminished, at least, by the amount of fat removed and generally more, according to the amount of water retained.

b. When cream was added to normal milk, the yield was increased, at least, by the amount of fat added and generally more, according to the amount of water retained.

10. *Comparison of Cheddar and Stirred-cured Processes.*

1. Loss of milk-constituents:

The losses in manufacture were essentially the same by both processes.

2. Yield of cheese:

The Cheddar process retained in the cheese a little more water, on an average, and made a little more cheese, amounting to about two pounds more of cheese for 10,000 pounds of milk.

3. Quality of cheese:

No difference in quality was perceptible in the cheese made by the two processes.

11. *Effects of Using High Temperature in Heating Curd.*

1. Loss of milk-constituents:

The higher temperature (106 degrees F.) caused a somewhat increased loss of milk-constituents in cheese-making.

2. Yield of cheese:

The yield of cheese was diminished by use of higher temperature.

3. Quality of cheese:

The cheese made by heating the curd at a high temperature was imperfect in flavor and lacking in firmness.

12. *Effects of Using Different Amounts of Rennet.*

1. Loss of milk-constituents:

When double the usual amount of rennet was used, there was slightly greater loss of milk-constituents in manufacture.

2. Yield of cheese:

The yield was not quite as large in proportion to the fat in the milk, when the larger amount of rennet was used.

3. Quality of cheese:

The cheese made with the larger amount of rennet appeared at the end of one month to have ripened more than that made with less rennet.

13. *Effects of Cutting Curd in Hard and in Soft Condition.*

1. Loss of milk-constituents:

The loss of milk-constituents in manufacture was essentially the same whether the curd was cut hard or soft.

2. Yield of cheese:

The yield was the same in proportion to the fat in the milk.

3. Quality of cheese:

The cheese was practically the same in quality.

14. *Effects of Cutting Curd Coarse.*

1. Loss of milk-constituents:

There was a smaller loss of milk-constituents when the curd was cut coarse.

2. Yield of cheese:

The yield was decidedly greater, when the curd was cut coarse, owing to retention of an increased amount of water.

3. Quality of cheese:

The cheese was salvy, owing to excess of water retained.

15. *Effects of Tainted Milk upon Cheese-making.*

1. Loss of milk-constituents:

The use of tainted milk in cheese-making increased the loss of milk-constituents.

2. Yield of cheese:

One hundred pounds of tainted milk produced one-half pound less of cheese than did good milk.

3. Quality of cheese:

The cheese was inferior in quality, being imperfect in flavor and loose in texture.

16. *Effects of Retaining Natural Gases in Milk.*

1. Loss of milk-constituents:

The loss of milk-constituents was not increased.

2. Yield of cheese:

The yield was normal in quantity.

3. Quality of cheese:

The quality was, in most cases, perfect.

17. *Effects of Exposing Milk to Foul Odors.*

1. Loss of milk-constituents:

Under the conditions employed, the loss of milk-constituents was not increased, but the experiments must be regarded only as preliminary and the results are not conclusive for general conditions.

2. Yield of cheese:

The yield was not affected.

3. Quality of cheese:

It was difficult to find any taint developed in the cheese, and they were perfect in body and texture.

18. *Effects of Aerating Milk by Separator.*

1. Loss of milk-constituents:

The loss of milk-constituents was a little greater in the separated milk.

2. Yield of cheese:

The separated milk gave a smaller yield of cheese.

3. Quality of cheese:

The cheese made from milk aerated by separator was perfect in every respect.

19. Tabulated Summary of Results.

1. COMPOSITION OF MILK.

	IN 100 POUNDS OF MILK.		
	Least.	Greatest.	Average.
	Pounds.	Pounds	Pounds.
Water	86.09	88.53	87.34
Total solids	11.47	13.91	12.66
Fat	3.04	4.40	3.70
Casein and albumen	2.53	3.76	3.14
Casein	1.93	3.00	2.48
Albumen	0.55	0.86	0.66
Sugar, ash, etc	5.32	6.37	5.82
Pounds casein for one pound of albumen	2.60	4.90	3.76
Pounds fat for one pound albu'n and casein	1.07	1.33	1.20
Pounds of fat for one pound of casein	1.35	1.74	1.50

2. COMPOSITION OF WHEY.

	In 100 Pounds of Whey.		
	Least.	Greatest.	Average.
	Pounds.	Pounds.	Pounds.
Water	92.45	93.57	93.08
Total solids	6.43	7.55	6.92
Fat	0.22	0.52	0.34
Casein and albumen	0.67	1.07	0.85
Casein	......	......	*0.15
Albumen	......	......	*0.70
Sugar, ash, etc	5.39	6.43	5.73

3. COMPOSITION OF GREEN CHEESE.

	In 100 Pounds of Green Cheese.		
	Least.	Greatest.	Average.
	Pounds.	Pounds.	Pounds.
Water	33.50	42.90	36.46
Total solids	57.10	66.50	63.54
Fat	30.84	37.24	34.33
Casein and albumen	22.11	26.10	24.25
Casein (insoluble)	20.67	24.37	22.68
Soluble casein and albumen	0.41	2.66	1.57
Sugar, ash, etc	3.12	6.74	4.96
Pounds of fat for one pound of casein	1.27	1.56	1.42

4. AMOUNT OF MILK-CONSTITUENTS LOST IN CHEESE-MAKING.

	Lost in Whey for 100 Pounds of Milk.		
	Least.	Greatest.	Average.
	Pounds.	Pounds.	Pounds.
Water	81.41	85.41	83.66
Total solids	5.81	6.83	6.22
Fat	0.21	0.50	0.31
Casein and albumen	0.61	0.94	0.75
Casein	......	......	*0.14
Albumen	......	......	*0.61
Sugar, ash, etc	4.71	5.86	5.16

* Calculated.

5. Amount of Milk-constituents Recovered in Cheese-making.

	Recovered in Cheese for 100 Pounds of Milk.		
	Least.	Greatest.	Average.
	Pounds.	Pounds.	Pounds.
Water	3.16	5.34	3.70
Total solids	5.31	7.51	6.43
Fat	2.77	4.11	3.39
Casein and albumen	1.90	2.82	2.39

6. Yield of Cheese and Whey.

	Least.	Greatest.	Average.
	Pounds.	Pounds.	Pounds.
Green cheese from 100 pounds of milk	8.47	12.44	10.12
Pounds of milk for one pound of green cheese	8.04	11.80	9.88
Pounds of whey from 100 pounds of milk.	87.56	91.53	89.88
Pounds of green cheese for one pound of fat in milk	2.50	3.11	2.75

XXIV. COMPARISON OF DAIRY BREEDS OF CATTLE WITH REFERENCE TO PRODUCTION OF BUTTER.

Several of the animals whose first period of lactation was completed when the last annual report was made have not yet completed their second period of lactation, and it is, therefore, impossible to present the results of the second period of lactation with any degree of fullness. On this account, it is thought best simply to present the tabulated results of individuals up to date and to reserve the discussion of data until a larger number of animals have completed their second period of lactation. This will enable us to give more complete and satisfactory results and to avoid useless repetitions and qualifications that are necessarily associated with incomplete results.

As stated in our last annual report, it was our design to use the De Laval Baby No. 2 separator during the second period of lactation in separating the cream for making butter. This was carried out with many of the cows and the results were found to be very uniform for all breeds, individuals, stages of lactation, etc. The loss of fat in separating rarely exceeded 0.08 pounds for 100 pounds of milk and the loss of fat in churning was often reduced to 0.03 pounds for 100 pounds of milk. It was, therefore, possible to make butter and have a total loss of only 0.11 pounds of fat for 100 pounds of milk. This does not, of course, include mechanical losses. As a result of our extended work, it was decided to use this common factor 0.11 pounds to indicate the amount of fat lost in making butter from 100 pounds of milk. It was only necessary, therefore, to know the amount of fat present in 100 pounds of milk in order to determine the amount of butter that could be made from the milk. Whether this factor is exact or not for general work, it is uniform for all the animals and for the purpose of comparison is entirely just to all. We shall present below data showing a comparison of results obtained by the deep-setting process, as described in a previous report, with results obtained by the separator, for the first period of lactation. Inasmuch as the results secured with the separator are more uniform and since the separator is rapidly displacing other methods of creaming, we shall, hereafter, base all our comparisons upon results obtained by the use of the separator.

1. Comparison of Results Obtained During the First Period of Lactation by Use of Deep-setting and Centrifugal Methods of Creaming Milk.

	Number of cows represented.	Pounds of milk given.	Pounds of fat in milk.	Pounds of Fat Lost.		Pounds of Butter Made.		Cost of food.	Cost of Butter per Pound.		Profits from Butter-making.		Increase of profit by use of separator.
				By deep-setting.	By separator.	By deep-setting.	By separator.		By deep-setting.	By separator.	By deep-setting.	By separator.	
									Cents.	Cents.			
Ayrshires	4	5,786	202.5	42.5	6.36	188	230	$43.30	23	18.7	$3.70	$14.20	$10.50
Devons	3	3,996	181.0	29.4	4.40	178	208	33.70	18.9	16.2	10.80	18.30	7.50
Guernseys	3	5,119	250.8	29.8	5.63	267	288	42.10	15.8	14.6	24.65	29.90	5.25
Holderness	2	4,498	161.9	28.9	4.95	157	185	34.60	22	18.7	4.65	11.65	7.00
Holsteins	1	7,438	278.1	73.1	8.20	241	318	54.50	22.6	17.1	5.75	25.00	19.25
Jerseys	4	4,587	251.6	29.0	5.04	262	290	44.90	17.1	15.5	20.60	27.60	7.00

The results contained in the table above show that in the case of every breed the separator gives better results in yield of butter. The increased yield was greatest with the Holstein, and second with the Ayrshires. According to the above results, a herd of six or seven Holsteins would, with a separator, make an increased yield of butter in one year sufficient to pay for a separator, while a herd of twelve Ayrshires, sixteen Devons, eighteen Holderness or Jerseys, or twenty-four Guernseys, would do the same.

SECOND PERIOD OF LACTATION — AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF HERD. (FOUR COWS).

MONTH OF LACTATION.	From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1	4.00	0.08	3.92	0.03	3.89	4.58	21.83	1 19	776.3	30.3	35.6	98.0	2.0	0.7	97.3
2	3.50	0.08	3.42	0.03	3.39	4.00	25.00	1.11	832.4	28.3	33.3	97.7	2.3	0.8	96.9
3	3.19	0.08	3.11	0.03	3.08	3.62	27.60	1.00	824.5	25.4	29.9	97.5	2.5	0.9	96.6
4	3.38	0.08	3.30	0.03	3.27	3.85	26.00	0.99	771.2	25.2	29.7	97.6	2.4	0.9	96.7
5	3.32	0.08	3.24	0.03	3.21	3.78	26.45	0.93	737.1	23.7	27.9	97.6	2.4	0.9	96.7
6	3.40	0.08	3.32	0.03	3.29	3.87	25.84	0.94	728.9	24.0	28.2	97.6	2.4	0.9	96.7
7	3.33	0.08	3.25	0.03	3.22	3.80	26.30	0.84	666.6	21.5	25.3	97.6	2.4	0.9	96.7
8	3.44	0.08	3.36	0.03	3.33	3.91	25.60	0.75	575.3	19.1	22.5	97.6	2.4	0.9	96.7
9	3.72	0.08	3.64	0.03	3.61	4.25	23.53	0.41	388.2	10.4	12.2	98.0	2.0	0.7	97.3
10	3.93	0.08	3.85	0.03	3.82	4.50	22.20	0.30	192.4	7.7	9.0	98.0	2.0	0.7	97.3

FIRST PERIOD OF LACTATION — DEVON BUTTER RECORD — MONTHLY AVERAGES OF HERD (THREE COWS).

MONTH OF LACTATION.	Churning.			From One Hundred Pounds of Milk.					
	Average temperature during churning.	Time of churning.	Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.
	Degrees.	Hrs. Min.							
1	64	 30	18.63	3.97	0.16	3.81	0.03	3.77	4.44
2	65	 31	20.65	4.20	0.29	3.91	0.07	3.78	4.45
3	64	 32	18.84	3.98	0.14	3.84	0.08	3.36	3.95
4	67	1	18.24	4.36	0.62	3.74	0.02	3.65	4.30
5	66	 53	19.12	4.48	0.76	3.72	0.05	3.40	4.00
6	67	1	19.30	4.43	0.79	4.04	0.03	3.74	4.40
7	68	 35	19.82	4.88	0.67	4.21	0.09	3.95	4.65
8	68	 57	19.57	4.76	0.59	4.17	0.12	3.93	4.62
9	65	 43	21.29	5.29	0.39	4.90	0.08	4.61	5.42
10	66	 42	18.96	4.93	0.42	4.51	0.07	4.36	5.14

FIRST PERIOD OF LACTATION — DEVON BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	Yield of Butter.				Monthly Yield of Dairy Products.						Percentages of Fat Recovered and Lost.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1*	22.50	4.96	4.54	0.64	333.0	265.9	67.1	52.3	12.6	14.8	96.0	4.0	0.7	95.0
2	22.50	5.33	4.22	0.70	476.0	386.0	90.0	68.8	18.0	21.2	93.1	6.9	1.7	90.0
3	25.30	5.39	4.70	0.64	485.2	395.2	90.0	70.8	16.3	19.2	96.0	4.0	2.0	84.0
4	23.25	4.90	4.75	0.65	453.7	360.7	93.0	73.5	16.7	19.5	85.8	14.2	0.5	84.0
5	25.00	5.15	4.86	0.57	424.8	342.3	82.5	65.5	14.5	17.0	83.7	17.3	1.1	75.6
6	22.70	4.90	4.63	0.60	408.5	325.2	83.3	65.3	15.3	18.0	84.2	15.8	0.7	77.5
7	21.50	4.72	4.55	0.57	364.5	287.3	77.2	55.2	14.5	17.0	86.3	13.7	1.8	81.0
8	21.65	4.85	4.45	0.53	345.8	274.5	71.3	55.3	13.6	16.0	87.6	12.4	2.5	82.5
9	18.45	4.40	4.20	0.57	309.9	239.5	70.4	53.4	14.5	17.0	92.6	7.4	1.6	87.0
10	19.50	4.21	4.63	0.51	298.5	227.6	70.9	55.6	13.0	15.3	91.4	8.6	1.4	87.3

* First month of lactation averaged twenty-three days.

FIRST PERIOD OF LACTATION — GUERNSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD. (THREE COWS.)

MONTH OF LACTATION.	CREAMING AND CHURNING.			FROM ONE HUNDRED POUNDS OF MILK.					
	Average temperature during churning.	Time of churning.	Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.
	Degrees.	Hrs. Min.							
1	63	 21	18.35	5.41	0.31	5.10	0.12	4.92	5.80
2	62	 48	17.15	4.80	0.38	4.42	0.04	4.28	5.04
3	63	 58	16.29	4.39	0.42	3.97	0.03	3.86	4.54
4	62	1 00	16.42	4.60	0.34	4.26	0.03	4.20	4.95
5	63	 28	18.50	4.56	0.26	4.30	0.02	4.15	4.88
6	63	 39	18.96	4.72	0.48	4.24	0.03	4.11	4.84
7	64	 39	17.15	4.82	0.54	4.28	0.04	4.18	4.92
8	65	 45	17.37	4.96	0.65	4.31	0.03	4.25	5.00
9	66	 30	16.41	5.23	0.68	4.55	0.06	4.49	5.28
10	69	 40	17.55	5.53	0.88	4.65	0.08	4.57	5.38

FIRST PERIOD OF LACTATION — GUERNSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	Yield of Butter.				Monthly Yield of Dairy Products.						Percentages of Fat Recovered and Lost			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1*	17.25	3.65	4.72	0.73	414.6	301.0	113.6	91.6	18.7	22.0	94.3	5.7	2.2	90.9
2	19.84	3.94	5.03	0.91	543.3	405.3	138.0	110.6	23.3	27.4	92.1	7.9	0.8	89.2
3	22.00	4.14	5.31	0.83	547.5	415.3	132.2	115.2	17.0	24.9	90.4	9.6	0.7	87.9
4	20.20	3.89	5.18	0.82	543.2	403.2	140.0	115.4	20.9	24.6	92.7	7.3	0.7	90.3
5	20.50	4.42	4.64	0.91	558.4	432.1	126.3	99.1	23.1	27.2	94.3	5.7	0.5	91.0
6	20.60	4.55	4.53	0.86	529.0	402.7	116.3	90.6	21.8	25.7	90.0	10.0	0.6	87.1
7	20.30	4.01	5.07	0.81	490.6	368.0	122.6	98.4	20.5	24.2	88.8	11.2	0.8	87.1
8	20.00	4.09	4.90	0.82	492.2	372.2	120.0	95.4	20.9	24.6	87.0	13.0	0.6	86.0
9	19.00	3.61	5.88	0.82	469.2	339.2	130.0	105.3	21.0	24.7	87.0	13.0	0.6	85.8
10	18.60	3.79	4.90	0.79	440.7	324.7	116.0	92.3	20.0	23.7	84.1	15.9	0.7	82.7

* First month of lactation averaged twenty-three days.

FIRST PERIOD OF LACTATION — JERSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD (FOUR COWS).

MONTH OF LACTATION.	CREAMING AND CHURNING.				FROM ONE HUNDRED POUNDS OF MILK.					
	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.
	Degrees.	Hrs.	Min.							
1	62	....	37	21.90	5.05	0.31	4.74	0.09	4.52	5.32
2	61	....	43	21.27	5.04	0.38	4.66	0.09	4.45	5.24
3	63	....	35	20.30	4.88	0.23	4.65	0.07	4.40	5.18
4	62	....	42	20.70	5.38	0.23	5.15	0.04	4.89	5.75
5	62	....	51	20.05	5.41	0.39	5.02	0.05	4.92	5.79
6	63	1	05	20.06	5.58	0.47	5.11	0.09	4.63	5.45
7	64	1	14	19.54	5.74	0.33	5.41	0.05	5.25	6.17
8	65	....	54	20.95	5.94	0.40	5.54	0.05	5.44	6.40
9	64	....	46	21.38	5.95	0.52	5.43	0.04	5.39	6.34
10	65	....	44	19.41	6.12	0.43	5.69	0.04	5.65	6.65

FIRST PERIOD OF LACTATION — JERSEY BUTTER RECORD — MONTHLY AVERAGES OF HERD — (*Concluded*).

MONTH OF LACTATION.	Yield of Butter.				Monthly Yield of Dairy Products.						Percentages of Fat Recovered and Lost.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1*	18.80	4.67	4.03	0.84	472.3	371.2	101.1	76.0	21.3	25.1	93.9	6.1	1.8	90.0
2	19.10	4.63	4.12	0.94	536.1	420.3	115.8	87.7	24.1	28.1	92.5	7.5	1.8	88.3
3	19.30	4.33	4.46	0.88	509.9	392.1	117.8	91.4	22.4	26.4	95.3	4.7	1.4	89.8
4	17.40	4.07	4.27	0.88	458.2	345.6	112.6	86.3	22.3	26.3	95.7	4.3	0.7	90.9
5	17.25	3.99	4.31	0.91	471.6	353.7	117.9	90.6	23.2	27.3	93.0	7.0	0.9	91.1
6	18.35	3.98	4.59	0.80	442.3	331.7	110.6	86.5	20.5	24.1	91.3	8.7	1.6	82.7
7	16.20	3.59	4.50	0.85	414.6	299.5	115.1	89.5	21.8	25.6	94.3	5.7	0.9	91.5
8	15.60	3.78	4.10	0.87	405.4	298.7	106.7	80.7	22.1	26.0	93.3	6.7	0.8	91.6
9	15.75	3.89	4.00	0.88	413.4	307.1	106.3	80.0	22.3	26.3	91.3	8.7	0.7	90.6
10	15.00	3.63	4.18	0.87	390.4	282.9	107.5	81.5	22.0	26.0	93.0	7.0	0.7	92.3

* First month of lactation averaged 25.5 days.

SECOND PERIOD OF LACTATION — AMERICAN-HOLDERNESS BUTTER RECORD — MONTHLY AVERAGES OF NELLIE 6TH.

MONTH OF LACTATION.	Date		From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
			Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
*	December,	1891	3.15	0.08	3.07	0.03	3.04	3.58	28.00	0.82	575.7	17.5	20.6	97.5	2.5	1.0	96.5
2	January,	1892	3.16	0.08	3.08	0.03	3.05	3.59	28.00	0.79	684.2	20.7	24.4	97.5	2.5	1.0	96.5
3	February,	1892	3.02	0.08	2.94	0.03	2.91	3.42	29.24	0.73	615.2	17.8	21.0	97.4	2.6	1.0	96.4
4	March,	1892	3.70	0.08	3.62	0.03	3.59	4.23	23.65	0.85	622.0	22.3	26.3	97.8	2.2	0.8	97.0
5	April,	1892	3.55	0.08	3.47	0.03	3.44	4.05	24.70	0.73	541.5	18.6	21.9	97.7	2.3	0.8	96.9
6	May,	1892	3.57	0.08	3.49	0.03	3.46	4.07	25.55	0.61	484.1	16.1	19.0	97.7	2.3	0.8	96.9
7	June,	1892	3.65	0.08	3.57	0.03	3.54	4.16	24.00	0.60	429.6	15.2	17.9	97.8	2.2	0.8	97.0
8	July,	1892	3.00	0.08	2.92	0.03	2.89	3.40	29.40	0.44	402.5	11.6	13.7	97.3	2.7	1.0	96.3
9	August,	1892	3.60	0.08	3.52	0.03	3.49	4.11	24.30	0.27	202.8	7.0	8.3	97.8	2.2	0.8	97.0
10	September,	1892	3.23	0.08	3.15	0.03	3.12	3.67	27.25	0.10	69.3	2.1	2.5	97.5	2.5	0.9	96.6

* First month of lactation contains twenty-four days.

SECOND PERIOD OF LACTATION — AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF JUNIETTA PEERLESS.

MONTH OF LACTATION.	Date.		From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
			Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1..................	May,	1892	4.27	0.08	4.19	0.03	4.16	4.90	20.40	1.35	852.7	35.5	41.8	98.1	1.9	0.7	97.4
2..................	June,	1892	2.98	0.08	2.90	0.03	2.87	3.38	29.60	1.08	958.8	27.5	32.4	97.3	2.7	1.0	96.3
3..................	July,	1892	2.59	0.08	2.51	0.03	2.48	2.92	34.25	0.91	966.1	24.0	28.2	96.9	3.1	1.2	95.7
4..................	August,	1892	2.55	0.08	2.47	0.03	2.44	2.87	34.50	0.81	868.3	21.3	25.1	96.9	3.1	1.2	95.7
5..................	September,	1892	2.73	0.08	2.65	0.03	2.62	3.08	32.50	0.81	789.6	20.7	24.3	97.1	2.9	1.1	96.0
6..................	October,	1802	3.15	0.08	3.07	0.03	3.04	3.58	27.90	0.94	809.5	24.6	29.0	97.5	2.5	2.0	96.5
7..................	November,	1892	3.38	0.08	3.30	0.03	3.27	3.85	26.00	0.95	742.1	24.1	28.5	97.6	2.4	0.9	96.7
8..................	December,	1892	3.35	0.08	2.29	0.03	3.24	3.81	26.25	0.83	675.9	22.1	26.0	97.6	2.4	0.9	96.7
9..................	January,	1893	4.13	0.08	4.05	0.03	4.02	4.73	21.15	0.71	465.2	18.7	22.0	98.0	2.0	0.7	97.3
10..................	February,	1893	4.33	0.08	4.25	0.03	4.22	4.96	20.20	0.30	169.7	7.1	8.4	98.1	1.9	0.7	97.4

SECOND PERIOD OF LACTATION — AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MANTON BELLE.

MONTH OF LACTATION.	Date.	From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
		Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pound of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat in buttermilk.	Per cent. of fat recovered in butter.
1..........	January, 1892	4.29	0.08	4.21	0.03	4.18	4.92	20.30	1.40	824.4	34.5	40.6	98.0	2.0	0.8	97.2
2..........	February, 1892	3.99	0.08	3.91	0.03	3.88	4.56	21.90	1.40	872.0	34.0	40.0	98.0	2.0	0.8	97.2
3..........	March, 1892	3.72	0.08	3.64	0.03	3.61	4.25	23.50	1.16	843.4	30.5	35.9	97.8	2.2	0.8	97.0
4..........	April, 1892	4.20	0.08	4.12	0.03	4.09	4.81	20.80	1.14	739.6	30.2	35.6	98.1	1.9	0.7	97.4
5..........	May, 1892	3.92	0.08	3.84	0.03	3.81	4.48	22.30	1.07	738.5	28.1	33.1	98.0	2.0	0.8	97.2
6..........	June, 1892	3.12	0.08	3.04	0.03	3.01	3.54	28.25	0.88	747.6	22.5	26.5	97.4	2.6	1.0	96.4
7..........	July, 1892	2.73	0.08	2.65	0.03	2.62	3.08	32.50	0.70	699.5	18.4	21.6	97.1	2.9	1.1	96.0
8..........	August, 1892	3.18	0.08	3.10	0.03	3.07	3.61	27.70	0.55	467.5	15.2	16.9	97.5	2.5	0.9	96.6
9..........	September, 1892	3.20	0.08	3.12	0.03	3.09	3.64	27.50	0.30	259.4	8.0	9.4	97.5	2.5	0.9	96.6
10..........	October, 1892	3.56	0.08	3.48	0.03	3.45	4.06	24.60	0.10	66.1	2.3	2.7	97.8	2.2	0.8	97.0

SECOND PERIOD OF LACTATION — AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF MISS FLOW 5TH.

MONTH OF LACTATION.	Date.		From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
			Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1	March,	1891	3.97	0.08	3.89	0.03	3.86	4.54	22.00	0.80	541.4	20.9	24.6	98.0	2.0	0.8	97.2
2	April,	1891	3.09	0.08	3.01	0.03	2.98	3.51	28.50	0.70	581.7	17.3	20.4	97.4	2.6	1.0	96.4
3	May,	1891	2.93	0.08	2.85	0.03	2.82	3.32	30.10	0.67	624.2	17.6	20.7	97.2	2.8	1.0	96.2
4	June,	1891	3.16	0.08	3.08	0.03	3.05	3.59	28.00	0.72	604.8	18.4	21.6	97.5	2.5	1.0	96.5
5	July,	1891	3.19	0.08	3.11	0.03	3.08	3.62	27.80	0.66	566.2	17.3	20.4	97.5	2.5	1.0	96.5
6	August,	1891	3.47	0.08	3.39	0.03	3.36	3.95	25.30	0.68	533.2	18.0	21.1	97.7	2.3	1.1	96.6
7	September,	1891	3.90	0.08	3.82	0.03	3.79	4.46	22.40	0.67	452.2	17.1	20.2	98.0	2.0	0.8	97.2
8	October,	1891	3.73	0.08	3.65	0.03	3.62	4.26	23.50	0.63	456.2	16.5	19.4	97.8	2.2	0.8	97.0
9	November,	1891	3.77	0.08	3.69	0.03	3.66	4.30	23.25	0.59	410.0	15.0	17.6	97.8	2 2	0.8	97.0
10	December,	1891	3.57	0.08	3.49	0.03	3.46	4.07	24.55	0.46	346.5	12.0	14.1	97.7	2.3	1.0	96.7

SECOND PERIOD OF LACTATION — AYRSHIRE BUTTER RECORD — MONTHLY AVERAGES OF QUEEN DUCHESS.

Month of lactation.	Date.	From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
		Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1*	December, 1891	3.47	0.08	3.39	0.03	3.36	3.95	25.30	1.13	715.4	24.0	28.3	97.7	2.8	0.9	96.8
2	January, 1892	3.92	0.08	3.84	0.03	3.81	4.48	22.20	1.33	916.9	35.0	41.3	98.0	2.0	0.8	97.2
3	February, 1892	3.50	0.08	3.42	0.03	3.39	4.00	25.00	1.19	864.1	29.3	34.5	97.7	2.3	0.9	96.8
4	March, 1892	3.62	0.08	3.54	0.03	3.51	4.13	24.20	1.16	872.3	30.7	36.1	97.7	2.3	0.9	96.8
5	April, 1892	3.45	0.08	3.37	0.03	3.34	3.93	25.30	1.13	854.1	28.7	33.8	97.7	2.3	0.9	96.8
6	May, 1892	3.87	0.08	3.79	0.03	3.76	4.42	22.70	1.17	825.2	31.0	36.4	98.0	2.0	0.8	97.2
7	June, 1892	3.32	0.08	3.24	0.03	3.21	3.78	26.45	0.98	772.6	24.8	29.2	97.6	2.4	0.9	96.7
8	July, 1892	3.50	0.08	3.42	0.03	3.39	4.00	25.00	0.90	701.5	23.9	28.1	97.6	2.4	0.9	96.7
9	August, 1892	3.77	0.08	3.69	0.03	3.66	4.31	23.20	0.60	418.1	15.3	18.0	97.9	2.1	0.8	97.1
10	September, 1892	4.25	0.08	4.17	0.03	4.14	4.87	20.53	0.30	187.1	7.7	9.0	98.1	1.9	0.7	97.4

* First month of lactation contained twenty-five days.

FIRST PERIOD OF LACTATION — DEVON BUTTER RECORD — MONTHLY AVERAGES OF ARTALIA.

MONTH OF LACTATION.	Date.		Creaming and Churning.				From One Hundred Pounds of Milk.					
			Average temperature during setting.	Average temperature during churning.	Time of churning.	Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.
			Degrees.	Degrees.	Hrs. Min.							
1	December,	1891	39	66	 20	21.06	4.82	0.08	4.74	0.07	4.67	5.49
2	January,	1892	38	66	 34	24.83	5.13	0.09	5.04	0.17	4.77	5.61
3	February,	1892	38	64	 22	17.72	4.01	0.36	3.65	0.20	3,45	4.06
4	March,	1892	44	63	 18	18.90	4.52	0.74	3.78	0.05	3.73	4.39
5	April,	1892	45	62	1 20	17.53	4.58	0.74	3.84	0.09	3.60	4.24
6	May,	1892	45	64	 53	18.48	4.38	0.72	3.66	0.05	3.39	3.99
7	June,	1892	48	69	 22	17.40	4.20	0.72	3.48	0.06	3.32	3.91
8	July,	1892	49	67	 45	17.48	3.68	0.41	3.27	0.22	2.72	3.20
9	August,	1892	47	63	 27	17.08	4.24	0.67	3.57	0.12	3.40	4.00
10	September,	1892	48	68	 52	13.60	4.08	0.76	3.32	0.12	3.02	3.55

First Period of Lactation — Devon Butter Record — Monthly Averages of Artalia — (*Concluded*).

Month of lactation.	Yield of Butter.				Monthly Yield of Dairy Products.						Percentages of Fat Recovered and Lost.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1	18.21	4.44	4.10	1.04	587.1	454.9	132.2	100.0	27.4	32.2	98.3	1.7	1.5	96.9
2	17.83	4.92	3.63	1.14	591.6	471.6	120.0	86.9	28.1	33.1	98.3	1.8	3.3	93.0
3	24.63	4.85	5.08	0.78	588.7	467.3	121.4	97.4	20.4	24.0	91.0	9.0	0.5	86.0
4	22.78	5.00	4.56	0.82	563.6	450.9	112.7	87.9	21.1	24.8	83.6	16.4	1.1	82.5
5	23.58	4.51	5.23	0.75	548.7	427.1	121.7	98.4	19.8	23.3	83.8	16.2	1.9	78.6
6	25.06	5.05	4.96	0.74	555.3	445.3	110.0	87.8	18.9	22.2	83.6	16.4	1.1	77.4
7	25.58	5.00	5.11	0.66	526.7	421.4	105.3	87.8	17.5	20.6	82.9	17.1	1.4	79.0
8	31.24	5.35	5.90	0.42	399.6	324.9	74.7	61.9	10.9	12.8	88.9	11.1	6.0	73.9
9	25.00	4.80	5.20	0.45	341.6	270.4	71.2	57.5	11.6	13.7	84.2	15.8	2.8	80.2
10	28.17	4.10	7.00	0.36	311.1	235.1	76.0	65.0	9.4	11.0	81.4	18.6	2.9	74.0

FIRST PERIOD OF LACTATION — DEVON BUTTER RECORD — MONTHLY AVERAGES OF GENEVIE'S GIFT.

MONTH OF LACTATION.	Date.		Creaming and Churning.					From One Hundred Pounds of Milk.					
			Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.
			Degrees.	Degrees.	Hrs.	Min.							
1*	May,	1891	45	64	....	41	16.52	3.25	0.16	3.09	0.01	3.07	3.61
2	June,	1891	46	66	....	27	16.95	3.42	0.20	3.22	0.02	3.14	3.69
3	July,	1891	46	64	....	35	19.33	3.99	0.49	3.50	0.02	3.43	4.04
4	August,	1891	47	67	1	55	18.97	4.68	0.48	4.20	0.01	4.04	4.75
5	September,	1891	47	67	....	32	21.24	4.95	0.83	4.12	0.02	3.44	4.05
6	October,	1891	....	66	1	05	22.09	5.58	0.30	5.28	0.04	4.70	5.53
7	November,	1891	....	65	....	30	25.37	5.51	0.08	5.43	0.16	5.28	6.21
8	December,	1891	....	64	....	35	23.78	6.15	0.30	5.85	0.11	5.69	6.69
9	January,	1892	....	64	....	47	23.66	6.06	0.38	5.68	0.03	5.54	6.52
10	February,	1892	....	64	....	40	23.75	6.06	0.40	5.66	0.05	5.61	6.60

* First month of lactation contains fifteen days.

FIRST PERIOD OF LACTATION—DEVON BUTTER RECORD—MONTHLY AVERAGES OF GENEVIE'S GIFT—(*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1	27.70	5.35	5.18	0.48	158.8	129.1	29.7	24.0	4.8	5.7	95.1	4.9	0.3	94.5
2	27.25	5.26	5.18	0.50	403.7	327.0	76.7	61.9	12.6	14.8	94.1	5.9	0.7	91.7
3	24.90	5.53	4.50	0.50	383.1	313.8	69.3	53.9	13.1	15.4	87.6	12.4	0.5	85.9
4	21.05	4.52	4.65	0.50	326.3	254.1	72.2	56.7	13.2	15.5	89.7	10.3	0.2	86.3
5	24.67	5.14	4.80	0.36	265.2	213.6	51.6	40.8	9.2	10.8	83.1	16.9	0.4	69.7
6	18.08	4.18	4.32	0.50	277.9	211.4	66.5	51.2	13.0	15.3	94.6	5.4	0.7	84.2
7	16.10	4.68	3.44	0.50	243.2	191.2	52.0	36.9	12.8	15.1	98.6	1.4	2.9	95.8
8	14.95	4.07	3.67	0.63	291.7	220.0	71.7	52.2	16.6	19.5	95.1	4.9	1.8	92.5
9	15.34	4.17	3.68	0.58	276.1	209.9	66.2	48.2	15.3	18.0	93.7	6.3	0.5	91.4
10	15.20	4.22	3.60	0.58	255.5	195.0	60.5	43.7	14.3	16.8	93.4	6.6	0.8	92.5

First Period of Lactation—Guernsey Butter Record—Monthly Averages of Stella Select.

Month of Lactation.	Date.	Creaming and Churning.					From One Hundred Pounds of Milk.					
		Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.
		Degrees.	Degrees	Hrs.	Min.							
1	March, 1892	38	68	....	28	12.20	3.94	0.61	3.33	0.03	3.26	3.84
2	April, 1892	43	63	1	37	15.18	4.14	0.77	3.37	0.03	3.31	3.89
3	May, 1892	48	62	1	52	15.64	3.95	0.76	3.19	0.02	3.11	3.66
4	June, 1892	47	62	1	52	19.55	4.55	0.64	3.91	0.06	3.85	4.53
5	July, 1892	48	65	....	15	18.08	3.67	0.38	3.29	0.03	3.12	3.67
6	August, 1892	48	65	....	28	19.41	4.30	0.71	3.59	0.06	3.48	4.09
7	September, 1892	47	65	....	30	17.38	4.81	0.69	4.12	0.04	4.08	4.80
8	October, 1892	49	65	....	52	19.75	5.15	1.20	3.95	0.03	3.89	4.58
9	November, 1892	46	67	....	37	16.92	5.86	1.36	4.50	0.08	4.42	5.20
10	December, 1892	44	68	1	05	20.45	6.31	1.26	5.24	0.04	5.01	5.89

First Period of Lactation — Guernsey Butter Record — Monthly Averages of Stella Select — (*Concluded*).

Month of lactation.	Yield of Butter.				Monthly Yield of Dairy Products.						Percentages of Fat Recovered and Lost.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1	26.04	3.66	7.10	0.92	743.0	540.0	203.0	174.5	22.2	28.5	84.5	15.5	0.8	82.7
2	25.71	4.50	5.70	0.83	636.6	495.1	141.5	116.7	21.1	24.8	81.4	18.6	0.7	80.0
3	27.32	4.90	5.58	0.71	602.4	479.4	123.0	100.9	18.8	22.1	80.8	19.2	0.5	78.7
4	22.07	5.00	4.40	0.92	610.9	488.7	122.2	94.5	23.5	27.7	85.9	14.1	1.3	84.6
5	27.25	5.50	5.00	0.73	616.0	505.0	111.0	88.4	19.2	22.6	89.7	10.3	0.8	85.0
6	24.45	5.40	4.50	0.69	526.0	428.6	97.4	75.9	18.4	21.5	83.5	16.5	1.4	80.9
7	20.83	4.22	4.95	0.64	397.7	303.5	94.2	75.1	16.2	19.1	85.7	14.3	0.8	84.8
8	21.83	5.00	4.37	0.62	422.7	338.2	84.5	65.2	16.4	19.3	76.7	23.3	0.6	75.5
9	19.23	3.75	5.13	0.67	383.2	281.0	102.2	82.2	17.0	20.0	76.8	23.2	1.4	75.4
10	16.98	4.05	4.20	0.75	394.7	297.2	97.5	74.3	19.7	23.2	80.0	20.0	0.6	79.4

FIRST PERIOD OF LACTATION — JERSEY BUTTER RECORD — MONTHLY AVERAGES OF ALBERT'S CAROL.

MONTH OF LACTATION.	Date.		Creaming and Churning.					From One Hundred Pounds of Milk.					
			Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. of butter fat.
			Degrees.	Degrees.	Hrs.	Min.							
1	May,	1892	47	62	....	41	19.64	3.99	0.18	3.81	0.03	3.70	4.35
2	June,	1892	48	61	....	37	23.69	4.57	0.33	4.24	0.06	4.15	4.88
3	July,	1892	48	65	....	30	18.51	4.28	0.19	4.09	0.05	4.03	4.74
4	August,	1892	48	66	....	18	19.06	4.64	0.18	4.46	0.04	4.42	5.20
5	September,	1892	47	65	....	17	17.69	4.60	0.32	4.28	0.06	4.22	4.96
6	October,	1892	49	65	....	47	24.67	5.13	0.32	4.81	0.04	4.65	5.47
7	November,	1892	46	66	....	20	19.05	5.78	0.37	5.41	0.09	5.30	6.23
8	December,	1892	44	67	....	45	21.29	6.35	0.75	5.60	0.06	5.54	6.50
9	January,	1893	42	67	....	18	22.40	6.50	0.91	5.69	0.07	5.62	6.61
10	February,	1893	42	67	....	17	21.30	7.05	0.48	6.57	0.07	6.50	7.65

FIRST PERIOD OF LACTATION — JERSEY BUTTER RECORD — MONTHLY AVERAGES OF ALBERT'S CAROL — (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST.			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in butter-milk.	Per cent. of fat recovered in butter.
1	23.00	5.15	4.47	0.87	603.6	486.4	117.2	91.0	22.3	26.2	95.5	4.5	0.8	92.7
2	20.50	5.55	3.70	0.90	553.6	453.6	100.0	73.0	23.0	27.0	92.8	7.2	1.3	90.8
3	21.10	4.55	4.64	0.88	554.0	432.2	121.8	95.5	22.4	26.3	95.6	4.4	1.2	94.2
4	19.20	4.25	4.52	0.82	469.7	359.2	110.5	86.0	20.8	24.5	96.1	3.9	0.9	95.3
5	20.20	4.15	4.90	0.72	433.6	329.1	104.5	83.0	18.3	21.5	93.0	7.0	1.3	91.7
6	18.30	5.15	3.55	0.80	438.5	353.4	85.1	61.1	20.3	24.0	93.8	6.2	0.8	90.6
7	16.10	3.52	4.60	0.90	432.2	309.4	122.8	95.8	23.0	27.0	93.6	6.4	1.6	91.7
8	15.35	3.80	4.04	0.94	434.6	320.4	114.2	85.9	24.0	28.3	88.2	11.8	0.9	87.2
9	14.55	3.77	3.90	0.96	429.9	299.9	130.0	100.5	25.1	29.5	87.5	12.5	1.0	86.5
10	13.07	4.00	3.27	1.03	374.4	280.8	93.6	64.9	24.4	28.7	93.2	6.8	1.0	92.2

SECOND PERIOD OF LACTATION — JERSEY BUTTER RECORD — MONTHLY AVERAGES OF BARBARA ALLEN.

MONTH OF LACTATION.	Date.		From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
			Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1	May,	1892	4.81	0.08	4.73	0.03	4.70	5.53	18.10	1.22	680.8	32.0	37.6	98.3	1.7	0.6	97.7
2	June,	1892	4.23	0.08	4.15	0.03	4.12	4.84	20.65	1.05	648.0	26.7	31.4	98.1	1.9	0.7	97.4
3	July,	1892	4.48	0.08	4.40	0.03	4.37	5.14	19.45	1.05	633.8	27.7	32.6	98.2	1.8	0.7	97.5
4	August,	1892	4.58	0.08	4.50	0.03	4.47	5.26	19.00	0.92	542.4	24.2	28.5	98.3	1.7	0.7	97.6
5	September,	1892	4.80	0.08	4.72	0.03	4.69	5.52	18.10	0.85	462.7	21.8	25.6	98.3	1.7	0.6	97.7
6	October,	1892	5.13	0.08	5.05	0.03	5.02	5.91	16.75	0.93	480.6	24.4	28.7	98.4	1.6	0.6	97.9
7	November,	1892	5.56	0.08	5.48	0.03	5.45	6.41	15.60	0.93	435.2	23.8	28.0	98.6	1.4	0.5	98.1
8	December,	1892	6.02	0.08	5.94	0.03	5.91	6.95	14.40	0.84	374.9	22.1	26.0	98.7	1.3	0.5	98.2
9	January,	1893	6.66	0.08	6.58	0.03	6.55	7.70	13.00	0.88	356.7	23.3	27.4	98.8	1.2	0.5	98.3
10	February,	1893	6.73	0.08	6.65	0.03	6.62	7.80	12.80	0.76	270.6	17.9	21.1	98.8	1.2	0.5	98.3

SECOND PERIOD OF LACTATION — JERSEY BUTTER RECORD — MONTHLY AVERAGES OF COUNTESS FLAVIA.

MONTH OF LACTATION.	Date.		From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
			Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1*................	November,	1891	5.37	0.08	5.29	0.03	5.26	6.19	16.15	1.15	240.0	12.7	14.9	98.5	1.5	0.5	98.0
2................	December,	1891	5.52	0.08	5.44	0.03	5.41	6.36	15.72	1.41	720.8	39.0	45.9	98.6	1.4	0.6	98.0
3................	January,	1892	6.17	0.08	6.09	0.03	6.06	7.13	14.00	1.44	626.8	38.1	44.8	98.7	1.3	0.6	98.1
4................	February,	1892	5.95	0.08	5.87	0.03	5.84	6.87	14.55	1.20	506.7	29.6	34.8	98.7	1.3	0.5	98.2
5................	March,	1892	6.25	0.08	6.17	0.03	6.14	7.22	13.85	1.18	504.1	30.9	36.4	98.7	1.3	0.5	98.2
6................	April,	1892	6.32	0.08	6.25	0.03	6.22	7.32	13.66	1.20	491.1	30.	36.0	98.7	1.3	0.5	98.2
7................	May,	1892	6.05	0.08	5.97	0.03	5.94	7.00	14.30	1.14	506.7	30.[illegible]	35.4	98.7	1.3	0.5	98.2
8................	June,	1892	5.05	0.08	4.97	0.03	4.94	5.81	17.20	0.88	453.9	22.4	26.4	98.4	1.6	0.6	97.8
9................	July,	1892	4.84	0.08	4.76	0.03	4.73	5.56	18.00	0.81	453.2	21.4	25.2	98.3	1.7	0.6	97.7
10................	August,	1892	6.43	0.08	6.35	0.03	6.32	7.44	13.44	0.84	349.8	22.1	26.0	98.8	1.2	0.5	98.3

* First month of lactation contained twelve days.

SECOND PERIOD OF LACTATION — JERSEY BUTTER RECORD — MONTHLY AVERAGES OF GILDERBLOOM.

MONTH OF LACTATION.	Date.		From One Hundred Pounds of Milk.						Yield of Butter.		Monthly Yield of Dairy Products.			Percentages of Fat Recovered and Lost.			
			Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent. butter fat.	Pounds of milk to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1................	March,	1892	5.39	0.08	5.31	0.03	5.28	6.20	16.10	1.06	525.9	27.9	32.7	98.5	1.5	0.5	98.0
2................	April,	1892	5.39	0.08	5.31	0.03	5.28	6.20	16.10	1.12	539.1	28.5	33.5	98.5	1.5	0.5	98.0
3................	May,	1892	5.30	0.08	5.22	0.03	5.19	6.10	16.40	1.08	549.3	28.5	33.5	98.5	1.5	0.5	98.0
4................	June,	1892	4.72	0.08	4.64	0.03	4.61	5.42	18.45	0.94	519.4	23.4	28.1	98.3	1.7	0.6	97.7
5................	July,	1892	4.55	0.08	4.47	0.03	4.44	5.22	19.15	0.87	513.4	22.8	26.8	98.2	1.8	0.7	97.5
6................	August,	1892	5.25	0.08	5.17	0.03	5.14	6.05	16.53	0.85	438.0	22.5	26.5	98.5	1.5	0.6	97.9
7................	September,	1892	5.10	0.08	5.02	0.03	4.99	5.87	17.04	0.70	360.8	18.0	21.2	98.4	1.6	0.6	97.8
8................	October,	1892	6.35	0.08	6.17	0.03	6.14	7.22	13.85	0.77	331.1	20.4	24.0	98.7	1.3	0.5	98.2
9................	November,	1892	5.65	0.08	5.57	0.03	5.54	6.52	15.34	0.58	267.8	14.8	17.4	98.6	1.4	0.5	98.1
10................	December,	1892	6.44	0.08	6.36	0.08	6.33	7.45	13.42	0.60	250.0	16.5	19.4	98.8	1.2	0.5	98.3

FIRST PERIOD OF LACTATION — SHORT-HORN BUTTER RECORD — MONTHLY AVERAGES OF BETSEY 10TH.

MONTH OF LACTATION.	Date		CREAMING AND CHURNING.					FROM ONE HUNDRED POUNDS OF MILK.					
			Average temperature during setting.	Average temperature during churning.	Time of churning.		Per cent. of fat in cream.	Pounds of fat in milk.	Pounds of fat in skim-milk.	Pounds of fat in cream.	Pounds of fat in buttermilk.	Pounds of fat in butter.	Pounds of butter containing 85 per cent butter fat.
			Degrees.	Degrees	Hrs	Min.							
1	May,	1892	48	61	....	33	20.14	4.56	0.39	4.17	0.06	4.09	4.81
2	June,	1892	48	63	....	30	21.07	4.02	0.27	3.75	0.12	3.53	4.15
3	July,	1892	48	68	....	20	20.52	3.92	0.41	3.51	0.13	3.21	3.78
4	August,	1892	47	66	....	20	19.29	3.88	0.33	3.55	0.18	3.37	3.96
5	September,	1892	48	62	....	20	18.93	3.95	0.41	3.54	0.11	3.43	4.03
6	October,	1892	49	66	....	30	16.51	4 15	0.60	3.55	0.08	3.47	4.08
7	November,	1892	48	67	....	27	20.58	4.45	0.54	3.91	0.10	3.77	4.44
8	December,	1892	44	65	....	52	19.20	4.42	0.58	3.84	0.10	3.74	4.40
9	January,	1893	41	68	....	38	22.75	5.02	0.88	4.14	0.10	4.01	4.72
10	February,	1893	42	66	....	49	21.65	4.80	0.43	4.37	0.08	4.29	5,05

FIRST PERIOD OF LACTATION — SHORT-HORN BUTTER RECORD — MONTHLY AVERAGES OF BETSEY 10TH. (*Concluded*).

MONTH OF LACTATION.	YIELD OF BUTTER.				MONTHLY YIELD OF DAIRY PRODUCTS.						PERCENTAGES OF FAT RECOVERED AND LOST			
	Pounds of milk to one pound of butter.	Pounds of milk to one pound of cream.	Pounds of cream to one pound of butter.	Pounds of butter per day.	Pounds of whole milk.	Pounds of skim-milk.	Pounds of cream.	Pounds of butter-milk.	Pounds of fat in butter.	Pounds of butter.	Per cent. of fat recovered in cream.	Per cent. of fat lost in skim-milk.	Per cent. of fat lost in buttermilk.	Per cent. of fat recovered in butter.
1*	20.80	4.83	4.31	0.97	576.0	449.6	117.4	90.1	23.2	27.3	91.5	8.5	1.3	89.7
2	24.10	5.61	4.30	0.95	687.1	564.6	122.5	94.0	24.2	28.5	93.3	6.7	3.0	87.8
3	26.45	5.85	4.52	0.80	650.6	539.4	111.2	86.6	20.9	24.6	89.5	10.5	3.3	81.9
4	25.25	5.43	4.65	0.68	531.6	433.7	97.9	76.9	17.8	21.0	91.5	8.5	4.6	86.9
5	24.80	5.35	4.64	0.58	425.5	345.5	80.0	62.8	14.6	17.2	89.6	10.4	2.8	86.8
6	24.50	4.65	5.27	0.57	433.7	340.4	93.3	75.6	15.1	17.7	85.5	14.5	1.9	83.6
7	22.50	5.26	4.30	0.65	437.8	354.6	83.2	63.8	16.5	19.4	87.9	12.1	2.3	84.7
8	22.75	5.00	4.55	0.63	445.2	356.2	89.0	72.8	16.2	19.1	86.9	13.1	2.3	84.6
9	21.20	5.50	3.86	0.63	411.8	336.8	75.0	55.6	16.5	19.4	82.5	17.5	2.0	80.0
10	19.80	4.00	4.95	0.67	369.4	277.0	92.4	73.8	15.8	18.6	91.0	9.0	1.6	89.4

* First month of lactation contained twenty-eight days.

XXV. TRADE-VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS, ADOPTED BY EXPERIMENT STATIONS.

	1892. Cts. per pound.	1893. Cts. per pound.
Nitrogen in ammonia salts	17½	17
Nitrogen in nitrates	15	15½
Organic nitrogen in dry and fine ground fish, meat and blood, and in high-grade mixed fertilizers	16	17½
Organic nitrogen in cotton-seed meal and castor-pomace	15	16½
Organic nitrogen in fine ground bone and tankage	15	15
Organic nitrogen in fine ground medium bone and tankage	12	12
Organic nitrogen in medium bone and tankage	9½	9
Organic nitrogen in coarse bone and tankage	7½	7
Organic nitrogen in hair, horn shavings and coarse fish scraps	7	7
Phosphoric acid, soluble in water	7½	6½
Phosphoric acid, soluble in ammonium citrate	7½	6
Phosphoric acid in fine bone and tankage	7	6
Phosphoric acid in fine medium bone and tankage	5½	5
Phosphoric acid in medium bone and tankage	4½	4
Phosphoric acid in coarse bone and tankage	3	3
Phosphoric acid in fine ground fish, cotton-seed meal, castor-pomace and wood ashes	5	5
Phosphoric acid in fine ground rock phosphate	2	2
Potash as high-grade sulphate, in forms free from muriates (chlorides) in ashes, etc	5½	5½
Potash in kainit	4½	4½
Potash in muriate	4½	4½
Organic nitrogen in mixed fertilizers	17	17½
Insoluble phosphoric acid in mixed fertilizers	2	2
VALUATION OF FERTILIZING INGREDIENTS IN FOODS.		
Organic nitrogen	....	17½
Phosphoric acid	....	5
Potash	....	5½

26. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS

Composition of fertilizers as guaranteed by manufacturers, and

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Acme Fertilizer Co., Maspeth, L. I.	Acme fertilizer No. 1.	Flatlands, L. I.	470
Acme Fertilizer Co., Maspeth, L. I.	Acme fertilizer No. 2.	Jamaica, L. I. Flatlands, L. I. Parkville, L. I.	493 459 450
Acme Fertilizer Co., Maspeth, L. I.	Acme potato fertilizer.	Parkville, L. I.	451
H. J. Baker & Bro., 215 Pearl street, New York.	A A ammoniated super-phosphate.	White Plains.	694
H. J. Baker & Bro., 215 Pearl street, New York.	Complete cabbage manure	Canarsie, L. I Parkville, L. I.	478 452
H. J. Baker & Bro., 215 Pearl street, New York.	Complete potato manure.	Queens, L. I. Blackburn, L. I. Flatbush, L. I.	542 453 479
H. J. Baker & Bro., 215 Pearl street, New York.	Pelican bone standard U. N. X L. D. fertilizer.	Glens Falls.	800
H. J. Baker & Bro., 215 Pearl street, New York.	The Victor special fertilizer.	Cutchogue.	690
Bowker Fertilizer Co., Boston and New York.	Ammoniated bone.	Syracuse.	
Bowker Fertilizer Co., Boston and New York.	Carpenter's special for cabbage.	Jamaica, L. I.	483
Bowker Fertilizer Co., Boston and New York.	Carpenter's special for potatoes	Jamaica, L. I.	484
Bowker Fertilizer Co., Boston and New York.	Fresh ground bone.	Syracuse.	901
Bowker Fertilizer Co., Boston and New York.	Hill and drill.	Scotia village. New Scotland. Greenfield Centre. Spencer.	824 76 797 862
Bowker Fertilizer Co., Boston and New York.	Potato phosphate.	Glens Falls.	806
Bowker Fertilizer Co., Boston and New York.	Stockbridge's celery manure.	Albany.	743

in New York State for the Spring of 1892.

as found by chemical analysis. Estimated in parts per hundred.

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	3.30 to 4.10 3.82	4 to 5 4.63	8 to 9 7.63	.... 1.44	.... 9.07	9 to 10 8.28
Guaranteed. Found.	4.95 to 5.35 4.34	6 to 6.50 5.26	8 to 9 8.00	.... 1.62	.... 9.62	5 to 6 6.60
Guaranteed. Found.	2 90 to 3.30 3.11	3.50 to 4 3.76	7 to 8 7.06	.... 1.38	.... 8.44	9 to 10 8.88
Guaranteed. Found.	2.50 to 3.30 3.12	3 to 4 3.78	10 to 12 10.07	1 to 3 1.60	.... 11.67	2 to 3 3.22
Guaranteed. Found.	4.70 5.01	5.75 6.08	5.00 6.14	.... 0.80	.... 6.94	7.00 7.00
Guaranteed. Found.	3.30 3.80	4.00 4.60	5.75 5.30	.... 0.93	.... 6.23	10.00 11.63
Guaranteed. Found.	1.65 2.35	2.00 2.85	8.00 7.74	.... 3.63	.... 11.37	2.00 2.52
Guaranteed. Found.	3.30 3.53	4.00 4.28	10.00 9.85	.... 0.59	.... 10.44	8.00 8.55
Guaranteed. Found.	1.65 to 2.50 2.75	2 to 3 3.34	8 to 10 8.77	.... 2.39	10 to 12 11.16	2 to 3 2.40
Guaranteed. Found.	4.50 to 5.35 4.11	5.50 to 6.50 5.00	5 to 7 7.44	.... 1.90	.... 9.34	6.50 to 7.50 7.22
Guaranteed. Found.	3.70 to 4 50 3.25	4.50 to 5.50 3.94	7 to 9 8.18	.... 1.94	.... 10.12	6.50 to 7.50 7.10
Guaranteed. Found.	2.50 to 3.30 3.35	3 to 4 4.06	.... 16.65	.... 2.39	18 to 22 19.04	....
Guaranteed. Found.	2.05 to 2 90 2.48	2.50 to 3.50 3.01	8 to 10 9.56	.... 2.05	10 to 12 11.61	2 to 3 2.00
Guaranteed. Found.	2.05 to 2.90 2.36	2.50 to 3.50 2.87	8 to 10 10.88	.... 0.87	10 to 12 11 75	2 to 3 1.81
Guaranteed. Found.	4.50 to 5.35 4.43	5.50 to 6.50 5.38	3.50 to 4.50 4.42	.... 2.63	6 to 8 7.05	5.50 to 6.50 6.01

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston and New York.	Stockbridge's manure.	Jamaica.	482
Bowker Fertilizer Co., Boston and New York.	Stockbridge's special compound manure for potatoes.	New Scotland. Albany. Glens Falls.	771 747 805
Bowker Fertilizer Co., Boston and New York.	Stockbridge's special compound manure for vegetables.	Albany.	745
Bowker Fertilizer Co., Boston and New York.	Stockbridge's special for cabbage.	Syracuse.	897
Bowker Fertilizer Co., Boston and New York.	Stockbridge's special for peas and beans.	Syracuse.	900
Bowker Fertilizer Co., Boston and New York.	Super - phosphate with potash.	Syracuse.	902
Bowker Fertilizer Co., Boston and New York.	Sure crop.	Greenfield Centre. New Scotland. Scotia village. Spencer.	798 770 823 863
Bradley Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Amsterdam.	840
Bradley Fertilizer Co., Boston, Mass.	B. D. sea fowl guano.	Amsterdam. Farmersville.	841 867
Bradley Fertilizer Co., Boston, Mass.	Complete manure for potatoes.	Gravesend, L. I. Jamaica, L. I. Flatlands, L. I.	455 491 460
Bradley Fertilizer Co., Boston, Mass.	Extra fine ground bone with potash.	Albany.	754
Bradley Fertilizer Co., Boston, Mass.	Farmers' new method fertilizer.	Jamaica, L. I.	539
Bradley Fertilizer Co., Boston, Mass.	Fish and potash.	Jamaica, L. I.	499
Bradley Fertilizer Co., Boston, Mass.	New method.	Oran.	890

Fertilizers, Etc.—(*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	3.35 to 4.10 3.49	4 to 5 4.23	5 to 7 7.88	.... 1.94	7 to 9 9.82	7 to 9 6.50
Guaranteed. Found.	3.30 to 4.10 4.17	4 to 5 5.06	7 to 8 9.74	.... 2.33	8 to 10 12.07	5 to 6 6.15
Guaranteed. Found.	3.30 to 4.10 3.69	4 to 5 4.48	7 to 8 9.74	.... 1.63	8 to 10 11.37	5 to 6 6.15
Guaranteed. Found.	4.10 to 4.95 5.53	5 to 6 6.71	5 to 6 5.08	.... 3.38	6 to 8 8.46	5 to 6 5.06
Guaranteed. Found.	2 to 3 3.07	2.40 to 3.65 3.73	6 to 8 10.37	.... 3.30	.... 13.67	6.30 to 7.50 6.38
Guaranteed. Found.	....	....	10 to 12 13.48	.... 1.85	12 to 14 15.33	1 to 2 1.42
Guaranteed. Found.	0.83 to 1.65 1.49	1 to 2 1.91	8 to 10 8.76	.... 2.39	10 to 12 11.15	1 to 2 1.30
Guaranteed. Found.	1.65 to 2.50 2.07	2 to 3 2.51	7 to 9 9.27	.... 2.31	8 to 10 11.58	1 to 2 2.01
Guaranteed. Found.	2.05 to 2.90 2.06	2.50 to 3.50 2.50	8 to 10 10.28	.... 1.78	10 to 12 12.06	1.50 to 2 1.86
Guaranteed. Found.	3.70 to 4.10 3.79	4.50 to 5.00 4.60	8.50 to 10 8.74	.... 1.01	10 to 12 9.75	7 to 8 8.04
Guaranteed. Found.	1.85 to 2.70 1.82	2.25 to 3.25 2.21	.... 7.81	.... 3.30	8 to 12 11.11	2 to 3 2.65
Guaranteed. Found.	1.65 to 2.50 3.20	2 to 3 3.88	8 to 10 9.85	.... 1.39	10 to 12 11.24	3 to 4 3.99
Guaranteed. Found.	2 to 3 3.13	2.40 to 3.50 3.79	4 to 6 6.30	.... 1.05	6 to 8 7.35	4 to 6 5.02
Guaranteed. Found.	0.83 to 1.65 1.17	1 to 2 1.41	8 to 10 8.74	.... 1.52	.... 10.26	2.1 to 3.02 2.14

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bradley Fertilizer Co., Boston, Mass.	Patent super-phosphate of lime.	Jamaica, L. I.	500
Bradley Fertilizer Co., Boston, Mass.	Potato fertilizer.	Caryville. Brewster. Coleman's Station Patterson.	732 714 722 715
Bradley Fertilizer Co., Boston, Mass.	Potato manure.	Jamaica.	538
Brown & Gilman, Philadelphia, Pa.	Special cabbage manure.	Canarsie, L. I.	477
Brown & Gilman, Philadelphia, Pa.	Special potato manure.	Canarsie, L. I.	476
Chemical Co. of Canton, Baltimore, Md.	Baker's special great corn and grass fertilizer.	East Lansing.	912
Chemical Co. of Canton, Baltimore, Md.	Resurgam guano.	East Lansing.	910
Clark's Cove Guano Co, New Bedford, Mass.	Atlas bone.	New Scotland.	768
Clark's Cove Guano Co., New Bedford, Mass.	Bay State fertilizer.	Altamont. Glens Falls.	772 810
Clark's Cove Guano Co., New Bedford, Mass.	Defiance complete fertilizer.	Altamont.	775
Clark's Cove Guano Co., New Bedford, Mass.	Great planet "AA" manure.	Queens, L. I.	549
Clark's Cove Guano Co., New Bedford, Mass.	Great planet "B" manure.	Saratoga.	795
Clark's Gove Guano Co., New Bedford, Mass.	King Philip alkaline guano.	Altamont. Glens Falls. Utica.	774 811 882
Clark's Cove Guano Co., New Bedford, Mass.	Sweepstakes potato manure.	Glens Falls.	813
Clark's Cove Guano Co., New Bedford, Mass.	Unicorn ammoniated super-phosphate.	Altamont. Glens Falls. Utica	773 812 881

FERTILIZERS, ETC.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	2.50 to 3.30 2.67	3 to 4 3.23	8 to 10 10.76	2 to 3 1.20	10 to 12 11.96	1.50 to 2.50 3.21
Guaranteed. Found.	2.05 to 2 90 2.12	2.50 to 3.50 2.57	9 to 10 10.04	.... 1.53	11 to 12 11.57	3.25 to 4.30 3.37
Guaranteed. Found.	2.70 to 3.50 2.85	3.25 to 4.25 3.45	6 to 8 7.70	.... 0.92	8 to 11 8.62	6 to 7 5.96
Guaranteed. Found.	2.50 to 3.30 2.76	3 to 4 3.35	6 to 8 7.56	.... 2.32	.... 9.88	6 to 7 5.79
Guaranteed. Found.	2.50 to 3.30 2.57	3 to 4 3.11	6 to 8 7.62	.... 2.44	.... 10.06	6 to 7 5.71
Guaranteed. Found.	0.83 to 1.65 1.70	1 to 2 2.06	9 to 11 8.82	.... 1.76	.... 10.58	2 to 3 2.30
Guaranteed. Found.	1.25 to 1.65 1.99	1.50 to 2 2.42	8 to 10 8.04	.... 2.33	.... 10.37	2 to 3 2.34
Guaranteed. Found.	....	....	11 to 15 11.30	1 to 2 2.39	13 to 17 13.69	....
Guaranteed. Found.	2.50 to 3.30 2.90	3 to 4 3.52	10 to 12 9.98	1 to 2 0.49	11 to 14 10.47	2 to 3 1.93
Guaranteed. Found.	0.83 to 1.65 1.33	1 to 2 1.61	6 to 8 7.91	2 to 4 1.61	8 to 12 9.52	2 to 3 1.96
Guaranteed. Found.	3.70 to 4.10 3.53	4.50 to 5 4.28	7.50 to 9.50 8.02	1 to 2 0.80	8.50 to 11 50 8.82	7.50 to 10 8.52
Guaranteed. Found.	4.95 to 6 55 5.01	6 to 8 6.08	5 to 6 6.01	.... 1.71	.... 7.72	7 to 9 7.46
Guaranteed. Found.	1.25 to 1.65 1.35	1.50 to 2 1.64	6.50 to 8 6.90	1 to 2.50 1.79	7.50 to 10 8.69	3 to 4 3.23
Guaranteed. Found.	2.90 to 4.10 3.45	3.50 to 5 4.19	7 to 9 7.60	1 to 2 1.48	8 to 11 9.08	7.50 to 10 7.18
Guaranteed. Found.	1.85 to 2.50 2.43	2.25 to 3 2.95	8.50 to 10 9.70	1.50 to 3 0.82	10 to 13 10.52	2.25 to 3 2.33

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Clark's Cove Guano Co , New Bedford, Mass.	White oak pure ground bone.	Altamont.	776
E. Frank Coe, New York city.	Alkaline bone.	Millerton.	717
E. Frank Coe, New York city.	XXV ammoniated bone super-phosphate.	Amenia. Mohawk.	723 847
E. Frank Coe, New York city.	Excelsior guano	Jamaica, L. I.	495
E. Frank Coe, New York city.	High grade ammoniated bone super-phosphate.	Millerton. Amenia. Glens Falls.	718 724 818
E. Frank Coe, New York city.	Potato fertilizer.	Millerton.	719
F. Frank Coe, New York city.	Red Brand excelsior guano.	Jamaica, L. I.	496
E. Frank Coe, New York city.	Soluble bone.	Mohawk.	846
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Am'oniated wheat and corn phosphate.	N. Hillsdale. Farmersville. Ithaca.	728 871 856
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated practical super-phosphate.	Ithaca. Owego.	855 880
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	New rival ammoniated super-phosphate.	N. Hillsdale. Farlin. Ithaca. Farmersville.	730 766 854 872
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Niagara.	Ithaca.	857
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Potato, hop and tobacco phosphate.	N. Hillsdale. Saratoga.	729 790
Darling Fertilizer Co., Pawtucket, R. I.	Animal fertilizer, special L.I. brand "C."	Mattituck, L. I.	686
Danbury Fertilizer Co., Danbury, Conn.	Bone meal.	Bedford Station.	710

FERTILIZERS, ETC.—(*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	2.50 to 4.10 3.46	3 to 5 4.20	.... 6.07	.... 10.90	20 to 25 16.97	....
Guaranteed. Found.	0.83 to 1.65 1.49	1 to 2 1.91	9 to 12 9.28	2 to 3 3.61	11 to 13 12.89	1.60 to 2.20 1.88
Guaranteed. Found.	0.83 to 1.25 0.78	1to 1.50 0.95	7 to 9 9.64	2 to 3 3.37	.... 13.01	0.80 to 1.20 0.81
Guaranteed. Found.	3.30 to 4 10 3.64	4 to 5 4.41	9 to 12 9.22	1 to 2 1.53	.... 10.75	3.40 3.67
Guaranteed. Found.	2.05 to 2.90 2.25	2.50 to 3.50 2.73	9 to 12 8.99	2 to 3 1.94	11 to 13 10.93	1.60 to 2.20 2.42
Guaranteed. Found.	2.05 to 2.90 2.45	2.50 to 3.50 2.97	8 to 10 7.76	.... 2.30	.... 10.06	6 to 7 5.52
Guaranteed. Found.	3.30 to 4.10 3.36	4 to 5 4.08	9 to 12 9.10	1 to 2 1.50	.... 10.60	6 5.52
Guaranteed. Found.	....	....	13 to 15 12.74	2 to 3 1.80	15 to 18 14.54	....
Guaranteed. Found.	2.05 to 2.90 2.20	2.50 to 3.50 2.67	10 to 13 11.55	1 to 2 2.59	.... 14.14	1.60 to 2.70 1.71
Guaranteed. Found.	0.83 to 1.65 1.45	1 to 2 1.76	8 to 10 7.77	1 to 2 2.68	9 to 12 10.27	1 to 2 1.60
Guaranteed. Found.	1.25 to 2.05 1.59	1.50 to 2.50 1.93	10 to 12 10.01	1 to 3 1.06	.... 11.07	1.60 to 2.70 1.56
Guaranteed. Found.	....	....	11.50 to 13 12.68	1 to 3 1.80	.... 14.48	....
Guaranteed. Found.	2.05 to 2.90 2.60	2.50 to 3.50 3.16	10 to 12 9.65	1 to 2 2.62	.... 12.27	3.20 to 4.30 3.56
Guaranteed. Found.	3.30 to 4.95 3.31	4 to 6 4.01	7 to 9 5.90	.... 2.62	.... 8.16	9 to 11 9.16
Guaranteed. Found.	3.30 to 3.70 3.62	4 to 4.50 4.39	.... 9.36	.... 13.56	21.20 22.92	....

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Danbury Fertilizer Co., Danbury, Conn.	XL fertilizer.	Bedford Station.	709
Danbury Fertilizer Co., Danbury, Conn.	Tankage.	Bedford Station.	711
J. H. Devin, Utica, N. Y,	J. H. Devin's fertilizer.	Deerfield.	883
L. Eggers & Son, West Troy.	Novelty Bone Works' ground bone.	West Troy.	765
L. Eggers & Son, West Troy.	Novelty Bone Works' phosphate.	West Troy.	764
Ellsworth, Tuthill & Co., Promised Land, L. I.	No. 1 fertilizer.	Aquebogue.	681
Ellsworth, Tuthill & Co., Promised Land, L. I.	No. 2 fertilizer.	Aquebogue.	682
Ellsworth, Tuthill & Co., Promised Land, L. I.	Special fertilizer.	Aquebogue.	650
G. B. Forrester, New York city.	Crop forcer.	Sheep's Head Bay, L. I.	457
G. B. Forrester, New York city.	Potato manure.	Gravesend, L. I.	454
Great Eastern Fertilizer Co., New York city.	General grain and grass fertilizer.	Mohawk.	848
Great Eastern Fertilizer Co., New York city.	General garden special.	Hollis.	540
Great Eastern Fertilizer Co., New York city.	Vegetable, vine and tobacco fertilizer.	Mohawk.	849
Hallock & Duryea, Mattituck, L. I.	Cabbage fertilizer.	Mattituck, L. I.	649
Hallock & Duryea, Mattituck, L. I.	Cabbage and cauliflower fertilizer No. 2.	Mattituck, L. I.	645

Fertilizers, Etc.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	2.05 to 2.90 2.58	2.50 to 3.50 3.11	8 to 10 10.22	.... 2.27	.... 12.49	3 to 4 4.15
Guaranteed. Found.	3 70 to 4.50 4.55	4.50 to 5.50 5.51	.... 8.23	.... 9.83	10.00 18.06	....
Guaranteed. Found.	2 50 to 3.30 3.58	3 to 4 3.75	7 to 9 8.86	1 to 2 1.31	.... 10.17	2 to 3 2.73
Guaranteed. Found.	3.30 4.27	4 5.18	.... 6.53	.... 14.18	19.20 20.71	....
Guaranteed. Found.	1.25 to 1.65 1.92	1.50 to 2 2.33	7 to 8 8.72	3 to 4 6.32	.... 15.04	4 to 5 3.08
Guaranteed. Found.	4.10 3.98	5.00 4.83	8.00 7.90	.... 0.94	.... 8.84	10.00 11.37
Guaranteed. Found.	4.10 5.18	5.00 6.29	4.00 3.50	.... 0.70	.... 4.20	7.00 7.59
Guaranteed. Found.	4.10 4.15	5.00 5.04	8.00 7.85	.... 3.89	.... 11.74	10.00 8.89
Guaranteed. Found.	5.75 7.85	7.00 9.52	5.00 6.44	....	.... 6.44	2.00 7.07
Guaranteed. Found.	3.50 4.90	4.25 5.94	5.50 8.00	....	.... 8.00	10.00 10.30
Guaranteed. Found.	2.50 to 3.30 2.65	3 to 4 3.21	8 to 12 8.54	1 to 3 0.72	9 to 15 9.26	2 to 4 2.66
Guaranteed. Found.	3.30 to 4.10 3.65	4 to 5 4.43	6 to 8 6.28	.... 0.37	.... 6.65	8 to 10 9.12
Guaranteed. Found.	2.05 to 2.90 2.37	2.50 to 3.50 2.88	8 to 12 8.57	1 to 3 0.60	9 to 15 9.17	3.25 to 4.30 4.14
Guaranteed. Found.	4.10 4.00	5.00 4.85	6.50 6.44	....	.... 6.44	8.08 8.19
Guaranteed. Found.	4.10 to 4.95 3.93	5 to 6 4.77	6 to 8 6.50	....	.... 6.50	6 to 8 7.16

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Hallock & Duryea, Mattituck, L. I.	Cutchogue Club fertilizer.	Mattituck, L. I.	643
Hallock & Duryea, Mattituck, L. I.	Hallock & Duryea's No. 3.	Mattituck, L. I.	646
Hallock & Duryea, Mattituck, L. I.	Potato fertilizer.	Mattituck, L. I.	648
Hallock & Duryea, Mattituck, L. I.	Special garden fertilizer.	Mattituck, L. I.	647
Hallock & Duryea, Mattituck, L. I.	Standard potato manure No. 1.	Mattituck, L. I.	644
Isaac C. Hendrickson, Jamaica, L. I.	Highgrade fertilizer.	Jamaica, L. I.	485
Lister's Agricultural and Chemical Works, Newark, N. J.	Ammoniated dissolved bone.	Schenectady.	827
Lister's Agricultural and Chemical Works, Newark, N. J.	Celebrated ground bone.	Amsterdam.	836
Lister's Agricultural and Chemical Works, Newark, N. J.	Corn manure No. 2.	Glens Falls.	808
Litser's Agricultural and Chemical Works, Newark, N. J.	Harvest Queen.	Amsterdam.	835
Lister's Agricultural and Chemical Works, Newark, N. J.	Increase ammoniated dissolved bone phosphate.	Amsterdam.	834
Lister's Agricultural and Chemical Works, Newark, N. J.	Pea fertilizer.	Jamaica, L. I.	494
Lister's Agricultural and Chemical Works, Newark, N. J.	Potato manure No. 1.	Troy.	787
Lister's Agricultural and Chemical Works, Newark, N. J.	Potato No. 2.	Chatham. Amsterdam.	838
Lister's Agricultural and Chemical Works, Newark, N. J.	Standard pure bone super-phosphate of lime.	Flatlands, L. I.	463
Lister's Agricultural and Chemical Works, Newark, N. J.	U. S. super-phosphate.	Amsterdam.	833

FERTILIZERS, ETC.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	4.10 4.48	5 5.43	8 7.56	.... 0.21	.... 7.77	10.00 9.12
Guaranteed. Found.	1.65 to 2.50 1.84	2 to 3 2.23	7.50 to 10 7.01	.... 0.21	.... 6.80	12 to 14 13.82
Guaranteed. Found.	3.30 3.06	4 3.71	8.00 8.65	.... 1.07	.... 9.72	10.00 8.00
Guaranteed. Found.	3.30 to 4.95 3.27	4 to 6 3.99	11 to 13 10.63	.... 0.27	.... 10.90	2 to 3 3.62
Guaranteed. Found.	3.30 to 4.10 3.36	4 to 5 4.08	7 to 9 7.36	.... 0.37	.... 7.73	9 to 10 10.16
Guaranteed. Found.	4.10 to 4.95 4.73	5 to 6 5.74	4 to 7 5.87	.... 0.65	5 to 9 6.52	9 to 10 10.00
Guaranteed Found.	1.80 to 2.05 2.21	2.20 to 2 50 2.68	9 to 10 9.39	2 to 3 2.09	11 to 13 11.48	1.50 to 2 1.98
Guaranteed. Found.	2.70 to 2.90 3.40	3.25 to 3.50 4.12	.... 10.12	.... 2.66	12 to 14 12.78	....
Guaranteed. Found.	1.80 to 2.50 2.53	2.20 to 3 3.07	.... 9.92	.... 1.98	9.25 to 11 11.90	4 to 5 4.66
Guaranteed. Found.	1.25 to 1.65 2.04	1.52 to 2 2.48	9.50 to 11 10.51	.... 2.24	.... 12.75	1.50 to 2 2.05
Guaranteed. Found.	1.80 to 2.05 2.14	2.20 to 2.50 2.60	9 to 10 8.65	2 to 3 2.63	11 to 13 11.28	1.50 to 2 3.49
Guaranteed. Found.	2.35 to 2.70 2.32	2.85 to 3.25 2.80	10 to 12 9.21	2 to 3 2.12	.... 11.33	1.50 to 2 2.17
Guaranteed. Found.	3.70 to 4.10 4.04	4.50 to 5 4.90	7.50 to 9 7.11	.... 1.10	.... 8.21	7 to 8 7.66
Guaranteed. Found.	1.80 to 2.50 2.41	2.20 to 3 2.93	9.25 to 11 10.07	.... 1.42	.... 11.49	4 to 5 3.75
Guaranteed. Found.	2.35 to 2.70 2.88	2.85 to 3.25 3.49	10 to 12 10.01	2 to 3 2.39	.... 12.40	1.50 to 2 1.99
Guaranteed. Found.	1.35 to 1.65 1.47	1.60 to 2 1.78	7 to 8 6.64	1 to 1.50 2.04	8 to 9.50 8.68	2 to 2.50 2.71

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Frederick Ludlam, New York city.	Riverhead Town Agricultural Society formula fertilizer.	Mattituck, L. I.	642
Mapes' Formula and Peruvian Guano Co., New York city.	"A" brand manure.	Flatlands, L. I.	466
Mapes' Formula and Peruvian Guano Co., New York city.	Complete manure for onions and vegetables.	Flatlands, L. I.	458
Mapes' Formula and Peruvian Guano Co., New York city.	Economical manure.	Flatlands, L. I.	467
Mapes' Formula and Peruvian Guano Co., New York city.	Manure for corn.	White Plains.	695
Mapes' Formula and Peruvian Guano Co., New York city.	Manure for potatoes, L. I. special.	Flatlands, L. I.	465
Mapes' Formula and Peruvian Guano Co., New York city.	XXV phosphate.	Bedford Station.	708
Mapes' Formula and Peruvian Guano Co., New York city.	Potato manure.	White Plains.	696
Maryland Fertilizer Co., Baltimore, Md.	Seneca Chief.	Oran.	887
Maryland Fertilizer Co., Baltimore, Md.	Tobacco food.	Oran.	888
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Buffalo fertilizer.	Herkimer.	851
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Erie King.	Herkimer.	853
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Potato, hop and tobacco phosphate.	Herkimer.	852
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Pure dissolved bone.	Amsterdam.	844
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Wheat, oats and barley phosphate.	Herkimer.	850

FERTILIZERS, ETC.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	4.10 4.40	5.00 5.34	8.00 8.02	.... 1.00	.... 9.02	10.00 10.08
Guaranteed. Found.	2.50 to 3 30 3.01	3 to 4 3.65	10 to 12 12.04	.... 0.40	12 to 16 12.44	2.50 to 3.50 3.47
Guaranteed. Found.	4.95 to 6.50 5.44	6 to 8 6.60	6 to 8 8.16	2.00 0.97	8 to 10 9.13	6 to 8 6.87
Guaranteed. Found.	2.50 to 3.30 3.07	3 to 4 3.80	6 to 8 9.22	.... 0.46	6 to 8 9.68	8 to 10 9.14
Guaranteed. Found.	3.70 to 4.10 3.81	4.50 to 5 4.61	8 to 10 10.15	.... 1.32	10 to 12 11.47	6 to 7 6.51
Guaranteed. Found.	3.30 to 4.10 3.45	4 to 5 4.18	6 to 8 7.86	.... 0.25	.... 8.11	7 to 9 7.15
Guaranteed. Found.	2.05 2.07	2.50 2.51	7.00 9.46	1.00 0.64	8.00 10.11	1.00 1.52
Guaranteed. Found.	3.70 to 4.10 3.79	4.50 to 5 4.60	8.00 8.70	.... 0.15	8 to 10 8.85	6 to 8 6.93
Guaranteed. Found.	1.65 to 2.50 2.09	2 to 3 2.54	9 to 12 9.25	.... 1.26	.... 10.51	1.50 to 2 1.84
Guaranteed Found.	2.30 to 2.70 2.41	2.75 to 3.25 2.93	10 to 13 10.41	1 to 2 0.93	.... 11.34	2.50 to 3 2.77
Guaranteed. Found.	2.50 to 3.80 3.13	3 to 4.65 3.90	8 to 12.30 7.56	2 to 3 2.67	10 to 15.30 10.23	1.50 to 2.50 0.92
Guaranteed. Found.	0.83 to 1.65 1.00	1 to 2 1.21	8.45 to 10.45 8.19	4 to 5 2.49	12.45 to 15.45 10.68	1.80 to 2.10 2.63
Guaranteed. Found.	2.50 to 3.30 2.88	3 to 4 3.50	8 to 11 7.76	1 to 2 2.80	9 to 13 10.56	2.70 to 3 25 2.58
Guaranteed. Found.	....	....	11 to 13 10.75	1.37 to 2.37 1.45	12 37 to 15 37 12.20	....
Guaranteed Found.	1.65 to 3.30 2.32	2 to 4 2.82	8 to 10 6.41	2 to 3 3.17	10 to 13 9.58	2 to 3 1.67

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Mitchell Fertilizer Co., Tremley, N. J.	Little giant phosphate.	Ghent.	739
Mitchell Fertilizer Co., Tremley, N. J.	Standard superphosphate.	Ghent.	738
Moller & Co., Bone Works, Maspeth, L. I.	Champion No. 1 pure bone fertilizer.	Canarsie, L. I.	472 475 471
Moller & Co. Bone Works, Maspeth, L. I.	Champion No. 2 pure bone fertilizer.	Canarsie, L. I.	471 474
National Fertilizer Co., Bridgeport, Conn.	Chittenden's ammoniated bone super-phosphate.	Cutchogue.	692
National Fertilizer Co., Bridgeport, Conn.	Chittenden's compound fertilizer for potatoes.	Queens. Cutchogue.	548 691
Oneonta Fertilizer Co., Oneonta, N. Y.	Ammoniated bone super-phosphate.	Owego.	875
Oneonta Fertilizer Co., Oneonta, N. Y.	Domestic phosphate.	Owego.	876
Oneonta Fertilizer Co., Oneonta, N. Y.	Potato special phosphate.	Owego.	874
Pacific Guano Co., Boston, Mass.	Nobsque guano.	Glens Falls.	802
J. E. Phelps, Jamaica, L. I.	Challenge fertilizer No. 2.	Jamaica, L. I.	487
J. E. Phelps, Jamaica, L. I.	Challenge vegetable fertilizer No. 1.	Jamaica, L. I.	486
Preston Fertilizer Co., Greenpoint, L. I.	Ammoniated bone super-phosphate.	Queens.	543
Preston Fertilizer Co., Greenpoint, L. I.	Corn fertilizer.	Guilderland Center.	782
Preston Fertilizer Co., Greenpoint, L. I.	Potato fertilizer.	Queens.	544

FERTILIZERS, ETC. — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	0.83 to 1.65 1.11	1 to 2 1.35	8 to 10 10.37	.... 2.63	.... 13.00	2.20 to 3.25 1.67
Guaranteed. Found.	2.50 to 2.90 2.51	3 to 3.50 3.02	9 to 10 10.42	.... 1.64	11.50 to 12.50 12.06	2.50 to 3 1.63
Guaranteed. Found.	4.10 to 4.50 3.50	5 to 5.50 4.25	8.50 to 9 8.78	.... 1.09	.... 9.87	8 to 9 7.09
Guaranteed. Found.	4 95 to 5.35 3.80	6 to 6.5 4.61	8.50 to 9 8.02	.... 0.80	10 to 11 8.82	6.50 to 7 5.90
Guaranteed. Found.	1.65 to 2.50 2.67	2 to 3 3.24	7 to 9 10.59	.... 1.06	9 to 11 11.65	2 to 4 3.11
Guaranteed. Found.	3.30 to 4.10 3.33	4 to 5 4.24	6 to 8 8.50	.... 1.45	8 to 10 9.95	6 to 8 7.17
Guaranteed. Found.	2.50 to 3.30 2.35	3 to 4 2.85	7 to 9 5.36	.... 0.87	.... 6.23	2.70 to 3.25 4.12
Guaranteed. Found.	1.65 to 2.50 0.79	2 to 3 0.96	7 to 9 13.93	.... 0.89	.... 14.82	2.7 to 3.25 0.16
Guaranteed. Found.	2.90 to 3.70 2.24	3.5 to 4.5 2.72	8 to 10 4.79	.... 0.55	.... 5.34	4.30 to 5.40 4.80
Guaranteed. Found.	1.15 to 1.65 1.25	1.40 to 2 1.52	9 to 12 9.18	.... 0.86	.... 10.04	2 to 3 2.72
Guaranteed. Found.	3.30 to 4.10 3.68	4 to 5 4.46	4 to 7 6.46	.... 0.67	6 to 9 7.13	10 to 11 10.77
Guaranteed. Found.	4.10 to 4.95 4.54	5 to 6 5.60	4 to 7 5.54	.... 0.58	5 to 9 6.12	9 to 10 11.76
Guaranteed. Found.	2.50 to 3.30 2.82	3 to 4 3.42	9 to 11 8.74	.... 2.10	.... 10.84	2 to 3 3.45
Guaranteed. Found.	3.30 to 4.10 3.35	4 to 5 4.06	5 to 7 6.97	.... 1.50	.... 8.47	8 to 10 9.62
Guaranteed. Found.	3.30 to 4.10 3.67	4 to 5 4.45	8 to 9 7.62	.... 1.73	.... 9.35	7 to 8 5.66

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Quinnipiac Co., New London, Conn.	Ammoniated dissolved bone.	Port Chester.	704
Quinnipiac Co., New London, Conn.	Climax.	Scotia village. Willow Creek.	821 759
Quinnipiac Co., New London, Conn.	Market garden manure.	Hollis.	541
Quinnipiac Co., New London, Conn.	Mohawk.	Willow Creek.	757
Quinnipiac Co., New London, Conn.	Pine Island phosphate.	Port Chester.	707
Quinnipiac Co., New London, Conn.	Potato manure.	Port Chester.	705
Quinnipiac Co., New London, Conn.	Potato phosphate.	Scotio village.	820
Quinnipiac Co , New London, Conn.	Quinnipiac phosphate.	Port Chester	706
Read Fertilizer Co., New York city.	Highgrade farmer's friend.	Mattituck, L. I.	639
Read Fertilizer Co , New York city.	Highgrade farmer's friend.	Jamaica, L. I.	480
Read Fertilizer Co., New York city.	Leader guano.	Spencertown. Jacksonville. Farmersville.	737 858 870
Read Fertilizer Co., New York city.	Leader guano.	Spencertown. Farmersville	736 868
John S. Reese & Co., Baltimore, Md.	Challenge crop grower.	Owego.	873
John S. Reese & Co., Baltimore, Md.	Crown.	Willow Creek.	758
John S. Reese & Co., Baltimore, Md.	Half-and-half	Willow Creek.	760
John S. Reese & Co., Baltimore, Md.	Pilgrim.	Willow Creek.	761

FERTILIZERS, ETC.—(*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1.65 to 2.50 1.82	2 to 3 2.21	9 to 12 9.54	1 to 2 0.74	10 to 14 10.28	2 to 3 2.53
Guaranteed. Found.	1.25 to 1.65 1.27	1.50 to 2 1.54	8 to 10 7.66	1 to 2 1.79	9 to 12 9.32	2 to 3 1.95
Guaranteed. Found.	3.30 to 4.10 3.51	4 to 5 4.34	8 to 10 8.86	1 to 2 0.78	9 to 13 9.64	7 to 8 6.94
Guaranteed. Found.	0.83 to 1.65 1.17	1 to 2 1.42	7 to 9 7.29	1 to 2 1.44	8 to 11 8.73	1 to 2 1.40
Guaranteed. Found.	2.05 to 2.90 2.73	2.50 to 3.50 3.31	9 to 12 11.98	1 to 2 1.92	10 to 14 13.90	1 to 2 2.16
Guaranteed. Found.	2.50 to 3.30 2.58	3 to 4 3.13	6 to 9 6.27	1 to 2 1.48	7 to 11 7.75	5 to 6 5.42
Guaranteed. Found.	2.05 to 2.90 2.31	2.50 to 3.50 2.81	8 to 11 7.88	1 to 2 0.28	9 to 13 8.16	3 to 4 3.41
Guaranteed. Found.	2.50 to 3.30 2.48	3 to 4 3.01	9 to 12 10.13	1 to 2 0.34	10 to 14 10.47	2 to 3 2.82
Guaranteed. Found.	3.30 to 4.10 3.25	4 to 5 3.94	7 to 9 7.32	.... 0.98	.... 8.30	7 to 8 7.69
Guaranteed. Found.	3.30 to 4.95 3.89	4 to 6 4.72	5 to 7 5.95	1 to 2 0.81	.... 6.76	10 to 12 9.95
Guaranteed. Found.	0.83 to 1.65 1.05	1 to 2 1.27	7 to 9 6.86	1 to 2 0.78	8 to 10 7.64	2 to 4 2.27
Guaranteed. Found.	0.83 to 1.65 0.99	1 to 2 1.20	8 to 10 8.27	2 to 4 0.45	10 to 12 8.72	4 to 6 4.13
Guaranteed. Found.	0.83 1.05	1.00 1.27	9.00 11.11	2.75 1.03	11.75 12.14	1.50 1.42
Guaranteed. Found.	....	....	10 to 12 13.42	.... 0.72	12 to 15 14.14	....
Guaranteed. Found.	0.83 0.89	1.00 1.08	11.00 10.90	3 1.88	.... 12.78	0.50 to 1.00 1.08
Guaranteed. Found.	1.25 to 1.65 1.24	1.50 to 2 1.50	6.50 to 8 8.36	.... 1.07	7.50 to 10.50 9.43	3 to 4 4.58

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
John S. Reese & Co., Baltimore, Md.	Soluble guano.	East Lansing.	911
Rogers & Hubbard Co., Middletown, Conn.	Pure ground raw knuckle bone flour.	White Plains.	702
Rogers & Hubbard Co., Middletown, Conn.	Soluble potato manure.	White Plains.	701
L. Sanderson, New Haven, Conn.	Mixed formula "A."	Jamaica, L. I.	489
Scott Fertilizer Co., Elkton, Md.	Sure growth compound.	Canarsie, L. I.	473
Standard Fertilizer Co., Boston, Mass.	"A" brand.	Schenectady.	831
Standard Fertilizer Co., Boston, Mass.	Grange bone and potash.	Schenectady.	832
Standard Fertilizer Co., Boston, Mass.	Standard fertilizer.	Albany.	742
Henry Stappenbeck, Utica, N. Y.	Bone meal.	Deerfield.	921
Henry Stappenbeck, Utica, N. Y.	Honest trade super-phosphate.	Deerfield.	884
W. D. Stewart & Co., Boston, Mass.	Soluble Pacific guano.	Amsterdam.	845
Stearns Fertilizer Co., New York city.	Americo guano asparagus manure	Mattituck, L. I.	688
Stearns Fertilizer Co., New York city.	Americo guano potato manure.	Mattituck, L. I.	685
R. H. Stone, Trumansburg, N. Y.	Eureka.	Trumansburg.	865
R. H. Stone, Trumansburg, N. Y.	King.	Trumansburg.	762
H. S Tavesu & Co., Baltimore, Md.	Special potato guano.	Riverhead.	651

FERTILIZERS, ETC.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1.25 1.78	1.50 2.16	9.00 10.38	2.75 1.14	.... 11.52	2 1.75
Guaranteed. Found.	3.50 to 4 4.01	4.25 to 4.80 4.86	.... 7.63	.... 17.10	24.5 to 26 24.72	....
Guaranteed. Found.	4.10 to 4.95 4.48	5 to 6 5.44	.... 6.44	.... 3.66	10 to 12 10.10	5 to 6 5.36
Guaranteed. Found.	3.30 to 4.10 3.30	4 to 5 4.00	6 to 8 11.10	.... 0.58	10 to 12 11.68	6 to 8 7.06
Guaranteed. Found.	3.30 to 4.40 3.66	4 to 5 4.44	8 to 10 9.69	.... 1.07	.... 10.76	7 to 8 6.56
Guaranteed. Found.	1.25 to 2.05 1.42	1.50 to 2.50 1.72	6.50 to 8.50 8.38	1.50 to 2.50 1.89	8 to 11 10.27	1 to 1.60 1.65
Guaranteed. Found.	....	....	8 to 12 9.73	4 to 5 1.67	12 to 17 11.40	3.25 to 4.30 3.24
Guaranteed. Found.	2.05 to 2.90 2.27	2.50 to 3.50 2.76	8 to 12 9.94	.... 2.17	10 to 15 12.11	2 to 3 2.13
Guaranteed. Found.	2.90 to 3.30 4.31	3.50 to 4 5.23	.... 21.15	.... 2.02	20 to 25 23.17	....
Guaranteed. Found.	2.50 to 3.30 2.78	3 to 4 3.37	8 to 12 10.40	1 to 2 0.27	.... 10.67	2 to 3 2.57
Guaranteed. Found.	2.25 to 2.90 2.72	2.75 to 3.50 3.30	8.50 to 12 8.23	2 to 4 1.44	10.50 to 16 9.67	2 to 3.50 2.16
Guaranteed. Found.	4.10 to 5.75 2.69	5 to 7 3.26	8 to 12 3.62	.... 1.06	.... 4.68	6 to 8 6.23
Guaranteed. Found.	4.10 to 5.75 2.72	5 to 7 3.30	9 to 13 3.45	.... 1.70	.... 5.15	6 to 9 6.53
Guaranteed. Found.	0.83 to 1.65 0.70	1 to 2 0.85	7 to 9 5.68	.... 0.91	.... 6.59	5 to 6 4.29
Guaranteed. Found.	....	....	8 to 10 6.70	.... 0.85	.... 7.55	6 to 8 3.79
Guaranteed. Found.	2.90 to 3.30 3.08	3.50 to 4 3.74	6 to 7 7.49	.... 0.95	.... 8.44	9 to 10 7.89

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
I. P. Thomas & Son, Philadelphia, Pa.	Farmers' choice bone phosphate	Queens, L. I	547
I. P. Thomas & Son, Philadelphia, Pa.	Tiptop raw bone super-phosphate.	Queens, L. I.	545
I. P. Thomas & Son, Philadelphia, Pa.	Potato manure.	Queens.	546
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Bearsley's acidulated phosphate.	Owego.	877
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Cabbage manure.	Flatlands, L. I.	469
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Potato manure.	Jamaica, L. I. Flatlands, L. I.	490 468
J. E. Tygert Co., Philadelphia, Pa.	Bone phosphate.	Albany.	749
J. E. Tygert Co., Philadelphia, Pa.	Potato guano.	Albany.	750
Walker Fertilizer Co., Clifton Springs, N. Y.	Ammoniated phosphate.	Geneva.	886
Walker Fertilizer Co., Clifton Springs, N. Y.	Walker's potash and vegetable grower.	Geneva.	885
P. White & Sons, Jamaica Bay, N. Y.	Long Island fertilizer.	Jamaica, L. I.	488
Williams & Clark, New York city.	Acorn brand acid phosphate.	Township.	780
Williams & Clark, New York city.	Americus brand ammoniated bone super-phosphate.	White Plains.	698
Williams & Clark, New York city.	Americus brand highgrade special for potato.	White Plains.	699
Williams & Clark, New York city.	Carteret bone meal.	Township. Saratoga.	777 789
Williams & Clark, New York city.	Dissolved bone and potash.	Township.	778

FERTILIZERS, ETC.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1.45 to 2.50 1.46	1.75 to 3 1.77	9 to 11 9.79	2 to 3 1.66	.... 11.45	2 to 4 2.65
Guaranteed. Found.	2.50 to 4.10 2.50	3 to 5 3.02	10 to 12 9.58	2 to 3 0.70	.... 10.28	2.75 to 4 3.71
Guaranteed. Found.	2.50 to 3.30 2.53	3 to 4 3.05	9 to 11 8.90	2 to 3 0.63	.... 9.53	6 to 9 6.90
Guaranteed. Found.	....	....	12 to 16 11.89	.... 1.79	.... 13.68	....
Guaranteed. Found.	3.70 to 4.50 3.78	4.50 to 5.50 4.59	7 to 8 7.61	.... 1.65	9 to 10 9.26	5 to 6 6.57
Guaranteed. Found.	3.30 to 4.10 3.40	4 to 5 4.12	6 to 7 7.29	.... 1.85	9 to 10 9.14	9 to 11 9.65
Guaranteed. Found.	1.85 2.04	2.25 2.48	9.00 9.43	.... 1.71	.... 11.14	2.50 2.41
Guaranteed. Found.	2.05 to 2.90 2.31	2.50 to 3.50 2.80	7 to 9 10.53	2 to 3 0.85	.... 11.38	7 to 9 6.60
Guaranteed. Found.	1.65 to 2.50 1.79	2 to 3 2.17	7 to 9 7.73	2 to 5 3.49	.... 11.22	1 to 2 0.38
Guaranteed. Found.	2.50 to 3.30 2.51	3 to 4 3.05	6 to 8 6.36	2 to 4 2.16	.... 8.52	7 to 8 5.53
Guaranteed. Found	2.50 to 3.30 3.14	3 to 4 3.81	12 to 15 8.92	.... 1.44	.... 10.36	2.00 2.12
Guaranteed. Found.	....	....	12 to 15 11.94	1 to 2 1.14	13 to 17 13.08	....
Guaranteed. Found.	2.50 to 3.30 2.47	3 to 4 2.99	9 to 11 9.85	1 to 2 0.41	10 to 13 10.26	2 to 3 2.40
Guaranteed. Found.	3.70 to 4.10 3.74	4.50 to 5 4.54	7 to 9 7.83	1 to 2 0.58	8 to 11 8.41	7 to 9 8.16
Guaranteed. Found.	1.65 to 2.50 2.01	2 to 3 2.44	.... 3.56	.... 12.15	14 to 18 15.71	1.00 2.65
Guaranteed. Found.	....	....	10 to 12 10.02	.... 1.62	.... 11.64	2 to 3 3.31

26. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Williams & Clark, New York city.	Royal bone phosphate.	Township. Amsterdam. Willow Creek.	779 842 859
Williams & Clark, New York city.	The prolific crop producer.	Amsterdam.	843
Williams & Clark, New York city.	Unicorn ammoniated dissolved bone.	Glens Falls.	815
Zell Guano Co., Baltimore, Md.	Economizer.	Spencer.	864
Zell Guano Co., Baltimore, Md.	Special potato manure.	Riverhead.	679

FERTILIZERS, ETC.—(*Concluded*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Demined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1.00 to 1.65 1.16	1.25 to 2 1.41	7 to 9 7.90	1 to 2 1.66	8 to 11 9.56	2 to 3 2.20
Guaranteed. Found.	0.83 to 1.65 1.31	1 to 2 1.59	6 to 9 7.65	1 to 2 1.02	7 to 11 8.67	1 to 2 1.43
Guaranteed. Found.	1.65 to 2.50 1.89	2 to 3 2.29	8 to 11 9.73	1 to 2 0.97	9 to 13 10.70	2 to 3 2.49
Guaranteed. Found.	0.83 to 1.65 1.16	1 to 2 1.41	9 to 12 11.02	.... 1.72	.... 12.74	1 to 2 1.56
Guaranteed. Found.	2.90 to 3.30 2.86	3.50 to 4 3.46	6 to 7 8.11	.... 0.72	.... 8.83	9 to 10 8.97

XXVII. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS

Composition of fertilizers as guaranteed by manufacturers, and

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston, Mass.	Alkaline bone.	Gorham.	942
Bowker Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Scottsville.	968
Bowker Fertilizer Co., Boston, Mass.	Hill and drill.	Canandaigua.	932
Bowker Fertilizer Co., Boston, Mass.	Sure crop.	Canandaigua.	933
Bradley Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Scottsville.	970
Bradley Fertilizer Co., Boston, Mass.	Niagara.	Stanley.	934
Bradley Fertilizer Co., Boston, Mass.	Patent super-phosphate.	Scottsville.	969
Bradley Fertilizer Co., Boston, Mass.	Sea fowl guano.	Mayville.	985
The Chemical Co of Canton, Baltimore, Md.	High grade Baker's standard guano.	Geneva.	922
The Chemical Co. of Canton, Baltimore, Md.	Ontario.	Geneva.	926
The Chemical Co. of Canton, Baltimore, Md.	Pure dissolved South Carolina bone.	Geneva.	943
The Chemical Co of Canton, Baltimore, Md.	Resurgam ammoniated bone phosphate.	Stanley.	927
The Chemical Co. of Canton, Baltimore, Md.	Wheat, corn and grass mixture.	Geneva.	925
E. Frank Coe, New York city.	Alkaline bone.	Mayville.	986
E. Frank Coe, New York city.	XXV. ammoniated bone.	Mayville.	987

in New York State for the Fall of 1892.

as found by chemical analysis. Estimated in parts per hundred.

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	....	....	10 to 12	2	12 to 14	1 to 2
Found.	....	....	11.77	2.88	13.65	1.03
Guaranteed.	1.65 to 2.50	2 to 3	8 to 10	2	10 to 12	2 to 3
Found.	1.69	2.05	10.02	2.28	12.30	2.26
Guaranteed.	2.05 to 2.90	2.5 to 3.5	8 to 10	2	10 to 12	2 to 3
Found.	2.48	3.01	11.35	1.81	13.16	2.34
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	2	10 to 12	1 to 2
Found.	0.85	1.03	10.39	2.73	13.12	1.61
Guaranteed.	1.65 to 2.50	2 to 3	7 to 9	1	8 to 10	1 to 2
Found.	1.95	2.37	10.26	1.34	11.60	1.81
Guaranteed.	0.83 to 1.65	1 to 2	7 to 9	1	9 to 10	2 to 3
Found.	1.25	1.52	8.73	1.93	10.66	2.33
Guaranteed.	2.05 to 2.90	2.5 to 3.5	8 to 10	2	10 to 12	1.5 to 2.5
Found.	2.39	2.90	10.57	1.42	11.99	1.97
Guaranteed.	2.05 to 2.90	2.5 to 3.5	8 to 10	2	10 to 12	1.5 to 2.5
Found.	2.61	3.17	10.33	1.48	11.81	1.76
Guaranteed.	2.05 to 2.90	2.5 to 3.5	9 to 11	....	....	2.5 to 3.5
Found.	2.33	2.83	9.79	2.59	12.38	2.71
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	2 to 3	10 to 13	4.4 to 6.6
Found.	0.83	1.00	8.41	2.40	10.81	3.88
Guaranteed.	....	....	14 to 16	....	....	....
Found.	....	....	15.14	1.45	16.59	....
Guaranteed.	1.25 to 2.05	1.5 to 2.5	8 to 10	....	....	2 to 3
Found.	1.44	1.75	8.22	2.21	10.43	2.37
Guaranteed.	0.83 to 1.65	1 to 2	9 to 11	2	11 to 13	2 to 3
Found.	1.00	1.22	9.23	2.08	11.21	2.16
Guaranteed.	0.83 to 1.65	1 to 2	9 to 12	2 to 3	11 to 15	1.6 to 2.2
Found.	2.60	3.17	8.67	3.11	11.77	2.13
Guaranteed.	0.83 to 1.25	1 to 1.5	7 to 9	2 to 3	9 to 12	0.80 to 1.20
Found.	1.09	1.32	10.56	4.00	14.56	1.42

27. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated wheat and corn phosphates.	Canandaigua.	930
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Diamond.	West Henrietta.	964
Crocker Fertilizer and Chemical Co., Buffalo. N. Y.	New rival.	Canandaigua.	931
Farmers' Fertilizer Co., Syracuse, N. Y.	Standard ammoniated corn phosphate.	Chapinville.	928
W. S. Farmer & Co., Baltimore, Md.	B. and P. fertilizer.	Churchville.	975
W. S. Farmer & Co., Baltimore, Md.	Clyde.	Churchville.	974
W. S. Farmer & Co., Baltimore, Md.	Harvest Queen.	Churchville.	973
W. S. Farmer & Co., Baltimore, Md.	New York special.	Churchville.	976
Great Eastern Fertilizer Co., Rutland, Vt.	Fertilizer for grain and grass.	Geneva.	924
Great Eastern Fertilizer Co., Rutland, Vt.	Fertilizer for wheat.	Geneva.	923
Lister's Agricultural and Chemical Works, Newark, N. J.	Corn fertilizer No. 2.	Sheridan.	988
Lister's Agricultural and Chemical Works, Newark, N. J.	Perfect.	Le Roy.	971
Lister's Agricultural and Chemical Works, Newark, N. J.	Potato fertilizer No. 2.	Le Roy.	966
Lister's Agricultural and Chemical Works, Newark, N. J.	Standard superphosphate.	Sheridan.	989
Lister's Agricultural and Chemical Works. Newark, N. J.	Success.	Le Roy.	967
Frederick Ludlam, New York city.	Cereal brand.	Honeoye Falls.	62

FERTILIZERS, ETC.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	2.05 to 2.90 2.20	2.5 to 3.5 2.67	10 to 13 9.81	1 to 2 2.44	11 to 15 12.25	1.6 to 2.7 1.95
Guaranteed. Found.	....	....	11 to 13 11.93	1 to 2 2.04	12 to 15 13.97	1.4 to 2 1.62
Guaranteed. Found.	1.25 to 2.05 1.32	1.5 to 2.5 1.61	10 to 12 9.69	1 to 2 4.31	11 to 14 14.00	1.6 to 2.7 1.86
Guaranteed. Found.	0.83 to 1.65 0.85	1 to 2 1.03	9 to 11 9.95	2 0.62	11 to 13 10.57	3.2 to 4.3 2.90
Guaranteed. Found.	....	....	10 13.02	1 0.63	11 13.65	2.50 2.20
Guaranteed. Found.	0.83 1.10	1 1.33	9 9.21	1 1.38	10 10.59	2.50 2.10
Guaranteed. Found.	1.25 1.33	1.50 1.61	10 10.42	1.50 1.34	11.50 11.77	2.50 2.48
Guaranteed. Found.	1.25 to 1.85 1.36	1.5 to 2.25 1.65	10 to 12 10.62	2 to 3 1.42	12 to 15 12.04	5 to 6 4.24
Guaranteed. Found.	2.50 to 3.30 2.61	3 to 4 3.17	8 to 12 9.91	1 to 3 1.01	9 to 15 10.92	2 to 4 2.31
Guaranteed. Found.	1.65 to 2.50 1.86	2 to 3 2.26	8 to 12 8.72	1 to 3 0.87	9 to 15 9.57	1.6 to 2.7 2.57
Guaranteed. Found.	1.80 to 2.50 2.40	2.20 to 3 2.91	9.25 to 11 10.27	.... 1.24	.... 11.51	4 to 5 3.66
Guaranteed. Found.	1.25 to 1.65 1.96	1.5 to 2 2.38	9.5 to 11 10.51	.... 2.14	.... 12.65	1.5 to 2.5 2.01
Guaranteed. Found.	1.80 to 2.50 2.16	2.20 to 3 2.62	9.25 to 11 9.76	.... 2.08	.... 11.48	4 to 5 4.82
Guaranteed. Found.	2.35 to 2.70 2.67	2.85 to 3.25 3.24	10 to 12 9.91	2 to 3 2.19	12 to 15 12.10	1.5 to 2 2.10
Guaranteed. Found.	1.25 to 1.65 2.06	1.50 to 2 2.50	9.50 to 11 10.56	.... 1.83	.... 12.39	1.5 to 2 2.14
Guaranteed. Found.	0.83 to 1.65 0.87	1 to 2 1.06	8 to 10 9.56	2 4.01	10 to 12 13.57	1 to 2 1.14

27. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Michigan Carbon Works, Detroit, Mich.	Homestead bone black.	Stanley.	939
Michigan Carbon Works, Detroit, Mich.	Jarves drill phosphate.	Stanley.	938
Milsom Rendering and Fertilizer Co., East Buffalo, N. Y.	Wheat, oats and barley phosphate.	Le Roy.	965
Newark Chemical Co., Newark, N. J.	Harmony.	Penn Yan.	952
Newark Chemical Co., Newark, N. J.	Harvest queen.	Penn Yan.	951
Newark Chemical Co., Newark, N. J.	Standard super-phosphate.	Penn Yan.	950
Pacific Guano Co., New York city.	Nobsque guano.	Stanley.	941
Pacific Guano Co., New York city.	Soluble Pacific guano.	Stanley.	940
Quinnipiac Fertilizer Co., New London, Conn.	Ammoniated dissolved bone.	Hopewell.	917
Quinnipiac Fertilizer Co., New London, Conn.	Climax.	Dundee.	945
Quinnipiac Fertilizer Co., New London, Conn.	Mohawk.	Dundee.	944
Rasin Fertilizer Co., Baltimore, Md.	Acid phosphate.	Penn Yan.	957
Read Fertilizer Co., New York city.	Farmers' friend.	Penn Yan.	948
Read Fertilizer Co., New York city.	New York State super-phosphate.	Penn Yan.	949
Read Fertilizer Co., New York city.	Standard.	Jacksonville.	915
John S. Reese & Co., Baltimore, Md.	Crown bone and potash.	Bergen.	978

Fertilizers, Etc. — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1.85 to 2.60 2.24	2.25 to 3.15 2.72	8 to 11 7.92	.... 0.30	.... 8.22	1.5 to 1.9 1.17
Guaranteed. Found.	1.00 to 1.65 1.62	1.25 to 2 1.97	to 9 7.73	2 to 3 1.78	10 to 12 9.51	0.27 to 0.54 0.20
Guaranteed. Found.	1.65 to 3.30 1.23	2 to 4 1.50	8 to 10 7.62	2 to 3 1.76	10 to 13 9.38	2 to 3 1.05
Guaranteed Found.	0.83 to 1.65 1.99	1 to 2 2.42	9 to 11 8.67	1 to 2 2.87	10 to 13 11.54	2.5 to 3 2.82
Guaranteed. Found.	1.00 to 1.65 2.03	1.25 to 2 2.46	10 to 12 9.36	1.5 to 2 3.03	11.5 to 15 12.39	2.5 to 3 2.95
Guaranteed. Found.	2.35 to 3.20 2.36	2.85 to 3.85 2.86	10 to 12 10.37	1.5 to 2.5 1.78	11.5 to 14.5 12.15	2.5 to 3 3.19
Guaranteed. Found.	1.25 to 1.65 1.36	1.5 to 2 1.65	8 to 12 8.05	1 to 2 1.47	9 to 14 9.52	2 to 3 2.37
Guaranteed. Found.	2.05 to 2.90 .04	2.5 to 3.5 3.69	8 to 11 9.36	2 to 3 1.78	10 to 14 11.14	2 to 3.5 2.14
Guaranteed. Found.	1.65 to 2.50 1.92	2 to 3 2.33	9 to 12 9.24	1 to 2 2.36	10 to 14 11.60	2 to 3 2.23
Guaranteed. Found.	1.00 to 1.65 1.29	1.25 to 2 1.57	8 to 10 8.35	1 to 2 1.77	9 to 12 10.12	2 to 3 2.14
Guaranteed. Found.	0.83 to 1.65 1.14	1 to 2 1.38	7 to 9 7.59	1 to 2 0.37	8 to 11 7.96	1 to 2 1.70
Guaranteed. Found.	....	....	14 14.97	1.50 0.72	15.50 15.69	....
Guaranteed. Found.	2.05 to 2.90 2.13	2.5 to 3.5 2.58	9 to 11 9.86	2 to 4 0.92	11 to 14 10.78	2 to 4 2.25
Guaranteed. Found.	1.25 to 2.05 1.02	1.5 to 2.5 1.24	9 to 11 8.97	2 to 4 0.86	11 to 13 9.83	2 to 4 4.11
Guaranteed. Found.	0.83 to 1.65 1.27	1 to 2 1.54	8 to 10 8.64	2 to 4 0.62	10 to 12 9.26	4 to 6 4.23
Guaranteed. Found.	....	....	10 to 13 16.99	2 0.35	12 to 15 17.34	2 to 3 1.18

27. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
John S. Reese & Co., Baltimore, Md.	Half-and-half.	Bergen.	977
John S. Reese & Co., Baltimore, Md.	Pilgrim.	Bergen.	979
Rochester Fertilizer Co., Rochester, N. Y.	Alkaline bone.	Penn Yan.	955
Rochester Fertilizer Co., Rochester, N. Y.	Blood and bone guano.	Penn Yan.	956
Samson Fertilizer and Chemical Co., North East, Penn.	Fish guano.	Westfield.	983
Samson Fertilizer and Chemical Co., North East, Penn.	New process fish guano.	Westfield.	984
Samson Fertilizer and Chemical Co., North East, Penn.	Superior ground bone.	Westfield.	982
Schaal Bros., Erie, Penn.	Erie city fertilizer.	Dunkirk.	981
Schaal Bros., Erie, Penn.	Pure ground bone.	Dunkirk.	980
Schaal Bros., Erie, Penn.	"A" brand.	Penn Yan.	953
Standard Fertilizer Co., Boston, Mass.	Grange bone and potash.	Penn Yan.	958
Standard Fertilizer Co., Boston, Mass.	Standard guano.	Penn Yan.	954
Walker, Stratman & Co., Pittsburg, Penn.	Big bonanza.	Starkey.	946
Walker, Stratman & Co, Pittsburg, Penn.	Butcher ground bone.	Starkey.	947
Walker, Stratman & Co., Pittsburg, Penn.	Fourfold.	Honeoye Falls.	961
Walton, Whann & Co., Wilmington, Del.	Diamond soluble bone.	Honeoye Falls.	959

Fertilizers, Etc.— (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	0.83 0.41	1 0.50	11 14.75	3 0.42	14 15.17	0.60 1.39
Guaranteed. Found.	1.25 to 1.65 1.47	1.5 to 2 1.78	6.5 to 8 9.76	1 to 2.5 1.32	7.5 to 10.5 11.08	3 to 4 2.29
Guaranteed. Found.	....	....	8 to 10 8.04	.... 1.93	.... 9.97	1.6 to 2.7 2.26
Guaranteed. Found.	0.83 1.30	1 1.58	8 to 10 9.02	1 1.79	9 to 10 10.81	1.6 to 2.7 1.75
Guaranteed. Found.	2.05 to 2.50 1.94	2.5 to 3 2.35	10 to 11 7.71	2 to 3 0.43	12 to 14 8.14	2.50 3.11
Guaranteed. Found.	1.25 to 1.65 1.37	1.5 to 2 1.66	8 to 9 7.91	2 to 3 0.39	.... 8.30	2.00 2.43
Guaranteed. Found.	2.90 to 3.70 3.40	2.5 to 4.5 4.13	.... 18.98	.... 5.73	23 to 25 24.71	....
Guaranteed. Found.	1.25 to 1.65 1.43	1.5 to 2 1.74	4 to 5 6.47	1 to 2 1.53	5 to 7 8.00	2 to 3 2.05
Guaranteed. Found.	2.50 to 3.30 4.28	3 to 4 5.20	.... 16.82	.... 3.24	20 to 22 20.06	....
Guaranteed. Found.	1.25 to 2.05 1.29	1.5 to 2.5 1.57	6.5 to 8.5 7.90	1.5 to 2.5 1.65	8 to 11 9.55	1.3 to 1.9 1.50
Guaranteed. Found.	....	....	8 to 12 12.12	4 to 5 2.84	12 to 17 14.96	2.5 to 3.25 2.07
Guaranteed. Found.	1 to 2.50 1.13	1.25 to 3 1.37	8 to 12 10.48	2 to 3 1.54	10 to 15 12.02	2 to 3 2.47
Guaranteed. Found.	2.50 to 3.30 2.84	3 to 4 3.45	10 to 11 8.17	1 to 2 3.63	12 to 13 11.80	1.1 to 1.6 2.09
Guaranteed. Found.	1.65 to 2.90 2.24	2 to 3.5 2.72	.... 11.98	.... 1.16	16 to 18 13.14	....
Guaranteed. Found.	0.83 to 1.65 1.50	1 to 2 1.82	6 to 7 7.81	1 to 2 3.50	7 to 8 11.31	1 to 1.5 1.21
Guaranteed. Found.	....	....	13 to 15 14.57	1 to 3 1.72	15 to 17 16.29	....

27. RESULTS OF ANALYSES OF COMMERCIAL

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Zell Fertilizer Co., Baltimore, Md.	Calvert guano.	Stanley.	936
Zell Fertilizer Co., Baltimore, Md.	Dissolved bone.	Stanley.	937
Zell Fertilizer Co., Baltimore, Md.	Economizer.	Stanley.	935

FERTILIZERS, ETC — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia	Available	Insoluble.	Total.	
Guaranteed. Found.	0.65 to 1.25 0.79	0.75 to 1.50 0.96	9 to 11 10.99	2 to 3 1.20	11 to 14 12.19	1.5 to 2.25 2.10
Guaranteed Found.	....	....	13 to 16 14.87	2 to 3 0.46	15 to 18 15.33	....
Guaranteed. Found.	0.83 to 1.65 1.13	1 to 2 1.37	9 to 11 12.67	2 to 3 0.88	11 to 14 13.55	1 to 2 1.39

REPORT OF THE HORTICULTURIST.

S. A. BEACH.

Some diseases of cultivated plants have been investigated by field and laboratory work during the past year. The work of testing the newer varieties of fruits and vegetables and comparing them with older well known kinds has been continued as in previous years. Systematic crossing for the purpose of originating new fruits has been undertaken with small fruits, grapes pears, apples and stone fruits. Grapes have been studied with reference to the ability of various cultivated varieties to set fruit of themselves.* Field experiments with potato scab were conducted in co-operation with Mr. C. E. Chapman at Peruville, Tompkins county, N. Y. Field experiments with celery diseases were conducted in co-operation with Mr. De Witt C. Curtis at Horseheads, Chemung county, N. Y. In co-operation with the Division of Vegetable Pathology of the United States Department of Agriculture several fungicides were tested for leaf-blight of pear seedlings. A brief account of the work with pear seedlings follows this report:

Addresses have been delivered at farmers' clubs and farmers' institutes in various parts of the State. The following bulletins have been written:

No. 40. BLACK KNOT OF PLUM AND CHERRY.

No. 41. INFLUENCE OF COPPER COMPOUNDS IN SOILS UPON VEGETATION.

No. 48. SOME BEAN DISEASES.

The Assistant Horticulturist has given his attention chiefly to the work with small fruits and vegetables besides assisting in various ways with the general horticultural work of the Station.

* This work was planned with no knowledge of the fact that Mr. M. B. Waite of the United States Department of Agriculture had planned a similar line of investigation with apples and pears.

He has obtained some very promising fruits as a result of crossing strawberries in previous years and has continued the same work this year. He has contributed to the Station bulletins, as follows:

No. 41, II. SPRAYING WITH FUNGICIDES FOR PREVENTION OF POTATO BLIGHT.

No. 44. STRAWBERRIES.

A more extended account of his work for this year will be found in his annual report.

BEAN ANTHRACNOSE AND ITS TREATMENT.

Popular Discussion.

Bean anthracnose is a disease which sometimes causes very serious loss to bean growers, whether market-gardeners, truck-farmers, or farmers, and in New York State, it frequently, if not usually, diminishes by a good percentage the profits of the crop. It has also been reported as prevalent in various other parts of America and in Europe.

Some New York farmers have attributed the loss of nearly their entire crop the past season to anthracnose, and this estimate was made after they were furnished with a sample of the disease as it appears on the pods, in order that the report might be made as accurate as possible. Many, on the other hand, reported loss varying from five per cent. to twenty per cent. A smaller number gave estimates of loss varying from twenty-five per cent. to nearly 100 per cent. and others reported no loss at all.

As noted in the last report of the Director of this Station,* nearly one-half the dry beans produced in the United States are raised in New York State. Those counties in which the crop exceeded 20,000 bushels in 1880 are named below in order of the rank of their yield, Monroe county heading the list with a yield of 293,563 bushels. California was the only State except New York which exceeded the yield of this one county. The following is the list: Monroe, Orleans, Livingston, Genesee, Wyoming, Niagara, Wayne, Jefferson, Clinton, Ontario.

According to the 1890 census report of the acreage of beans§ on the seed farms of the country, New York State heads the list

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* Tenth Annual Report N. Y. Experiment Station, p. 23.

§ Except Lima beans.

with 4,600 acres, or thirty-six per cent. of the whole, a greater acreage than all the rest of the United States combined, excepting Illinois and Michigan.

In the acreage devoted to snap or string beans on truck-farms, the "New York and Philadelphia" district stands second only to the "South Atlantic" district. The statistics of the acreage devoted by market gardeners to snap beans are not at hand, but it is known that snap beans are with them an important crop. On the whole it may be said that the bean crop of New York State is of sufficient importance to justify a study of bean diseases.

It is readily seen that a loss of five per cent. of the crop means a loss of more than five per cent. of the profits, and, whether the crop be small or large, an injury amounting to five per cent. of the yield is of sufficient importance to justify an inquiry as to its cause and remedy. Especially is this true when an injury results from a disease capable of propagating itself from year to year in the diseased seed, and one that under favorable conditions for its development may raise the loss from five per cent to fifty or seventy-five per cent., or perhaps entirely ruin the crop.

Such a disease is the bean anthracnose, frequently but incorrectly called bean rust. The latter name should be reserved for the true bean rust, which is quite a different, and, so far as the writer's observation goes, much less troublesome disease of beans. Again, much of the loss popularly attributed to rust is really due to a bacterial disease which blights the foliage and causes watery spots on the green pods, followed frequently by decay. Sometimes it is even more destructive than the anthracnose. Frequently the anthracnose and this blight are present on the same plant and even on the same leaf or pod.

It is well at the outset to have these distinctions clearly in mind, for the following discussion is devoted first to but one of these diseases, namely, the anthracnose, and afterwards the blight and rust are given brief consideration. With the aid of the following descriptions of the way this disease affects the different parts of the plant, together with the accompanying illustrations, it is hoped that the careful reader will find no trouble in recognizing bean anthracnose.

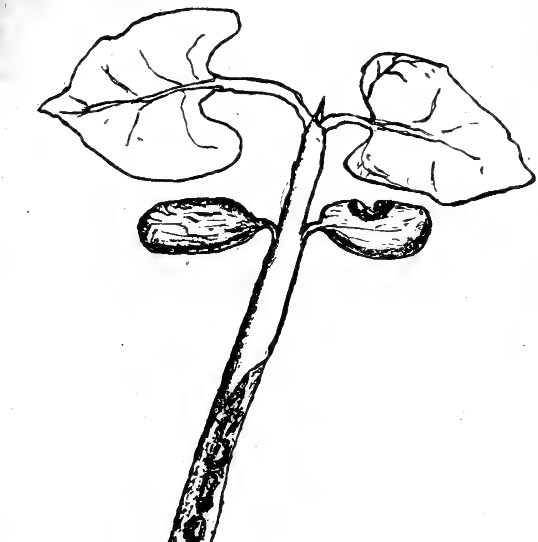

Figure 1.— Bean seedling affected with anthracnose.

DISEASED SEED.—When anthracnose infected seed is planted the disease most frequently is found on the seed leaves (cotyledons) as soon as they push through the surface of the soil, but it may be found on any other part of the plant above the roots. Sometimes it eats through the main stalk and in that way destroys the young plant, or it may kill it before it is able to lift itself through the surface of the soil. By killing the young seedlings and the germinating seed a good stand of beans is prevented sometimes causing a loss of twenty-five per cent. of the seed planted. Dr. Halsted* reports a loss of fifty per cent. on seed grown indoors in boxes. With such seed planted in the field even a greater loss might occur. Fig. 1 from a sketch of a diseased seedling shows the pits on the seed-leaves and along the stem. The stem is nearly eaten through by the disease.

APPEARANCE ON YOUNG PLANTS.—With those plants which succeed in outgrowing its early attacks, the disease continues its depredations on stems and foliage. Very often it eats off the stalklet of a leaflet at the point where it is attached to the main leaf stalk (petiole), and frequently it drops the whole leaf by eating through the petiole at the joint near the base of the leaf.

APPEARANCE ON LEAVES.—Figure 2 from a photograph shows the appearance of the disease on the underside of a leaf. It causes the veins to become black and shriveled, and in the softer tissue it forms dark spots. It seems to show a fondness for the veins of the leaf and for the fiber bundles of the plant. These are blackened by its attacks. One of its most characteristic appearances is seen in the dark-colored veins and veinlets on the under side of the leaf. It may also become established in the soft green substance of the leaf (parenchyma) between the veins where it usually forms narrow, elongated, dark-colored patches that soon break away and leave irregular cracks in the leaf with blackened edges.

APPEARANCE ON PODS.—The appearance of the diseased spots on the pods is well shown in Fig. 2. On the sides of the pods, or of the tender young stems, it is readily recognized by the black

* Annual Report of New Jersey Experiment Station, 1891, p. 285.

pits with red borders. At first these are usually circular, but afterwards may become more irregular in outline, sometimes by coalescence forming very large patches. Along the edges of the pods it is seen in narrow strips of dark color. The pits above mentioned are commonly bordered by a narrow reddish discoloration between the diseased portion and the healthy green tissue of the pod.

APPEARANCE OF SPORE MASSES.—Soon after the formation of a spot, there appears in the central portion of the diseased area pinkish white dots about the size of pin points. These dots are caused by exudations from the tissues which the fungus has filled with its black threads, and they consist of spore masses; that is to say, the spores which the fungus has produced to spread the disease are here pushed forth in masses. These are also well illustrated in Fig. 2. The spores are held together in masses this way by some substance which readily dissolves in rain or dew, after which they may be scattered to other plants by winds, insects or passing animals. This provision of the fungus for spreading its germs to other plants seems to afford a reasonable explanation for the opinions held by many farmers, that the disease does most damage in damp locations, and that cultivation when the plants are wet with rain or dew is apt to spread the disease more rapidly. The spores are produced by the anthracnose on whatever part of the plant it may happen to be living, but probably are formed in greatest abundance on the succulent tissues of the pod.

In the anthracnose the bean plant has a powerful and persistent foe. If present in the seed it attacks the young plant from the moment it starts to germinate and keeps up the warfare until it has succeeded in establishing itself in the newly formed seed ready for another season's campaign. By injuring the foliage it weakens the plant so that it lessens the yield in this way, and also by its attacks on the pod prevents them from filling perfectly, if at all. On the seed it causes specks, pits, wrinkles or blisters, and all degrees of discoloration. Sometimes the discoloration is so faint as to be scarcely noticeable. As demonstrated by Dr. Halsted, and abundantly confirmed at this Station, these infected beans carry the disease from one season to another.

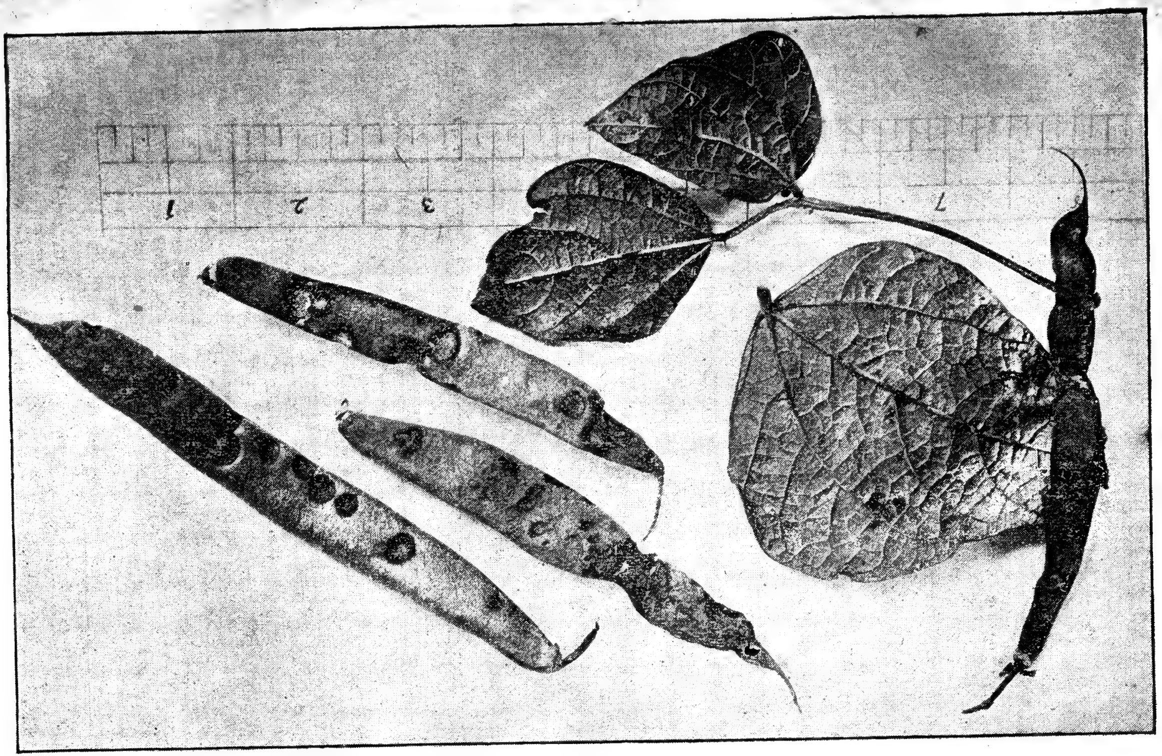

Figure 2.— Anthracnose on pods and leaves. The black veins, blackmid-rib and blackspots in the leaves (parenchyma) show the work of the disease

Experiments in Treating Bean Anthracnose.

By means of laboratory, greenhouse and field experiments, investigations have been conducted for the purpose of learning whether bean anthracnose could be in any way prevented. These investigations have included the following experiments:

1. Preliminary greenhouse experiments in treating diseased seed with the following fungicides; namely, hot water, ammoniacal solution of copper carbonate and Bordeaux mixture. The seed was soaked in these fungicides before planting and the effect of the treatments on the disease carefully noted.

2. Field experiments with seed soaked in the following fungicides; namely, hot water, copper sulphate, iron sulphate (copperas), mercuric bichloride (corrosive sublimate).

3. Comparisons of plants grown from diseased seed with plants grown from healthy seed.

4. Treatment of plants from diseased seed by spraying different lots with Bordeaux mixture, cupric polysulphide and cupric borate respectively. At the suggestion of D. G. Fairchild the two latter mixtures were tested and soap was added to all three substances.

It will be noticed that these investigations have proceeded on three separate lines, namely:

a. Treatment of diseased seed.

b. Comparison of yield from healthy seed with yield from diseased seed.

c. Spraying diseased plants.

TREATMENT OF DISEASED SEED.— The treatment of diseased seed will be discussed more fully hereafter. It may be simply stated here that the total yield of marketable beans from areas planted with treated seed was in every case less than the yield of marketable beans from equal areas planted with untreated seed. At present, therefore, this method can not be recommended. See "Seed Soaked in Fungicides," p. 543 et seq.

COMPARISON OF YIELD FROM HEALTHY SEED WITH YIELD FROM DISEASED SEED.— The second line of investigation has shown that the selection of clean seed is the most important and effective known method of securing healthy plants. It ought never to be neglected with the hope of controlling the disease by means of fungicides, first, because treatment with fungicides can not completely check the disease after it has once gained a foothold in the field nor can it restore the dead; second, because a good stand of plants can not be confidently expected from diseased seed.

It is true that in the experiments here reported, the plants treated with Bordeaux mixture gave cleaner and larger yield than those from healthy seed, notwithstanding the fact that the Bordeaux-treated plants came from diseased seed, that is to say, from seed selected because it was diseased. This may be accounted for in two ways; first, the healthy seed was planted just as selected by ordinary care and when germinated showed at once a few plants spotted with the disease, and these diseased plants were purposely allowed to remain mixed with the healthy plants to see what difference would appear between the crop from diseased and from healthy seed as selected with ordinary care; second, the diseased seed was planted adjacent to the healthy seed. Here then were two sources of infection for the healthy plants, namely, from a few diseased plants in their own ranks and from the many diseased plants in neighboring rows. The result was that as the season advanced the healthy plants became more and more diseased till finally in yield and vigor they dropped behind the diseased plants treated with Bordeaux mixture. Had the healthy seed been sorted again carefully before planting, had the crop been planted by itself, and had every diseased plant been rooted out and carried from the field immediately after the plants showed themselves above ground, there is every reason to believe that the crop would have been larger and the beans cleaner than they were under the "ordinary care" method. The data which justifies this opinion are given more fully hereafter. See "Selections of Healthy Seed," p. 546.

Where the seed can be secured from a field known to be free from the disease it is advisable to do so. If, however, the only seed available contains diseased beans, the sound ones only should be used for planting. All wrinkled, blistered, spotted beans or those with sunken pits or with any discolorations whatever, should be rejected. From a badly diseased lot of seed a rigid selection may secure but a small per cent. of sound seed as was the case with the yield from a badly diseased row in one of the experimental plots the past season. Ninety per cent. of the entire yield was marketable, but only one per cent. was fit for seed. If, however, any one knowing the life history of the disease is content to plant infected seed, surely there is no ground for complaint if he reaps what he has sown.

By means of the following tables, the yield of the crop grown from healthy seed may be compared with the yield from an equal area planted with diseased seed and with a third equal area which was planted with diseased seed and the plants sprayed with Bordeaux mixture. In column I is given a comparison of the yield of pods counting the total yield of plants from healthy seed as 100. In column II a similar comparison of the weight of the total yield is given.

	I. Yield by number of pods.	II. Yeild by weight of pods.
Healthy seed	100	100
Diseased seed	90	83
Bordeaux mixture	115	123

SPRAYING DISEASED PLANTS.— Spraying plants with weak Bordeaux mixture gave the best results of any treatment with fungicides tested. The formula used was two pounds of copper sulphate and one and one-third pounds of freshly slaked lime to thirty gallons of water, and enough soap to make a suds. The object of adding the soap is to cause the mixture when applied in a fine spray to form a thin film or coating over the entire surface of the leaf instead of standing in separate, even though minute, drops. If soap is not used it would probably be best to use less water with the weight of copper and lime above given, taking rather from twenty-one to twenty-six gallons of water for the given amount of the other ingredients.

The first spraying was given fourteen days after planting. At this time very few plants had expanded the third leaf. The withering distorted foliage and the black pits on stem and seed leaves (see Fig. 1), showed that the disease was actively at work. Care was taken to cover every part of every plant with the spray since the object of the spray is not to kill the fungus in the affected plant, but to prevent its spreading to healthy foliage and infecting the new leaves. Any application strong enough to kill the fungus within a diseased plant would also kill the plant.

After an interval of nine days, the beans were sprayed again; the third treatment followed the second at an interval of twenty-three days; and finally after another interval of eighteen days a fourth treatment was made. No unyielding rule for the number or frequency of treatments can be given. If rains are abundant, and the fungicide is washed off from the leaves, the foliage must again be covered with the spray in order to ward off the disease. On the other hand should pleasant weather prevail, and the fungicide remain on the foliage, it will not be necessary to spray again until sufficient new foliage has grown out to justify another treatment. With field beans three sprayings may prove sufficient, but probably snap or string beans may profitably be given four treatments, but, as before stated, no invariable rule can be given. In the following table a comparison is made of the yield of plants treated with the different fungicides, counting the yield of the Bordeaux-sprayed plants as 100. The amount of damage from anthracnose is deducted in each case. In column I, the yield is computed from the total number of pods produced, and column II gives the yield by weight of the total number of pods.

	I. Yield by number of pods.	II. Yield by weight of pods.
Cupric borate	56	40
Untreated	64	51
Cupric polysulphide	71	54
Untreated	61	57
Bordeaux mixture	100	100
Untreated	61	51

For the benefit of those who may be interested in the details of the experiments and a description of the microscopic character of the fungus which causes bean anthracnose, a more extended account is appended below.

In conclusion the following treatment for bean anthracnose is recommended.

1. *Selection of sound seed for planting.*
2. *Immediate removal of infected seedlings from the field.*
3. *Keeping the foliage covered with Bordeaux mixture.*

The first recommendation may well be followed out during leisure hours between harvest and planting time. It will probably accomplish as much as two good sprayings, and we have no doubt that time spent in selecting seed is very profitably employed.

The second recommendation should be carried out thoroughly. To pull out the plants and leave them on the ground is not sufficient, for on the uprooted plants the fungus will quickly ripen its spores and will live long after the plant is dead.

Many object to the use of Bordeaux mixture because they experience so much trouble in preparing and applying it. Preparation of Bordeaux mixture may be simplified by a test which obviates the necessity of weighing the lime, and, where large quantities of lime are used, permits slacking the lime in large quantities at one operation. The copper sulphate is weighed and mixed with an amount of water sufficient to dissolve it. When it is completely dissolved, the lime, in the form of thin whitewash, is strained through burlap (gunny sacking) into the copper sulphate solution.* A drop or two of potassium ferrocyanide (saturated aqueous solution) added from time to time after thoroughly stirring the mixture will show when enough lime has been added to form the Bordeaux mixture.§ If not enough lime has been used, the drop of ferrocyanide will turn to a very dark color the moment it touches the mixture; if enough lime has been used, the ferrocyanide will not change color when it is dropped into the mixture. Water is then added till the Bordeaux mixture is diluted to the desired strength. The commercial form of potassium ferrocyanide may be used for this test. A supply for the entire season may be purchased for a few cents.

* If care is used in keeping the whitewash free from any substance which would clog the nozzle, straining the mixture may be dispensed with.

§ This test was first proposed by Dr. G. Patregeon. See Jour. d'Agric, Pratique, 1890 t. I. p. 701.

When Bordeaux mixture is applied with a knapsack pump the motion of the body will keep the mixture well stirred, but when a barrel-pump is used, the motion of the cart is not sufficient to prevent the copper compounds from settling to the bottom. When this occurs, part of the mixture is applied in a very weak form and a part has an excessive amount of copper. Finally when the sediment is discharged it often clogs the nozzle and causes much trouble. These difficulties are best overcome by arranging some kind of dash or agitator so that with every stroke of the pump the whole mixture is thoroughly stirred. An agitator is even more necessary for the application of Paris green than for Bordeaux mixture. Some manufacturers now supply large pumps with agitators.

The true Vermorel nozzle is considered best for applying the Bordeaux mixture, better than the modifications of it which are sometimes offered. Success in treating the anthracnose as above recommended depends very much upon the kind of nozzle used and the care taken to cover all parts of the plants with the spray. The nozzle should throw a very fine spray.

SPREAD OF DISEASE ON GATHERED PODS.— Experiments with gathered pods on snap beans from diseased plants proved beyond question that pods, which were apparently sound and without blemish when first gathered may become badly spotted in two or three days time. It was also proven by inoculation that unblemished pods may soon become infected by spores from diseased pods. It was very easy to see that shipments of snap beans gathered from diseased plants might be sent from the producer in apparently good condition and yet become very badly spotted by the time they reached the consumer.

DISCUSSION OF THE FUNGUS AND DETAILS OF EXPERIMENTS.

Bean anthracnose is so named because of the sunken spots or "ulcers" formed by the disease on the pods or other succulent tissue. It is due to a parasitic fungus known as *Colletotrichum Lindemuthianum* (Sacc. and Magn.), Briosi and Cavara, but was formerly known as *Glœosporium Lindemuthianum*, Sacc. and Magn. It is found on various varieties both of bush and pole beans of the species *Phaseolus vulgaris*, L., and is not confined to wax and butter beans. In an article on *Glœosporium Lindemuthianum* published in the Department of Agriculture Report, 1887, page 361, it is stated that "It is the pods and the beans they contain that are chiefly affected, the other parts of the plant being rarely if ever attacked. Frank attempted to infect the leaves and stems but with no result. He also tried to infect different plants but failed." During the past season we have frequently found the fungus fruiting on stems and leaves and have seen plants killed by the disease not only before they had produced any pods but even before they had blossomed. Early in the season there have been found rows of beans with every plant infested with anthracnose. In 1891 Dr. Halsted* showed that the disease may be carried over winter in infected seed and that the disease frequently appears on the stems and cotyledons of plants growing from such seed. He also succeeded in infecting the leaves and in transferring the disease to healthy bean plants. The results he obtained have found abundant confirmation in the work at this Station during the past season.

MICROSCOPIC CHARACTERS. — The microscopic characters of this fungus may be briefly given as follows:

The mycelium is septate, branched and of variable diameter. It may be hyaline or nearly so, but just beneath the epidermis it forms a dense, dark-colored stroma, which precedes the production of spores. From this stroma arise the dense clusters of basidia that at first lift the unbroken epidermis and form dark dots or pimples (acervuli) visible to the naked eye, on the diseased surface. On the extremities of the basidia spores are produced, and finally pale pinkish colored masses of them about the size of pin points burst the epidermis as shown on the diseased spots of the pods in Fig. 2. Sometimes neither the blackened color of the stroma nor the pink tint of the spore masses is noticeable, but such exceptions are infrequent. Grown on sterilized potato plugs in test tube cultures the spore masses were

* Annual Report N. J. Exper. Station, 1891, page 284.

nearly colorless and showed no pink tint. According to Frank* the spores fall on the surface of the host and send out a germ tube which presses its enlarged end closely against the epidermal cells. From this a colorless hypha penetrates the cell walls and grows into a mycelium which fills the cell cavities. Then the mycelium penetrates into the underlying tissues.§ "Almost immediately the cell walls of the host and their contents become discolored and in the exocarp the cell walls collapse, thus forming an almost solid mass of cell walls and mycelium." Fig. 3 illustrates a section of the pod through the collapsed tissue which underlies a cluster of basidia. The epidermis which formerly covered the acervulus has broken away and a portion of its recurved edge is seen at the right. A seta is also shown projecting beyond the acervulus, and a few spores remain attached to the ends of the basidia. The collapsed tissue is seen below. By the collapse of the tissues the anthracnose pits are formed. In the leaf parenchyma, as previously stated, the tissue becomes collapsed and brittle, so that rifts through the leaf soon form in the center of diseased spots.

The basadia are upright (perpendicular to the stroma) and unbranched. Associated with them are a few setae which when mature are long and of dark brown color. Sometimes the setae are septate and sometimes they arise from a many-celled bulbous base.

The conidia are illustrated in Fig. 4. They vary in length from 11.5u to 18u and in diameter from 3.7u to 5.3u. An average of sixteen measurements gave the following dimensions: 15.2u x 4.4u They are non-septate, hyaline, oblong, cylindrical or sometimes slightly narrowed towards one end. They burst through the epidermis in masses held together by some substance which soon dissolves in water.

The fresh conidia may be germinated readily in sterilized broth made from bean pods or foliage. They germinate less readily in sterilized water. Germination usually begins at or near the extremities of the spore, and two or more germ tubes may issue from one spore. Figure 5 illustrates the progress of germination

* Deutschen Botanischen Gesellschaft, Berichte der, Band 1, 1883, pp. 31-34.
§ U. S. Dept. Agr. Report, 1887, p. 363.

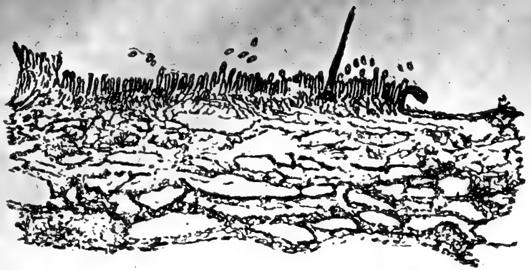

FIG. 3.—Section through an acervulus showing the clustered basidia with spores, and the collapsed tissue of the pod underneath. A black seta projects beyond the basidia at the right of which is seen a portion of recurved epidermis of the pod. *Ad. nat. del.* x $\frac{100}{0}$ *S. A. B.*

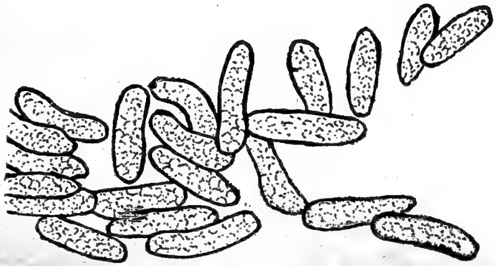

FIG. 4.—Conidia of Colletotrichum Lindemuthianum, x $\frac{600}{1}$ *Ad. nat. del. S. A. B.*

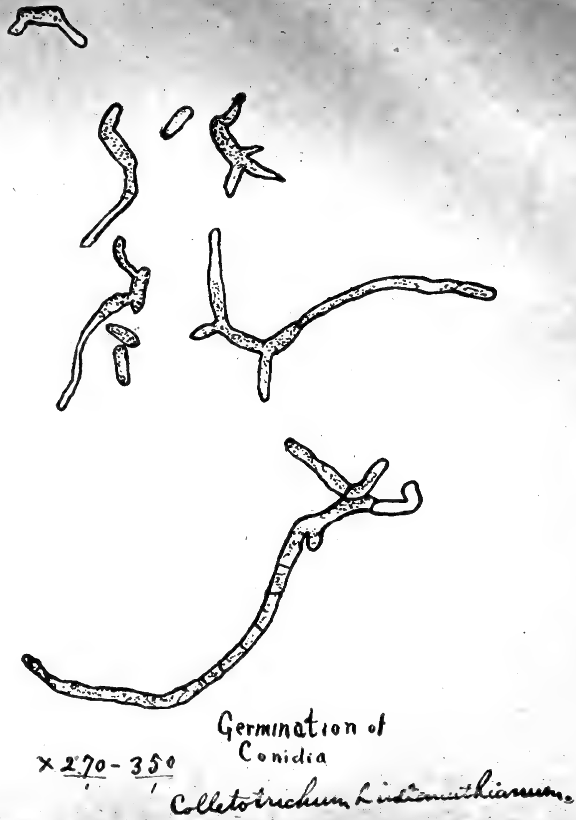

FIG. 5.—Conidia germinated in bean broth. *Ad. nat. del. S. A. B*

about twenty-four hours after the spores were put into bean broth. At this stage some of the hyphae were already septate and branched. The appearance of the hyphae seemed to be influenced somewhat by the media in which they are grown.

PREVALENCE IN WESTERN NEW YORK.— Reports as to the prevalence of bean anthracnose have been received from fifty-seven farmers representing nearly every county in western New York. When the letters of inquiry were sent out, a sample anthracnosed pod was inclosed, that there might be no misunderstanding as to the particular disease which was being investigated. Though these reports are few in number yet they throw some light on the importance of finding a remedy for the disease, since in several instances the apparent loss from this trouble was very great.

Of the fifty-eight reports above mentioned, thirty-six (sixty-two per cent.) reported the disease, two were doubtful as to its presence, and twenty stated that the disease had not appeared this season. The estimates of the damage varied from a slight amount to nearly or entirely the whole crop. Seventeen estimated the loss at less than twenty per cent.; ten reported loss from twenty per cent. to thirty per cent.; three reported loss from thirty per cent. to fifty per cent.; two reported loss from fifty per cent. to seventy-five per cent.; one reported a loss of from seventy-five per cent. to 100 per cent., and three reported nearly or quite 100 per cent. loss.

SEED SOAKED IN FUNGICIDES.— As stated previously, several methods of treating beans for anthracnose by soaking the seed in fungicides have been experimented with in field and greenhouse. Laboratory investigations of the disease were begun in January, 1892, and the greenhouse experiments were started soon afterwards. With the seed used and under the conditions of soil, heat and moisture found in the greenhouse, the seed could be safely treated by soaking as follows:

1. Water at 140 degrees F. five minutes.
2. Water at 130 degrees F. fifteen minutes.
3. Bordeaux mixture (six pounds sulphate of copper, four pounds lime, twenty-two gallons water) one hour.

4. Ammoniacal solution of copper carbonate (five ounces copper carbonate, three pints ammonia twenty-six degrees, fifty gallons water) one hour.

5. Potassium sulphide (one ounce sulphide, two gallons water) one hour.

In the last of the greenhouse experiments tried, a bench was prepared with rich soil over a layer of well-rotted sod. In it was planted diseased seed treated according to each of the above methods excepting the first one. Three rows were allowed for each treatment and five rows were left untreated. When the young plants appeared there was an abundance of disease on all classes. After a few weeks the remaining plants became well established, and the disease in every case made so little progress that no marked difference could be seen between the plants of the different classes. A comparison of the effects of the various methods of treatment used can, therefore, best be made from the records of germination and disease during the first weeks of the experiment. Plants removed in thinning the rows are included in this report. It is probable that many of these which were very young but apparently healthy when removed were in reality infected at that time and would finally have dropped into the diseased class as did others like them which were allowed to remain. By means of the following table the apparent results of the different treatments may be compared:

Treatment.	Per cent. diseased or that failed to grow.	Per cent. healthy.	Per cent healthy removed in thinning.
Untreated, five rows	60	5	38.3
Bordeaux, three rows	58.3	16.6	25
Ammoniacal, three rows	58.3	8.3	33.3
Hot water, three rows	50	25	25

It appears that the hot-water treatment gave the greatest freedom from disease. When this line of investigation was continued in field experiments the Bordeaux mixture and ammoniacal solution of copper carbonate were dropped from the list of fungicides used in soaking the seed since, as shown in the above table, they gave less favorable results than did the hot water treatment, and in both cases the disease appeared on over half the plants from which under field conditions it might easily spread until every plant in the field was infected. In field experiments with soaked seed the following methods were used:

Hot water. Seed soaked fifteen minutes in water at 120 degrees F., then for five minutes in water at 130 degrees F.

Copper sulphate. Seed soaked for one hour in solution of copper sulphate. Strength of solution one ounce to one gallon of water.

Iron sulphate (copperas). Seed soaked in iron sulphate for one hour, using one ounce to one gallon of water.

Mercuric bichloride (corrosive sublimate). Seed soaked for one hour in solution of mercuric bichloride. Strength of solution one-eighth ounce to one gallon of water.

Some of the results obtained from these experiments are compared in the following table.

	I Comparison of stand.	II Comparison of yield.	III Comparison of poor beans.
Hot water	43	84	88
Untreated	100	100	100
Copper sulphate	21	28	136
Untreated	100	100	100
Iron sulphate	88	71	132
Untreated	100	100	100
Mercuric bichloride	28	19	81
Untreated	100	100	100

In column I is given a comparison of the stand of plants secured under each treatment from equal areas, counting the stand from untreated seed in each case as 100.

In column II the total yield of marketable beans is compared in the same way.

In column III a similar comparison is made of the percentage of poor beans in the total yield in each case.

For example, column III shows that for every eighty-eight ounces of poor beans produced under hot water treatment there were 100 ounces of poor beans produced from an equal yield of untreated plants. The reason why the latter class is credited with the larger total yield in column II is plainly because a much better stand of plants was secured as shown by column I.

It appears that in all these experiments the hot water treatment has given better results than treatment with any other fungicide used in soaking the seed. The important fact to notice is that the untreated seed gives a greater yield of marketable beans than do any plots of the treated seed. This is not because plants from untreated seed were any less diseased but because they gave a better stand of plants. Even when the treatment of the seed by the best fungicides is so severe that the stand is seriously injured there remains enough of the disease to injure the crop under field conditions. At the time of harvesting the crop in the above noted experiments not a sound plant or even a sound pod was found in the whole lot. These results certainly give little encouragement for hope that treatment of seed with fungicides will yield sufficiently good results to justify recommending its adoption. It should be noted, however, that with plants grown indoors for twenty-four days Dr. Halsted found * beneficial results from soaking seed for two hours in ammoniacal solution of copper carbonate five times the strength used in the greenhouse experiment reported above. He reports that one-fifth of the plants from treated seed were affected by the disease and these but slightly, while nearly one-half the plants from untreated seed were badly affected. Sixty per cent. of the seeds germinated in each lot.

SELECTION OF HEALTHY SEED.— One experiment was conducted in order to compare plants from healthy seed with plants from diseased seed. The so-called healthy seed really contained some affected beans, as was apparent when they germinated. The sorting of the seed was not done personally and though most of the seed was healthy, yet a second sorting with great care would have discovered other imperfect specimens. This seed was planted in two equal areas, and the adjacent ground on one side of each area was planted with diseased seed of the same variety obtained from the same source. The soil was uniform in character for both classes

* Annual Report of New Jersey Experiment Station, 1891, p. 286.

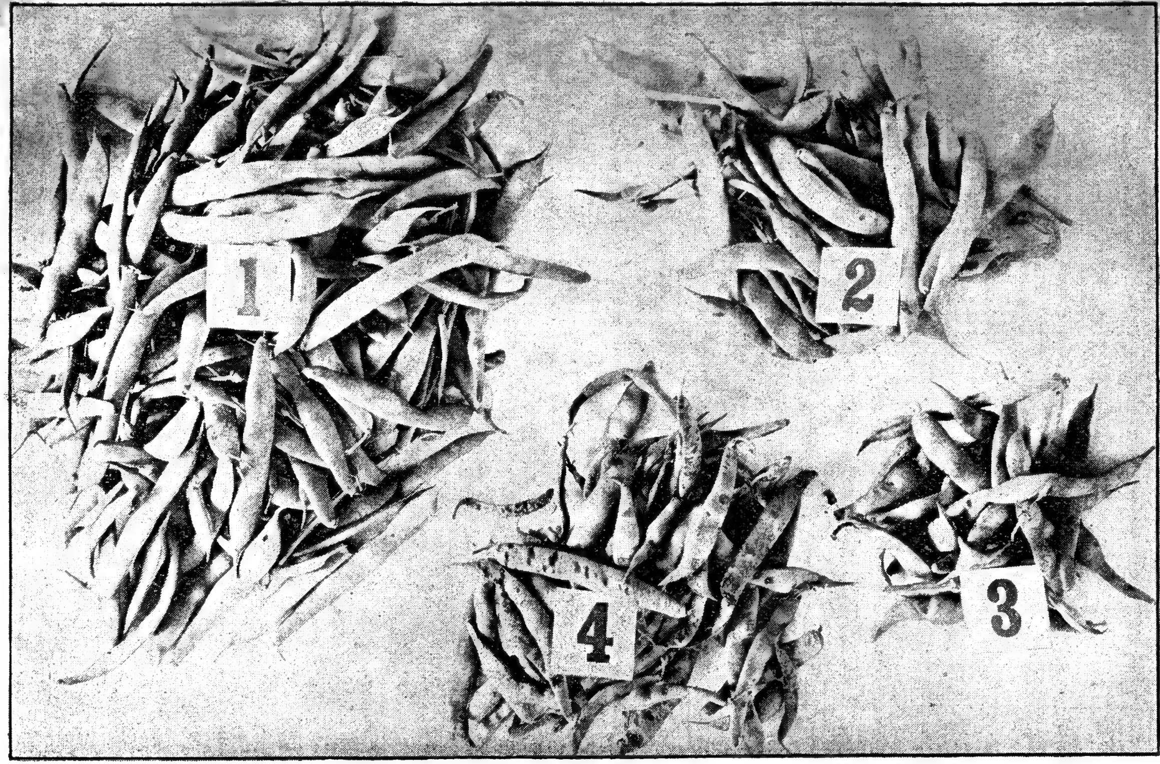

Fig. 6.—Classes a, b, c and d from an untreated row.

of seed and uniform treatment was given to both. The crop was gathered as snap beans and a record of the yield was kept both by weight and by number of pods produced. In order to determine accurately the severity of the disease the pods were classified as follows:

a. Free from any appearance of disease.

b Slightly diseased.

c. Badly diseased.

d. Very badly diseased.

Figures 6 and 7 from photographs will assist in giving an idea of this classification. The pods shown in Fig. 6 are from an untreated row. Those shown in Fig. 7 were picked at the same time from a corresponding row treated with Bordeaux mixture, and well illustrate the good effects of spraying. In each case the plants came from diseased seed. Group No. 1 in each figure shows the amount free from disease; No. 2 shows those slightly diseased; No. 3 shows those badly diseased, and No. 4 shows those very badly diseased.

Five pickings were made, the last one September twenty-seventh. The records of the season's yield were then combined in one table. In order that this report might not be needlessly cumbered with tables, a somewhat arbitrary method was employed to find one numerical expression for the amount of injury from anthracnose in each case. To do this it was necessary to estimate the per cent. of injury represented by each one of the three classes, "*b*," "*c*," and "*d*." This was done, and, on consultation with the two persons who assisted in assorting, five per cent. was adopted to express the amount of damage in class "*b*," forty per cent. for class "*c*," and ninety per cent. for class "*d*." If the percentage of injury thus found is deducted from the total yield of each of these three classes and they are then combined with class "*a*," the result will state the yield for each experiment less the percentage of total damage to the pods from anthracnose. It is a difficult matter to express either in words or in figures the degree of damage to the crop from the disease. The above method was adopted because it includes in the record those pods which were too badly diseased to ripen seed. It will be seen at once, since there may be many such pods in a diseased field, that a record of the yield of ripened beans could not give an accurate expression of the amount of disease.

In the following table, column I gives the comparative stand of plants from equal areas planted alike, counting the stand from healthy seed as 100. Column II gives the comparative yield by number of pods, counting that from healthy seed as 100. The yield here given is the total yield less the percentage of injury from anthracnose. Column III in a similar way compares the yield by weight. Column IV gives the comparative amount of damage done to foliage at the close of the season, September 27, 1892, counting the damage to plants from healthy seed as 100. The damage to foliage at this date was partly due to bacterial blight, and it was impossible to make separate estimates of the effects of each disease. The estimate was very carefully made with the assistance of Mr. D. G. Fairchild.

	I. Stand of plants.	II. Yield by number of pods.	III. Yield by weight of pods.	IV. Comparative damage to foliage.
Healthy seed	100	100	100	100
Diseased seed	84	91	83	108

It is instructive to compare with the above the following table, showing in a similar way the comparative condition of the plants earlier in the season, at the time of the first picking:

	I. Stand of plants.	II. Yield by number of pods.	III. Yield by weight of pods.	IV Comparative damage to foliage.
Healthy seed	100	100	100	100
Diseased seed	84	62	58	175

This shows plainly that the effect of the disease on plants from healthy seed became more and more marked as the season advanced. At the time of the first picking, they were ahead of the plants from diseased seed by thirty-eight points on yield

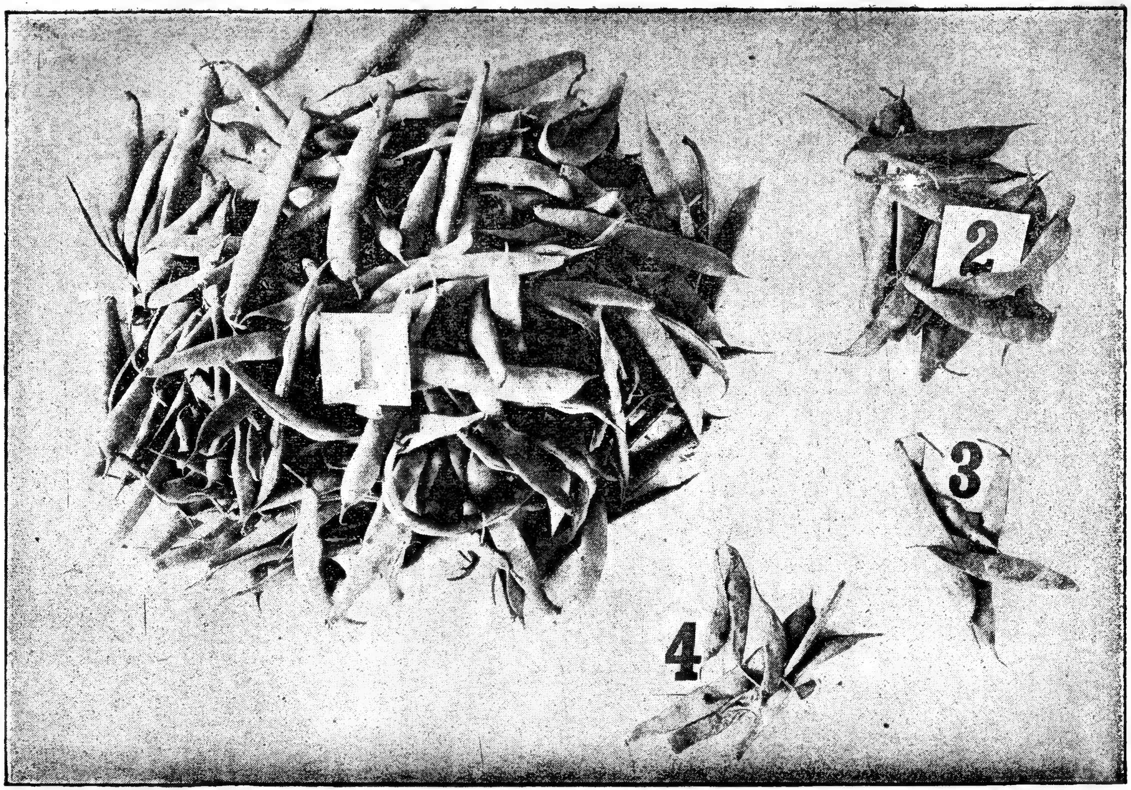

Fig. 7.--Classes *a*, *b*, *c* and *d* from Bordeaux treated row.

of pods, forty points on yield by weight, and seventy five points on condition of foliage; but for the entire season the difference was but nine points, seventeen points and eight points, respectively. The few diseased plants discovered among this lot as the beans were coming up, were purposely left, and they have furnished an excellent object lesson on the importance of eradicating the disease in the beginning of the season. From these plants and from the plants in adjoining rows grown from diseased seed, the anthracnose undoubtedly spread to the healthy plants and in a marked degree reduced their yield.

TREATMENT BY SPRAYING.— This part of the subject has already been quite fully discussed, but only the Bordeaux formula there recommended has been given. The cupric borate formula used was as follows: Dissolve two pounds of copper sulphate in water, and separately dissolve in water two and two-tenths pounds of powdered borax; mix and dilute the whole to thirty gallons; finally add soap as for the Bordeaux mixture.

The formula used for cupric polysulphide was as follows: Dissolve in water two pounds copper sulphate and separately dissolve in water two pounds potassium sulphide; mix the two and dilute to thirty gallons; add soap as before.

It will be noticed that these fungicides, as suggested by Mr. Fairchild, contain equal amounts of copper per gallon, and therefore are strictly comparable as to the efficiency of equal amounts of copper in these particular forms. It was noticed after the first application that the cupric polysulphide had injured the foliage somewhat and that even greater injury resulted from the use of cupric borate. Therefore, in subsequent treatment all the formulas were reduced to thirty-seven and one-half gallons of water, instead of thirty gallons. The results do not indicate that it is advisable to use either the cupric polysulphide or the cupric borate mixture as a remedy for bean anthracnose.

Bibliography.

1. SACCARDO AND MAGNUS.—Glœosporium Lindemuthianum, n. s. Michelia I, p. 129, 1878. The fungus was first observed by Lindemuth at Popplesdorf in 1875 and is here named in honor of its discoverer.

2. SACCARDO, P. A.— **Glœosporium Lindemuthianum**, Sacc. Fungi Italici, plate 1032, with the above name and the following reference: "Padovo, Mich. I, 129, in leguminibus Phaseolus vulgaris. Tunio 1875."

3. ——————.— **Glœosporium Lindemuthianum**, Sacc. and Magnus, Sylloge Fungorum, Vol. III, p. 717, No. 89.

4. FRANK, B.—**Ueber einige neue und weniger bekannte Pflanzenkrankheiten.** Deutschen Botanischen Gesellschaft, Berichte der, Band I, 1883, pp. 31-34. *Glœosporium Lindemuthianum*, Sacc. and Magn. States that the disease first became serious in 1882 when the investigations here reported were undertaken. The fungus attacks the half-grown pods and continues until they reach normal size. Describes the appearance of the disease on the pod and germination of conidia on the surface of the pod and on glass. Mentions the formation of a secondary spore with dark violet membrane on the surface of the pod from which a germ tube enters the epidermal cell by piercing through the cell wall. After gaining entrance to an epidermal cell in this way the mycelium rapidly develops and spreads to the surrounding tissue. Describes inoculation experiments which were successful only on the pods. In one instance the fungus fruited within five days after inoculation.

5. TRELEASE, WM.—**The Wax Bean Fungus.** The Country Gentleman, Vol. L, p. 800, Albany, N. Y., 1885. One and three-fourths columns with illustration of conidia and diseased pod. A popular discussion of the general appearance and microscopic characters of the disease. States that it attacks stems, leaves and pods of the common bean, *Phaseolus vulgaris*., L., especially the white wax variety. Mentions the susceptibility of some varieties and discusses the probable causes, stating that "The susceptibility of the wax beans to the attacks of this fungus is not improbably connected with the very delicacy of its tissues — which are still healthy tissues — * * * * for which we prize it."

6. SORAUER, P.— Pflanzenkrankheiten, Vol. II, pp. 422-423, second edition, 1886. Gives botanical characters of *Glœosporium* genus and states in substance the description of *Glœosporium Lindemuthianum* as given by Frank.

7. PENZIG, DR. O — "Studi Botanici Sugli Agrumi e Sulle Piante affini, Ann. d. Agria., 1887, Pl. XXXVIII, Figs. 3 and 4, p. 384, has figured and described *Colletotrichum glœosporioides* and so far as can be judged from the illustrations the fungus has every generic characteristic of that upon the bean. In this Funghi Agrumicoli, 1882, p. 66, Fig. 90, Penzig described the same fungus as *Vermicularia glœosporioides*." The above reference is quoted from the 1887 report U. S. Department of Agriculture, p. 864.

8. SCRIBNER, F. L.— Anthracnose of the bean. *Glœosporium Lindemuthianum,* Sacc. and Magn., Report of Section of Vegetable Pathology in United States Department of Agriculture Report 1887, pp. 361-364, with colored plate of diseased pods, acervulus, conidia and sections of diseased spots on the pod. Under *General Observations* states that this fungus attacks water melon rinds. Gives external characters of the disease on the bean, conditions favoring the disease, botanical characters and suggestions for treatment. Notes the presence of setae in the acervuli and remarks that if these prove an organic part of the fungus the classification will probably be changed to Colletotrichum Lindemuthianum.

9. ——————.— Anthracnose of the bean. *Colletotrichum Lindemuthianum,* Orchard and Garden, vol. xi, pp. 193-194, Little Silver, New Jersey, October, 1889. Refers to the article in the 1887 report of the United States Department of Agriculture, just quoted, and adds observations on the injury caused by the disease. States that field beans are subject to its attacks and no varieties of "string" beans are exempt, not even those with green pods. Notes again the presence of setae in the acervuli "the presence of which separates our fungus from the genus *Glœosporium* under which it has heretofore been classed and places it in the genus *Colletotrichum*, the name here adopted." Gives suggestions as to treatment. The article is illustrated with two figures, one showing a diseased pod, the other the microscopic appearance of the fruiting fungus.

10. BRIOSI AND CAVARA.— Colletotrichum Lindemuthianum (Sacc. and Magn.). Briosi et Cavara. I Funghi parasiti della pianti coltivate ed utile, No. 50, Pavia, Italy, summer of 1889. They refer to Scribner (See No. 8) stating that he first noticed the

setae but as they find these setae constantly present they decide to change the generic name to *Collétotrichum*.

11. GALLOWAY, B. T.— Anthracnose of the bean. Bulletin No. 8, Botanical Division, United States Department of Agriculture, 1889, p. 65. Replies to letter of inquiry from New Orleans, La., regarding this disease and states the cause suggesting remedies. On page 64, of the same bulletin, this fungus is noted as destructive to melon leaves in North Carolina, where it is called "melon rust."

12. KIRCHNER OSKAR.— Die Krankheiten und Beschadigungen unserer Landw. Kulturpflanzen, p. 77. Stuttgart, 1890. Gives a brief statement of the appearance of *Glœosporium Lindemuthianum* Sacc. and Magnus, on bean pods and young seeds. Recommends, if possible, planting in dry airy situations.

13. HALSTED, B. D.— Fungi injurious to garden crops. Ohio State Hort. Soc. Report of meeting December, 1890. Mentions *Colletotrichum Lindemuthianum* as causing "bean spot" and states that it probably also causes "melon rot."

14. ——————.— Anthracnose in bean seeds. Garden and Forest, vol. v, p. 18, 1892. States that "It is certain that *Colletotrichum Lindemuthianum* can exist from one season to another in the mature beans and when these diseased seeds are planted the best possible condition is given for perpetuating the disease." It is recommended that before planting, the seed be soaked one hour in a solution of three ounces of copper carbonate, one quart of ammonia, and four and a half gallons of water.

15. BEACH, S. A.— Anthracnose of Bean. Country Gentleman, vol. lvii, p. 88, 1892. Notes the development of the disease from blistered beans which though blistered were not noticeably discolored. Suggests treating the seed by soaking, as recommended by Dr. Halsted, in Garden and Forest, of January 13, 1892.

16. FRANK AND SORAUER.— Pflanzenschutz, p. 62, Berlin, 1892, Paul Parry. A short note on treatment of bean anthracnose states that with pole beans copper salts are effective as a remedy if applied early. An excellent figure illustrates the appearance of the disease on affected pods.

Professor L. H. Pammel, E. G. Lodeman and D. G. Fairchild have kindly assisted the writer in compiling the above references.

Bean Blight.

In the article on Bean Anthracnose reference was made to a bacterial disease which in some cases is even more destructive to beans than anthracnose. In the kitchen garden at this Station it was very destructive during the past season. It developed into a serious malady about the first of August and did the most damage during the hot weather of that month. A plat of wax beans was the first to be badly affected and the plants were ruined within a few days after the serious nature of the disease first attracted attention. The foliage became spotted and yellowed in large areas of the leaf surface and soon the leaves withered and fell away. Many of the pods contained soft or watery spots showing the presence of the disease, or they became withered from lack of nourishment after the foliage was destroyed. From these beans the disease spread to an adjacent plot of a different variety and it also was soon completely ruined.

In its early stages this blight forms small pimples which have a watery appearance. These may occur on the pods, blossoms (?), foliage or stems. They may or may not have a dull red border but do not have either the black color or the sunken spots which characterize anthracnose. Microscopic examination in the early stages of the blight failed to reveal the presence of any mycelium but bacteria were always present. In later stages saprophytic fungi gained entrance through the diseased places and hastened the destruction which the bacteria had inaugurated.

The question suggested itself whether the blight might not be an accompaniment of the anthracnose attacking the tissues already infested by this fungus. The question was answered in the negative by the fact that in one field blight was found everywhere present on Mexican tree beans while no trace of the anthracnose could be found on any plants of this variety though they were growing adjacent to Red Kidney beans which were attacked by the anthracnose. At the close of the season Mr. J. W. Stepfield, of Horseheads, N. Y., in whose field these things were noticed, reported that the anthracnose did not appear on the Mexican tree beans at all during the season.

This blight affects the foliage and pods as before stated and also affects the beans within the pods. Some of the pods fail to ripen while others which mature, produce beans that are discolored by the disease or wrinkled or disfigured with rough spots. It is possible that the blight may be communicated to the crop of the following season in the seed, as is probably the case with the blight of lima beans, and therefore all blemished seed should be rejected when planted. Whether this blight on the common beans, *Phaseolus vulgaris*, L. is identical with the one next described as attacking Lima beans is a question not yet decided. The subject is under investigation and the results may be noted in a subsequent report.

Blight of Lima Beans.

A bacterial disease occurs in Lima beans and forms definite characteristic spots on pods and leaves, especially in its earlier stages. These spots differ in appearance from those formed by the blight on *Phaseolus vulgaris* but whether the difference in appearance is due to the influence of the different host plants, and the blight in both cases is due to the same germ has not been decided. Probably the two diseases are distinct. Figure 8, from a photograph, shows the characteristic spots on leaves and pods of Lima beans. So far as noticed, these spots are never black, but often have a reddish purple border inclosing an area of a light red color. On the leaves the spots gradually increase in size and develop a straw colored center of dead tissue. Sometimes the centers of the spots on the pods also become straw colored. In the Station garden this blight did considerable damage, and on October tenth it was almost impossible to find a Lima pod free from the disease.

A study of the blight has been made in the laboratory in the following way. The germ was first isolated by means of plate cultures. It was then transferred to various nutrient media

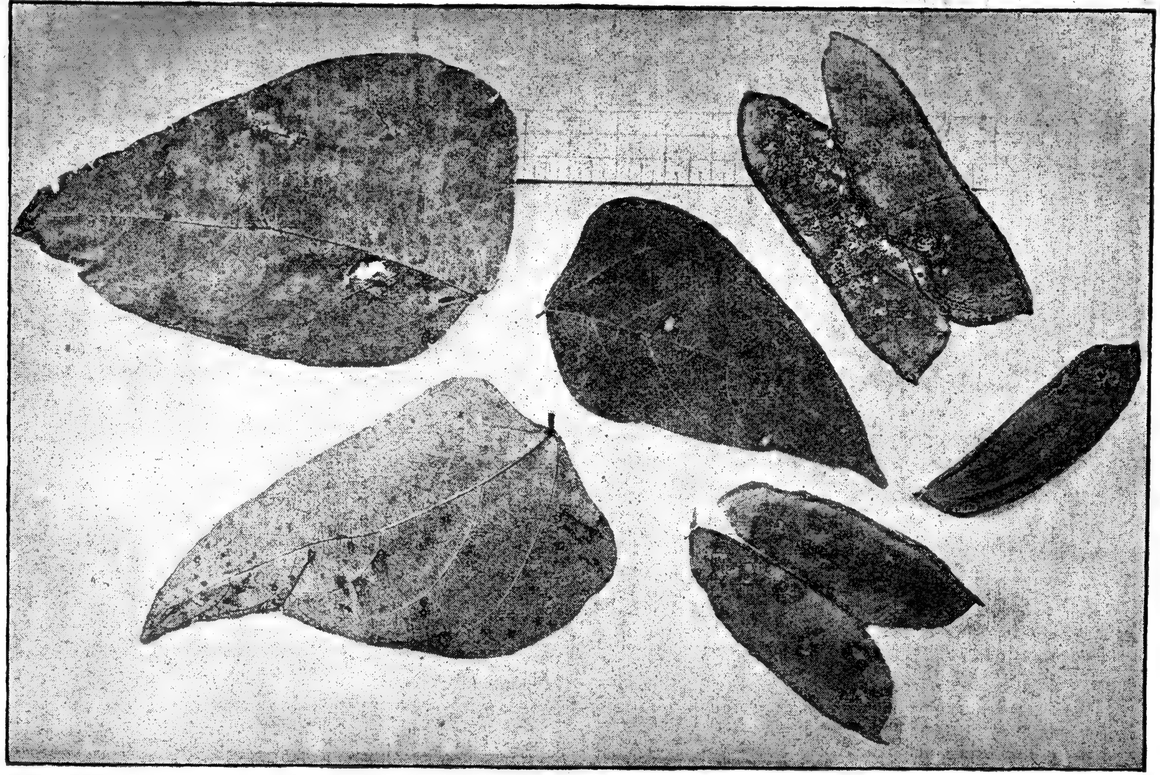

Fig. 8.— Bacterial blight on pods and leaves.

and from the latter cultures inoculations were made on healthy pods kept in moist chambers. These inoculations produced decay at the spots where the virus was introduced, while punctures made at the same time, but not inoculated, showed no signs of decay. The germ grew less readily on pods of wax or kidney beans kept in moist chamber and had but slight effect on the seedlings of *Phaseolus vulgaris* when applied to the unbroken epidermis. The tests thus far made indicate that the blight of Lima beans may be propagated by planting the diseased seed. The only treatment at present recommended is the selection of healthy seed.

Bean Rust.

Uromyces Phaseoli, (Pers.) Winter.

Figure 9 gives an illustration of the true rust of the common field or garden bean, *Phaseolus vulgaris*, L. as it appears on the leaves and pods. It may be found also on the stalks and petioles. So far as is known from our investigations, it is not nearly so destructive to beans as either the anthracnose or the blight and it is so distinct from either of them that a careful observer will at once recognize the difference. It certainly assumes importance in some localities, for Dr. Halsted includes bean rust in the class of "Worst Fungi of Garden Crops."* On certain plots of beans grown at this Station during the past season the rust was very abundant, but the attack came quite late in the season and the foliage suffered but slightly as compared with the injury to other plots from blight and anthracnose. The disease was seldom found on the pods and did no perceptible injury to them. Specimens of the fungus were submitted to Prof. George F. Atkinson, who reported that "The specimens of *Uromyces* on *Phaseolus vulgaris*, L. I find on comparison to be the *Uromyces appendiculatus* (Pers.), Lev. It agrees with specimens in Rabenhorst's Fungi Europaei marked No. 1292, *U. appendiculatus* (Pers.), Lev., and No. 2168 *U. Phaseolarum* (Wall.), DBy, a synonymous species. Probably the question as to what the name is is one of synonymy. *Uromyces Phaseoli* (Pers.), Winter§ is probably the name that should be used.

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* Proceedings New Jersey Hort. Society, winter meeting 1889-90.

§ Die Pilze, bd. I., p. 157, Winter's Rabenhorst's Kryptogamen Flora.

On the foliage the bean rust first forms little brown spots nearly circular in outline about as large as pin heads. These break out all over the leaf on either surface, and the spores produced in them are soon discharged as a rusty brown powder. After an indefinite time these spots change in color from brown to black and produce spores of larger size and different shape and texture. It frequently happens that one leaflet is sprinkled with the brown spots while its companion on the same leaf stalk is covered with black spots or both kind of spots may be found on one leaflet. This is not strange since the different colored spots represent different stages of the same disease. The dust which they discharge is composed of spores which have the same function as do the seeds of higher forms of plant life, namely, the propagation of the species.

The fungus grows inside of the leaf for sometime before the rust spots break out and the need of treating the disease is not realized till the rust spots appear. It is then impossible to destroy the fungus without killing the foliage with it. We are not aware that any experiments have been tried for the purpose of controlling this disease and therefore no recommendations as to treatment of bean rust are made at present. It is not known to live over winter in the seed. Probably it winters in the rusted leaves as is the case with wheat rust which resembles bean rust in its botanical characters.

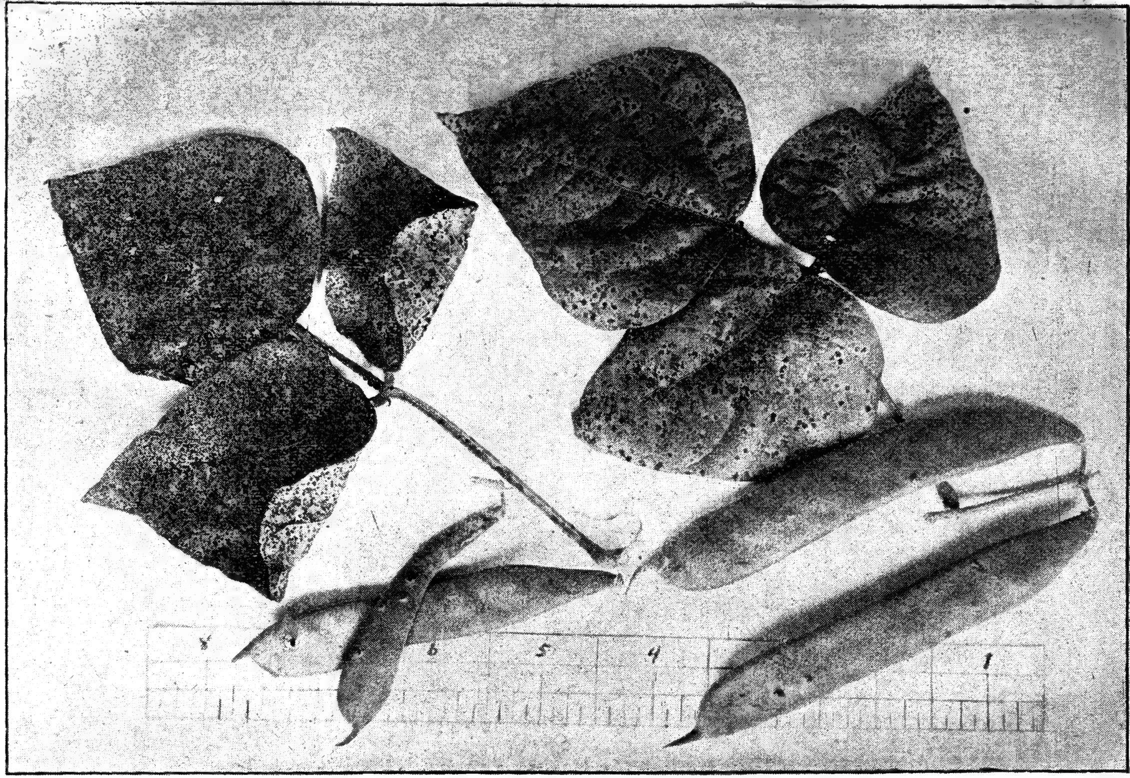

Fig. 9. —Bean rust (*Uromyces Phaseoli*) on pods, stems and leaves .

Leaf-spot of Chrysanthemums.

In the fall of 1891, a leaf spot was quite prevalent on chrysanthemums at the Station greenhouse and at other greenhouses in the vicinity the same disease was found. The disease first appears in small dark brown spots, which increase in size and number till the leaf tissue dies and the foliage drops off. In badly diseased plants nearly all the leaves wither and fall away. Even when the attack is less serious the diseased plants are unsightly and are not nearly so vigorous or thrifty as are the healthy plants, which hold all their foliage.

A microscopic examination of affected leaves showed that the disease was due to a fungus of the genus Septoria. Specimens submitted to Dr. Halsted were pronounced identical with the fungus referred to by him in an article on "Fungous Troubles in the Cutting Beds," published in *Garden and Forest*, February 24, 1892. In this article attention was called to the "damping off" of chrysanthemums cuttings and severe blighting of the foliage due to the same fungous disease.

The cuttings become infected from the disease on the stock plants before they are put into cutting beds and so it is best to avoid the use of diseased plants when making cuttings. How to secure healthy plants free from the Septoria is a question which has been investigated at this Station during the past year and with most favorable results. It has been found that starting with diseased plants, the disease can be practically controlled, and we have reason to believe that by following the treatment here suggested, any chrysanthemum grower can secure healthy stock from which to grow healthy plants.

In treating the diseased plants three fungicides were tested. These were applied in solution by means of a spray using chiefly the Vermorel nozzle because a very fine spray was desired. These fungicides were: (1.) Potassium sulphide (one ounce to one gallon of water). (2.) Ammoniacal solution of copper carbonate (five ounces carbonate dissolved in three pints of ammonia 26 degrees then diluted to fifty gallons with water, and enough soap added to form a suds); (3) Bordeaux mixture (dissolve two pounds of copper sulphate, add whitewash made of one and one-half pounds fresh slaked lime, then dilute to twenty-two gallons with water and add enough soap to form a suds).

The Bordeaux mixture proved most effective and the potassium sulphide least effective. Since the Bordeaux mixture is quite noticeable on the foliage some may prefer to use the ammoniacal solution for the last application before the plants blossom.

The diseased spots on the leaves develop little pimples in which are borne numerous spores which are so minute as to be invisible to the naked eye and which readily float in the air or are washed on to the surrounding foliage by rains or by spray from the sprinkler. The removal of spotted leaves is therefore a reasonable precaution to prevent the spread of the disease, and since such foliage is full of the disease germs it is best to burn it. The treatment which may be expected to rid the plants of this disease is briefly summed up as follows:

(1.) Remove and burn diseased foliage.

(2.) Cover the remaining foliage with Bordeaux mixture to prevent the further development of the disease. Five or six applications will usually be sufficient to keep the foliage covered with the Bordeaux mixture through the season, especially if the soap is used. The object of using the soap is to cause the mixture to spread in a thin film over the entire surface of the leaf. Our experience has been that, applied in this way, the mixture adheres so well to the foliage that it is not necessary to make another application till there is sufficient new growth unprotected to justify another treatment.

The following account of an experiment will perhaps show more clearly the efficiency of Bordeaux mixture for chrysanthemum leaf blight as compared with ammoniacal solution of copper carbonate.

When the plants were selected for this experiment every leaf was examined and counted and the per cent. of leaf surface injured by the disease was estimated for each class as follows:

	Number of plants treated.	Per cent. of plants plainly attacked by the disease.	Per cent. of injury to leaf surface of the entire class.
1. Bordeaux mixture	28	50.1	15.9
2. Ammoniacal solution of copper carbonate	33	36.6	10.7
3. Untreated	20	23.4	6.8

When the plants were in bloom a final estimate of the amount of injury to these plants from the Septoria gave the following results:

	Number of plants treated.	Per cent. of plants plainly attacked by the disease.	Per cent. of injury to leaf surface of the entire class.
1. Bordeaux mixture	24	100	5.3
2. Ammoniacal solution of copper carbonate	32	100	11.6
3. Untreated	20	100	31.5

By comparing the per cent. of leaf surface injured by the disease before treatment, with the per cent. of diseased foliage at the close of the experiment, it is seen that at the beginning of the experiment the Bordeaux treated plants were in the worst condition, while at the close they were in the best condition, having gained 10.6 points as compared with their condition at the beginning, and in the same period the plants treated with ammoniacal solution of copper carbonate gained 0.9 of a point and the untreated plants lost 24.7 points. Plants treated with ammoniacal solution of copper carbonate therefore gained 25.6 points as compared with the untreated plants, and those treated with Bordeaux mixture gained 35.2 points as compared with the untreated plants. All these plants were given the same care throughout the experiment and therefore the different classes were kept in close proximity to each other, thus favoring the spread of the disease to the healthy plants, for in order to show the comparative values of the different treatments, no diseased foliage was removed from any of the plants after the experiment was well under way. Under these conditions the diseased foliage was continually spreading the disease to the treated as well as the untreated plants, and probably it is on this account that the disease gained a foothold on every plant. Florists and gardeners could easily avoid this source of the disease by removing the diseased foliage, but this alone will not suffice to keep the disease in check, when it has once gained entrance to the plants, and it is advocated only in connection with the use of the fungicides, either Bordeaux mixture or ammoniacal solution of copper carbonate.

Experiments in Treatment of Potato Scab.

Experiments were conducted during 1892 both at the Station and in co-operation with Mr. C. E. Chapman, of Peruville, N. Y., for the purpose of investigating the following questions:

1. To what extent can potato scab be prevented by treating the seed with fungicides?

2. Is spraying the seed and the surrounding soil as effective in preventing scab as soaking the seed before planting?

3. What are the comparative merits of different fungicides for the prevention of potato scab?

General observation will confirm the statement that under favorable conditions the scab fungus will live from year to year in the soil. Such places are known to produce a scabby crop whenever they are planted to potatoes. Sometimes they become so badly infested with the scab that they are no longer planted with potatoes on that account, thus showing that the soil has become permanently infected with the scab fungus. In the following pages such soil will be referred to as "infected" soil, meaning that it is infected with the potato scab fungus. So far as our observation goes badly infected soils are usually found on the former site of a cattle yard, door yard or kitchen garden or perhaps where a portion of a straw stack has rotted or in some such location where the soil has been abundantly enriched and successive crops of potatoes grown.

In planning the work with potato scab for the past season it was decided to secure if possible some thoroughly infected land for a portion of the experiments in order to give the proposed remedies the severest possible test. Through the courtesy of Mr. C. E. Chapman, of Peruville, Tompkins county, N. Y., a piece of such ground was offered free of charge for this work and Mr. Chapman, who is an experienced potato grower, and who also appreciates the necessity of very careful work in conducting such experiments, personally attended to the preparation of the soil and assisted in all the details of the experiments at his place..

The ground selected at Peruville served as a dooryard years ago. It has been planted to potatoes repeatedly but finally has been abandoned for this purpose because the crops were invariably so scabby as to be nearly or quite unmerchantable.

Similar experiments were carried on at this Station on more favorable ground which was not known to be infected with the scab. By means of these duplicate experiments it was possible to compare the proposed remedies on favorable and unfavorable soils. Two methods of using the remedies were tried, namely, (1) by soaking the seed before planting, and (2) by spraying the soil and seed at planting time. In every experiment and in the rows left untreated for comparison scabby tubers were used for seed so as to give the treatments a more thorough test.

These experiments show that under certain conditions potato scab can be largely prevented in a practical way. On badly infected ground, on "scabby ground" if you please, no treatment was of any practical benefit. The failure was not in every case a complete one, but no practical advantage resulted from the treatment. On the more favorable soil at the Station a decided advantage resulted from some of the treatments, chiefly from zinc sulphate (white vitriol), iron sulphate (copperas) and mercuric chloride. These investigations confirm in a measure both the work of Bolley* who found beneficial results from soaking the seed in mercuric chloride, and of Kinney§ who found that Bordeaux mixture sprayed on the soil and seed at planting time lessened the amount of scab in the crop.

It should be borne in mind that lessening the amount of scab on the immediate crop is not the only advantage arising from treating the seed with fungicides, for if the fungus once becomes established in the soil it may live there from year to year and it is therefore wise to take care not to introduce the disease into uninfected soils. Tubers selected from a scabby crop, though apparently smooth, may contain microscopic germs of the disease and ought therefore to be disinfected either by spraying or

* Bull. 4, North Dakota Expt. Station, Dec., 1891.

§ Bull. 14, Rhode Island Expt. Station, Oct., 1891.

soaking with some fungicide before they are planted. The same may be said of purchased seed of unknown origin. The cost of treating the seed is slight and the operation does not require much labor.

The following preventive measures are also recommended:

(1.) Select soil free from the scab fungus if possible. No treatment is known which will insure a crop of smooth tubers on infected soil.

(2.) Plant only clean, smooth seed.*

(3.) Scabby potatoes or scabby beets§ should be thoroughly cooked before being fed to stock in order to prevent the fungus from being disseminated with the manure.§§

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*In experiments conducted by Thaxter, scabby seed very greatly increased the number of diseased tubers produced. See Annual Rep. Conn. Exp. Station for 1891, p. 157. See, also, Beckwith in report of this Station for 1887, p. 310.

Bolley gives an excellent discussion of this point which leads to the following statement based on abundant experimental evidence: "Scabby or disease-bearing seed tubers can and will under ordinary circumstances produce a diseased crop." See Bulletin No. 4, North Dakota Expt. Station, Dec., 1891.

§In the Bulletin just quoted Bolley states that potato scab also attacks the various varieties of beets.

§§Thaxter says he is convinced "That the practice of feeding scabby tubers to stock is one of the most important means by which the disease is spread on farms. In view of the well-known fact that great numbers of fungus spores can and do pass through the digestive tract without injury, and that the scab fungus is known to grow luxuriantly in decoctions of horse or cow dung, it is not unreasonable to assume that its spores, passing through the digestive tracts of stock fed with diseased potatoes, continue their development in the manure after evacuation." See Annual Report Conn. Expt. Station for 1891, p. 158.

Kinney states that "Stable manure scattered in the furrows at time of planting is favorable to the development of the disease." Bul. 14, Oct., 1891, Rhode Island Expt. Station.

In view of the nature of the disease Thaxter's conclusion on this point seems better than the more positive statement just quoted. He says "Barnyard manure which has not been contaminated by the scab fungus may not materially increase the amount of scab."

Hexamer observed that under the exclusive use of commercial fertilizers scab almost entirely disappeared while under the exclusive use of barnyard manure the amount of scab increased. See American Agriculturist, Vol. LI, p. 172.

Humphrey states that "Potatoes raised on barnyard manure were markedly more scabby and more deeply scabbed than the rest." See annual Rep. Mass. State Ex. Station for 1889, p. 219.

Green finds that the use of barnyard manure as a potato fertilizer has increased the yield, but not always the total marketable product because of the prevalence of potato scab. See Bulletin Ohio Expt. Station, Jan., 1890.

(4.) The relation of soil conditions to the development of potato scab received considerable attention before the real cause of the trouble was known. In Beckwith's experiments at this Station excessive moisture favored the development of the disease,* and Humphrey § states that light, open, thoroughly drained soil seems to be less favorable to the development of the disease than does heavy, damp soil. But, in the bulletin referred to, Bolley well says, "There is no substantiated evidence that any soil of whatsoever kind can in itself give origin to the disease. That certain characters in a soil may increase the capabilities of the disease to work damage is possible. This point, however, is not proved, and even if it were, it need not militate against the use of any particular kind of soil if care is taken to avoid the first cause, the plant parasite. The same argument holds for the use of manures, though it is possible that barnyard manures may become contaminated from refuse matter containing the disease and thus become a source of infection.

(5.) If the presence of scab is suspected, dig the potatoes as soon as they are matured.**

MANNER OF APPLYING THE FUNGICIDE.

Regarding the question whether spraying the seed and the surrounding soil at planting time is as effective in preventing scab as simply soaking the seed before planting, our investigations indicate that under the conditions of these experiments the former method was more successful than the latter, but the treatment is somewhat more laborious and takes more material. This opinion is based chiefly on the results of the experiments at the Station since on the Peruville soil the treatments had comparatively little effect. When the first method was used the freshly opened furrow or hill was sprayed with the fungicide, then after the seed was dropped it also was sprayed and then covered. When the latter method was followed the seed was soaked in the fungicide one and a half hours and then planted.

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* Annual Report for 1887, p. 311.

§ Annual Report Mass. State Expt. Station for 1890, p. 220.

** Thaxter states that scab spots deepen as long as the tubers remain in the ground. See Annual Report Conn. Expt. Station for 1891, p. 159.

COMPARISONS OF FUNGICIDES.

For the purpose of investigating the question as to the comparative merits of different fungicides, seven fungicides were tested, namely (*a*) copper sulphate (blue vitriol or blue stone), (*b*) iron sulphate (copperas), (*c*) zinc sulphate (white vitriol), (*d*) Eau Celeste, (*e*) Bordeaux mixture, (*f*) mercuric chloride (corrosive sublimate), and (*g*) ammoniacal solution of copper carbonate. The best results were obtained from the use of iron sulphate, zinc sulphate and mercuric chloride but further experiments must be made before it can be definitely stated which of these is most effective. The formula for either the iron sulphate or the zinc sulphate solution is one ounce of the sulphate to one gallon of water. The mercuric chloride formula is "Dissolve two ounces of the chloride in two gallons of hot water, let it stand several hours, or over night, then dilute to fifteen gallons." It should be remembered that the mercuric chloride is very poisonous. Only wooden vessels should be used in making any of these solutions. There is but slight difference in the cost of these three solutions— less than one cent per gallon in each case.

NATURE OF POTATO SCAB.

Since the cause of potato scab has been definitely determined its treatment can be more intelligently studied than was formerly possible. The very careful work of Dr. Roland Thaxter at the Connecticut Experiment Station and of Prof. H. L. Bolley of the North Dakota Experiment Station has shown that the cause of potato scab is a parasitic fungus.

Regarding the question as to whether a distinction should be made between the so-called "surface" scab and "deep" scab it will be sufficient for our purpose to quote Prof. Bolley's statement * that the economic interest of the subject is essentially centered about the establishment of the fact that the general first cause of the disease is in parasitic plant action § and his

* Bull. 4, North Dakota Expt. Station, Dec., 1891, p. 6.

§ Prof. Bolley states that "In order to understand the form which the scabs as such assume one must keep in mind the structure of the potato tuber and the *effort always made by living tissues to heal a wound*. In plants this is most rapidly accomplished by the formation of bark rind or corky tissues composed of layers of tabular cells rapidly developed from the underlying soft tissues (parenchyma). The ultimate form which the scabs assume is the result of a continuous formation of layers of cork below the area of disease, because of the irritating and eroding action of the parasite. These later cork formations push up, distort and rupture the disease eaten parts above." See Bull. 4, North Dakota Experiment Station, Dec., 1891, pp. 8–9.

investigations go to show that the chief damage to the crop arises from the action of the fungus to which Dr. Thaxter has given the name *Oöspora scabies.* It appears that Dr. Thaxter's work** in 1891, showing that this parasitic fungus causes potato scab, was confirmed both by his later investigations and by those of Prof. Bolley, and the theories that the scab is primarily due to injuries resulting either from insect depredations, or from excess of water in the soil, or from mechanical irritation, or from chemical action, or from the action of manure or other fertilizers, must be abandoned and it must be conceded that these supposed causes influence the prevalence of the disease only in so far as they may furnish more favorable conditions for the growth or distribution of the fungus which really causes the scab. Figure 10* illustrates in a very interesting way the results of one of Dr. Thaxter's inoculation experiments. From a pure culture the fungus was applied to the surface of this tuber in lines so as to form the monogram R. T., and so successful was the inoculation that the scab formed a nearly perfect monogram. Figure 11 illustrates a potato badly scabbed by the action of the fungus *Oöspora Scabies*, Thax.

DETAILS OF EXPERIMENTS.

As previously stated two kinds of soil were selected for the experiments with potato scab during the past season namely, at Peruville, soil so thoroughly infected with the scab fungus that whenever planted with potatoes it invariably produced a crop that was mostly so scabby as to be unmerchantable; and at the Station, soil that was not known to be infected with the scab fungus. Scabby seed was selected for planting in both places and alternate rows were always left untreated for the sake of comparison. In making up the following tables each treated row was compared with the untreated rows on either side of it except in one or two instances where but one untreated row could be used for this purpose.

** 1891, Annual Report Conn. Expt. Station, p. 159.
* Figures 10 and 11 are from Annual Report Conn. Expt. Station, for 1890.

Figure 10.— "Deep" scab, induced by inoculation in form of monogram R. T.

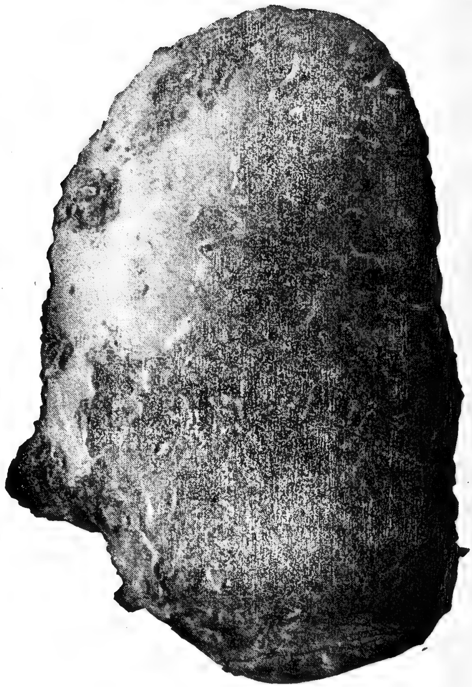

Figure 11.— Specimen of ordinary "deep" scab

The experiments were planned so as to compare the effects of different fungicides applied in two ways. Series A includes all experiments in which the seed was soaked for one and a half hours in the fungicide before planting. Series B includes all experiments in which the freshly opened furrow or hill was sprayed with the fungicide, then the seed was dropped, the furrow or hill sprayed again and the seed covered. The fungicides were prepared as follows:

a. Copper sulphate (blue vitriol or blue stone) one ounce dissolved in one gallon of water.

b. Iron sulphate (copperas) one ounce dissolved in one gallon of water.

c. Zinc sulphate (white vitriol) one ounce to one gallon of water.

d Eau Celeste.— Dissolve one pound of copper sulphate in water and just before using add one and a half pints of ammonia and dilute to twenty-two gallons.

e. Bordeaux mixture.— Dissolve six pounds of copper sulphate, add a whitewash made from four pounds of fresh-slaked lime and dilute to twenty-two gallons.

f. Mercuric chloride (corrosive sublimate).— Dissolve two ounces in two gallons of hot water and let it stand several hours or over night, then dilute to fifteen gallons.

g. Ammoniacal solution of copper carbonate.— Wet five ounces of the carbonate with a little water, then dissolve in three pints of ammonia 26 degrees and dilute to fifty gallons.

In the following tables the per cent of scab * under each treatment is compared with the per cent of the scab in adjacent untreated rows.§

* The amount of scab found on the crop when it was harvested can not be correctly estimated by dividing the potatoes into two classes, "scabby" and "not scabby," because all grades of differences existed between the "not scabby" class of the different experiments, some being very much more scabby than others. After the potatoes were dug, therefore, they were washed and divided into four classes, (1) free from scab, (2) slightly scabby, (3) badly scabby but merchantable, and (4) unmerchantable. Then counting the amount of scab on the unmerchantable class as 100 per cent, the average amount of scab on class 2 was estimated as fifteen per cent as compared with class 4, and the average amount of scab on class 3 was estimated at thirty per cent as compared with class 4. From these estimates the total per cent of scab in each experiment is easily computed and the results afford a basis of fair comparison of the amount of scab present under each treatment.

§ In series A there were planted twice as many rows at Peruville as at the Station and this was taken into account in computing the general average of all experiments, except with part of *f.* and *g.* which lacked the necessary rows for comparison.

TABLE I.

SERIES A.—SOIL AND SEED SPRAYED AT PLANTING TIME.

	Station Experiments.		Peruville Experiments.		Average of all Experiments.	
	Treated	Untreated	Treated.	Untreated.	Treated.	Untreated.
a Copper sulphate	*	*	55.0	69.9	......	....
b Iron sulphate	42.7	63.8	89.5	86.2	66.1	75.0
c Zinc sulphate	26.8	63.8	92.5	90.9	70.6	81.9
d Eau Celeste	45.2	58.3	92.9	93.2	77.0	81.6
e Bordeaux mixture ..	44.2	50.1	91.0	94.3	75.4	79.6
f Mercuric chloride ...	13.5	40.9	86.5	93.1	50.0	67.0
g Ammoniacal solution of copper carbonate.	37.8	40.6	91.1	87.0	64.4	63.8

SERIES B.—SEED SOAKED BEFORE PLANTING.

	Station Experiments.		Peruville Experiments.		Average of all Experiments.	
	Treated	Untreated	Treated.	Untreated.	Treated.	Untreated.
a Copper sulphate	*	*	97.2	96.7	......	....
b Iron sulphate	26.9	49.5	88.1	93.3	57.5	71.4
c Zinc sulphate	34.6	49.5	‡58.4	92.1	46.5	70.8
d Eau Celeste	†	....	†	....	......	....
e Bordeaux mixture ..	22.9	34.9	93.1	97.5	58.0	66.2
f Mercuric chloride ...	15.1	34.9	96.5	97.7	55.8	66.3
g Ammoniacal solution of copper carbonate.	*	*	98.0	98.5	......	....

On much of the ground used in the Peruville experiments every fungicide tested proved either utterly or practically useless whether the seed was soaked or sprayed, so that when these results are included in the average results of all experiments the per cent. of injury from the scab is much higher and the apparent effect of the treatment is less marked than is the case with the experiments on other soil.

It will be noticed that at the Station the treatments apparently lessened the amount of the scab in every instance. The difference in the per cent. of scab, comparing the treated rows with corresponding untreated rows, is given in the following table.

* Results were unfortunately vitiated.

† Treatment killed the seed.

‡ A comparison with other untreated rows indicates that the soil of this experiment might have been less thoroughly infected than it was in the untreated rows with which it must be compared.

Experiments in which there was more scab in the treated than in the untreated rows are indicated by a *. It will be noticed that this occurred in none of the Station experiments and in but few of the Peruville experiments:

TABLE II.

	Series A.			Series B.		
	Station experiments.	Peruville experiments.	Average of all experiments.	Station experiments.	Peruville experiments.	Average of all experiments.
a Copper sulphate	†	14.9	....	†	*0.5	.....
b Iron sulphate	21.1	*3.3	9.9	22.6	5.2	14.0
c Zinc sulphate	37.0	1.6	11.3	13.1	‖33.7	24.3
d Eau Celeste	13.1	0.3	4.6	....	....	‡
e Bordeaux mixture	5.9	3.3	4.2	17.9	4.4	8.2
f Mercuric chloride	27.4	6.6	17.5	19.8	1.2	10.5
g Ammoniacal solution of copper carbonate	2.8	*4.1	*0.6	†	0.5	0.5

Taking all things into consideration§ it appears that in series A where the soil and seed were sprayed, an average of all experiments shows that the use of mercuric chloride gave greatest freedom from scab, but in the Station experiments alone where

† Results unfortunately vitiated. ‡ Killed by the treatment. ‖ See note Table I.

§ Before attempting to draw any conclusions from these tables it will be well to examine the first table with reference to the variation in the amount of scab in the untreated rows. It will be noticed that the amount of the scab in the untreated plots at the Station varied from 40.6 per cent. to 63.8 per cent. in series A and from 34.9 per cent. to 49.5 per cent. in series B, notwithstanding the fact that they were very near to each other. The average of the untreated plots in all experiments as seen by the same tables shows a variation from 63.8 per cent. to 81.9 per cent. in series A and from 66.2 per cent. to 71.4 per cent. in series B. Probably this variation in the amount of scab in the untreated plots is partly due to the varying scabbiness of the seed and to the varying amounts of the scab fungus present in the soil. It is necessary to bear these things in mind when considering the comparative merits of the different fungicides as apparently shown in these tables. On the other hand it may be said that the treated rows were always compared with adjacent untreated rows so as to avoid, as far as possible, untrustworthy comparison; this together with the fact that the experiments were all duplicated and some in series A were tested in three separate plots, and that series B also duplicated series A in the kind and strength of the fungicides used, renders the results of considerable value.

the differences in the results were less liable to be due to variation in the amount of the scab fungus in the soil, the zinc sulphate treatment gave apparently the greatest freedom from scab followed by mercuric chloride and iron sulphate in the order named. Copper sulphate lessened the amount of the disease but also lessened the yield. Eau Celeste, Bordeaux and ammoniacal solution of copper carbonate had little value at the strength used.

Turning now to series B where the seed was simply soaked in the fungicides before planting, an average of all the experiments shows that zinc sulphate was apparently most successful, possibly due in part to favorable soil conditions; but the results obtained at the Station alone where the soil conditions seemed to be more uniform indicate that iron sulphate was most effective followed by mercuric chloride, Bordeaux mixture and zinc sulphate in the order named. There were some indications that Bordeaux mixture slightly injured the yield, and this was also noted in preliminary greenhouse experiments. Eau Celeste, copper sulphate and ammoniacal solution of copper carbonate had little or no effect at the strength used. These apparent discrepancies in the results may be due to the fact that the amount of the scab present in the soil or seed was not uniform in the different rows as shown by the variation in the amount of scab in untreated rows. These experiments and those of other investigators show that preventive treatment is in a measure successful; but it will be necessary to investigate this subject further in order to determine what fungicide, cheap and easily applied, is most effective in preventing potato scab.

It should be remembered that, as previously stated, these experiments were planned so as to give the proposed remedies the severest possible tests, therefore scabby seed was selected for each experiment and part of the experiments were conducted on badly infected ground. It is reasonable to suppose that much more favorable results in preventing scab could be obtained by avoiding infected soil, by selecting smooth seed, and by using all the precautions mentioned on pp. 563-4.

Some Celery Diseases.

Outline of Discussion.

I. Center Blight (bacterial).
  Treatment suggested.
II. Stalk blight (bacterial).
III. Celery leaf spot diseases.
  Celery Septoria (*Septoria Petroselini*, Desm., var. *Apii*, B. & C.).
    Spraying.
    Soaking the seed in Fungicides.
  Celery Cercospora (*Cercospora Apii*, Fr.).
  Celery Phyllosticta (*Phyllosticta Apii*, Hals.).
IV. The Celery Rusts (*Puccinia bullata* (Pers.), Winter, and *Puccinia Castagnei*, Thum.).
V. Experiments in spraying.
VI. May celery be safely sprayed with copper compounds?

INTRODUCTION.

Celery is subject to different diseases due to bacteria or filamentous fungi. In some celery growing districts of the State these diseases have come to be of considerable economic importance, and their attacks are increasing in frequency and severity. It is the purpose of this article to give a brief description of some of these diseases, to state some of the results of investigations made under the direction of this Station during the summer of 1892, and to collate such other information on the subject of celery diseases as may be deemed reliable and important to celery growers.

CENTER BLIGHT OR CENTER ROT.

This name is commonly given to any disease of the heart or center of the celery plant. Our attention has been called to two troubles of this kind, apparently different, but possibly both are due to the same primary cause. One of these troubles will be at once recognized by the name "soft rot." A severe attack destroys the whole center, but frequently the disease appears in blotches or strips on some of the tender central stalks and rapidly runs down the stem, marking its progress by the soft and discolored tissues which have been killed by the disease. Sometimes in the first stages of the disease the watery tissues do not assume a deep color till they have been exposed for some time to the air.

The other trouble mentioned above is manifested in a grayish or dark tinge of the affected part frequently accompanied by a slight withering or wilting of the leaflets, and watery pimples or wrinkles may appear on the otherwise healthy surface of the stalk. Finally the diseased leaflets become brown and completely withered and the stalk decays. In its first stages this trouble injures the flavor and appearance of the blanched celery and thereby lessens or wholly destroys its market value. As before stated it is possible that both these troubles are simply different manifestations of the same disease, but this has not yet been proved.

The extent to which conditions of soil may affect the prevalence of center blight is not well understood, but it is believed by many that center blight is more apt to be serious whenever soil conditions are unfavorable to thrifty growth of the celery plants; and that anything which weakens or checks the growth of the plants whether it be leaf blight, lack of available plant food in proper proportion, or unfavorable soil conditions, is favorable to the development of center blight. Practical experiments must determine for each celery grower what is necessary to be done on his particular soil to insure the best growth of celery, whether it be tile draining, rotation of crops, subsoiling or application of potash, phosphoric acid or nitrogenous fertilizers. We can well believe that when plants are in the healthiest condition they are best able to withstand disease, and, therefore, it is best to secure a healthy vigorous growth of the celery plants.

Center blight in this section is more prevalent during the hot summer months than in autumn, and, consequently, the early varieties suffer most. The self-blanching kinds are used largely for early celery and this probably is one reason why the disease is reported more commonly on these varieties. The "green" celery is by no means exempt, but there are some reasons for thinking that, after all, the self-blanching kinds are more susceptible to disease than the green varieties.* The White Plume has been mentioned in particular as subject to this disease.

Weather conditions certainly have much to do with the activity of the disease. When the atmosphere is hot and moist the center blight makes most rapid progress and the injury is correspondingly great. These conditions are frequently found during July and August when the celery is banked up for blanching and the warm moist atmosphere surrounding the plants favors not only the production of tender succulent whitened centers but also favors the development of center blight.

Plants that are not too severely attacked may, under favorable conditions, form new centers and especially is this true of young and vigorous plants. Even those which are very badly attacked may recover as was shown by selecting a few such plants, stripping off the outer foliage and setting them in pots in the greenhouse late in the fall. With but one exception the plants formed new healthy centers, though the outer foliage still showed a little blight. The fact that celery can to such an extent withstand the inroads of the germs of center blight even after the disease has destroyed some portion of the plant, shows the importance of so treating the plants and the soil as to secure as healthy and vigorous a growth as possible.

TREATMENT SUGGESTED.

The experiments conducted in 1892 under the direction of this Station by Mr. DeWitt C. Curtis, of Horseheads, N. Y., in spraying for prevention of center blight, gave only negative results. The fact that beneficial results can be obtained from the use of fungicides for this disease has not yet been established. For the present, therefore, it is best to oppose the disease by sanitary measures, that is to say, by adopting those methods of growing and handling the celery crop which seem to be most favorable for the development of vigor and vitality in the plants and by avoiding so far as possible those conditions which are most favorable to the development of the disease. It is suggested that the following methods be given a trial.

1. When celery is to be grown on the same ground year after year do not allow the refuse to rot on the ground. It is filled with diseased germs, and it would be better to take the celery,

* See "Fungi as Related to Variegated Plants," by B. D. Halsted in Bull. Torrey Botanical Club, vol. xix, pp. 84–88.

including the diseased plants, off from the field before stripping for market.

2. Try blanching with boards, instead of earth, during hot weather.

3. Experiment in a small way with fertilizers in order to determine what element or combination of elements will give the best plants on that particular soil. For instance make a small strip of soil rich in nitrogen another rich in phosphoric acid and another rich in potash, and compare the results with those obtained from using banyard manure and from unmanured strips.

4. Be careful to keep the plants free from leaf blight from the start. This will necessitate treating them in the seed-bed as hereafter recommended.

STALK BLIGHT.

Before the celery is banked a bacterial disease is seen affecting the leaf stalks (petioles) where the leaflets join the main leaf stalk. From such a diseased joint the blight extends downwards and the leaflets above the joint wither from lack of nourishment. Sometimes this stem blight seems to start from an insect puncture and the eggs and larvae of some insect, probably dipterous, have been found in the decaying stems, but on the other hand many diseased stalks show no evidence of insect puncture. It is possible that the germs of the disease are distributed to some extent by insects, but its origin can not be attributed primarily to an insect sting. Probably this trouble is due to the same germ which causes the soft rot of the centers. Of itself it does not appears to be a serious difficulty, but if it proves to be identical with the center blight it deserves attention.

CELERY LEAF SPOT DISEASES.

There are several parasitic fungi which attack the leaves of celery causing them to become spotted or blighted. These fungi live within the leaf, absorb for their own growth the nourishing juices of the host plant, and produce countless spores for the reproduction of their kind. The spores, which are the germs of the fungi, are too small to be seen with the naked eye and are so light that they easily float in the air and are readily carried by the winds to other plants. By means of these spores produced by diseased foliage the fungous diseases spread and infest healthy foliage.

CELERY SEPTORIA.

One of the fungi which causes celery leaf spot or leaf blight is known to botanists under the name of *Septoria Petroselini*, Desm., var. *Apii* B. & C.* So far as could be determined most of the damage from celery leaf spot in 1892 in central and western New York was due to this Septoria. It was described as occurring on celery by Briosi and Cavara,§ Pavia, Italy, in 1890.

In 1891 it was found by Chester** in Maryland, by Halsted§§ in New Jersey and by Humphrey|| in Massachusetts. This fungus attacks not only the leaves but every part of the plant above ground. It causes watery streaks to appear along the stalks which resembled somewhat the bacterial disease but which in a few days become dotted with the fungus fruits. Its spores are borne in little globular receptacles, called pycnidia, which project slightly above the surface of the leaf and are visible to the naked eye as little black dots or pimples scattered over the diseased surface. See Fig. 16.

The leaf spot disease is illustrated in Fig. 12. An enlarged view of five pycnidia is shown in Fig. 13 where they are seen projecting

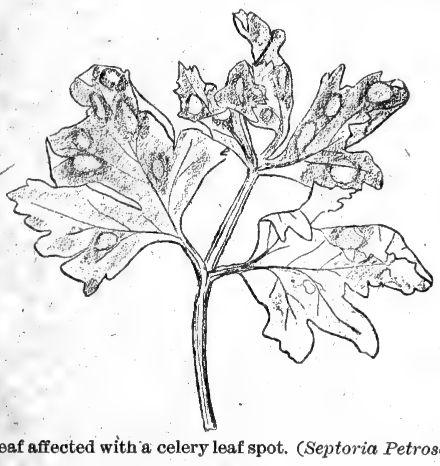

Fig. 12. Portion of leaf affected with a celery leaf spot. (*Septoria Petroselini*, Desm. var. *Apii*, B. & C.)

* Humphrey states in the 1891 Annual Report of the Mass. State Experiment Station, p. 231, that "So far as it has been possible to examine material and descriptions it appears that this form on celery is separated by no distinct features from the following previously described ones on Umbelliferæ; Septoria Sii, Rob. & Desm., S. Cryptotæniæ, E. & Rau., S. Saniculæ, E. & E. and S. Dearnessii, E. & E.

§ Funghi Parisitti Fascecola, vi, No. 144.

** Bulletin Torrey Botanical Club, Dec., 1891, p. 372.

§§ 1891 Annual Report N. J. Expt. Station, pp. 255-256.

|| 1891 Annual Report Mass. State Expt Station, p. 231.

above the surface of the leaf. In the center of each is an opening through which the spores escape and within which appear the

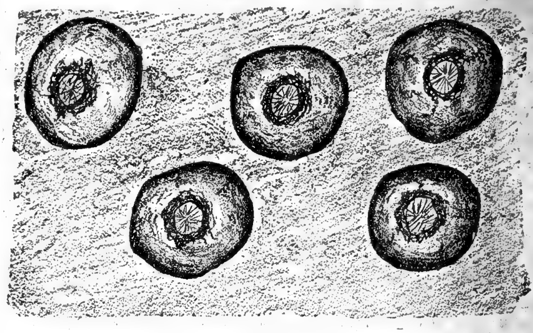

Fig. 13. Enlarged view of a portion of one of the leaf spots in Figure 12.

outlines of some of the spores that fill the cavity. The spores, isolated and still more magnified, are shown in Fig. 14.*

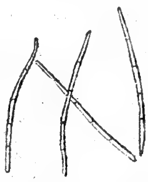

Fig. 14. Spores of the Septoria.

A study of this fungus last season disclosed the important fact that the pycnidia may occur on any aerial part of the plant, including the seeds (seed coats), and the pedicels on which they are borne. Fig. 15, somewhat enlarged from nature, illustrates the way in which the pycnidia cover the stems and seeds. To the naked eye they appear like black specks.

While the development of the disease from diseased seed has not been definitely observed, it is certainly true that the disease appears in the seed bed, and it is reasonable to suspect that the introduction and rapid distribution of the disease in this country is due to the importation of infected seed. The more we study plant diseases the more thoroughly are we impressed with the importance of perfectly sound seed for all farm and garden crops. Various diseases of beans, corn, oats, potatoes and

*Figures 12, 13 and 14, kindly furnished by Dr. B. D. Halsted for this Report, first appeared in Bulletin Q of N. J Expt. Station, 1892.

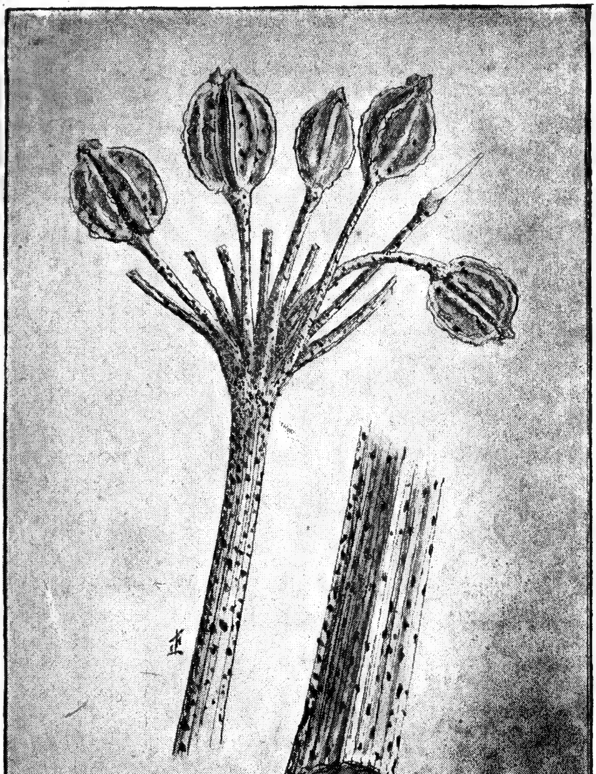

Fig. 15.— Magnified view of celery seed and portions of stems dotted with pycnidia of *Septoria Petroselini* Des., var. *Apii*, B. and C. (W. P. W., del.)

other crops are known to be propagated year after year in the diseased or infected seed. It is not wisdom to plant such seed and then blame the weather for all blights, rusts and mildews. While it is true that weather conditions exert a very important influence on the rapid development and spread of those diseases it is also true that many diseases are introduced into the field in the blemished, infected seed, and when the weather conditions are unfavorable for the development of the diseases we have "good luck" with the crop, otherwise we have varying degrees of "bad luck." Weather conditions are beyond our control; soil conditions and seed conditions are not wholly beyond our control, and there can be no doubt that in a very important sense much bad luck is self inflicted by neglecting to secure so far as practicable the best conditions of soil and seed

Celery seed, on which the pycnidia can be seen, ought, of course, to be rejected, but there is no better way of securing healthy seed than by rejecting all diseased plants and gathering seed only from healthy plants. We have no assurance that this is done at present, but the benefits of this course are so apparent that it seems worth an effort to secure them.

Spraying.—Under the present methods of obtaining seed the best way of preventing the appearance of the disease is to try spraying with Bordeaux as soon as the little plants begin to unfold the first leaves, and spray once or twice a week thereafter till the plants are transplanted. No experiments in this line have yet been reported, but it is certain that if the fungus can be successfully fought in the seed bed no other method is likely to prove so inexpensive in material and labor. Experiments made at this station have demonstrated that even before the first leaf appears the plantlets may be safely sprayed with Bordeaux mixture, of the strength hereafter recommended.

If the seed-bed treatment can be made as effective as it is hoped that it may be, the question of spraying will be very much simplified. There is reason to believe that, if the plants leave the seed bed in a perfectly healthy condition, and if the ground to which they are transplanted is not contaminated with the refuse of previous crops which have suffered from this disease, there is little to fear from the Septoria.*

If for any reason the seed-bed treatment has been omitted, or if there is reason to fear infection from the refuse of last year's diseased plants left on the field, spraying the plants after transplanting may still be found beneficial; but the field treatment is more costly both in labor and material, and the seed-bed treatment ought, therefore, to be given thorough trial before it is abandoned.

No unvarying rule can be given for the number of treatments which it is best to give in the field. The object of the treatment is to keep the entire foliage of the celery plants covered with the mixture in order to prevent the germination of the spores by means of which the disease is distributed. When frequent and hard rains occur it will obviously be necessary to spray more often than when the weather is pleasant. Under ordinary circumstances treatments are given from ten days to two weeks apart.

A good nozzle is indispensable for satisfactory work, and we prefer the improved Vermorel to any we have tried. With a

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* The advantage of having healthy plants for transplanting is well illustracted by the following extract from last season's notes, dated August 12, 1892; "A remarkable example of leaf spot disease directly traceable to the seed bed is seen in the celery grown by Mr. M. W. Rickey, Jr., of Horseheads. He has a field of about two acres of celery set with plants grown by himself with the exception of six rows (2,000 plants) secured from Mr. ———. All plants are of the same variety. The six rows were set near one side of the field and the remaining part of the field was filled with plants of his own raising. This arrangement put an area of home-grown plants on each side of the plants from Mr. ———'s seed bed. At first the six rows were the thriftiest plants in the field and made better growth than the home-grown plants. Gradually they began to show the leaf spot (*Septoria Petroselini* Des., var. *Apii*, B and C), and at present writing they can be easily distinguished from the rest of the celery even at a distance by the yellowed or spotted foliage and stunted growth due to this disease. The home-grown plants nearest these rows have also become infected to some extent; but the farther you go from the six diseased rows the less you find of the disease, and in other parts of the field only occasionally is a spotted leaf found. It is a clear case of thorough infection of plants before transplanting, and emphasizes the importance of spraying the seed beds." Under date of December 3, 1892, Mr. Rickey writes that the plants in the six rows continued diseased and stunted till the crop was gathered, though he thought they were somewhat benefited by application of lime. They yielded about one-half as much as an equal area planted with home-grown plants.

knapsack pump one man ought to be able to spray at least two acres in a day of ten hours, and with a barrel pump using two or four nozzles the work could be done much more rapidly and at less expense.

So far as it is possible to judge from the tests made last season a good strength for Bordeaux for this purpose is shown in the following formula,* namely, three pounds of copper sulphate, and two pounds of lime to twenty-two gallons of water. The ammoniacal solution of copper cabonate§ may be substituted for the Bordeaux mixture in the last application of the season.

Soaking the Seed in Fungicides.— Experiments in soaking the seed in fungicides are now in progress, but the results are not yet ready for publication and no recommendations in this direction can be made at present.

CELERY CERCOSPORA.

This disease also causes a spotting of the leaves of celery. It is caused by a parasitic fungus known to botanists as *Cerospora Apii*, Fr., and it sometimes causes serious loss to celery growers. Prof. Scribner has discussed its characters and distribution in the

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* Many object to the use of Bordeaux mixture because they experience so much trouble in preparing and applying it. Preparation of Bordeaux mixture may be simplified by a test which obviates the necessity of weighing the lime, and, where large quantities of lime are used, permits slacking the lime in large quantities at one operation. The copper sulphate is weighed and mixed with an amount of water sufficient to dissolve it. When it is completely dissolved, the lime, in the form of thin whitewash, is strained through burlap (gunny sacking) or carefully poured into the copper sulphate solution. A drop or two of potassium ferrocyanide (saturated aqueous solution) added from time to time after thoroughly stirring the mixture will show when enough lime has been added to form the Bordeaux mixture. If not enough lime has been used, the drop of ferrocyanide will turn to a very dark color the moment it touches the mixture; if enough lime has been used, the ferrocyanide will not change color when it is dropped into the mixture. Water is then added till the Bordeaux mixture is diluted to the desired strength. The commercial form of potassium ferrocyanide may be used for this test. A supply for the entire season may be purchased for a few cents. Success in treatment with Bordeaux mixture as above recommended depends much upon the kind of nozzle used and the care taken to cover all parts of the plants with the spray.

§ The ammoniacal solution of copper carbonate is made by dissolving five ounces of copper carbonate in three pints of ammonia 26°B and then diluting to fifty gallons with water. If the carbonate is first moistened with water it will dissolve more readily in the ammonia.

Report of the Secretary of Agriculture of the United States for 1886, pp. 117 to 120. By the courtesy of the Secretary of Agriculture we are enabled to present in this bulletin Figs. 1, 2 and 5 of plate V in that report.* See Figs. 1, 2 and 5, plate 16.

Dr. Halsted also treats of this disease in Special Bulletin Q of New Jersey Experiment Station, April, 1892. After giving an account of an experiment in spraying for the prevention of this disease, he says: "This experiment demonstrates beyond question that the celery blight can be checked by spraying with ammoniacal carbonate of copper, even after the fungus has become well established upon the plants, and may make all the difference between a fair crop and one that is too poor to harvest for the market. One of the suggestions that this experiment offers is the importance of beginning the treatment early."

CELERY PHYLLOSTICTA.

In Bulletin Q above quoted, Dr. Halsted treats of another leaf spot caused by a fungus known to science as *Phyllosticta Apii*, Hals. He says: "After becoming familiar with it there is no trouble in distinguishing it from Cercospora, even when the two diseases are found on the same leaf. The Phyllosticta spot begins as a dull brown patch, never becoming of the light ashy color, so characteristic of the Cercospora in one of its stages. This is a rapidly growing fungus, is particularly fond of moisture and flourishes in the shade, usually being found upon the younger or lower leaves. It was particularly easy to grow the Phyllosticta upon sterilized petioles in test tubes. The pycnidia (in which the spores are produced) would form and mature in great abundance within five days. While experiments have not been made upon

*EXPLANATION OF PLATE 16. Fig. 1 illustrates a diseased leaf. Fig. 2 gives a magnified view of a section of a leaf through a diseased spot; along the upper and lower edges are seen the oulines of the empty cells which form the skin of the leaf. The interior cells are filled with the living substance of the leaf. The threads of the fungus are seen traversing the interior tissue and sending branches through the lower surface of the leaf to produce spores for the propagation of the fungus. Fig. 5, still more magnified, shows the germination of the spores. In bulletin 49 of Cornell Experiment Station, page 316, Atkinson shows that the conidia are obclavate and not clavate as originally figured in the Department of Agriculture Report referred to. In Fig. 2 as shown here, the spores are therefore obclavate.

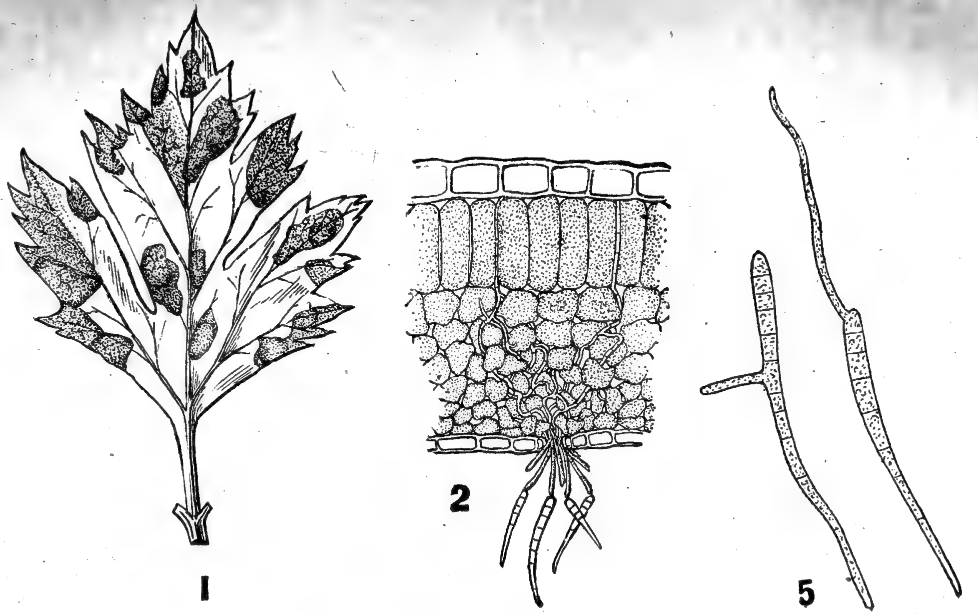

Plate 16.—*Cercospora Apii*, Fres.

this fungus it is probably true that the same remedy as that for the Cercospora, applied in the same manner, would prove effective."

THE CELERY RUSTS.

The word rust as here used refers to fungi that form rust spots on the foliage which discharge a rust like powder and it does not refer to the reddish discolorations sometimes found on the roots or extending along the stalks when they are blanched. In the bulletin above referred to it is stated that "There are two true rusts of the celery as recorded in the books. The *Puccinia bullata*, (Pers), Winter, which has a wide range geographically, being found throughout Europe, North America and Australia, thrives upon a large number of the members of the order (Umbelliferae) to which the celery belongs. Prof. W. G. Smith* mentions it as very destructive in England. Like many another fungus its inroads may be expected at any time in this country upon our cultivated Umbelliferae.

"The other species of celery rust (*Puccinia Castagnei*, Thum.), should it be distinct from the one mentioned above, is perhaps confined to France, where it was discovered."

EXPERIMENTS IN SPRAYING.

Through the kind co-operation of Mr. De Witt C. Curtis, of Horseheads, N. Y., who placed at the disposal of the station a portion of a large field of celery grown on muck land, some experiments were made in spraying for prevention of celery diseases in 1892. The purpose of the experiments was three fold, namely;

1. To determine the comparative merits of fungicides of different strengths.

2. To compare the efficiency of few treatments with frequent treatments.

3. To determine the amount of copper adhering to sprayed plants when they were prepared for market.

Unfortunately no experiments could be undertaken in treating the seedlings at this time. The field experiments were on early celery of the White Plume and New Golden varieties. Spraying commenced May eighteenth, soon after the celery was transplanted

*Gardener's Chronicle, vol. xxvi, N. S., 1886, p. 756, with engravings.

to the field. One plot was sprayed twice a week, two plots were sprayed once a week, and one plot was sprayed every two weeks. Treatment was continued till the first of July. During this time there were frequent rains, and celery made good growth and was comparatively free from disease. The first specimens of the leaf spot, Septoria, were sent to the station, June eighteenth, at which time the disease was already attracting the attention of other celery growers. Although the disease was found scattered among the plants selected for experiment, it did so little damage even to untreated plants, that the contrast between sprayed and unsprayed rows was seldom very marked. The spraying was not without effect in some cases, and the results seemed to indicate that:

1. Semi-weekly treatment gave greatest freedom from disease.
2. Potassium sulphide was less efficient than the ammoniacal solution of copper carbonate.
3. Bordeaux mixture (used only for the first two applications) gave better results than similar treatment with potassium sulphide or ammoniacal solution of copper carbonate.

In other parts of this field and in other localities later in the season the Septoria caused very serious loss.

In this field the center blight did not become serious till the second week in August, after which it caused the loss of one-half the remaining early celery.

At the suggestion of the Station Horticulturist, Mr. Curtis also sprayed some late celery of the Giant Paschal variety and reported the results. It was sprayed first in the seed bed, about August first, with Bordeaux mixture containing three pounds copper sulphate, two pounds lime to twenty-two gallons water, and again after transplanting, about August fifteenth. The results are given in Mr. Curtis own words: "I sprayed a portion of the seed bed in the field before the plants were taken from the bed. Afterwards sprayed the celery left on the seed bed to mature, together with several rows transplanted from such seed bed. The effect seems to have been good, as there was very little blight of any kind after the spraying. Mr. Treat, the farmer, thinks the spraying of this celery saved considerable portion of it, and it leads him to think that the strongest Bordeaux mixture, using three pounds of sulphate to twenty-two gallons of water was very beneficial, and that it should have been continued to a later day in the growth of the whole field, with both early and late celery."

As before stated there is no doubt that this disease infests the plants in the seed bed, and the importance of early treatments can not be too strongly urged. It is not wise to defer treatment till the disease attracts attention, because at that time it is almost certain to be scattering infection to neighboring plants. If the mixture is properly prepared the young plants will not be injured by its application. If treatment is begun early, and the mixture applied often enough to keep the foliage covered there is reason to expect that the disease can be controlled. It would be very desirable to get seed guaranteed to be from perfectly healthy plants, but it is doubtful whether such seed can be secured at present.

MAY CELERY BE SAFELY SPRAYED WITH COPPER COMPOUNDS?

In the past there has generally been much hesitation about recommending the use of copper mixtures for spraying celery lest the copper might adhere to the celery and thereby render it unfit for food. This subject has been investigated by this Station during the past season (1892) and one of the most important results of the season's work on celery diseases and their treatment is the establishment of the fact that copper mixtures prepared and applied as above recommended may be used in treating celery diseases with no fear of poisonous results. Samples of sprayed celery, stripped and prepared as for market, were submitted to the Chemist for analysis. The results of the analyses appear in the following table. Column I gives the material used in spraying; column II gives the average weight of dry substance per head; column III gives the number of treatments; column IV gives the per cent. of metallic copper found in the dry substance. When copper sulphate is prescribed by physicians as a tonic or astringent, the dose is from one-fourth grain to two grains. If the copper were in the celery in the form of sulphate, column V shows how many heads of celery, like the samples analyzed, it would be necessary to eat in order to get a tonic dose; column VI shows the number of heads it would be necessary to eat to get a serious, but not necessarily fatal, dose.

TABLE SHOWING THE PER CENT. OF METALLIC COPPER IN SPRAYED AND UNSPRAYED CELERY PLANTS.

I. MATERIAL USED IN SPRAYING.	II. Number of sprayings.	III. Grams of dry substance per head.	IV. Per cent. of metallic copper found in dry substance.	V. Number of heads of celery necessary for a tonic dose, estimating copper as sulphate.	VI. Number of heads necessary for a serious dose.
Bordeaux mixture (3 pounds copper sulphate, 2 pounds lime and 22 gallons of water)	2	5.08	0.00049	166 to 1,328	66,400
Ammoniacal solution of copper carbonate (5 oz. carbonate, 3 pints 26 deg. ammonia and 50 gallons of water)	3				
Ammoniacal solution of copper carbonate (formula as above).	10	3.50	0.00048	249 to 1,992	99,600
Ammoniacal solution of copper carbonate (formula one-half strength given above)	10	4.00	0.00042	249 to 1,992	99,600
Ammoniacal solution of copper carbonate (formula one-half strength given above)	3	7.83	0.00064	83 to 664	33,200
Unsprayed	0	8.93	0.00081	57 to 456	22,800
Bordeaux mixture (2 pounds sulphate, 1⅓ pounds of lime and 22 gallons water)	2	5.83	0.00100	71 to 568	28,400
Ammoniacal solution of copper carbonate (formula one-half strength given above)	1				
Bordeaux mixture (formula as above)	2	5.17	0.00193	41 to 332	16,600
Potassium sulphide (1 oz. to 2 gallons water)	8				
Potassium sulphide (formula as above)	3	3.83	0.00173	62 to 496	24,800
Potassium sulphide (formula as above)	10	1.90	0.00263	83 to 664	33,200
Muck soil unsprayed	0	......	0.00001	....	....

It should be noted that the unsprayed plants used for these analyses were taken from the field a few weeks later than the sprayed plants, and also that they were of a larger variety. The presence of copper in the unsprayed soil furnishes sufficient explanation for the presence of the small amounts of copper found in the untreated celery. No explanation is offered for the fact that in every instance where the celery was sprayed with potassium sulphide, analysis of the plants showed more than the average amount of copper in the plant.

These investigations show that when this sprayed celery was stripped and ready for market the sprayed plants were no more poisonous than the unsprayed. Were the copper present in the plant as sulphate it would be impossible for any man to eat enough of it to get even an astringent dose. We may therefore conclude that Bordeaux mixture or ammoniacal solution of copper carbonate prepared according to the formulae advocated on previous pages may be sprayed on celery before banking the plants without any fear of poisonous results.

Recapitulating the results of the investigations of celery leaf spot diseases as herein set forth it may be stated that:

1. Copper mixtures may be used as herein recommended with no fear of poisonous results.

2. Celery Septoria attacks the seed as well as the foliage.

3. The season's experiments indicate that Bordeaux mixture is to be preferred in treating celery for the Septoria.

It is recommended:

1. That diseased seed be rejected.

2. That plants be thoroughly treated with Bordeaux mixture in the seed bed.

3. That the treatment with Bordeaux mixture be continued from transplanting time to blanching time if there is reason to anticipate attacks of leaf spot.

4. That the refuse of a diseased crop be not allowed to rot on the ground if celery is to be grown there the following year.

Variety Tests of Apples.

The varieties of apples thus far received at this Station for testing have, with few exceptions, been top worked on young bearing trees of Baldwin or Rhode Island Greening. In a few cases they were top-worked on some other variety and in several instances root-grafted or budded trees of the variety to be tested were planted. Many old varieties have been admitted to the orchards for the sake of comparison with the newer sorts.

This top-working of varieties received at the Station for testing was begun in 1883 and since then has been continued at intervals till at the present time there are three hundred and ninety-six varieties of applies and twenty-two varieties of crab-apples growing in the Station orchards, making a total of four hundred and eighteen varieties. Many of the kinds first introduced are now bearing from a few fruits to three or four bushels per tree. Notes on a few of these varieties are given below. It should be remembered that this report does not pretend to make a final statement as to the merits of these varieties, but simply shows their record thus far at this Station. Undoubtedly in some localities some of them will do better than they have done here, in other places they may not do so well as they have done here. As the trees become older, it will be possible to make more extended reports and to include new features that may be brought out by the data constantly accumulating in the Station's annual records.

NOTES ON VARIETIES.

Acuba-leaf Reinette, *Reinette a feuille d'Acuba* — In 1883 cions of this variety from Messrs. Ellwanger & Barry, Rochester, N. Y., were set in a young bearing tree. Five years afterwards it bore a few fruits and this season (1892) it produced a full crop of fine apples. Fruit medium or above, oblong, inclined to conical; calyx nearly closed, set in a moderately broad, shallow, corrugated basin; stem slender, set in a deep cavity; skin smooth, yellow, largely covered with deep blush and splashes of red; flesh yellowish white, tender, breaking, mild subacid; quality good to very good. Season, October to December.

ANANARNOE.—A Russian apple planted at the Station in 1884. The stock was furnished by Ellwanger & Barry, Rochester, N. Y. The few specimen fruits borne this year, 1892, may be described as follows: Fruit medium, nearly round, symetrical; calyx open, in a wide, corrugated basin; stem slender, set in a deep narrow cavity; skin smooth, yellow, nearly covered with stripes and splashes of beautiful red; flesh white, coarse, subacid, nearly good in flavor and quality. Season, September.

COUNT ORLOFF.—A Russian apple planted at the Station in 1884. The stock was furnished by Ellwanger & Barry, Rochester, N. Y. The few fruits borne this year, 1892, barely ripened before they became watercored and worthless. Season, August.

GRAND SULTAN.—A Russian apple, received from Ellwanger & Barry. Top-worked on a bearing tree in 1883, it has made a vigorous growth and this year, 1892, bore a large crop. Also the stock planted in 1884 bore a comparatively good crop. Season, August to September. Like the Count Orloff, this fruit, when ripening, is apt to become watercored and worthless.

JEFFRIS.—A well-known September apple, of excellent quality; a moderate grower and very productive. It seems to be peculiarly subject to the scab (*Fusicladium*) though not so much so as is the Fameuse.

JERSEY SWEETING.—A well-known variety that begins to ripen the last of August. Fruit greenish yellow, sometimes nearly covered with pale, dull red. It seems to be even more susceptible to attacks of the scab (*Fusicladium*) than the Jeffris.

LORD SUFFIELD.—An English apple valuable for culinary use. Fruit medium to large, conical, greenish yellow. Tree productive but in the Station orchard it has blighted badly for several years, notwithstanding all efforts to keep the blighted limbs cut out, and it is doubtful whether it will survive another season.

No. 225, DEPT.—A Russian apple, of United States Department of Agriculture importation, received in 1888 from Merrill, Anthony & Co., Geneva, N. Y., and top-worked on a bearing tree. The first specimens of fruit were borne this season, and may be described as medium in size, greenish yellow, slightly blushed on one side;

flesh not coarse, moderately juicy, pleasant flavored, sweet, good quality. Begins to ripen early in September.

TETOFSKY.—A Russian apple of upright, slow growth, very hardy and productive. It begins to ripen about the first of August and is excellent for culinary use.

WORKAROE.—A Russian apple planted in the Station orchard in 1884. The stock was received from Ellwanger & Barry, Rochester, N. Y. The few specimen fruits borne this year, 1892, may be described as follows: Fruit medium to large, inclined to conical, sides unequal; calyx nearly closed, set in broad, moderately shallow basin; stem short, set in a deep narrow cavity; flesh firm, juicy, subacid, with an agreeable flavor; quality good. Begins to ripen about the first of September.

AT WHAT AGE DO APPLE TREES BEGIN TO FRUIT?

People who are planning to plant apple trees frequently ask how long a time must elapse after planting before the trees will begin to bear. The question can not be definitely answered because the bearing age, even with the same variety, differs in different locations and under different methods of treatment. As a contribution to our knowledge in this direction the following table is given. It shows the number of years that elapsed after the different varieties were planted or top-grafted in the Station orchards before the first specimens of fruit were produced:

Apples.—Age when first specimens of fruit were borne.

	Top-worked, years.	Planted, years.		Top-worked, years.	Planted, years.
Acuba-leaf Reinette	4		Chenango Strawberry	5	
Alexander	8		Cooper's Market	5	
Amasia*	9		Count Orloff		8
Ananarnoe		8	Cox's Pomona	2	
Astravskoe		4	Czar's Thorn		8
Aunt Ginnie	4		Domine	5	
Baldwin	8		Duchess of Oldenburg	2	
Belborodooskoe*		8	Duke of Devonshire	9	
Ben Davis	4		Dumelow	5	
Berkoff*		8	Early Harvest	4	
Birth*	9		Early Strawberry*	9	
Brownlee's Russet	4		Esopus Spitzenburgh,	9	
Carolina June	4		Fallawater	5	

* Has not fruited yet.

Apples.—Age, etc.—(Continued.)

Variety	Top-worked, years.	Planted, years
Fall Pippin	9	....
Fameuse	5	....
Gideon	4	....
Golden Russet	9	....
Golden Sweet	9	....
Grand Duke Constantine*	......	8
Grand Sultan	9	8
Gravenstein	8	....
Green Newtown Pippin	5	....
Groskoe Selenka Gruner	3	8
Haas	2	....
Hurlbut	5	....
Jefferis	4	....
Jersey Sweeting	4	....
Kalkidouskoe	......	8
Karabowka	......	1
Keswick	3	....
King of Tompkins County	5	....
Lady Henniker	9	....
Lady Sweet	9	....
Longfield	4	....
Lord Suffield	3	....
Maiden's Blush	4	....
McMahon's White	4	....
Melon	4	....
Menagère*	9	....
Monmouth	5	....
Mother	9	....
Munson's Sweet	5	....
Northern Spy*	9	....
No. 7 (Gideon)	4	....
No. 226 (Russian)	4	....
Occident	9	....
Ontario	9	....
Peck's Pleasant	7	....
Pewaukee	5	....
Pomme Grise	5	....
Primate	3	....
Pumpkin Russet	9	....
Pumpkin Sweet	9	....
Rambo*	9	....
Rawle's Janet	5	....
Red Astrachan	5	....
Red Beitigheimer	8	....
Red Russet	9	....
Red Transparent	......	3
Reinette de Caux	9	....
Repka	......	4
Rhode Island Greening	5	....
Rome Beauty	2	....
Roxbury Beauty	5	....
Saint Lawrence	9	....
Small's Admirable	4	....
Sops of Wine	5	....
Stump	7	....
Sutton's Russet	9	....
Talman's Sweet	8	....
Tetofsky	4	....
Titouka	9	....
Tufts	5	....
Twenty Ounce	5	....
Vandevere	5	....
Wagener	4	....
Washington Royal	4	....
Westfield Seek-no-further	9	....
White Pippin	5	....
William's Favorite	3	....
Winesap	5	....
Workaroe	......	8
Yellow Bellflower	9	....
Yellow Transparent	4	....

With nursery trees planted in the Station orchards when two or three years old the first specimens of fruit have seldom been produced in less than eight years, the average time for fourteen varieties, being 6.57 years. The varieties grafted on bearing trees, as might be expected, have commonly borne their first specimens of fruit sooner than have the planted varieties, and also have pro-

* Has not fruited yet.

duced full crops sooner than have the planted trees. With seventy-nine varieties top-worked on bearing trees the average length of time after top-working before the first fruits were produced has been 5.72 years. The average number of years between top-working and fruiting is shown for each class in the following table:

Number of varieties averaged.	CLASS.	Average number years between top-working and fruiting.
9	Early summer	4.44
6	Summer	3.66
11	Early fall	5.82
15	Fall	5.87
10	Early winter	5.70
21	Winter	6.47
7	Late winter	6.43

It is interesting to note that in this table the average number of years between top-working and fruiting is least with the early summer and summer apples; it increases pretty constantly with early fall, fall and early winter varieties and is greatest with the winter sorts.

Some nurserymen hold the opinion that summer pears are more apt to bear in the nursery row than are winter pears. It has also been remarked that early cling peaches, like Amsden, Alexander and Waterloo begin fruiting at a very early age. From such limited data it would be unwise to draw general conclusions, yet in spite of many individual exceptions there seems to be considerable evidence to support the opinion that as a class early orchard fruits come into bearing at an earlier age than do the late varieties as a class.

Yield of Apples in 1892.

The following table compares the yield of the different varieties of apples that fruited at the Station in 1892, shows the orchard age of the trees and at the same time indicates which of the trees were planted and which were top-worked on bearing stock. Since the trees are not all of the same orchard age and since many varieties are just beginning to bear, the orchard age of each variety is given in the following table for the sake of comparison:

TABLE SHOWING (1) YIELD OF APPLES IN 1892; (2) NUMBER OF YEARS SINCE EACH VARIETY WAS TOP-WORKED ON A YOUNG BEARING TREE, OR SINCE IT WAS PLANTED, AND (3) SEASON OF RIPENING AT GENEVA.

NOTE.—The following abbreviations are used to denote the season of ripening: E. S., for early summer; S., for summer; E. F., early fall; F., for fall; E. W., for early winter; W., for winter; L. W., for late winter.

NAME.	Yield in 1892.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Acuba-leaf Reinette	Very large.	9	....	E. W.
Alexander	Good	9	....	F.
American Newtown Pippin, see Green Newtown Pippin				
Ananarnoe	Few	8	....	E. F.
Aporta, see Alexander				
Aunt Ginnie	Few	9	....	E. F.
Aurora, see Twenty Ounce				
Baltimore Pippin, see Ben Davis				
Baltimore Red, see Ben Davis				
Baltimore Red Streak, see Ben Davis.				
Belle Fleur, see Yellow Bellflower				
Bell's Early, see Sops of Wine				
Ben Davis	Very large.	9	....	L. W.
Bennington, see Sops of Wine				
Boston Russet, see Roxbury Russet.				
Brooke's Pippin, see Green Newtown Pippin				
Brownlee's Russet	Few	9	....	W.
Brown's Golden Sweet, see Talman Sweet				
Buckley, see Chenango Strawberry				
Canada Pippin, see White Pippin				
Carolina June	Fair	9	....	S.
Carolina Red Streak, see Ben Davis.				
Cayuga Red Streak, see Twenty Ounce				
Cheat, see Domine				
Chenango Strawberry	Good	9	....	S.
Cling Tight, see Domine				
Coleman, see Twenty Ounce				
Cooper's Redling, see Cooper's Market				
Cooper's Market	Very large.	9	....	W.

TABLE SHOWING THE YIELD OF APPLES IN 1892, ETC.—(*Continued*).

NAME.	Yield in 1892.	Years since top-worked on bearing tree.	Years since tree was planted	Season at Geneva.
Count Orloff	Few	....	8	E. S.
Cox's Pomona	Good	9	....	E. F.
Czar's Thorn	Few	....	8	E. F.
Dodge's Early Red, see Sops of Wine	....	....	....	....
Domine	Few	9	....	L. W.
Duchess of Oldenburg	Good	9	....	S.
Duke of Devonshire	Large	9	....	W.
Dumelow	Very large	9	....	W.
Dumelow's Seedling, see Dumelow	....	....	....	....
Early French Reinette, see Early Harvest	....	....	....	....
Early Harvest	Fair	9	....	E. S.
Early Ripe	Few	4	....	E. S.
Emperor Alexander, see Alexander	....	....	....	....
English Golden, see Golden Russet	....	....	....	....
English Golden Russet, see Golden Russet	....	....	....	....
English Pippin, see Longfield	....	....	....	....
English Red Streak, see Domine	....	....	....	....
Esopus Spitzenburg	Few	9	....	W.
Fallawater	Good	9	....	E. W.
Fall Queen, see Haas	....	....	....	....
Fall Pippin	Good	9	....	F.
Fall Wine	Fair	9	....	F.
Fameuse	Fair	9	....	F.
Flint Russet, see Pumpkin Russet	....	....	....	....
Frank, see Chenango Strawberry	....	....	....	....
Gardener's Apple, see Mother	....	....	....	....
Gideon	Few	4	....	F.
Gillett's Seedling, see Rome Beauty	....	....	....	....
Golden Russet	Fair	9	....	L. W.
Grand Sultan	Good	....	8	E. S.
Gravenstein	Fair	9	....	F.
Gray Apple, see Pomme Grise	....	....	....	....
Green Newtown Pippin	Few	9	....	L. W.
Green Winter Pippin, see Green Newtown Pippin	....	....	....	....
Green Vandevere, see Vandevere	....	....	....	....
Groskoe Selenka Gruner	Few	....	8	E. S.
Groskoe Selenka Gruner	Very large	9	....	E. S.
Gros Pomier, see Haas	....	....	....	....
Haas	Fair	9	....	F.

TABLE SHOWING THE YIELD OF APPLES IN 1892, ETC. — (*Continued*).

NAME.	Yield in 1892.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Hogan, see Domine	....	....	....	.....
Hominy, see Sops of Wine	....	....	....	.....
Hoss or *Horse*, see Haas	....	....	....	.....
Hower or *House*, see Fall Wine	....	....	....	.....
Howe's Russet, see Roxbury Russet	....	....	....	.....
Hurlbut	Good	9	....	E. W.
Hurlbut Stripe, see Hurlbut	....	....	....	.....
Jackson Apple, see Chenango Strawberry	....	....	....	.....
Jefferis	Good	9	....	S.
Jeniton, see Rawle's Janet	....	....	....	.....
Jenette, see Rawle's Janet	....	....	....	.....
Jersey Sweeting	Good	9	....	S.
July Apple, see Primate	....	....	....	.....
July Pippin, see Early Harvest	....	....	....	.....
Kalkidouskoe	Few	...	8	E. F.
Kentucky Pippin, see Ben Davis	....	....	....	.....
Keswick	Good	9	....	E. F
King Apple, see King of Tompkins County	....	....	....	....
King of Tompkins County	Fair	9	....	E. W
Lady Henniker	Good	9	....	E. W.
Lady Sweet	Fair	9	....	L. W.
Lady Washington, see Yellow Bellflower	....	....	....	.....
Large White Juneating, see Early Harvest	....	....	....	....
Lima, see Twenty Ounce	....	....	....	.....
Longfield	Fair	4	....	E. W.
Lord Suffield	Few	9	....	S.
Lyman's Pumpkin Sweet, see Pumpkin Sweet	....	....	....	.....
Maiden's Blush	Fair	9	....	F.
Marietta Russet, see Roxbury Russet	....	....	....	
Maryland Queen, see Haas	....	....	....	
McMahan's White	Few	4	....	E. W.
Melon	Few	9	....	W.
Molly Whopper, see Fallawater	....	....	....	.....
Monmouth	Good	9	....	W.
Morgan's Favorite, see Twenty Ounce	....	....	....	.....
Mother	Fair	9	....	E. W.
Mountain Pippin, see Fallawater	....	....	....	.....

TABLE SHOWING THE YIELD OF APPLES IN 1892, ETC. — (*Continued*).

NAME.	Yield in 1892.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Munson's Sweet	Fair	9	....	F.
Musk Spice, see Fall Wine	....	....	....	.....
Neverfail, see Rawle's Janet	....	....	....	.....
Newtown Pippin, see Green Newtown Pippin	....	....	....	.....
New Brunswick, see Duchess of Oldenburg	....	....	....	.....
New York Pippin, see Ben Davis	....	....	....	.....
North American Best, see Primate	....	....	....	.....
Norton's Melon, see Melon	....	....	....	.....
No. 7 (Gideon)	Few	4	....	E. F.
No. 161 m Russian, see Birth	....	....	....	.....
No. 226 Dept. (Russian)	Few	4	....	E. F.
No. 477 Dept. (Russian), see Birth	....	....	....	.....
Occident	Few	9	....	.....
Ohio Wine, see Fall Wine	....	....	....	.....
Oldenburg, see Duchess of Oldenburg	....	....	....	.....
Ontario	Very large	9	....	W.
Palmer Greening, see Washington Royal	....	....	....	.....
Peck's Pleasant	Few	9	....	E. W.
Petersburgh Pippin, see Green Newtown Pippin	....	....	....	.....
Pewaukee	Few	9	....	W.
Pomme Grise	Few	9	....	E. W.
Pommeroy, see Lady's Sweet	....	....	....	.....
Pound, see Fallawater	....	....	....	.....
Pound Sweet, see Pumpkin Sweet	....	....	....	.....
Powers, see Primate	....	....	....	.....
Primate	Fair	9	....	E. S.
Prince's Harvest, see Early Harvest	....	....	....	.....
Prussian, see Twenty Ounce	....	....	....	.....
Pumpkin Russet	Good	9	....	F.
Pumpkin Sweet	Fair	9	....	F.
Putnam Russet, see Roxbury Russet	....	....	....	.....
Queen Anne, see Mother	....	....	....	.....
Rawle's Janet	Good	9	....	W.
Red Astrachan	Good	9	....	E. S.
Red Cheek Pippin, see Monmouth	....	....	....	.....
Red Pippin, see Ben Davis	....	....	....	.....

TABLE SHOWING THE YIELD OF APPLES IN 1892, ETC.—(*Continued*).

NAME.	Yield in 1892.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Red Russet	Fair	9	....	L. W.
Red Vandevere, see Vandevere	.....	.....	.....	.....
Reinette a feuille d'Acuba, see Acuba-leaf Reinette	.....	.....	.....	.....
Reinette de Caux	Very large	9	....	W.
Reschestwenskoe, see Birth	.....	.....	.....	.....
Rigley, see Cooper's Market	.....	.....	.....	.....
Roa Yon, see Lady's Sweet	.....	.....	.....	.....
Rock Rimmon, see Rawle's Janet	.....	.....	.....	.....
Rome Beauty	Few	9	....	F.
Rough and Ready, see Primate	.....	.....	.....	.....
Roxbury Russet	Good	9	....	W.
Russet Golden, see Golden Russet	.....	.....	.....	.....
Russian Emperor, see Alexander	.....	.....	.....	.....
St. Lawrence	Fair	9	....	E. F.
Sanguineus, see Fameuse	.....	.....	.....	.....
Scott, see Primate	.....	.....	.....	.....
Seek-no-further, see Westfield Seek-no-further	.....	.....	.....	.....
Sharpe's Spice, see Fall Wine	.....	.....	.....	.....
Sherwood's Favorite, see Chenango Strawberry	.....	.....	.....	.....
Sinclaire Yellow, see Early Harvest	.....	.....	.....	.....
Small's Admirable	Large	9	....	F.
Smith's Beauty of Newark, see Duchess of Oldenburg	.....	.....	.....	.....
Smyrna, see Chenango Strawberry	.....	.....	.....	.....
Snow, see Fameuse	.....	.....	.....	.....
Sops of Wine	Fair	9	....	E. S.
Sour Harvest, see Primate	.....	.....	.....	.....
Spitzenburg, see Esopus Spitzenburg	.....	.....	.....	.....
Strawberry, see Chenango Strawberry	.....	.....	.....	.....
Striped R. I. Greening, see Domine	.....	.....	.....	.....
Stump	Fair	9	....	E. F.
Sutton's Beauty	Few	9	....	W.
Sweet Russet, see Pumpkin Russet	.....	.....	.....	.....
Sweet Wine, see Fall Wine	.....	.....	.....	.....
Sylvan Russet, see Roxbury Russet	.....	.....	.....	.....
Talman's Sweet	Fair	9	....	W.
Tart Bough, see Early Harvest	.....	.....	.....	.....
Tetofsky	Very large	9	....	E. S.

TABLE SHOWING THE YIELD OF APPLES IN 1892, ETC.— (*Concluded*).

NAME.	Yield in 1892.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Titouka	Few	9	....	E. F.
Tompkins County King, see King of Tompkins County				
Tom's Red, see King of Tompkins County				
Tufts	Large	9	....	F.
Tufts Baldwin, see Tufts				
Tulpehocken, see Fallawater				
Twenty Ounce	Fair	9	....	E. F.
Uncle Sam's Best, see Fall Wine				
Vandevere	Good	9	....	F.
Victoria Pippin, see Ben Davis				
Victoria Red, see Ben Davis				
Wagener	Good	9	....	W.
Waltz Apple, see Peck's Pleasant				
Warren Pippin, see Yellow Bellflower				
Warner Russet, see Roxbury Russet				
Washington, see Sops of Wine				
Washington Royal	Few	4	....	L. W.
Watermelon, see Melon				
Westfield Seek-no-further	Fair	9	....	W.
White Pippin	Good	9	....	W.
White Vandevere, see Vandevere				
Wells, see Domine				
William's Early, see William's Favorite				
William's Favorite	Fair	9	....	E. S.
William's Red, see William's Favorite				
Winesap	Fair	9	....	W.
Winter Blush, see Fallawater				
Workaroe	Few	....	8	S.
Yellow Bellflower	Few	9	....	W.
Yellow Harvest, see Early Harvest				
Yellow Transparent	Few	4	....	E. S.
Yellow Vandevere, see Vandevere				
York Russet, see Pumpkin Russet				

Notes on Self-pollination of the Grape.*

The grape has small greenish blossoms, which open in a peculiar and interesting way, protecting the stigmas from outside pollen till they have opportunity to become self-fertilized. The petals of the opening flower form a kind of cap which covers the sexual organs. When the flower begins to open, the petals break away from their attachment at the base, but remain fastened to each other above and thus keep the stigma and anthers covered. The petals finally curve outward and upward from the base and the expansion of the stamens usually lifts and dislodges the cap. The calyx in all *Vitaceæ* is practically obsolete and plays no part in the opening of the flower. In *Cissus* and *Ampelopsis*, which are nearly related to the grape, the petals open at the top and expand in the usual way.

An opening bud is shown in Fig. 17; *a* being a petal just detached at the base, and curved outward, disclosing a portion of a filament *b*, and a portion of the outline of the pistil. Fig. 18

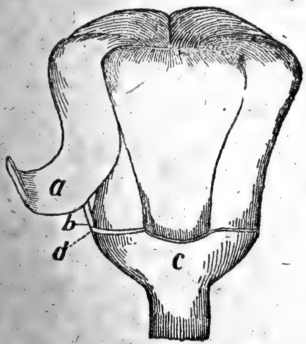

Fig. 17.— Opening bud of grape blossom showing the manner in which the cap becomes loosened at the base.

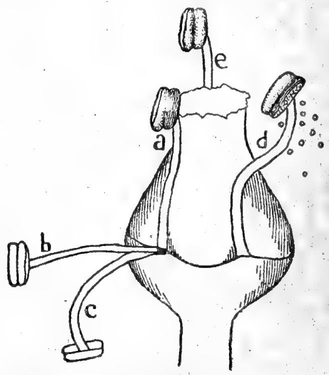

Fig. 18.—Diagramatic illustration of grape stamens.

shows the pistil with the cap removed, and illustrates the expansion of the different forms of stamens. If the flower has short filaments, as at *a*, they become reclined *b* or recurved *c*. If the flower has long filaments *d* they become erect, as at *e*.

* A portion of this paper was read at the Rochester meeting of the American Association for the Advancement of Science, August, 1892.

During the past season a study has been made of many varieties of grapes commonly found in the vineyards and gardens of this State, in order to discover (1) whether self-pollination commonly takes place before the blossoms open, and, if so, (2), whether such pollination is always sufficient to insure the development of perfect clusters of fruit.

Self-pollination occurs before the blossoms open.— The best time for examining grape buds to find out whether self-pollination takes place before the flower opens, is just at the time when dehiscence of the corolla begins. Dehiscence usually begins at the base of one of the sepals and extends upwards half or two-thirds of its length. The straightening up of the stamens if they have long filaments, or the reclining or recurving of the stamens, if they have short filaments, afterwards dislodges the corolla, or cap as it is frequently called, and carries it upwards and to one side, thus uncovering the stigma. Occasionally the filaments fail to perform this work and the cap persists for an indefinite period, as a withered covering on the apex of the young fruit.

The anther cells are already opened when dehiscence begins, but the pollen has not yet been discharged from them. The dehiscence of the corolla allows the moisture to escape and the pollen becoming somewhat dry, is discharged abundantly on the pistil before the cap is displaced, thus insuring self-pollination before the stigma is exposed to the access of foreign pollen.

Self-pollination before the flowers opened was observed in the vines named below. When it is said that the observations were made before the flowers open it is meant, as explained above, that dehiscence had begun, but that no petals had loosened from their attachment at their base, and therefore it is correct to say that the observations were made before the flowers opened.

List of grapes in which self-pollination was observed before the flowers opened:

I. VITIS LABRUSCA, L., cultural varieties.
- Adirondack.
- Catawba.
- Concord.*
- Cottage.

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* See also annual report this Station, 1885, p. 253.

VITIS LABRUSCA, L., cultural varieties — (*Continued*).

Diamond.
Grayson.
Hartford.
Hayes.
Iona.
Isabella.
Jefferson.
Jennie May. See Concord.
Lady.
Maxatawney.
Moore's Early.
Niagara.
Pocklington.
Prentiss.
Telegraph.
Vergennes.
Winchell.
Worden.
Two typical wild vines transplanted to the vineyard.

Total V. LABRUSCA 23

II. VITIS VULPINA, L. (RIPARIA of Michaux), cultural varieties.

Clinton.
Marion.

Total V. VULPINA.................................... 2

III. VITIS ÆSTIVALIS, Mx.

Typical wild vine transplanted to the vineyard.

Total V. ÆSTIVALIS.................................... 1

IV. VITIS SOLONIS, Sou.

Typical wild vine transplanted to the vineyard.

Total V. SOLONIS 1

V. VITIS CHAMPINI, Planch.

Typical wild vine transplanted to the vineyard.

Total V. CHAMPINI.................................... 1

VI. VITIS DOANIANA, Mun.

Typical wild vine transplanted to the vineyard.

Total V. DOANIANA 1

VII. VITIS RUBRA, Mx.

Typical wild vine transplanted to the vineyard.

Total V. RUBRA.................................... 1

VIII. VITIS VINIFERA, L., cultural variety.*

Black St. Peters.

Total V. VINIFERA 1

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* In several other varieties of *vinifera* self-pollination has been observed before the flowers open. See Gard. Chron., 1871, p. 737; cf. also ibid. p. 1098.

IX. HYBRIDS OF LABRUSCA AND VINIFERA.

a. Varieties one-half *Labrusca* and one-half *vinifera.*

Massasoit, *Rogers No.* 3.
Wilder, *Rogers No.* 4.
Rogers No. 5.
Lindley, *Rogers No.* 9.
Gaertner, *Rogers No.* 14.
Agawam, *Rogers No.* 15.
Requa, *Rogers No.* 28.
Barry, *Rogers No.* 43.
Black Eagle.
Burnet.
Eumelan.
Highland.
Mills.
Senasqua.
Triumph.

Total.. 15

b. Varieties more than one-half *Labrusca.*

Brighton.
Centennial.
Duchess.
Eldorado.
Lady Washington.

Total.. 5

c. Other hybrids of *Labrusca* and *vinifera.*

Ambrosia.
Hercules.
Geneva.

Total.. 3

Total hybrids, *vinifera* and *Labrusca*........................ 23

X. HYBRIDS OF LABRUSCA AND BOURQUINIANA.

Delaware.
Nectar.
Olita.
Poughkeepsie Red.
Roscoe.

Total.. 5

XI. HYBRIDS OF LABRUSCA AND VULPINA.

Beagle.
Canonicus.
Early Market.
Elvibach.
Elvira.
Empire State.
Etta.
Missouri Riessling.
Profitable.

Total.. 9

XII. HYBRID OF ÆSTIVALIS AND LABRUSCA.
Rutland.
Total 1

XIII. HYBRIDS OF VULPINA AND VINIFERA.
Amber Queen.
Canada.
Total 2

XIV. HYBRID OF CANDICANS, VULPINA AND LABRUSCA.
Elvicand.
Total 1

XV. CULTURAL VARIETIES OF UNKNOWN PARENTAGE.
Caywood, No. 50.
Herald.
Little Blue.
Unknown (Labrusca or hybrid of Labrusca and ?)
Total 4

Total vines of all species and varieties 76

The total number of individuals in which self-pollination was observed is seventy-six, distributed among eight species, with their hybrids and crosses. Several other varieties were examined without being able to demonstrate that self-fertilization occurred before the blossoms opened, but in no case was this true, when buds could be found at the proper stage of development above noted, viz., just beginning dehiscence. In every instance when buds could be found in the right stage of development, it was found that self-pollination occurred before the cap was displaced sufficiently to allow the access of foreign pollen.

Why Some Grapes Fail To Set Perfect Clusters.

With the varieties of grapes named in the above list any failure of the blossoms to set fruit can not be attributed to lack of self-pollination. It is well known that several of these varieties when grown by themselves, that is, with no other variety near by, set fruit imperfectly, but this failure can not be attributed to a deficient amount of pollen produced, for in none of these varieties was a deficiency in the pollen supply observed. Possibly the failure may result from the discharge of the pollen before the stigma is receptive, that is, before the surface of the stigma is ready to receive it; but probably it is due to the impotency of the pollen on the pistil of the same flower. In either case the remedy would be the same, namely, the growing of vines of other varieties in proximity to these self-sterile kinds, to supply them with pollen of a congenial kind at the proper season. Fig. 19 illustrates the result of a lack of proper pollination in two clusters of the Lindley grape.

The self-fertility of several varieties was tested by inclosing clusters of grapes in paper bags before the blossoms opened, and allowing them to remain covered until the blossoming period had passed. This effectually shut out foreign pollen and made it possible for the stigmas to be pollenized only by stamens of the same flower or of the same cluster. In this way it was found that several of the varieties experimented with are unable to set fruit unless furnished with other pollen than that produced by themselves; other varieties set fruit imperfectly when supplied only with their own pollen, while still others treated in the same way produce perfect or nearly perfect clusters of fruit.

Good sized clusters of blossoms were selected for the experiments whenever practicable, and it is estimated that the average number of flowers per cluster was more than fifty, so that from 100 to 500 blossoms were used for each variety under experiment. The results of these tests are given below. In order to indicate the degree of self-fertility, as shown by these experiments, the varities are designated as "fully self-fertile," "partly self-fertile," "pollen self-irritant," or "pollen impotent," as the case may be.

With those which are designated as "fully self-fertile," from 97 per cent to 100 per cent of the blossoms developed into fruit.

With those designated as "partly self-fertile," the number of flowers which produced fully developed fruit varied from none to 97 per cent.

Those varieties which set fruit that soon dropped or that persisted throughout the season in a dwarfed and abortive state, are designated as having "pollen self-irritant," meaning that in these cases self-pollination incites a slight growth of the ovary, but is unable to cause the development of perfect fruit.

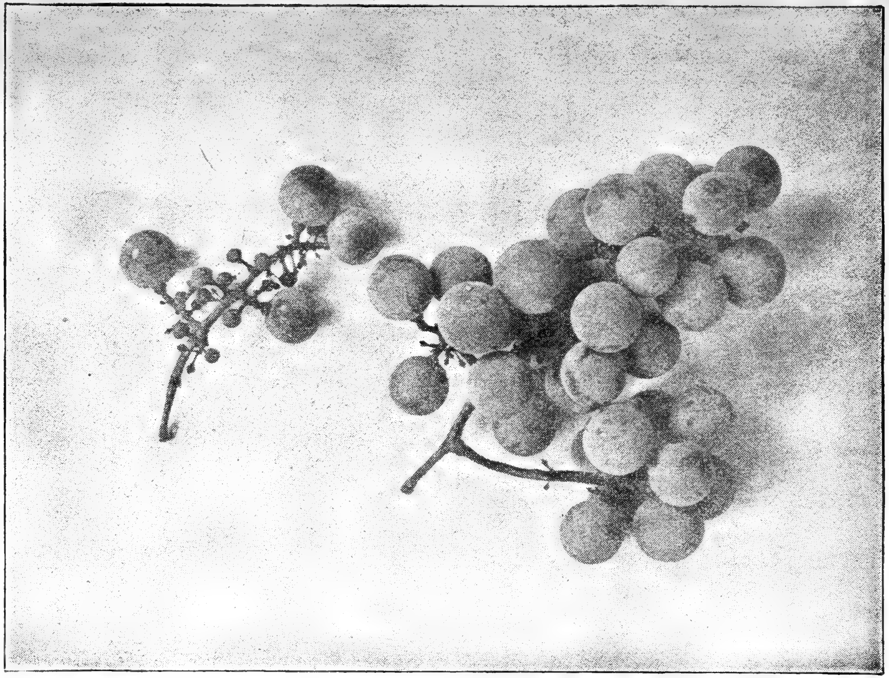

Fig. 19.—Clusters of Lindley grape. The abortive fruits result from the lack of proper pollination.

The fourth class is designated by the words "pollen self-impotent," meaning that self-pollination is unable to incite any apparent development of the ovaries.

List of Grapes Tested as to Self-fertility.

I. *V. Labrusca.* Cultural varieties.

1. Concord.—Ten clusters bagged. "Partly self-fertile," almost "fully self-fertile."
2. Diamond.—Two clusters bagged. "Fully self-fertile."
3. Niagara.—Ten clusters bagged. "Fully self-fertile."
4. Winchell.—Ten clusters bagged. "Fully self-fertile."

Total 4

II. Hybrids one-half *Labrusca* and one-half *vinifera.*

1. Massasoit, *Rogers No.* 3.—Two clusters bagged. "Pollen self-irritant."
2. Wilder, *Rogers No.* 4.—Two clusters bagged "Pollen self-irritant."
3. Rogers No. 5.—Two clusters bagged. "Pollen self-irritant."
4. Rogers No. 13.—Two clusters bagged. "Fully self-fertile."
5. Gaertner, *Rogers No.* 14.—Two clusters bagged. "Pollen self-irritant."
6. Agawam, *Rogers No.* 15.—Ten clusters bagged. "Partly self-fertile; a large per cent of the flowers developed into fruit."
7. Merrimac, *Rogers No.* 19.—Two clusters bagged. "Pollen self-irritant."
8. Rogers No. 24.—Two clusters bagged. "Fully self-fertile."
9. Requa, *Rogers No.* 28.—Two clusters bagged. "Pollen self-irritant."
10. Rogers, No. 32.—Two clusters bagged. "Fully self-fertile."
11. Aminia, *Rogers No.* 39.—Two clusters bagged. "Pollen self-irritant."
12. Essex, *Rogers No.* 41.—Two clusters bagged. "Pollen self-irritant."
13. Barry, *Rogers No.* 43.—Two clusters bagged. "Pollen self-impotent."
14. Herbert, *Rogers No.* 44.—Two clusters bagged. "Pollen self-irritant."
15. Salem, *Rogers* 53.—Ten clusters bagged. "Pollen self-impotent," possibly "self-irritant" to some extent.
16. Black Eagle.—Two clusters bagged. "Pollen self-irritant."
17. Eumelan.—Ten clusters bagged. "Pollen self-irritant."

Total 17

III. Hybrid of *Labrusca* and *vinifera,* less than one-half *vinifera.*

1. Brighton.—Ten clusters bagged. "Pollen self-irritant."

Total 1

IV. Hybrid of *Bourquiniana* and *Labrusca.*

1. Delaware.—Ten clusters bagged. "Fully self-fertile."
Total 1

V. *Vitis æstivalis.*—Typical wild vine transplanted to the vineyard. Five clusters bagged. "Fully self-fertile."
Total 1

VI. *Vitis Doaniana.*—Typical wild vine transplanted to the vineyard. Two clusters bagged. "Pollen self-irritant."
Total 1

Of the four varieties purely *Labrusca*, three were found to be fully self-fertile and the fourth was nearly so. Its clusters would commonly be called "loose" but not imperfect.

Of the eighteen hybrids of *Labrusca* and *vinifera* three were fully self-fertile, and these three had long filaments. Whether self-pollination occurred before the blossoms opened was not noted. Another one, though not fully self-fertile still developed a large per cent of the ovaries into perfect fruit. It has short filaments. Self-pollination occurs before its blossoms open.

Eleven had pollen self-irritant only, i. e., the ovaries started to develop, but soon fell away or persisted as abortive fruits. Ten of these have short filaments, and one has long filaments. Self-pollination was observed with seven of this class. Whether it occurred with the other four can not be stated.

One proved to have "pollen impotent," i. e., the ovaries were not incited to any perceptible growth. It has short filaments and self-pollination occurs before the blossoms open.

One hybrid of *Labrusca* and *vinifera* less than one-half *vinifera*, had pollen self-irritant only. It has short filaments.

With the eighteen hybrids of *Labrusca* and *vinifera* above noted, only those varieties having long filaments can develop fruit when only self-fertilized, but not all which have long filaments can develop fruit when only self-fertilized. In every instance the vines with short filaments were really pistillate, since they failed to develop fruit when only self-fertilized. According to Munson,* in all species of *Vitis*, wild vines having pistillate flowers with short recurved stamens are almost always practically

* In a personal letter.

abortive, unless the flowers are supplied with pollen from hermaphrodite or from staminate blossoms, each to be found on some other vine, as no vine ever produces flowers of different sexual characters.* Rarely has he found vines with pistillate flowers and short stamens that were capable of self-fertilization, and in such cases the flowers appeared semi-hermaphrodite.

The following observations were also made:

1. A specimen of *æstivalis* transplanted to the vineyard has long filaments and proves to be fully self-fertile.

2. Vitis *Doaniana*, as represented by a specimen transplanted to the vineyard, has pollen self-irritant only, and fails to fruit when self-fertilized.

3. The Delaware, classed doubtfully as hybrid of *Bourquiniana* and *Labrusca* has long filaments and is fully self-fertile.

4. Pollen that is self-impotent only, or self-irritant only, may prove fully potent on other varieties. This was the case this season with Merrimac (Rog. 19), which has fertilized *V. Solonis*, and with Eumelan, which has fertilized Clinton.

Grapes Unfruitful when Standing Alone.

These experiments show that under the conditions of soil and climate found at this Station the following varieties may be expected to prove unfruitful when planted by themselves, out of the reach of pollen from other varieties:

Black Eagle.
Brighton.
Eumelan.
Massasoit (*Rogers No.* 3).
Wilder (*Rogers No.* 4).
Rogers No. 5.
Gaertner (*Rogers No.* 14).
Merrimac (*Rogers No.* 19).
Requa (*Rogers No.* 28).
Aminia (*Rogers No.* 39).
Essex (*Rogers No.* 41).
Barry (*Rogers No.* 43).
Herbert (*Rogers No.* 44).
Salem (*Rogers No.* 53).

* Observations on cultural varieties in the Station vineyard shows that staminate flowers and perfect flowers may occur on the same vine, though this is rarely the case.

GRAPES FRUITFUL WHEN STANDING ALONE.

The following varieties were found able to set fruit of themselves:

Concord.
Diamond.
Niagara.
Winchell (*Green Mountain*).
Rogers No. 13.
Agawam (*Rogers No.* 15).
Rogers No. 24.
Rogers No. 32.
Delaware.

The Effect of Rainfall upon Pollination—Note on Preliminary Experiments.*

The disastrous effects of excessive rainfall at blooming time upon the "setting" of fruit has long been admitted by fruit growers but few experiments, so far as we are aware, have been made to prove this long-accepted belief.§

The following is a brief account of two preliminary experiments made with the purpose of throwing light upon this question. The season being well advanced before it was possible to arrange for the experiments, the tests are upon a small scale and the results can not be said to prove conclusively anything in regard to the subject.

The plants experimented with consisted of two Duchess grapevines and two Mount Vernon pear trees. Of the condition of the experimental plants previous to 1892 we are not able to state definitely, but to all appearances all were equally healthy. The writers are aware that the lack of definite knowledge of the previous condition of the plants might lead to erroneous conclusions, but they present this note as a purely preliminary one and hope to repeat and extend the experiments the following season.

In order to produce an artificial rainfall a Vermorel nozzle, attached to an ordinary garden hose connected with the hydrant, was used. The nozzle was thrust among the leaves of the pear tree and while it did not always keep every part of the treated plant wet down, the foliage was decidedly moist during the

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* This paper, by D. G. Fairchild and the Station Horticulturist, was presented at the Chicago meeting of the American Horticultural Association, 1892. Inasmuch as the data on which it is based were secured by experiments at this Station, it is thought best to include it in this report.

§ That of Dr. B. D. Halsted, published in the 1890 report of N. J. Expt. Station, pp. 330 to 332, is all we are cognizant of.

greater part of the period of treatment. With the grape, on the other hand, the spray was directed so as to cover completely the whole vine. The temperature of the water used was one and seven-tenths degrees Fahr. warmer than rain water coming from the eaves, both being tested at the same time. The water was from a reservoir fed by springs.

EXPERIMENT WITH MOUNT VERNON PEAR TREE.

On May sixteenth, two Mount Vernon pear trees, apparently of equal vigor, standing within 100 feet of each other, were selected. Into one was thrust the Vermorel nozzle with its broad fine spray. The tree was about twenty-five feet high and the spray from the nozzle did not entirely cover it, in fact the original design, soon abandoned, was to wet only one-half of the tree and leave the other half dry. At the inauguration of the experiment, only a few blossoms had opened upon either tree, and, as no insects had been busy about the fruit trees, owing to the cold weather immediately preceding, no risk from previous pollination was run.

The water was turned on at noon of May sixteenth, and kept running (except from 10 a. m. of the twenty-first, to 10 a. m. of the twenty-third, during an almost constant rain-storm precipitating .72 of an inch of water), until 3 p. m. of the twenty-fifth. The total length of time in which the tree was kept wet was 219 hours, or nine days and three hours.

Effect on flowers.— On May seventeenth, after the tree had been under the spray twenty-four hours, an examination was made of the stigmas of many of the flowers and they were found to be dusted with pollen, although no insects had been seen about the tree. Pollen was taken from fresh anthers on the 21 (the fifth day), and placed in weak sugar solution, to test its germinative power. It proved to be perfectly capable of germination. The flowers at this time presented a curious appearance. The anthers of the innermost stamens were plump and of their normal pink color, while the outermost ones were swollen and decayed, and contained many disintegrated pollen germs and a few that had evidently been induced to germinate by the excess of moisture. The power of the male elements to withstand long continued moisture was apparently great, for at the close of the experiment, after the rain had ceased, many authers opened and shed an abundance of pollen,* while the anthers of flowers on adjacent trees had withered and fallen several days previously. After turning off the water on the twenty-fifth, an examination with a hand lens was made of flowers on both the side nearest to and that farthest from the spray, with the following result:

Of 403 flowers counted on the side receiving the most water, 103 were possessed of plump anthers and apparently normal stigmas.

Of 303 flowers upon the dryer side, only three were still fresh and capable of fertilization.

The effect of the water in retarding the development of the flowers was strikingly illustrated.

Effect on foliage.—A second effect and one not looked for particularly, was the disastrous effect of the rain upon the foliage of the tree. After the spray had been applied three or four days, the foliage which, up to that time had appeared perfectly normal, assumed gradually a sickly color and became spotted with small irregular grey spots, surrounded by red borders. The petals of the flowers too were affected in a similar way, the spots often assuming a bright rose color. A microscopic examination revealed the presence of no fungus, although the symptoms indicated the attacks of the leaf-blight (*Entomosporium maculatum*, Lev.). While this peculiar spotting was not entirely absent from the untreated tree, upon this it was observable only in small amount. This peculiar sickly foliage has not recovered its green color and at the present writing (September 22) the difference is easily observable from a distance of one hundred yards. The small size of the individual leaves and their reddish coloration mark the tree as decidedly diseased.

Although, as mentioned above, after the spray had been removed many flowers with perfect anthers and pistils remained capable presumably of self-pollination, only one fruit, bearing three seeds was borne by the tree. This was produced about midway between that half, more heavily wet down and that more nearly dry. The unsprayed tree produced a fair crop of normal fruit.

EXPERIMENT WITH DUCHESS GRAPE.

Two vines situated near each other were selected for this experiment. One was left untreated for a check, the other was sprayed for twelve nights and days. Since the Duchess came into blossom later than was anticipated, the sprayed vine was under treatment a week before the check began to bloom. Unavoidably the spray was discontinued before either of the vines were out of blossom. It will, therefore, be seen that the twelve days' treatment did not cover the entire period that the vines were in bloom.

Effect on blossoming.— The first apparent effect of the spray was to retard the opening of the grape blossoms four days, as compared with the blossoming of the check vine. This effect was noticeable during the blossoming period, and the treated vine continued in blossom at least four days longer than the check. Retarding the blossoming period, however, had no perceptible influence on the ripening of the fruit, for the fruit of both vines ripened at the same time.

Effect on foliage.— After a few days' treatment the sprayed vine assumed a paler and less healthy color, but before the close of the season it was impossible to detect any difference in the two vines in this regard.

Effect on pollen.— A microscopic examination made after the spray had been running eleven days failed to disclose any perceptible injury to the pollen. The pollen germs were not disintegrated nor had they germinated, and no difference could be detected between them and pollen grains from the check vine. By its peculiar structure the grape blossom is well adapted to withstand protracted rains without injury to the sexual organs. As shown by one of the writers in a recent paper,* many grapes pollenize their own stigmas before the blossoms open sufficiently enough to allow the entrance of outside pollen, and the Duchess belongs to this

* Notes on self-pollination of grape, read before the Rochester, N. Y., meeting of the A. A. A. S., August 22, 1892.

class. Although self-pollination is thus insured efficient fertilization does not always follow, and consequently in some varieties it does not result in the production of fruit. Such grapes are able to set fruit only when supplied with outside pollen. It is, therefore, probable that with grapes of this class, e. g., Salem and Brighton, the effect of constant spraying throughout the blossoming period would give more marked results than with the variety noted in this experiment.

Effect on fruits.— The most marked and permanent influence of the spray was seen in the character of the fruit. The clusters from the treated vine had very many abortive berries either with no seeds at all or with only mere rudiments of seeds. A few clusters were nearly or quite perfect. These may have blossomed after the spray had been discontinued. All other clusters had many abortive fruits and showed every gradation of loss up to 80 or 90 per cent. No cluster was seen in which all the berries were abortive.

With the check vine perfect clusters were numerous, and abortive berries were comparatively few.

The whole loss of fruit on the sprayed vine can not be computed by comparing the amount of perfect with abortive fruit, because some blossoms must have failed to form even abortive fruit, and some of the abortive fruits dropped before the grapes were gathered. It should be borne in mind, therefore, that the total loss of fruit from the spraying is not represented in the following figures. A comparison of the fruit of the two vines shows the following results:

1. Counting all berries, whether perfect or abortive, the average weight of a berry from the sprayed vine was 8.5 grains, and the average weight of a berry from the check vine was 17.5 grains, showing a difference of 106 per cent.

2. The amount of abortive berries was compared with the perfect berries of each vine, and 60 per cent of the fruit from the sprayed vine was abortive, while but 21 per cent of the fruit from the check vine was abortive.

The similarity of effect in the two experiments encourages us to look for interesting results along these lines of investigation, but it is as yet too early to draw any conclusions.

Variety Tests of Grapes.

Some of the newer varieties of grapes which have fruited in the Station vineyards are described below; comment is also made on a few older and better known grapes and references are given to the reports of varieties which have been noted in previous publications of this Station.

The botanical classification of a variety is indicated by an italicized abbreviation of the name of the species to which it belongs.* A hybrid is indicated by an "X" separating the names of the species of which it is the offspring; thus, *vin.* X *Lab.* indicates a hybrid of *vinifera* fertilized by *Labrusca.* When it is known to which of the two species the female parent belongs, this parent is named first.

When a hybrid is more closely related to one species than to any other this relationship is indicated by an "X" following the name of the species to which it is most closely related; thus, "*Lab.* X" shows that the hybrid is most closely related to the *Labrusca* species.

The names of the species represented in a hybrid are also frequently given in parentheses following the name of the hybrid; thus, Bailey, (*Lab.*, *Lin.* *vulp.*) indicates that the three species named are represented in the parentage of this variety; Brighton, *Lab.* X (*Lab.*, *Vin.*) indicates that Brighton is a hybrid of *Labrusca* and *vinifera*, with more of *Labrusca* than of *vinifera* blood.

Synonyms are printed in italics and inclosed in parentheses.

Adirondack. *Lab.*—This is an amateur grape only, said to have originated at Port Henry, Essex county, N. Y. Our vines are

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* The following abbreviations are used, viz.: *Lab.* for *Labrusca*, L. the wild Fox grape; *vulp.* for *vulpina*, L. (*riparia*, of Mx.), the wild grape of the river banks; *cand.* for *candicans* Engel., the Mustang grape of Texas; *æst.* for *æstivalis*, Mx., the wild Summer grape; *vin.* for *vinifera*, L., the cultivated grape of Europe; *Lin.* for *Lincecumii*, Buck., the Post-oak grape of Texas; *Bourq.* for *Bourquiniana*, Mun., and *rup.* for *rupestris*, Scheele, the Rock or Sand grape of Western Mississippi Valley and Texas.

healthy and productive. The fruit ripened this season about ten days before Concord. Berry somewhat oblong, translucent, juicy and vinous; quality very good, but, as grown here, it has an after flavor that is not agreeable. See also p. 493 of this Station's Annual Report for 1891.

Agawam. (*Rogers* 15.) *vin.* x *Lab.* This is one of the few Rogers hybrid grapes that are capable of self-fertilization. Well-filled clusters of its fruit are formed even when outside pollen is excluded from the blossoms. This season it ripened with Concord. See also Annual Reports of this Station for 1888, p. 105; 1889, p. 342; 1890, p. 328.

Aledo. Received in 1888 from B. F. Stinger, Charlottesville, Ind. Bunch medium, compact; berry medium to large, green or lightly tinged with yellow, nearly round, oblate; ripened about with Concord this season. See also Annual Report of this Station for 1891, p. 494.

Alexander Winter. Received in 1892 from S. R. Alexander, of Bellefontaine, Ohio, who states that it was grown from a lot of mixed seed planted in 1884. His description says that the bunch and berry are of good size, amber color and very best quality; that it ripens in September and is hardy and productive. We have not seen the fruit yet.

Alice. *Lab.* A wilding or chance seedling found near an old stone wall and sent to the Station by Mr. Ward D. Gunn, of Cedar Hill, Ulster County, N. Y., in 1889. It is a red grape, medium size, in bunch and berry, juicy, of good quality and good flavor. This season it ripened unevenly. Season about with Concord, or a little earlier.

Amber. (*vul.*, *Lab.*). A seedling of Taylor well described in the Bushberg Catalogue, as "bunch long, shouldered, moderately compact; berry medium, pale amber when fully ripe. Ripens later than Concord." Not productive here this season. See also Annual Report of this Station for 1891, p. 494.

Amber Queen. *vul.* X *vin.* A seedling of Marion X Black Hamburg. Vine vigorous and productive. Bunch large, shouldered; berry medium to large, reddish purple; flesh tender, pleasant flavored, slightly astringent, especially if in eating the fruit the seeds are discarded. Ripened this season not quite so early as Concord. Some clusters did not "fill" well, thus showing that it is not fully self-fertile. See also Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342; and 1890, p. 328.

Ambrosia. (*vin.*, *Lab.*). This is a seedling of Salem originated by Alfred Rose, Penn Yan, N. Y. Bunch large, compact, handsome, often slightly shouldered. Berry white with delicate bloom, medium to large, nearly round, but slightly flattened. It drops from the cluster easily. Skin medium thickness. Pulp not melting, but separates readily from the seeds, juicy, pleasant flavored, very good quality. Vine vigorous and bore well this season. An amateur grape only. See also Annual Report of this Station for 1891, p. 494.

America. *Lin.* X *rup.* Received from T. V. Munson, Denison, Texas, in the spring of 1892, who describes it as follows: "Vine very vigorous, hardy and productive; bunch large, conical, shouldered; berry large, black; seeds small; skin thin; juice red; pulp melting, of very good quality." We have not yet seen the fruit.

Aminia. *vin.* X *Lab.* This grape should be set near some other variety that blossoms at the same time, because it can not set fruit of itself.

Antoinette. *Lab.* Obtained in the spring of 1892 from G. W. Campbell, Delaware, Ohio, who describes it as a "large, white, Concord seedling, good, hardy." We have not yet seen the fruit.

Arnold's No. 16. See Canada.

August Giant. *vin.* X *vul.* A seedling of Black Hamburg X Marion. See Annual Reports of this Station for 1889, p. 342, and 1890, p. 325.

Bacchus. *vul.* A seedling of Clinton. See Annual Reports of this Station for 1889, p. 342, and 1890, p. 326.

Bailey. *Lin.* X,(*Lin.*,*Lab.*,*vul.*). A seedling of Post Oak X Triumph, originated by T. V. Munson, Denison, Tex., who sent it to this Station in the fall of 1892. Prof. Munson's description is as follows: "Vine moderately vigorous and very productive; bunch large, cylindrical; berry large, black; skin thin, tough; pulp meaty, red juice, very good quality." We have not yet seen the fruit.

Barry. (*Rogers No.* 43.) *vin.* X *Lab.* See Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342; 1890, p. 326. This grape should be set near some other variety that blossoms at the same time, because it can not set fruit of itself.

Beagle. *Lab.* X, (*Lab.*, *vul.*). A seedling of Elvira X Ives, originated by T. V. Munson, Denison, Tex., and sent to this Station in 1888. Bunch medium to large, sometimes slightly shouldered; berry medium, oblong, black, with heavy bloom; pulp firm, sweet and separates readily from the few medium-sized seeds; skin thin; vine vigorous, and this season moderately productive. Ripened about three days later than Moore's Early. See also Annual Report of this Station for 1891, p. 494.

Berckmans. *vul.* X, (*vul.*, *Lab.*, *Bourq.*). This is a seedling of Clinton X Delaware, originated by Dr. A. P. Wylie, Chester, S. C. It was received in 1892 from T. S. Hubbard Co., Fredonia, N. Y., with the statement that "In growth and foliage it is similar to Clinton; bunch and berries larger than Delaware, of same color, and nearly or quite equal in quality." We have not yet seen its fruit.

Bertha. A white grape of unknown parentage, originating with Theophile Huber, Illinois City, Ill., and received at this Station in the spring of 1892.

Big B. Con. *Lin.* X *Lab.* This is a seedling of Post Oak X Concord, originated by T. V. Munson, Denison, Tex. It was received at this Station in 1892. We have not yet seen its fruit.

Big Extra. *Lin.* X, (*Lin.*, *Lab.*, *vin.*). Received from T. V. Munson in the spring of 1892. His description states that it is "A seedling of the Post Oak X Triumph. Vine vigorous, hardy and very productive; bunch large, cylindrical; berry large, black; skin tough; juice red; pulp tender and of very good flavor." We have not yet seen the fruit.

Big Hope. *Lin.* X, (*Lin.*, *Lab.*, *vin.*). A seedling of Post Oak X Triumph, originated by T. V. Munson, Denison, Tex., and received at the Station in the fall of 1892. Prof. Munson describes it as: "Vine vigorous, hardy and very productive; bunch very large, cylindrical, double; berry medium, dark red with small seeds; skin thin, tough; pulp tender, with pale red juice and very good flavor."

Black Delaware. See **Nectar**.

Black Eagle. *Lab.* X *Vin.* Originated by Stephen Underhill, Croton Point, N. Y. It is incapable of setting fruit by itself and hence when not well pollinated from other vines its clusters are imperfectly filled. Vine vigorous and productive; "bunch large, moderately compact; berry large, oval, black, with blue bloom; flesh rich and melting, with little pulp." See also Annual Report of this Station for 1891, p. 494.

Blanco. *Lab* X, (*Lab.*, *vul.*, *vin.*) This is a seedling of Elvira X Triumph. It has not proved productive here. See Annual Report of this Station for 1888, pp. 107-108, "Seedling No. 24 from T. V. Munson," also 1889, p. 343, under the same name.

Bloom. See **Creveling.**

Brighton. *Lab.* X, (*Lab. vin.*). A seedling of Concord X Diana-Hamburg. This excellent grape is incapable of fertilizing its own blossoms. Its pollen is self-irritant only. In order that its clusters may be well filled it should therefore be mingled with other varieties which have the same season of blossoming. See also Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342; 1890, p. 328, and 1891 p. 494.

Brilliant. *Lab.* X, (*Lab.*, *vin.*, *Bourq.*). This is a seedling of Lindley X Delaware. See Annual Report of this Station for 1888, pp. 107-108, "Seedling No. 21 from T. V. Munson," also 1889, p. 343, under same name.

Burnet. *Lab.* X *vin.* This is a seedling of Hartford Prolific X Black Hamburg. Vine vigorous and moderately productive this season. Bunch large, well shouldered and well filled; berry large, oval, black. Ripened this season later than Concord. See also Annual Reports of this Station for 1887, p. 341; 1888, p. 105; Annual Report of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342, and 1890, p. 326.

Campbell. (*Lab.*, *vin.*). A white grape of Catawba season or later. It originted with T. V. Munson, of Denison Tex., who sent it to this Station in the spring of 1886. It is a seedling of Truimph. Bunch large, cylindrical, moderately compact; berry medium, tinged with yellow; seeds few and small; skin thin, pulp melting but as grown here this season it is not of best quality. Vine moderately productive, a weak grower. Prof. Munson states that at five degrees below zero it is tender in bud but hardy in vine. Our vines, however, have successfully withstood a lower temperature than five degrees below zero and borne fruit the following season. See also Annual Report of this Station for 1889, p. 343.

Canada. (*Arnold No.* 16.) *vul.* X *vin.* This is a seedling of Clinton X Black St. Peters. It ripened this season with Catawba. Bunch small to medium, very compact; berry medium, oblong, tapering toward the pedical to which it adheres firmly, shining purple-black with blue bloom; skin thin; pulp quite tender though it does not readily release the seeds, juicy, sweet with a pleasant vinous flavor and good quality. Vine moderately vigorous and fairly productive. The Bushberg Catalogue says of the vine that "It proves tender and unreliable in most parts of the United States but is successfully grown in some localities in France." As a table grape, all things considered, it is not superior to other well known varieties of the same season. See also Annual Report of this Station for 1891, p. 494, "Arnolds No. 16."

Canonicus. *Lab.* X, (*Lab.*, *vul.*). This grape was sent to the Station in 1889 by the originator, Mr. D. S. Marvin, of Watertown, N. Y. It has done so well in our test vineyard that we consider it worthy of further trial. Vine vigorous and productive; bunch rather loose, medium or above; berry above medium, round, pale green, translucent and covered with whitish bloom; skin thin; pulp sweet, tender, juicy, sprightly.

Carman. *Lin.* X, (*Lin.*, *Lab.*, *vin.*). A seedling of Post Oak X Truimph originated by T. V. Munson. It was received at this Station in the spring of 1892 and we have not yet seen its fruit. Prof. Munson describes it as follows: "Vine very vigorous, productive and perfectly hardy; bunch very large, conical; berry large, black; seeds small; skin tough; pulp meaty with white juice and very good flavor."

Catawissa. See **Creveling.**

Catawba. *Lab.* See Annual Reports of this Station for 1887, p. 371; 1888, p. 105; 1889, p. 342, and 1890, 328.

Cayuga. *Lab* X, (*Lab.*, *vin.*) A seedling of Eumelan x Adirondack originated by D. S. Marvin, Watertown, N. Y. It was received here in

1892, from H. S. Anderson, Union Springs, N. Y., who furnishes the following description: "Bunch, good size; berry much like Isabella in shape and size, black, vinous, excellent quality. Season early as Champion." We have not yet seen its fruit.

Centennial. *Lab.* X, (*Lab.*, *vin.*). A seedling of Eumelan X some Labrusca grape. Not a vigorous grower. Bunch conical, compact; berry medium or above, white, tinged with pink, juicy, sprightly, vinous with very pleasant flavor. The pulp does not readily release the seed. An amateur grape. See also Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342; and 1890, p. 330.

Champion. *Lab.* See Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342; and 1890, p. 326.

Chandler. *Lab.* A white grape of good quality received in the spring of 1892 from N. M. Chandler, Ottawa, Kas. Mr. Chandler believes that it is from Worden seed and describes it as "very hardy and a fair cropper."

Chautauqua. *Lab.* A chance seedling from the Concord vineyard of H. T. Bashtite, near Brocton, Chautauqua Co., N. Y. It was sent to this Station in 1892 by N. Lerch, Lockport, N. Y.

Clevener. (*Bourq.?*) It is thought by some that this is identical with a grape cultivated in Switzerland under the name of Clevener or Burgunder traube (Burgundy grape)* a Burgundy grape from Switzerland. Bunch medium; berry medium, round, black with blue bloom; pulp juicy, somewhat melting and somewhat astringent. A rampant grower and productive. See also Annual Report of this Station for 1891, p. 494.

Clinton. *vulp.* See Annual Report of this Station for 1891, p. 495.

Colerain. *Lab.* Obtained by the Station in the spring of 1892 from G. W. Campbell, of Delaware, O., who describes it as follows: "A white Concord seedling of excellent

*Munson regards some of the Burgundy grapes of Switzerland, such as Clevener, the Traminer, etc., as northern representatives of the *Vitis Bourquiniana* in Europe, while the more southern type of *Bourquiniana* is seen in the Herbemont. He also adds in a personal letter: "For the United States, east of the Rocky Mountains, the only successful, or partially successful, European varieties belong to the form I distinguish as *V. Bourqniniana*, including our Herbemonts, Le Noirs, Devereauxes, etc., in the south and the similar element in combination with V. *Labrusca* in Delaware, etc., succeeding also fairly in the north."

quality, full medium size both in bunch and berry. Fruit finer in quality than Concord and ripens a week or ten days earlier than that variety." We have not yet seen the fruit of this variety.

Concord. *Lab.* A pure Fox grape introduced to cultivation by E. W. Bull, of Concord, Mass. See Annual Reports of this Station for 1887, p. 105; 1888, p. 105; 1889, p. 342; and 1890, p. 326.

Cortland. *Lab.* This is a seedling of Concord x Hartford, originated by M. F. Cleary, Cortland, N. Y. It is said to be a very early grape. We have not yet seen its fruit.

Cottage. *Lab.* A seedling of Concord. See Annual Report of this Station for 1891, p. 495.

Creveling. (*Catawissa, Bloom.*) See Annual Report of this Station for 1891, p. 495. Not productive here, although set in a mixed vineyard.

Croton. *vin.* X, (*vin.*, *Bourq.*, *Lab.*) This is a seedling of Delaware X Chasselas de Fontainbleau. A white grape which originated with S. W. Underhill, Croton Point, N. Y., beautiful in appearance, melting and pleasant flavored. A valuable amateur fruit here. See also Annual Report of this Station for 1891, p. 495.

Daisy. (*Lab*, *vin.*) A seedling of Goethe. Bunch medium size, rather loose; berry resembling Isabella in shape, dark red with lilac bloom; pulp tender, sweet, pleasant flavored, vinous; skin thin and slightly astringent; seeds few. Ripens about with Worden. Was not very productive here this season. See also Annual Report of this Station for 1891, p. 495.

Delaware. (*Bourq.*, *Lab.*) Munson considers this grape a hybrid of *Bourquiniana* and *Labrusca*, see note under Clevener. See Annual Report of this Station for 1891, p. 495.

Diamond. (*Moore's Diamond.*) *Lab.* This is a seedling of Concord X Iona. An excellent white grape which ripened this season with Worden. The vine is vigorous and a good bearer. Its blossoms are perfectly self-fertile. Bunch medium to large; berry, medium, slightly oblong; pulp tender, juicy, sprightly, with fine flavor. See also Annual Report of this Station for 1890, p. 332.

Downing. *Lab.* X *vin.* A seedling of Israella X Muscat Hamburg. Bunch, long, medium or above; berry, above medium, decidly oblong, of dark red color, shading to black; thick skin, few seeds, pulp of fine flavor, tender, breaking. Season here this year a little earlier than Concord. The fruit is fine, but the vine at the age of six years has not yet proved productive here. Mr. J. G. Burrow, of Fishkill, N. Y., who sent the grape to the Station in 1887, says that in favorable localities for grape culture it is much esteemed as a fine table and market grape, but it must have favorable location and must not be allowed to overbear. T. T. Lyon, of South Haven, Mich., notes* that its foliage was exceptionally healthy in unfavorable seasons in that locality, and that the vine has been moderately productive, but late in ripening its fruit.

Dr. Collier. (*Big Red.*) *Lin.* X, (*Lin., vin., Lab.*) One of Prof. Munson's grapes, named in honor of the Director of this Station, a seedling of Post Oak X (Lindley ?) It was received here in the fall of 1892. We have not yet seen the fruit. Prof. Munson has described it as follows: Vine, hardy, vigorous and productive; bunch large cylindrical; berry large, dark-red; skin thin and tough; pulp juicy, tender, with red juice, good flavor, and quite good quality.

Dr. Hexamer. *Lin.* X, (*Lin., Lab., vin.*) This is a seedling of Post Oak X Triumph, originated by T. V. Munson, Denison, Texas, and sent to this Station in the fall of 1892. Prof. Munson's description is as follows: Vine vigorous, hardy and productive; bunch large, cylindrical; berry large, black, with tough skin; pulp juicy, tough, with red juice and very good flavor.

Dr. Warder. An early black grape of unknown parentage, originated by Theophile Huber, Illinois City, Ill. Cuttings were received here in the spring of 1892. We have not yet seen its fruit.

Dracut Amber. *Lab.* Ripened this season a little earlier than Worden, and was moderately productive. It seem to be but a slight improvement of the wild Fox grape, and therefore we can see no reason for cultivating it when better varieties can be grown in its place. Bunch large, compact, sometimes shouldered; berry large, round, pale red; pulp foxy and not tender. See also Annual Report of this Station for 1891, p. 495.

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* Bull. 88, Mich. Expt. Station, Dec., 1892, pp. 23–26.

Duchess. *Lab.* X, (*Lab.*, *Bourq.*) This was produced by fertilizing a white Concord seedling with mixed pollen of Delaware and Walter. See Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342, and 1890, p. 330. Vine vigorous and productive this season.

Early Dawn. *Lab.* X. *vin.* This is a seedling of Muscat Hamburg X Isabella. An early black grape originated by Dr. W. A. M. Culbert, of Newburgh, N. Y. It was obtained by the Station in the spring of 1892. We have not yet seen its fruit.

Early Market. (*Lab.*, *vul.*) A handsome black grape originated by T. V. Munson, Denison, Texas. It is a seedling of Elvira. Bunch medium, somewhat compact; berry medium, black with abundant bloom; pulp tender, not melting, not juicy, sweet, but rather insipid; skin tender; seeds few and small. Ripened this year from two to three weeks later than Moore's Early. See as yet no reason for its introduction here. See also Annual Report of this Station for 1891, p. 495.

Early Ohio. *Lab.*, (or *Lab.*, X.) A chance seedling sent to this Station in 1891 by C. S. Curtice Co., Portland, N. Y.

Eaton. *Lab.* A seedling of Concord. See Annual Reports of this Station for 1889, p. 342, and for 1890, p. 326.

Eldorado. *Lab.* X, (*Lab.*, *vin.*) Produced by fertilizing the Concord with Allen's Hybrid and hence it is one-fourth Vinifera. Bunch large and regular if well filled, but does not always set fruit perfectly. Berry large, round, clear golden yellow with thin white bloom. Pulp tender, separating readily from the seeds, excellent quality and high flavor. Medium early. A desirable amateur grape. See also Annual Report of this Station for 1891, p. 495.

Elsinboro. See **Elsinburgh.**

Elsinburgh. (*Elsinboro*, *Smart's Elsinborough.*) *æst.* An amateur grape. See Annual Report of this Station for 1891, p. 495.

Elvibach. *Vul.* X, (*vul*, *Lab.*) This seedling of Elvira X Bacchus originated with T. V. Munson, Denison, Texas. Vine very vigorous and quite productive. Season medium early. Bunch medium or above, compact; berry medium or below, black with abundant bloom; skin thin and tough; pulp slightly vinous, and with the full number of seeds, from which it is easily separated. Not an ideal table grape and we can not as yet recommend it for cultivation in this locality. See also Annual Report of this Station for 1891, p. 496.

Elvicand. *Cand.* X, (*cand.*, *vul.*, *Lab.*) This is a seedling of Elvira X candicans, originated by T. V. Munson, Denison, Texas. Vine vigorous and bears large, handsome clusters of large, dark red berries covered with lilac bloom. Skin thin with slight astringency; pulp separates readily from the few small seeds and is tender, juicy, sweet and sprightly with excellent flavor. Ripened this season with Concord. We judge that this grape may prove a desirable acquisition in this State and recommend it for more extended trial.

Elvira. (*vul.*, *Lab.*) A seedling of the Taylor introduced in 1874. Vine a vigorous grower and very productive, but fruit not suitable for market on account of its tendency to crack. It is surpassed by other varieties for table use. See also Annual Report of this Station for 1891, p. 496.

Emma. Received from H. E. Van Dieman, United States Pomologist, in the spring of 1892. A white grape of unknown parentage that originated with Theophile Huber, of Illinois City, Ill. We have not yet seen its fruit.

Empire State. *vulp.* X *Lab.* This is a seedling of Hartford Prolific x Clinton. See Annual Reports of this Station for 1889, p. 342, and for 1890, p. 330. Moderately productive here. Can see no reason why its place may not be well filled by better white grapes of the same season.

Essex. (*Rogers* 41.) *vin.* X *Lab.* Bunch medium, compact, shouldered; berry large, nearly orbicular, very dark reddish purple, covered with abundant bloom. Pulp sweet, tender, not melting, but separates readily from the seeds. Ripens with Concord. Moderately productive. Its blossoms can fertilize themselves but slightly if at all, hence this grape should be set near some other variety that blossoms at the same time.

Esther. *Lab.* A Concord seedling originated by E. W. Bull, who also originated the Concord. It was sent to the Station in the spring of 1892, by Geo. S. Josselyn, Fredonia, N. Y., who says that it is a white grape that ripens a few days earlier than Concord. We have not yet seen its fruit.

Etta. (*Lab.*, *vul.*) The Bushberg Catalogue calls this the best of Rommel's white grapes, superior to its parent, the Elvira. Bunch medium, compact, often so heavily shouldered as to form a double bunch. Very productive, but neither rich nor high flavored and can not be classed among the best table grapes. See also Annual Report of this Station for 1891, p. 496.

Eumelan. (*Lab.*, *vin.*) Munson refers this to *Labrusca* and *vinifera* parentage. See Annual Reports of this Station for 1888, p. 105; 1889, p. 342, and for 1890, p. 326. Experiments made this season show that this grape is unable to set fruit of itself and it should, therefore, be set in proximity to other vines blossoming at the same season.

Faith. (*Lab.*, *vul.*) A seedling of Taylor. Bunch long, medium, shouldered; berry small to medium, white or pale amber with slight bloom, juicy, sweet and pure flavored. Ripe this season about with the Diamond. Do not consider it as desirable as Diamond here. See also Annual Report of this Station for 1891, p. 496.

Fern Munson. *Lin.* X, (*Lin.*, *Lab.*, *vin.*). A seedling of Post Oak X Triumph, originated by T. V. Munson, of Denison, Tex., who describes it as follows: "Vine vigorous, hardy and productive; bunch large, cylindrical; berry large, black; seeds small; skin thin; pulp juicy, tender, of best flavor; juice red." It was received at this station in the spring of 1892, and we have not yet seen its fruit.

Francis B. Hayes. See **Hayes.**

Gaertner. (*Rogers No* 14.) *vin.* X *Lab.* See Annual Report of this Station for 1891, p. 496. This grape should be set near some other variety that blossoms at the same time, because it can not set fruit of itself.

Geneva. *Lab.* X, (*Lab.*, *vin.*). (Seedling of wild Fox grape X Muscat Alexandria) x Iona is given as the parentage of this grape. As grown here it has a fine appearance, but in flavor and quality it is not considered equal to other white grapes of the same season.

Berry above medium size and free from either foxiness or astringency. See also Annual Report of this Station for 1890, p. 330, and for 1891, p. 496.

Glenfield. (*Lab.*) A chance seedling from the grounds of Geo. J. Magee, Watkins, N. Y. It was sent to this Station in 1889. Bunch large, moderately shouldered, compact, attractive, although unique in color; berry large, nearly round, of a peculiar dull grayish green color, covered with whitish bloom; pulp very tender, juicy, sweet and with an agreeable flavor. Can discover neither foxiness nor astringency. As a table grape it has many good qualities, but its color may be against it in market. It seems worthy a place in the amateur collection.

Gold Dust. *Lab.* X, (*Lab.*, *vin.*, *Bourq.*). A white grape, seedling of Lindley X Delaware, originated by T. V. Munson. Bunch rather loose, medium size; berry medium, greenish yellow; pulp not melting. Did not ripen well here this season, and we are not yet prepared to recommend it for further trial in this locality. See also Annual Report of this Station for 1888, pp. 107, 108, "Seedling No. 22," and for 1889, p. 343.

Golden Grain. *Lab.* X, (*Lab.*, *vin.*, *Bourq.*). This is a seedling of Lindley X Delaware, originated by T. V. Munson. It ripens about with Concord. Bunch medium or above; berry medium, green with whitish bloom; pulp does not readily separate from the seed; flavor pleasant. We are not yet prepared to recommend this grape for further trial in this section. See also Annual Reports of this Station for 1888, pp. 107, 108, "Seedling No. 20," also for 1889, p. 343.

Gov. Ireland. *Lab.* A pure seedling of Moore's Early, originated by T. V. Munson, Denison, Texas. Bunch large; berry large, dull black with whitish bloom; pulp thick, firm, not juicy, slightly vinous; skin tender. We are not yet ready to recommend this grape for further trial in this section. See also Annual Report of this Station for 1891, p. 496.

Gov. Ross. (*vin.*, *Lab.*) This is a seedling of Triumph, originated by T. V. Munson. It was received at this Station in the fall of 1892. We have not yet seen the fruit. Prof. Munson's description is as follows: "Vine does not take first rank in hardiness, is of medium growth and productiveness. Bunch very large, cylindrical; berry large, yellow, with thin, tough skin and small seeds; juice white; pulp melting; flavor best."

Grayson. *Lab.* This is a seedling of Moore's Early, originated by T. V. Munson, of Denison, Texas. Bunch, medium, somewhat compact and slightly shouldered. Berry large, black, with abundant bloom, no pulp and few seeds; sweet and pleasant though it is neither vinous nor sprightly and lacks decided flavor. Moderately productive. Ripens a little before Concord. See also Annual Report of this Station for 1891, p. 496.

Hartford. (*Hartford Prolific.*) *Lab.* See Annual Report of this Station for 1890, p. 327.

Hartford Prolific. See **Hartford.**

Hayes. (*Frances B. Hayes.*) *Lab.* This is a seedling of Concord. See Annual Reports of this Station for 1887, pp. 341 2; 1888, p. 105; 1889, p. 342, and 1890, p. 331.

Herald. An early black grape of unknown parentage received from G. A. Ensenberger, Sr., Bloomington, Ills., in the spring of 1889. Vine vigorous and productive; bunch medium, compact; berry above medium, poor in flavor and quality. Ripened this season a little before Moore's Early.

Herbert. (*Rogers* 44.) *vin.* X *Lab.* Vine vigorous, hardy and productive as grown here in a vineyard of mixed varieties, although its blossoms are unable to fertilize themselves. Bunch, large rather long, shouldered and moderately compact; berry large, black; pulp sweet, tender and of good flavor when first tasted but afterwards a slight astringency is noticeable, especially if the fruit is not thoroughly ripe. Ripened this season with Concord. This grape should be set near some other variety that blossoms at the same time because it can not set fruit of itself.

Hercules. (*Lab., vin.*) A seedling of one of the Rogers Hybrid grapes sent to the Station in 1889 by G. A. Ensenberger, Bloomington, Ill. Bunch large to very large, sometimes shouldered, attractive in appearance, resembling Black Hamburg. Berry very large, round, black with blue bloom; pulp rather juicy, not tender and does not readily release the seeds; flavor good. Fruit cracks and drops badly. Season about with Concord.

Hermann Jaeger. *Lin.* X *Bourq.* This is a seedling of Post Oak X Herbemont, originated by T. V. Munson, Denison, Texas. It was received at this Station in the spring of 1892. We have not yet seen its fruit. Professor Munson describes it as follows: "Vine exceedingly vigorous, healthy and prolific. It will probably endure the winters as far north as forty degrees. Bunch very large shouldered, or double shouldered, compact; berry medium, dark purple, covered with a rich bloom, very persistent to the stem; skin thin, tough; pulp melting, very juicy, sweet and sprightly, of the best quality; seeds small. Ripens with or a few days later than Concord."

Highland. *Lab.* X *vin.* This is a seedling of Concord X Jura Muscat. It ripened here this season fully as late or later than Catawba, and was very productive. Bunch large, shouldered, moderately compact; berry large, round, black, with abundant bloom; pulp almost melting, tender, juicy, slightly vinous. The fruit is good but the vine is not a regular bearer and it ripens very late for this locality. See also Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342, and 1890, p. 327.

Hopican. *Lab.* X, (*Lab.*, *vin.*) Originated by D. S. Marvin, of Watertown, N. Y. It was received at the Station in 1889. Bunch medium to large, compact, slightly shouldered; berry medium, pale green with white bloom; pulp tender, separating readily from the seeds, with good flavor but neither very sweet nor very juicy; skin thin. Concord season. We are not yet ready to recommend its further trial.

Hopkins. *Lin.* X *Bourq.* A seedling of Post Oak X Cynthiana, originated by T. V. Munson, Denison, Texas, and described by him as follows: "Vine hardy, very vigorous and very productive; bunch very large, cylindrical; berry medium, black, with thin, tough, skin and small seeds; pulp meaty, juicy, of very good flavor; color of juice red." We have not yet seen this fruit.

Illinois City. A white grape of unknown parentage, originated by Theophile Huber, Illinois City, Ill. It was received at the Station in the spring of 1892. We have not yet seen the fruit.

Iona. *Lab.* A seedling of Catawba. See Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342, and 1890, p. 328.

Isabella. *Lab.* See Annual Reports of this Station for 1888, p. 105; 1889, p. 342, and 1890, p. 327.

Janesville. (*Lab.*, *vul.*) We can do no better than quote the description of this grape, as given in the Bushberg Catalogue: "An early black grape, now generally discarded for better varieties. Vine a vigorous grower, hardy, healthy and productive; bunch medium, compact; berry medium to large, black; skin thick; flesh pulpy; quality, about like Hartford; colors even earlier than this variety, but ripe about the same time." See also, Annual Report of this Station for 1891, p. 496.

Jefireson. *Lab.* This is a seedling of Concord x Iona. See Annual Reports of the Station for 1887, p. 341; 1888, p. 105; 1889, p. 342, and 1890, p. 329.

Jennie May. *Lab.* Our vines appear to be identical with Concord.

Jessica. See Annual Reports of this Station for 1887, p. 341; 1888, p. 105; 1889, p. 342; and 1890, p. 331.

Jewel. (*Bourq.*, *Lab.*) A seedling of Delaware, originated by John Burr, Leavenworth, Kansas. Season very early; vine moderately productive; bunch medium; berry black, with bluish bloom, medium to large; skin rather thick; pulp not very juicy, vinous, somewhat astringent and not readily separated from the seeds. We are not yet ready to recommend it for further trial in this section. See also Annual Report of this Station for 1891, p. 497.

Juno. (*Bourq.*, *Lab.*) A seedling of Delaware, sent to the Station in 1889 by G. A. Ensenberger, Bloomington, Ill. A white grape of Worden season, vigorous and productive, so far as tested here. Bunch medium, sometimes slightly shouldered; berry white, translucent, with yellowish tinge, medium, round; pulp somewhat foxy, not melting, but tender and separates readily from the seeds, not more than good in quality and flavor; skin thin. The fruit kept in good condition till December, and was not discarded from storage as worthless till the last of January.

Lady. *Lab.* A seedling of Concord. See Annual Reports of this Station for 1888, p. 106; 1889, p. 342; and 1890, p. 331.

Lady Washington. *Lab.* X, (*Lab., vin.*). This is a seedling of Concord X Allen's Hybrid. See Annual Reports of this Station for 1887, p. 341; 1888, p. 106; 1889, p. 342; and 1890, p. 331.

Leader. A chance seedling received in the spring of 1892 from Frank Ford & Son, Ravenna, O. We have not seen its fruit.

Leavenworth. (*Stayman & Black's No.* 47.) *Lab.* A white Concord seedling, sent to the Station in 1889 by Stayman & Black, Leavenworth, Kansas. It has not yet fruited here.

Lindley. (*Mary, Rogers' No.* 9.) *vin.* X *Lab.* See Annual Reports of this Station for 1887, p. 341; 1888, p. 106; 1889, p. 342, and 1890, p. 329.

Lindmar. *Lab.* X, (*Lab., vin.*). This is a seedling of Lindley X Martha, originated by T. V. Munson, Denison, Tex. A white grape medium in size, bunch and berry. It did not ripen well this season, and we are not yet prepared to recommend it for trial in this locality. See also Annual Reports of this Station for 1888, "Seedling 20 1-2," pp. 107, 108, and 1889, p. 343.

Linn. Originated by P. B. Crandall, Ithaca, N. Y. In 1892 it was received at the Station for testing. We have not yet seen its fruit.

Little Blue. *Lab.*, (or *Lab.* X.) A grape of unknown parentage, sent to the Station in 1888 by A. J. Caywood & Son, Marlborough, N. Y. Bunch medium; berry medium, oblong, black; pulp juicy, melting, sweet, of good quality; skin so tender that it is liable to crack. Ripened this year with Moore's Early. As yet it has proved only moderately productive. See also Annual Report of this Station for 1891, p. 497.

Livingston. (*vin., Lab.*) A black seedling of a Rogers Hybrid; the originator thinks it is from Agawam seed. Originated by Daniel W. Babcock, Dansville, N. Y., and sent to this Station in 1892. We have not yet seen its fruit.

Lutie. A grape of unknown parentage, originated by Dr. Chisholm, and introduced by I. G. Coles, Nashville, Tenn.

It is said to be an early red grape. It was received from Samuel Wilson, Mechanicsville, Pa., in the spring of 1892. We have not seen its fruit.

Mabel. *Lab.* X, (*Lab.*, *Bourq.*) A seedling of Walter received in 1888 from A. J. Caywood & Son, Marlborough, N. Y. Bunch medium, compact; berry medium, black with blue bloom; skin thin, tough; pulp almost melting, very juicy. Ripened this season a little before Concord and was moderately productive. We are not yet ready to recommend it for trial as a table grape. See also Annual Report of this Station for 1891, p. 497.

Marie Louise. A white grape of unknown parentage, originated by Theophile Huber, Illinois City, Ill. It was received at the Station in the spring of 1892.

Marion. *vul.* Bunch medium, compact, shouldered; berry medium, black, with abundant blue bloom; pulp vinous, free from astringency or foxiness. Valued in some localities for a dark red wine. Season later than Concord. Vine vigorous and productive. See also Annual Report of this Station for 1891, p. 497.

Mary. See Lindley.

Mary's Favorite. *Lab* X, (*Lab.*, *Bourq.*, [*vin.?*].) This is a seedling of Delaware X (a Rogers Hybrid?) received by the Station in 1889 from J. F. Coffin, Westland, Ind. Season medium early. Vine has thus far proved vigorous and productive. Bunch small to medium, shouldered; berry medium, black, with blue bloom; pulp not melting, but juicy, sweet and vinous; skin thin; seeds few; a pretty little table grape. but, as grown here, it has not yet proved superior to other well-known varieties of the same season.

Massasoit. (*Rogers No.* 3.) *vin.* X *Lab.* See Annual Report of this Station for 1891, p. 497. This grape should be set near some other variety that blossoms at the same time, because it can not set fruit of itself

Mathilde. (*Bourq. Lab.*) A seedling of Delaware sent to the station in 1889 by G. A. Ensenberger, Bloomington, Ills, who recommends it as a wine grape. The vine has thus far proved vigorous and productive. Bunch large, very compact, so much so that the fruit sometimes cracks; berry small to large, the small ones being seedless, round or nearly so, handsome dark red with lilac bloom; pulp very juicy, separates readily from the seed, almost melting, vinous, and when fully ripe not sweet but of good quality. We consider it worthy of further trial but doubt whether it will prove a desirable acquisition to the list of table grapes for this locality on account of its acid flavor and too compact cluster.

Maxatawney. *Lab.* A chance seedling that originated in Montgomery Co., Pa., in 1844. Bunch above medium, compact; berry large, pale red, or white tinged with red; pulp not melting, flavor not equal to Catawba. Ripens fully as late as Catawba. Vine moderately productive. See also Annual Report for 1891, p. 497.

Merrimack. (*Rogers No.* 19.) *vin.* X *Lab.* See Annual Report of this Station for 1891, p. 497. This grape should be set near some other variety that blossoms at the same time because it can not set fruit of itself.

Metternich. *vul.* X, (*vul., Lab., Bourq.*) This is a seedling of Clinton X Poughkeepsie-Red sent to the Station in 1888 by A. J. Caywood & Son, Marlborough, N. Y. A medium early grape that thus far has proved moderately productive. Bunch small to medium, compact; berry medium, light red, translucent; skin thin, tender; pulp tender, sweet, vinous, sprightly and pure flavored. See also Annual Report of this Station for 1891, p. 497.

Missouri Riessling. (*vul., Lab.*) A seedling of the Taylor. It is grown in Illinois and Missouri for white wine. Season about with Concord or later. As grown here it agrees with the following description from the Bushberg Catalogue: "Bunch medium, moderately compact, slightly shouldered; berry medium, round, greenish white but light red when fully ripe." See also Annual Report of this Station for 1891, p. 497.

Monroe. (*Lab.*, —.) A seedling from mixed seed of Concord Delaware, Diana, and Rebecca. See Annual Reports of this Station for 1887, p. 34; 1888, p. 106; 1889, p. 342, and 1890, p. 327.

Montefiore. *vul.* X, (*vul., Lab.*) A seedling of the Taylor. A red wine grape. Ripened this season with Concord. Bunch small to medium, compact sometimes shouldered; berry small medium, round, black with delicate bloom; skin thin and firm; pulp melting, vinous, with good flavor. Not a table grape. Moderately productive here.

Moore's Early. *Lab* A seedling of Concord. See Annual Reports of this Station for 1887, p. 341; 1888, p. 106; 1889, p. 342 and 1890, p. 327.

Nectar. (*Black Delaware.*) *Lab.* X, (*Lab.,Bourq.*) This is a seedling of Concord X Delaware, received from A. J. Caywood & Son, Marlborough, N. Y., in 1888. See Annual Report of this Station for 1891, p. 497.

Niagara. *Lab.* Seedling of Concord X Cassady. See Annual Reports of this Station for 1888, p. 106; 1889, p. 342, and 1890, p. 332.

Noah. (*vulp., Lab.*) A seedling of the Taylor. It resembles the Elvira in many respects, but the skin does not crack as does that of the Elvira. Color yellowish when fully ripe; pulp firm, of good quality, but does not separate quite readily from the seed. Season about with Concord, or a little later. In this locality there are better grapes of its season for table use. See also Annual Report of this Station for 1891, p. 497.

Northern Muscadine. *Lab.* A brownish red grape, ripening with the Worden. Pulp foxy, sweet; skin thick; vine vigorous and productive. See also Annual Report of this Station for 1891, p. 498.

Norwood. *Lab.* See Annual Reports of this Station for 1889, p. 342, and 1890, p. 327. Has not proved productive here.

Olita. (*Bourq., Lab.*) A seedling of Delaware, originated by T. V. Munson, Denison, Tex. Bunch medium to large, compact, attractive, often shouldered; berry, when fully ripe, pale yellowish green, with abundant white bloom, medium or above; skin thin, tough; pulp nearly or quite melting, juicy, of good quality and agreeable flavor, with no foxiness and but slight astringency. Seeds few and small. Ripened this season with Concord and was moderately productive. Think it worthy of further testing as a table grape. See also Annual Report of this Station for 1891, p. 498.

Opal. (*Lab.,vin.*) A white (yellow) seedling of Lindley, originated by T. V. Munson, of Denison, Tex., and sent to this Station in 1886. It has not been productive here.

Oneida. (*vin., Lab.*) A red seedling of Merrimack, received from the T. S. Hubbard Co., Fredonia, N. Y., in 1892.

Paradox. *Lab.* This is a seedling of Hartford X Iona, sent to the Station in 1889 by W. D. Barns, Middlehope, N. Y. Vine vigorous and productive. Bunch medium or above, compact, shouldered; berry medium, black, with blue bloom, pulp separates readily from the seeds, is sweet and pure flavored. Ripe with Concord or a little before.

Paragon. (*Burr's No.* 15.) *Lab.* (or Lab. X.) A grape of unknown parentage, originated by John Burr, of Leavenworth, Kan., and received at this Station in 1888. Vine has thus far proved productive and moderately vigorous; bunch handsome, large, well shouldered; berry black with abundant blue bloom, medium to large, round; pulp tender, separating easily from the seeds, sprightly, vinous, and of good quality; skin thin. Ripened this season with Worden. We consider it worthy further trial as a table grape.

Pearl. (*Vul., Lab.*) A seedling of the Taylor. Bunch medium, compact; berry medium, white, tinged with yellow; season later than Concord. As tested here it has not proved very productive. See also Annual Report of this Station for 1891, p. 498.

Perkins. *Lab.* An early grape of pale red color when fully ripe. Vine vigorous and productive; bunch above medium, compact, shouldered; berry medium, oblong; pulp sweet, juicy, not melting and with foxy flavor.

Pocklington. *Lab.* A seedling of Concord. See Annual Reports of this Station for 1888, p. 106; 1889, p. 342; 1890, p. 332.

Poughkeepsie Red. *Lab.* X, (*Lab., Bourq.*) This is a seedling of Iona X Delaware or Walter. When fully ripe the pulp is tender, almost melting, juicy, sweet and of excellent quality. See Annual Reports of this Station for 1888, p. 106; 1889, p. 342; 1890, p. 329, and 1891, p. 498.

Prentiss. *Lab.* A seedling of Isabella. See Annual Reports of this Station for 1888, p. 106; 1889, p. 342, and 1890, p. 332.

Profitable. *Lab.* X, (*Lab.*, *vul.*) This is a seedling of Elvira X Perkins, originated by T. V. Munson, Denison, Texas. It was received at this Station in 1888 and has thus far proved productive. Bunch medium, moderately compact, not attractive in appearance, because the berries assume a pale red color only when fully ripe, and therefore until every berry is thoroughly ripened the cluster has an unripe appearance from the green color of a few nearly ripened berries. Pulp, tender, as is also the skin. Quality as grown here not the best; vine vigorous and productive. The fruit ripened here this season about with Concord. See also Annual Report of this Station for 1891, p. 498.

Reagan. *Lin.* X, (*Lin.*, *Lab.*, *vin.*) This is a seedling of Post Oak X Triumph, originated by T. V. Munson, Denison, Texas, and sent to this Station in the fall of 1892. Prof. Munson describes it as follows: "Vine very vigorous, hardy and very productive; bunch large, cylindrical; berry large, black with thin skin; pulp with red juice, melting, juicy and of very good flavor."

Red Bird. *Lab.* X, (*Lab.*, *vin.*) This is a seedling of Lindley X Champion, originated by T. V. Munson, Denison, Texas, and sent to the Station in 1888. Bunch usually compact, medium or above; berry above medium, round, dull red with slight lilac bloom; skin thick, tough; pulp, sugary, juicy, not melting and does not readily release the seeds; quality good. Vine has thus far been vigorous and productive. See also Annual Report of this Station for 1891, p. 498.

Red Eagle. (*Lab.*, *vin.*) A seedling of Black Eagle originated by T. V. Munson, Denison, Texas, who sent it to the Station in 1888. Bunch medium, loose; there seems to be imperfect self-fertilization of the blossoms the same as with its parent, for the clusters are not always well filled. Like its parent, it has short stamens. Berry red, with abundant lilac bloom, medium to large, round; pulp juicy, melting, of excellent quality. It ripens a little before Concord. As yet it has been only moderately productive here. See also Annual Report of this Station for 1891, p. 498.

Requa. (*Rogers* 28.) *Vin.* X *Lab.* Vine, vigorous and moderately productive; bunch large, shouldered; berry dark red with abundant whitish bloom, medium or above; pulp tender, sweet and pleasant flavored, notwithstanding its slight foxiness. Ripened this season about with Catawba. This grape should be set near some other variety that blossoms at the same time, because it can not set fruit of itself.

Rochester. *Lab.* X A seedling from mixed seed of Concord, Delaware, Diana and Rebecca. An early grape, vigorous and productive. Bunch large, shouldered, very compact. Because of the compactness of the cluster, the fruit sometimes cracks. Berry medium or above, dark red, almost purple, with whitish bloom; pulp slightly sweet, vinous, somewhat foxy, but of excellent quality. A desirable early red grape for the amateur. See also Annual Reports of this Station for 1887, pp. 341-342; 1888, p. 106; 1889, p. 342, and 1890, p. 329.

Rockwood. *Lab.* A seedling of Concord, and, like that grape, originated by E. W. Bull. It was sent to the Station in the spring of 1892, by Geo. S. Josselyn, of Fredonia, N. Y., who says it is a black grape of Moore's Early season. We have not yet seen its fruit.

Rogers No. 3. See **Massasoit.**

Rogers No. 4. See **Wilder.**

Rogers No. 5. *vin.* X *Lab.* This grape should be set near some other variety that blossoms at the same time, because it can not set fruit of itself.

Rogers No. 9. See **Lindley.**

Rogers No. 14. See **Gaertner.**

Rogers No. 15. See **Agawam.**

Rogers No. 19. See **Merrimack.**

Rogers No. 28. See **Requa.**

Rogers No. 41. See **Essex.**

Rogers No. 43. See **Barry.**

Rogers No. 44. See **Herbert.**

Rogers No. 53. See **Salem.**

Rommel. *Lab.* X, (*Lab.*, *vin*, *vul.*). A seedling of Elvira X Triumph, originated by T. V. Munson, Denison, Texas, and sent to this Station in 1892. We have not yet seen its fruit.

Roscoe. *Lab.* X, (*Lab*, *Bourq.*). A white grape, a seedling of Delaware X Martha, originated by T. V. Munson, Denison, Texas, and sent to this Station in 1888. We have not yet seen its fruit.

Rustler. *Lab.* X, (*Lab., vin.*). A white grape, seedling of Lindley X Martha, originated by T. V. Munson, Denison, Texas. It was received at this Station in 1888. It has not yet borne sufficient fruit to justify its description.

Rutland. *Lab.* X, (*Lab., vin.*). Supposed to be a seedling of Eumelan X Adirondack. It is of Eumelan size and color. Bunch medium, compact, not shouldered; berry medium, black; the pulp, which does not separate easily from the seed, is fleshy, sprightly and vinous; quality very good; season about with Worden. Moderately productive here this season.

Salem. (*Rogers* 53.) *vin.* X *Lab.* See Annual Reports of this Station for 1887, p. 341; 1888, p. 106; 1889, p. 342; 1890, p. 329. This grape should be set near some other variety that blossoms at the same time, because it can not set fruit of itself.

Seedlings, unnamed, as follows:

Caywood No. 50. A grape of unknown parentage, received in 1888 from A. J. Caywood & Son, Marlborough, N. Y. Bunch medium, often shouldered, usually not compact; berry dull black with abundant whitish bloom, nearly round; skin tough; plenty of seeds, which do not readily separate from the thick pulp; pulp sweet, slightly vinous, of good quality. Healthy foliage; vigorous and productive vine. Ripe this season a little before Worden. See also Annual Report of this Station for 1891, p. 494.

Edmeston No. 1. *Lab.* A Concord seedling, originated by D. G. Edmeston, Adrian, Mich., and received from him in the spring of 1892. We have not yet seen its fruit.

No. 2, from J. Shull, Ilion, N. Y. *Lab.*, (*or Lab.* X). A grape of unknown parentage received from the originator in the fall of 1892. We have not yet seen the fruit.

No. 2, Gerbig. (*Lab., vin.*). A seedling of Eumelan, originated by A. V. Gerbig, Archbald, Pa.; cuttings were sent to the Station in 1892.

No. 2, Thompson. *Lab.* X, (*Lab., vin.*) A red seedling of Brighton, originated by Jos. T. Thompson, Oneida N. Y. Cuttings were received at the Station in 1892. We have not seen the fruit. Mr. Thompson says it is much like Brighton.

No. 3, Thompson. A white grape of unknown parentage, originated by Mr. Jos. T. Thompson, Oneida, N. Y. Cuttings were received at this Station in the spring of 1892. We have not yet seen its fruit.

No. 4, Thompson. A black grape of unknown parentage, originated by Jos. T. Thompson, Oneida, N. Y. Cuttings were sent to the Station in 1892. We have not yet seen the fruit.

No. 10, Gerbig. (*Lab.*, *vin.*) A seedling of No. 2, Gerbig. See above. It was originated by A. V. Gerbig, Archbald, Pa., who sent cuttings of it to the Station in 1892.

No. 12, from T. Huber. A black grape of unknown parentage, originated by Theophile Huber, of Illinois City, Ills., who says it is an immense bearer, of good quality, but the fruit drops from the pedicel to some extent. We have not yet seen the fruit.

No. 42, c, from J. G. Burrow, Fishkill, N. Y. *Lab.* It is a seedling of Concord X Jefferson, received at the Station in 1888. The fruit is excellent, but the vine has not always proved productive here. Bunch handsome in appearance, medium size, so compact that occasionally berries are choked so much as to cause them to wither instead of ripening. Berry darker red than Delaware, with lilac bloom, sometimes becoming almost purple, medium or above, not very uniform in size; pulp juicy, sweet, tender, melting, fine flavored, slightly vinous, refreshing. Ripened this season about with Concord. Worthy further trial as an amateur grape. See also Annual Reports of this Station for 1888, p. 106, and 1889, p. 342.

Seedling of Isabella. *Lab.* This grape was sent to the Station in 1889 by G. A. Ensenberger, Sr., Bloomington, Ill. In many respects it resembles the Isabella, but is earlier and has a more compact cluster than its parent. Ripened this season a little later than Moore's Early. In cold storage it kept in good condition till November, and was discarded as worthless in January. The vine has thus far been hardy, vigorous and productive.

A white grape of unknown parentage originated by D. S. Marvin, Watertown, N. Y. Mr. Marvin believes it to be from seed of Delaware X Sherman making it *vul.* X, (*vul.*, *Lab.*, *vin.*), and also says it is better, hardier and early than Delaware and that the vine resembles Sherman more than Delaware. It was received by the Station in 1892. We have not yet seen its fruit.

Senasqua. *Lab.* X *vin.* This is a seedling of Concord X Black Prince. Bunch medium to large, shouldered, and so compact that the fruit is liable to crack; berry medium to large, black with blue bloom; pulp fleshy, sprightly, vinous and of good quality. Ripened this season a few days later than Concord, and was moderately productive. See also Annual Reports of this Station for 1887, pp. 341-342; 1888, p. 106; 1889, p. 342, and 1890, p. 327.

Smart's Elsinborough. See Elsinburgh.

Standard. (*Bourq.*, *Lab.*) A seedling of Delaware originated by Mr. John Burr, of Leavenworth, Kans. It was received at the Station in 1888. Bunch medium to large, compact, handsome shouldered; berry medium to large, round, black with abundant bloom; pulp fleshy, vinous, does not readily separate from the medium sized seeds. Somewhat earlier than Concord but not so good in quality. Vine has proved vigorous here and bore a good crop this season.

Telegraph. *Lab.* Bunch medium, very compact, shouldered; berry medium, round, black; pulp juicy, sweet, pleasant flavored, of good quality but does not readily separate from the seeds. Ripened about with Catawba this season, though it is said to be almost as early as Hartford. Has not yet proved very productive here.

Theophile. A white grape of unknown parentage, originated by Theophile Huber, Illinois City, Ills. Cuttings were received at this Station in the spring of 1892. We have not yet seen its fruit.

Triumph. *Lab.* X *vin.* This is a seedling of Concord X Chasselas Musqué, originated by Geo. W. Campbell, Delaware, Ohio. In this locality it is an amateur grape only. Bunch large, compact; berry pale green to golden yellow with delicate bloom; pulp tender, almost melting, very juicy, somewhat vinous with an agreeable flavor and no foxiness; skin thin, very tender and liable to crack. Season later than Concord. Moderately productive here.

Ulster Prolific. See **Ulster**.

Ulster. (*Ulster Prolific.*) *Lab* X *æst.* This is a seedling of Catawba X wild *æstivalis* Bunch medium, compact; berry medium or above, roundish oval, red, juicy, sweet and pleasant but with a somewhat foxy flavor; pulp tender, not melting. Ripened this season a little later than Concord and was moderately productive. See also Annual Reports of this Station for 1888, p. 106; 1889, p. 343; and 1890, p. 330.

Vergennes. *Lab.* A chance seedling. See Annual Reports of this Station for 1887, p. 341; 1888, p. 106; 1889, 343 and 1890 p. 330.

Victoria. *Lab.* A white seedling of Concord, originated by T. B. Miner, Linden, Union County, N. J. It was received at this Station in the spring of 1892 from the T. S. Hubbard Co., Fredonia, N. Y. We have not yet seen its fruit. It is not identical with Ray's Victoria, which was introduced by W. M. Samuels, Clinton, Ky., about 1872.

Wheaton. (*Bourq., Lab.*) A seedling of Delaware, originated by Daniel W. Babcock, Dansville, N. Y., and sent to the Station in 1892. It is a white grape. We have not yet seen its fruit.

White Jewel. (*Burr's No.* 19.) A grape of unknown parentage, originated by Mr. John Burr, Leavenworth, Kan. Bunch medium, compact; berry medium, round, white with abundant bloom, adheres well to the pedicle; skin thin and tender; pulp very juicy, sweet but not melting, and has a mild pleasant flavor. Ripened this season a little later than Moore's Early. Vine vigorous and productive. We are not yet prepared to recommend it for further trial in this section.

Wilder. (*Rogers No.* 4.) *vin.* X *Lab.* One of the most popular of the black Rogers hybrids. It bore a good crop this season and ripened earlier than Concord. Its blossoms can not fertilize themselves and this grape should, therefore, be set where it will be freely supplied with pollen from other vines. See also Annual Reports of this Station for 1887, p. 341; 1888, p. 106; 1889. p. 342, and 1890, p. 327.

Winchell. (*Green Mountain.*) *Lab.* An early, productive white grape. Bunch medium or above, long, rather loose; berry medium, juicy, of pleasant flavor and good quality. Ripened this season with Moore's Early. Worthy extended trial. See also Annual Reports of this Station for 1887, "Seedling from J. M. Paul," p. 341; 1888, "Green Mountain," p. 105; 1889, "Green Mountain," p. 342, and 1890, "Green Mountain," p. 331. It is now conceded that the "Green Mountain" is identical with the "Winchell," introduced by Ellwanger & Barry, Rochester, N. Y.

Witt. *Lab.* A seedling of Concord, said to be an early white grape. It was planted at the Station in 1892, and we have not yet seen its fruit.

Woodruff Red. *Lab.* A chance seedling, supposed to be from Concord X Catawba, originated by C. H. Woodruff, Ann Arbor, Mich. Bunch large, shouldered; berry large, dark red; pulp thick, not easily separated from the seeds; quality medium, with foxy flavor; vine vigorous and productive. Ripened this season a few days later than Concord. See also Annual Reports of this Station for 1888, p. 106; 1889, p. 343; 1890, p. 330.

Worden. *Lab.* A seedling of Concord. See Annual Reports of this Station for 1887, p. 341; 1888, p. 106; 1889, p. 343; and 1890, p. 328.

List of grapes growing in the Station Vineyards in 1892, not including Station seedlings.

Adirondack.
Agawam.
Aledo.
Alexander Winter.
Alice.
Amber.
Amber Queen.
Ambrosia.
America.
Aminia.
Antoinette.
Arnold's No. 16. See Canada.
August Giant.
Bacchus.
Bailey.
Barry.
Beagle.
Berckmans.
Bertha.
Big B. Con.
Big Extra.
Big Hope.
Big Red. See Dr. Collier.
Black Delaware. See Nectar.
Black Eagle.
Blanco.
Brighton.
Brilliant.
Burnet.
Burr No. 15. See Paragon.
Burr No. 19. See White Jewell.
Campbell.
Canada.
Canonicus.
Carman.
Catawba.
Cayuga.
Centennial.
Champion.
Chandler.
Chautauqua.
Clevener.
Clinton.
Colerain.
Concord.
Cortland.
Cottage.
Crevelling.
Croton.
Daisy.
Delaware.
Diamond.
Diana.
Doctor Collier.
Doctor Hexamer.
Doctor Warder.
Downing.
Dracut Amber.
Duchess.
Early Dawn.
Early Market.
Early Ohio.
Eaton.
Eldorado.
Elsinburgh.
Elvibach.
Elvicand.
Elvira.
Emma.
Empire State.
Essex.
Esther.

Etta.
Eumelan.
Faith.
Fern Munson.
Frances B. Hayes. See Hayes.
Gaertner.
Geneva.
Glenfeld.
Gold Dust.
Golden Grain.
Gov. Ireland.
Gov. Ross.
Grayson.
Hartford.
Hartford Prolific. See Hartford.
Hayes.
Herald.
Herbert.
Hercules.
Hermann Jaeger.
Highland.
Hopican.
Hopkins.
Illinois City.
Iona.
Isabella.
Janesville.
Jefferson.
Jennie May. See Concord.
Jessica.
Jewel.
Jordan. See Moyer.
Juno.
Lady.
Lady Washington.
Leader.
Leavenworth.
Lindley.
Lindmar.
Linn.
Little Blue.
Livingston.
Lutie.
Mabel.
Marie Louise.
Marion.
Mary. See Lindley.
Mary's Favorite.
Massasoit.
Mathilde.
Maxatawney.
Merrimack.
Metternich.
Mills.
Missouri Riessling.
Monroe.
Montefiore.
Moore's Early.
Moyer.
Nectar.
Niagara.
Noah.
Northern Muscadine.
Norwood.
Olita.
Oneida.
Opal.
Paradox.
Paragon.
Pearl.
Perkins.
Pocklington.
Poughkeepsie Red.
Prentiss.
Profitable.
Reagan.
Red Bird.
Red Eagle.
Requa.
Rochester.
Rockwood.
Rogers No. 3. See Massasoit.
Rogers No. 4. See Wilder.
Rogers No. 5.
Rogers No. 9. See Lindley.
Rogers No. 13.
Rogers No. 14. See Gaertner.
Rogers No. 15. See Agawam.
Rogers No. 19. See Merrimack.
Rogers No. 24.
Rogers No. 28. See Requa.
Rogers No. 32.
Rogers No. 39. See Aminia.
Rogers No. 41. See Essex.
Rogers No. 43. See Barry.
Rogers No. 44. See Herbert.
Rogers No. 53. See Salem.
Rommel.
Roscoe.
Rustler.

Rutland.
Salem.
Seedlings unnamed.
Caywood No. 50.
Edmeston No. 1.
No. 1, J. T. Thompson.
No. 2, J. Shull.
No. 2, Gerbig.
No. 2, J. T. Thompson.
No. 3, J. T. Thompson.
No. 4, J. T. Thompson.
No. 10, Gerbig.
No. 12, T. Huber.
No. 42c, J. G. Burrow,
Seedling of Isabella from G. A. Ensenberger, Sr.
White from D. S. Marvin.
Senasqua.
Standard.
Stayman and Black's No. 47. See Leavenworth.
Telegraph.
Theophile.
Triumph.
Ulster Prolific. See Ulster.
Ulster.
Vergennes.
Victoria.
Vitis æstivalis, Mx.
Vitis Arizonica, Engel.
Vitis Berlandieri, Planch.
Vitis Bourquiniana, Munson.
Vitis candicans, Engel.
Vitis cinerea, Engel.
Vitis Champini, Planch.
Vitis cordifolia, Mx.
Vitis coriaceæ, Shut.
Vitis Doaniana, Mun.
Vitis Labrusca, L.
Vitis monticola, Planchon.
Vitis Munsoniana, Simpson.
Vitis mustangensis, Buckl. See V. candicans.
Vitis Novo-Mexicana, Munson. See V. Solonis.
Vitis palmata, Engel. See V. rubra.
Vitis Romaneti, Planch.
Vitis rotundifolia, Mx.
Vitis riparia, Mx. See V. vulpina.
Vita rubra, Mx.
Vitis rupestris, Scheele.
Vitis Solonis, Sou.
Vitis vulpina, L.
Wheaton.
White Jewel.
Wilder.
Winchell.
Witt.
Woodruff Red.
Worden.
Wyoming Red.
Total 200

Experiments with Nursery Stock.

At the request and through the co-operation of this Station and a large number of nurserymen of Western New York, a series of experiments with nursery stock was undertaken at this Station in 1891 by the Division of Vegetable Pathology of the United States Department of Agriculture. The work was carried on by D. G. Fairchild, Assistant Pathologist. A brief report of this work was published in the Tenth Annual Report of this Station, 1892, pp. 179-181. A more complete account of this work for 1891 and 1892 is given below by Mr. Fairchild, together with a brief report of the work in co-operation with the Station Horticulturist in testing different fungicides as to their efficiency in preventing the leaf blight of pear seedlings.

EXPERIMENTS IN PREVENTING LEAF DISEASES OF NURSERY STOCK IN WESTERN NEW YORK.*

By D. G. Fairchild.

[Plates 20-28.]

It is the intention to give in the following paper a brief account of experiments made during the seasons of 1891 and 1892 with a view of preventing the various leaf diseases of nursery stock. These experiments were carried on at Geneva, N. Y., one of the largest nursery centers east of the Mississippi. The kindness of Dr. Collier, director of the New York State Agricultural Experiment Station, made it possible for the work to be done upon the Station grounds, where proximity to the laboratories and assistance from the Station staff greatly facilitated the work.

To bring together in one article the results of the experiments, it will be necessary to repeat in part matter that has previously been published.§

* First published in Vol. VII., pp. 240-264 of Journal of Mycology, U. S. Dept. Agr., Washington, D. C.

§ Annual Report of the Secretary of Agriculture for 1891, p. 368, Bull. 3, Div. of Veg. Pathology, pp. 57-60. Tenth Ann. Report N. Y. Agri. Expt. Sta., 1892, pp. 179-181.

The original object of the experiments conducted at Geneva was to throw light upon the following questions:

(1.) Can the leaf-blight of pear, cherry, plum, and quince stocks and the powdery mildew of the apple be prevented by the use of Bordeaux mixture or ammoniacal solution of copper carbonate?

(2.) What effect is produced upon the growth of nursery stock, budded, and not budded, by repeated treatments with Bordeaux mixture and ammoniacal solution?

(3.) What effect, if any, has the variety of stock upon the scion or "bud" with respect to its resistance to leaf-blight?

While the experiments have thrown considerable light upon the first and second questions, the nursery was not extensive enough nor the soil uniform* enough to admit of any general conclusions being drawn as to the third question. Further, the experiment was begun so late in the season that it was not possible to secure stocks of uniform size, and it is doubtful if any experiments, unless made upon uniform soil, with stocks grown from cuttings, will settle, in a satisfactory manner, a phase of this problem in which there are so many variable factors.

The various leaf diseases will now be discussed, together with the results of the experiments made for preventing them. The numerous details, of interest only to those who are pursuing similar studies, are given in small type at the close of the article.

PEAR-LEAF BLIGHT (*Entomosporium maculatum*, Lev.).

This disease is perhaps the greatest obstacle to the profitable production of pear stocks. The principal injury is caused by a premature defoliation of the seedlings. When such defoliation takes place early in the season, as is quite commonly the case, the young seedlings are forced to form a new set of leaves, presumably at great expense to the reserve material stored for use the coming

* As the experiments progressed it was plainly evident that a strip 30 feet or so wide, at the west end of the block, had at some previous time received fertilizers, which rendered it eminently suited to the needs of pear stocks. As no accurate record of this portion of the farm seems to have been kept, it was impossible to ascertain what fertilizers had been used upon the strip.

spring. Often this formation of new leaves is repeated two or three times, the seedling finally becoming too exhausted to continue the struggle. If the following winter be survived enough growth may be made to render budding possible.

Although the disease is very abundant on bearing trees further south, it seems to be confined in western New York, at least in its severe attacks, to one, two, and three year old seedlings, occasionally defoliating a budded stock of some susceptible variety, like the Flemish Beauty. All ordinary budded stocks are commonly immune from the disease, although the stocks into which the buds are inserted may have been diseased before being budded.* So far as the author's observations go the fungus causing the disease does not attack the seeds of the pear or the cotyledons of the young seedlings until two weeks after the appearance of the latter above the surface of the soil. Early in the season it attacks only the foliage, but later, as the defoliation continues, it is found on the succulent growing tip of the stem. For three or four inches from the terminal bud the bark is covered with small, sunken spots, bearing in their centers the mature fruiting bodies of the fungus, this condition first becoming noticeable about the middle of August. As first pointed out by Sorauer,† it is in these sunken spots that the parasite passes the winter. In America the parasite lives from year to year, as it does in Germany, upon the bark of the growing seedling and infects the young leaves upon their first appearance in the spring. On May 20, before the foliage of last season's unbudded stocks was two-thirds grown, mature pustules were found upon the young leaves in immediate proximity to these spots upon the twigs. A microscopic examination of the spots revealed the parasite in an active condition. There is little

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* The terms "seedlings" and "stocks" are here employed as in common use among nurserymen. A seedling in nursery parlance means a plant grown from seed before it is transplanted into the nursery row, while the term stock is used to designate the seedling after transplanting either before or after budding. Whenever I have referred to stocks which have been budded I have used the term "budded stocks" or "buds."

† *Sorauer, P.* Handb. d. Pflanzenkrankheiten Zweite Aufl., 1886, vol. ii, p. 378. Monatschr. d. ver. zur Beford. d. Gartenb. Kgl. preuss. St., Jan. 1878. (Cited by Frank Krankh. d. Pfl. p. 590.)

doubt that the infected twigs are the principal means by which the fungus is carried through the winter and the presence of an ascigerous form, described by Sorauer, seems almost unnecessary to a maintenance of the disease in a region once infested.

The practice of allowing stocks to remain in the nursery rows when the leaf-blight has affected them so severely as to render them unbudable seems unwise when considered from a hygienic standpoint. Such stocks are almost sure to harbor the parasite in its winter form upon their slender branches, which are lacking in vigor. It is from these stocks that the disease apparently spreads to other plantings of seedlings in the vicinity, and to such budded stocks as are susceptible. It would seem advisable, therefore, that when leaf-blight causes a large number of failures in the seed bed the diseased seedlings should be headed back to within one or two inches of the ground and all side shoots likely to harbor the parasite removed. Such procedure would undoubtedly decrease the liability to so early an attack of the disease and enable growth to be made before the malady had time to spread from infected localities. The same immunity as that shown by rapidly growing "buds" may prove here a valuable factor. It has been objected, however, that the simultaneous appearance of several shoots from the headed-back seedling would prevent, or at least hinder severely, the budders in their work the following fall. This obstacle could be overcome by the early removal of all but one shoot. It seems to me that this method of eradicating the disease is sufficiently promising to warrant a thorough test. The matter of protecting seedlings by wind-breaks has not been thoroughly tested to my knowledge, and from observation on the spread of this disease I am inclined to believe it is worthy a systematic trial. The freedom from leaf-blight, which isolated blocks of pear seedlings often show, tends to confirm the observation that the malady travels quite slowly from seedling to seedling. In an experimental block of seedlings mentioned below it required nearly two months for the disease to travel from the east to the west end, a distance of 150 feet.

Two quite distinct experiments were made with a view of preventing this disease, one inaugurated in 1891 to test the effect of fungicides upon stocks, and the other carried on during the season of 1892 with seedlings in the seed bed.

EXPERIMENTS WITH STOCKS.

These experiments were inaugurated in the spring of 1891 and continued until the fall of 1892. The stocks planted in 1891 were sprayed both seasons, the design being to ascertain the effects of two consecutive years. The results are here presented briefly and the minor details are to be found at the close of the article.

All the stocks were sprayed on the same dates; in 1891 on May 21, June 3 and 24, July 9 and 24, and August 8 and 28. One-half the stocks were treated seven times, on the dates just indicated, and one-half only three times, on the first three dates named. In 1892 the dates of treatment were May 26-27, June 15-16, June 23, July 6-7 and 21, and August 5. One-half were sprayed five times, on the first five dates mentioned, the other half six times, as just indicated. The only fungicides used were Bordeaux mixture and ammoniacal solution. In 1891 both preparations were of essentially standard strength, but in 1892 the Bordeaux mixture was reduced to the sixty-gallon formula, as explained on a subsequent page, 671.

FRENCH PEAR STOCK

1891.—Four rows (1,922 stocks), of which 1,462 were treated and 460 left untreated. One-half the treated stocks were sprayed with ammoniacal solution, the other half with Bordeaux, at the dates above indicated. Although the disease was not so abundant in 1891 as in 1892, the contrast between treated and untreated was striking. Seven treatments with Bordeaux proved efficacious, while neither three treatments with Bordeaux nor seven with ammoniacal solution showed as good results, and three treatments with ammoniacal solution were without apparent effect. On October 9 a count of those stocks forced by the premature fall of the foliage to put forth new leaves gave the following figures:

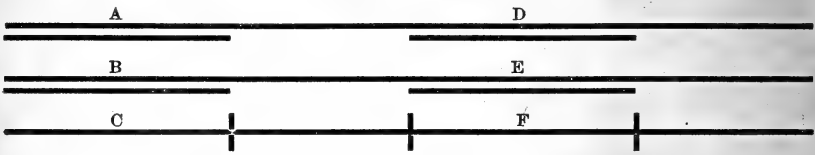
Table 1.— Showing number of French stocks forced to put out new leaves.

NUMBER AND TREATMENT OF STOCKS.	Total releaved.	Per cent releaved.
388 stocks treated 7 times with Bordeaux	4	1.0
356 stocks treated 3 times with Bordeaux	55	16.4
361 stocks treated 7 times with ammoniacal solution	50	13.8
357 stocks treated 3 times with ammoniacal solution	161	45.0
460 stocks untreated	97	21.0

1892.— The same rows of stocks as were employed in 1891 were treated in 1892, but one-half of them had been budded the fall previous, as subsequently described on pp. 666, 669. The other half were purposely left unbudded to furnish a means of testing the fungicides. The treatments were made on dates given above, using the formulæ mentioned on pp. 670, 671. During the course of the season little difference between treated and untreated budded stocks was noticeable, as none but the Flemish Beauty were subject to the disease. At the close of the season, however, the foliage on treated Flemish Beauty was much superior to that on untreated. Bordeaux proved superior to ammoniacal solution and entirely efficacious.

The greatest contrast in the experiment was between the treated and untreated stocks which had not been budded. The susceptibility of these unbudded seedlings afforded an excellent opportunity to test the efficacy of the fungicides, and the results fully warranted the extended use of Bordeaux mixture upon such stocks. As early as June 24 the difference between treated and untreated sections was visible, 75 per cent of the foliage of the untreated being diseased, while the sections sprayed with Bordeaux mixture remained healthy. Plates 20 and 21 show fairly well the contrast as it appeared on October 11, the two rows standing only three and a half feet apart. The difference consisted not only in the presence of foliage on the treated and its absence on the untreated, but in an increased growth of the former, as is shown by weights and measurements of the stocks given below. A calipering of these stocks in 1891 showed no appreciable average difference in diameter.

Diagram 1.—*Showing arrangement of treated and untreated rows:*



EXPLANATION OF DIAGRAM 1.

A and B, treated seven times in 1891, and six times in 1892, with Bordeaux: C, control on row opposite; D and E, treated three times in 1891, and five times in 1892, with Bordeaux; F, control on row opposite. This portion of the experiment was situated on rows VI, VII, and VIII, as indicated in Table 2, below, and in the plan on p. 664. The unbudded portion alone is considered.

Table 2.— Showing weights and measurements of treated and untreated French pear stocks in November.

ROW.	Section.	Diagram designation.	Treatment.	Number of seedlings.	Average weight as dug.	Average weight of top.	Average diameter at collar, in thirty-seconds of an inch.
					Oz.	Oz.	
VIII	Bb 2	A	Bordeaux, 7 times in 1891, 6 times in 1892	57	7.6	6.4	22.0
VII	Cb 2	B	Bordeaux, 7 times in 1891, 6 times in 1892	61	8.8	6.8	27.5
VI	D 6	C	Untreated in 1891 and 1892	57	5.9	4.0	17.6
VIII	Bb 1	D	Bordeaux, 3 times in 1891, 5 times in 1892	63	9.1	7.1	23.1
VII	Cb 1	E	Bordeaux, 3 times in 1891, 5 times in 1892	63	7.8	5.7	22.0
VI	Db	F	Untreated in 1891 and 1892	57	5.9	4.0	17.6

The above data were secured in the following manner: The first week in November each individual stock was dug carefully and the dirt cleaned from the roots. It was then calipered and weighed. The top was then cut off and weighed separately. These data are, perhaps, the first published showing the superiority of treated pear seedlings in other respects than that of foliage. As regards a comparison of the two copper compounds, it will be sufficient to say that the Bordeaux was in all respects superior to the ammoniacal solution. In the order of their efficacy the four methods of treatment are as follows: Bordeaux, six treatments; Bordeaux, five treatments; ammoniacal solution, six treatments; ammoniacal solution, five treatments. Five treatments with the ammoniacal solution proved almost entirely ineffectual. Plate 22 shows the average of stocks treated six times with ammoniacal solution.

JAPAN PEAR STOCKS.

1891.— One row of 466 stocks was planted in a manner precisely similar to that described for the French stocks. The dates of treatment were as above given, one-half the treated portion receiving three treatments and the other seven, one-half being treated with Bordeaux, the other with ammoniacal solution. The results obtained were striking, as illustrated by the following notes on the releaved stocks:

Table 3.— Showing number of Japan stocks forced to put out new leaves.

NUMBER AND TREATMENT OF STOCKS.	Total number releaved.	Per cent releaved.
87 stocks treated 7 times with Bordeaux	1	801
88 stocks treated 3 times with Bordeaux	21	2.17
87 stocks treated 7 times with ammoniacal solution	15	142.
90 stocks treated 3 times with ammoniacal solution	9	3.0
114 stocks untreated	47	1.21

The average diameter of the stocks near the collar was not perceptibly greater in the treated than in the untreated, the average difference amounting to less than one thirty-second of an inch. The untreated Japan stocks suffered more from the disease than the untreated French stocks.

1892.— The same row of stocks as that employed the previous season was treated, but one-half or more of the stocks were budded in 1891, as described subsequently on pp. 666, 669. The treatments given were as described on pp. 670, 671. As early as June 24, the unbudded stocks, which had not been treated, showed the disease plainly, every stock being affected. At this date it was evident that the Japan stocks, as introduced from the south, were more susceptible to leaf-blight than the imported French or the native-grown American stocks. The latter were at this date scarcely affected by the disease. From the two years' experiments upon Japan stocks from Franklin Davis & Co.'s nurseries it seems probable that these when imported from the south will not show any greater immunity from leaf-blight than the French or American stocks. A more extended experiment, however, is needed to settle this point. The results of treatments with fungicides was as striking as that gained from the French stocks. The foliage on the budded stocks remained reasonably free from the disease until quite late in September when the stocks in the untreated portions began to drop their leaves badly; those treated six times with Bordeaux held their leaves almost intact. The Bordeaux proved in general more efficacious than the ammoniacal solution in the treatment of both budded and unbudded stocks, and six treatments were more effective than five. But one noteworthy exception existed in the first section treated five times with ammoniacal solution, which is possibly explainable by superiority of soil.

Below are given in Table 4 the notes on foliage and caliper made October 19, 1892:

Table 4.— Showing condition of Japan stocks as regards foliage and caliper.

Section.*	TREATMENT.	ESTIMATED PER CENT OF FOLIAGE DROPPED.		Average caliper of unbudded at collar in 1-32 of inch.
		Budded stocks.	Un budded stocks.	
Aa1	Ammoniacal solution, 5 treatments	0	0	26.6
Ba1	Ammoniacal solution, 5 treatments	0	80	13.4
Ca1	Ammoniacal solution, 5 treatments	80	80	15.0
Aa2	Ammoniacal solution, 6 treatments	0	50	20.3
Ba2	Ammoniacal solution, 6 treatments	0	15	24.7
Ca2	Ammoniacal solution, 6 treatments	85	60	21.6
Ab1	Bordeaux mixture, 5 treatments	0	10	18.7
Bb1	Bordeaux mixture, 5 treatments	0	25	19.7
Cb1	Bordeaux mixture, 5 treatments	40	50	21.3
Ab2	Bordeaux mixture, 6 treatments	0	5	21.5
Bb2	Bordeaux mixture, 6 treatments	0	10	18.5
Cb2	Bordeaux mixture, 6 treatments	0	0	23.1
D-I	Untreated (budded)	15	....	....
D-II	Untreated (budded)	40	....	....
D-III	Untreated (budded)	95	....	....
D-IV	Untreated (not budded)	....	98	13.2

* Designations in this column refer to the varieties of "buds," for details of which see p. 669.

It is noticeable from the above table that Bordeaux mixture afforded the greatest immunity, also that the untreated unbudded stocks made much less growth than those treated with Bordeaux. A reference to the plan (page 664) will show the situation of the row (No. IX). When it is remembered that of all of the French stocks, those standing in row VIII, only three and one-half feet distant, made the best growth, the element of soil difference is hardly to be considered as a disturbing factor.

AMERICAN PEAR STOCKS.

1891.—Four rows containing 1,673 stocks were subjected to a course of treatment similar in every respect to that given the French and Japan stocks. Owing to the lateness of the season when application was made to the growers of American seedlings only second-grade stocks were to be obtained. Because of this unfortunate but unavoidable circumstance no comparison could be drawn as to the comparative value of American, Japan, and imported French stocks. The results of the treatments with fungicides while not as striking as with the French stocks, are valuable as adding testimony to the efficacy of the Bordeaux.* Seven treatments with this mixture proved entirely efficacious, raising the percentage of stocks wholly free from the disease from two-tenths of 1 per cent to 39 per cent. On October 9 a count was made of the number of stocks in each section which pushed out new leaves because of the severity of leaf-blight. The results of this count are as follows:

Table 5.—Showing number of American stocks forced to put out new leaves.

NUMBER AND TREATMENT OF STOCKS.	Total number releaved.	Per cent. releaved.
326 stocks treated 7 times with Bordeaux	7	2.14
288 stocks treated 3 times with Bordeaux	93	32.29
313 stocks treated 7 times with ammoniacal solution	51	16.29
325 stocks treated 3 times with ammoniacal solution	94	28.92
421 stocks untreated	152	36.10

* See Bull. 3 Div. Veg. Path., p. 59.

1892.— The same rows of stocks were employed this season as had been treated the previous season, as many as possible of them having been budded as described subsequently on page 669. Those not budable were left standing for further treatment with fungicides. The treatments were as described on pp. 670, 671. Owing to the inferior character of the stocks originally planted this whole block would be considered worthless, as not one-half the stocks were budable in 1891. The effect of the Bordeaux mixture, however, was plainly observable and a rough estimate made October 19 of the percentage of foliage still upon the unbudded stocks showing the Bordeaux to be much superior to the ammoniacal solution, and six treatments superior to five.

QUINCE LEAF-BLIGHT (*Entomosporium macalatum*, LEV.)

Much that was said in reference to pear leaf-blight applies equally well to quince leaf-blight, which is caused by the attacks of the same fungus. The parasite, so far as the author's observation goes, never attacks the bark on the young shoots but is confined wholly to the foliage. The Angers quince seems more susceptible than the Orange and it is rare to observe after the first week in September a block of quince cuttings from which at least fifty per cent of the leaves have not fallen. Unlike the disease on the pear, the quince leaf-blight often seriously defoliates bearing trees in this section and commonly causes the fruit-grower much loss from its attacks on the ripening fruits, in which form it is called "fruit spot."*

The experiments in the prevention of this disease were confined to one row of Angers quince cuttings, treated partly with Bordeaux mixture and partly with ammoniacal solution.§§

ANGERS QUINCE STOCKS.

1891.— One row of 509 cuttings was planted and treated with fungicides in a manner described on pp. 668, 671. The season being an unusually dry one, no disease of any consequence appeared, and

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* Bull. 3 Div. Veg. Path., pp. 65–68, Pl. vii, viii.

§§ For formulæ of fungicides and dates of treatment, see pp. 670, 671.

as stated in a previous publication§ the insignificant quantity of leaf-blight present offered no opportunity to test the fungicides in a satisfactory manner.

1892.—The same row of cuttings as employed in 1891 was treated this season, but one-half or more of each section had been budded in the fall previous, as noted below, p. 666. The treatments were identical with those made upon the pear stock; see pp. 670, 671. As early as July 7 the leaves on the untreated section left without budding showed the disease plainly, while the foliage of those sections treated with Bordeaux and ammoniacal solution remained free from the disease. By August 30 two-thirds of the foliage of the unbudded, untreated portion had fallen to the ground, while the treated sections standing in the same row, as shown in the plan, p. 664. Row V, remained intact. Plates 23 and 24 show the appearance of the treated and untreated sections.

On September 29 the difference manifested by these stocks was not one of foliage only. The twigs of the treated, upon close examination, were apparently a trifle more robust, and the caliper of the cuttings at the base showed a considerable increase not to be attributed to differences in soil. Below are given the data secured from a careful calipering of the unbudded stocks at the collar, made October 15. The figures given are in thirty-seconds of an inch and represent the average diameter of stocks in each section:

Table 6—Showing average caliper of treated and untreated unbudded quince stocks.

Section.	NUMBER AND TREATMENT OF STOCKS.	Average diameter.
Aa1	16 stocks treated five times with ammoniacal solution	25.3
Ba1	16 stocks treated five times with ammoniacal solution	26.2
Ca1	16 stocks treated five times with ammoniacal solution	26.3
Aa2	15 stocks treated six times with ammoniacal solution	25.0
Ba2	16 stocks treated six times with ammoniacal solution	27.0
Ca2	15 stocks treated six times with ammoniacal solution	24.0
Ab1	15 stocks treated five times with Bordeaux mixture	27.0
Bb1	16 stocks treated five times with Bordeaux mixture	25.2
Cb1	16 stocks treated five times with Bordeaux mixture	25.2
Ab2	17 stocks treated six times with Bordeaux mixture	29.2
Bb2	17 stocks treated six times with Bordeaux mixture	26.4
DIV.*	90 stocks untreated	20.6

§ Bull. 3, op. cit., pp. 58-59.

* Unfortunately a section, Cb2, was not staked off in planning the experiment.

The inference from the above table is that the stocks which held their leaves through the season made a greater growth in diameter than those from which the foliage dropped in July and August. Taking the average of all stocks treated with ammoniacal solution, ninety-four in number, we have 25.7 thirty-seconds of an inch, while the average of eighty-one stocks treated with Bordeaux was 26.5 thirty-seconds. The better of these two averages (26.5) when compared with the untreated (20.6) gives an increase in diameter of 5.9 thirty-seconds or nearly three-sixteenths of an inch.

CHERRY LEAF-BLIGHT (*Cylindrosporium padi*, Karsten).

The leaf blight of cherries caused by the same species of fungus as that producing plum leaf-blight, is very widespread. Scarcely a wild species of the genus *Prunus* is entirely exempt from the disease, and at all stages from seedlings in the seed bed to old bearing trees, cultivated cherries are subject to its attacks. The greatest variation exists, however, as regards the susceptibility of different varieties, some being nearly exempt and others, as the English Morello, materially damaged by it. Remarkable cases of immunity are sometimes observed. Of seedlings used for budding, only the Mazzard seems in any serious degree damaged by the disease. In unfavorable years the defoliation is so serious as to render the first year's growth of stocks almost insignificant. Mazzard seedlings of the second year are also badly attacked. The greatest damage probably occurs where Mazzard stocks are budded with susceptible varieties, in which case the cumulative effect of the disease appears. It is a fact to be noted here, however, that the cherry leaves attacked by the parasite remained attached to the stocks long enough to take on the yellow autumn tints characteristic of foliage from which the valuable ingredients of potash and phosphoric acid have been removed.* It is probable, although no experiments have to my

* According to the prevailing views of the physiological botanists, Pfeffer, Sachs, Detmer, Wiesner and others, the valuable mineral constituents of leaves are withdrawn from them at the same time as they become yellow and before they fall to the ground; but the recent paper of Wehmer, *Die dem Laubfall voraufghende vermeintliche Blattentleerung. Ber. d. deutsch. bot. Gesellsch.* 10 *Jahrg.*, *Heft.* 3, *pp.* 152–163, indicates that the grounds for this belief may not have been sufficiently proven, and the whole subject needs further investigation.

knowledge been made to establish it, that the premature fall of the leaves does not entail so great a loss to the cherry seedling as does the fall of the pear foliage, which drops while still green.

The experiments in the prevention of this disease, extending over a period of two seasons, were made upon the two well-known kinds of stocks, Mahaleb and Mazzard. In 1891 only the stocks not yet budded were treated, while in 1892 the stocks budded in the fall of 1891 were sprayed, suitable control being left.

For record of budding see pp. 665, 668. Bordeaux mixture and ammoniacal solution of standard strength were employed in 1891; ammoniacal solution of standard strength and Bordeaux of one-third strength in 1892.*

MAHALEB CHERRY STOCKS.

1891.— One row of 449 stocks was planted and treated with fungicides at the dates described for all the stocks on page 671. One-half, excepting controls, received six and the other three sprayings. One-half were treated with ammoniacal solution, the other with Bordeaux. As mentioned in Bulletin No. 3,§ where an account of this experiment has already been given, the leaf blight was not present in any considerable amount during this season and the efficacy of the two fungicides was not given a test of any severity. The treated portions, however, remained freer from disease than the untreated.

1892.— The same row which had been budded in the fall of 1891, as described subsequently, was treated this season in a manner precisely similar to that described for the pear stocks, page 671. Care was taken that the undersides of the leaves were wet by the spray and to accomplish this the Vermorel nozzle was directed upwards. On June 24 the first signs of leaf-blight were noticed upon the budded, untreated, stocks, the unbudded stocks remaining almost entirely free throughout the season. By July 16 the leaves of the untreated began

* See pp. 670, 671 for formulæ of all fungicides used. § Op. cit. p. 58.

to fall and continued dropping until many of the stocks were left nearly leafless. On October 4 a careful count was made of the number of leaves which had fallen from each individual stock in the row. This was accomplished, in a comparative way, by counting the leaf-scars on each stock. Below is given for convenience a condensed statement of the condition of the stocks with regard to height, diameter three inches above the union, and freedom from leaf-blight. All numbers represent averages. Height above ground (measured September 28) is represented in feet and inches, while the figures for diameter (measured October 15) are in thirty-seconds of an inch. Only budded stocks are here taken into account.

Table 7.— Showing condition of budded Mahaleb stocks, treated and untreated, as regards foliage and measurements.

Section.	NUMBER, KINDS AND TREATMENT OF STOCKS.	Average number of leaves fallen October 4.	Average height above ground.		Average caliper three inches above union.
			Ft.	In.	
Aa1	16 budded Windsor stocks. Ammoniacal, five treatments	8.0	5	8	23
Aa2	18 budded Windsor stocks. Ammoniacal, six treatments	7.8	5	10	23
Ab1	13 budded Windsor stocks. Bordeaux, five treatments	13.1	6	0	24
Ab2	17 budded Windsor stocks. Bordeaux, six treatments	7.4	6	0	25
DIII	7 budded Windsor stocks, untreated	54.8	5	0	16
Ba1	18 budded Yellow Spanish stocks. Ammoniacal, five treatments	6.4	4	9	22
Ba2	17 budded Yellow Spanish stocks. Ammoniacal, six treatments	6.4	4	9	21
Bb1	18 budded Yellow Spanish stocks. Bordeaux, five treatments	7.3	5	4	21
Bb2	18 budded Yellow Spanish stocks. Bordeaux, six treatments	4.8	5	1	23
DII	8 budded Yellow Spanish stocks, untreated	21.3	4	1	16
Ca1	16 budded Montmorency stocks. Ammoniacal, five treatments	8.5	3	7	21
Ca2	18 budded Montmorency stocks. Ammoniacal, six treatments	10.3	3	5	21
Cb1	22 budded Montmorency stocks. Bordeaux, five treatments	4.0	3	5	21
Cb2	16 budded Montmorency stocks. Bordeaux, six treatments	6.1	3	9	19
DI	4 budded Montmorency stocks, untreated	65.7	3	6	17

The conclusion which can be drawn from the table seems to be that the treated sections held their leaves better, made as good a growth in height, and without exception a greater growth in diameter, or "caliper," than the untreated sections. That this increased growth was due entirely to the fungicide it will not be possible to maintain, for this difference may possibly have been brought about in part or wholly by variations in the soil. That none of the mixtures injured the "buds" it is believed is clearly shown.

The answer to question 3, as to the effect of fungicides on the growth of budded stocks, is here, for the Bordeaux mixture at least, satisfactorily found, for both Windsor and Yellow Spanish stocks did better under treatment with Bordeaux than without treatment. There still remains a doubt as to the beneficial effect of ammoniacal solution. In all cases where used it was apparently slightly injurious to the foliage. The leaves assumed a yellowish, unhealthy appearance. Plates 25 and 26 show the comparison between treated and untreated "buds."

MAZZARD CHERRY STOCKS.

1891.— One row of 468 stocks was experimented with, receiving as nearly as possible a course of treatment identical with that given the Mahaleb stocks. During the season, as in the case of the Mahalebs, only an insignificant amount of leaf-blight was present, affording no opportunity to test the fungicides. The powdery mildew (*Podosphera oxyacanthæ*, (DC.), Winter ?) made its appearance in small amount on the stocks in August and offered an opportunity to observe the beneficial effects of Bordeaux mixture in the treatment of this disease. Seven treatments with Bordeaux materially decreased the amount of the disease and proved superior to seven treatments with ammoniacal solution.* Three early treatments with either fungicide had no preventive effect.

1892.— The same row as that treated in 1891 was used this season, but budded with three different varieties identical with those budded on the Mahaleb stocks, as shown in the table on p. 668. The treatments were similar in all respects to those given the Mahaleb stocks. The condition of the stocks at the close of the season is shown by the following table:

* See Bull. 3 Div. Veg. Path., 1892, p. 58.

Table 8.— Showing condition of budded Mazzard stocks, treated and untreated, as regards foliage and measurements.

Section.	NUMBER, KINDS AND TREATMENT OF STOCKS.	Average number of leaves fallen October 10.	Average height above ground. Ft.	In.	Average caliper three inches above union.
Aa1	25 budded Windsor stocks; ammoniacal, five treatments	5.0	4	10	16
Aa2	30 budded Windsor stocks; ammoniacal, six treatments	5.3	5	6	20
Ab1	27 budded Windsor stocks; Bordeaux, five treatments	6.4	5	9	20
Ab2	27 budded Windsor stocks; Bordeaux, six treatments	5.3	5	10	20
DI	11 budded Windsor stocks: untreated*	13.7	4	9	20
Ba 1	27 budded Yellow Spanish stocks; ammoniacal, five treatments	4.2	4	5	19
Ba2	28 budded Yellow Spanish stocks; ammoniacal, six treatments	4.6	4	10	21
Bb1	31 budded Yellow Spanish stocks; Bordeaux, five treatments	2.9	5	6	18
Bb2	31 budded Yellow Spanish stocks; Bordeaux, six treatments	2.5	4	5	18
DII	14 budded Yellow Spanish stocks; untreated	8.7	3	2	15
Ca1	26 budded Montmorency stocks; ammoniacal, five treatments	6.3	3	7	18
Ca2	18 budded Montmorency stocks; ammoniacal, six treatments	6.8	3	3	17
Cb1	26 budded Montmorency stocks; Bordeaux, five treatments	5.9	3	1	17
Cb2	26 budded Montmorency stocks; Bordeaux, six treatments	5.0	3	1	17
DIII	7 budded Montmorency stocks; untreated	24.2	2	8	14

The disease did comparatively little damage upon these stocks, but, as shown by the table, the treated sections were superior to the untreated, and the Bordeaux slightly superior to the ammoniacal solution when six treatments are compared.§ The difference between five and six treatments was not very marked.

A comparison of the two tables brings out the fact which is noteworthy in this connection, that the "buds" §§ on Mahaleb stocks averaged greater in diameter throughout than those on the Mazzard. This difference is constant when stocks receiving the same treatment are compared in each row, with the exception of the untreated section of Windsors when compared with

* By an accident this section received one late spraying with Bordeaux, and hence it is rendered unfit for comparison.

§ The superiority of Bordeaux is not fully shown by the figures, as in every case the effect of the ammoniacal solution was evidently injurious to the health of the foliage.

§§ The term "bud" is here used, as among nurserymen, to indicate a budded stock after the top has been cut off and the inserted bud itself allowed to grow.

that treated once by mistake. This constant difference in diameter, at three inches above the base ("caliper"), is of such importance as to merit further observations. The author regrets that the control rows were left so small, and feels warranted in drawing only the general conclusion, which was strikingly demonstrated, that the fungicides were effective to a remarkable degree in preventing the disease and that treated made the best growth.

PLUM LEAF-BLIGHT (*Cylindrosporium padi* Karsten).

The plum leaf-blight in western New York, aside from giving much trouble to nurserymen, does very great damage to many varieties of bearing trees, defoliating them in August and September. This disease is considered by the plum-growers in the vicinity of Geneva, as their most persistent enemy. A large orchard belonging to E. Smith & Sons, two miles northwest of the city, was, they informed me, winter-killed about thirty years ago because of defoliation the summer previous. It is a common opinion among orchardists that leaf-blight, through its retarding effect upon the maturation of the wood, renders the trees incapable of withstanding the changes in temperature of a trying winter. Whatever the explanation of this fact may be, it seems self-evident that a tree which drops its leaves before the normal season suffers very material loss.

Of nursery stocks, the native-grown seedlings suffer the most from this disease, often losing all their leaves by the middle of August. Myrobolan and Marianna stocks are not to any extent subject the first season. In entire contradistinction to the immunity exhibited by pear "buds" which resist to a remarkable degree pear leaf-blight, the budded plum stocks are particularly susceptible to plum leaf-blight. Apparently the same conditions of rapid growth which afford immunity in the one case tend to susceptibility in the other. The two instances offer a fertile field for inquiry.

The experiments on this disease were made with Bordeaux mixture and ammoniacal solution upon two rows of stocks, one of

Marianna, containing 504 stocks, and the other of Myrobolan, containing 474 stocks. As described previously* the results of the first season's experiment were entirely negative, as the disease failed to appear.

On October 9, the three varieties, Early Prolific (Early Rivers), Purple Egg (Hudson River Purple Egg), and Italian Prune (Fellenberg), were budded upon both rows of stocks as set forth subsequently, p. 665. Numerous stocks were left unbudded to test the effect of the fungicides and the end of each row was left untreated.

The rows were treated in 1892, with Bordeaux and ammonical solution, the formulae of which are described on pp. 670, 671. One-half the treated stocks received five sprayings and the other six, at the dates given on p. 646. In all respects the two rows were treated alike.

MYROBOLAN STOCKS.

1892.—The disease made its first appearance in June upon the unbudded stocks which were carried over from 1891, and strangely enough only upon the treated portions. This dropping of the treated Myrobolan foliage was confined to the leaves situated on the larger limbs in the interior portion of the bushy growth. Although only a small per cent of the foliage was thus affected, the difference between treated and untreated was quite evident. After the lapse of three or four weeks this falling of the leaves ceased. The unbudded stocks which were not treated remained remarkably free from the disease, but in this respect were excelled by the Marianna unbudded, untreated stocks. The budded stocks were not so soon affected as the unbudded, but the Early Prolific "buds" in the untreated section began dropping their foliage in July and throughout the season were manifestly worse affected. The following table shows the data collected in September and October, after all growth had practically ceased:

* Bull. 3 Div. Veg. Path., p. 58.

Table 9.— Showing condition of budded Myrobolan stocks treated and untreated, as regards foliage and measurements.

Section.	NUMBER, KINDS AND TREATMENT OF STOCKS.	Average number of leaves fallen October 10.	Average height above ground September 28. Ft.	In.	Average caliper three inches above union, October 15.
Aa1	11 budded Early Prolific stocks, ammoniacal, five treatments	69.8	3	6	14.8
Aa2	16 budded Early Prolific stocks, ammoniacal, six treatments	115.8	3	6	14.3
Ab1	18 budded Early Prolific stocks, Bordeaux, five treatments	66.0	4	0	15.4
Ab2	13 budded Early Prolific stocks, Bordeaux, six treatments	57.5	3	8	16.9
DI	8 budded Early Prolific stocks, untreated	312.5	3	9	14.3
Ba1	13 budded Purple Egg stocks, ammoniacal, five treatments	36.3	4	1	16.2
Ba2	20 budded Purple Egg stocks, ammoniacal, six treatments	32.8	4	2	15.1
Bb1	16 budded Purple Egg stocks, Bordeaux, five treatments	6.1	3	8	15.4
Bb2	16 budded Purple Egg stocks, Bordeaux, six treatments	9.7	4	3	15.6
DII	10 budded Purple Egg stocks, untreated	123.3	4	7	16.4
Ca1	12 budded Italian Prune stocks, ammoniacal, five treatments	15.8	3	10	14.3
Ca2	16 budded Italian Prune stocks, ammoniacal, six treatments	8.2	3	7	15.3
Cb1	16 budded Italian Prune stocks, Bordeaux, five treatments	7.8	3	6	15.5
Cb2	15 budded Italian Prune stocks, Bordeaux, six treatments	6.3	4	0	16.4
DIII	11 budded Italian Prune stocks, untreated	52.8	3	9	15.0

From this table the only conclusion admissible is in regard to the amount of leaf-blight. It is evident that the treated portions lost only a small number of leaves in comparison with the untreated, and in so far the fungicides proved effective.

MARIANNA STOCKS.

1892.— The treatment of these stocks was in all respects identical with that of the Myrobolan stocks and the results were in general similar. The treated unbudded stocks lost a number of their leaves from an early attack of the fungus in June and July, but the untreated unbudded portion of the row remained remarkably free from the disease throughout the season, more so in this regard than the Myrobolan. The budded stocks showed little superiority in regard to leaf-blight over the budded Myrobolan and evidently no considerable degree of immunity was afforded by the stock to the scion. But a comparison of the two tables brings out the fact that the Purple Egg "buds" made markedly the best growth upon Marianna stocks. These "buds" averaged more than one-eighth of an inch greater in diameter and were on an average ten inches higher. The other less rapidly growing stocks, did not show such a marked difference, and too much reliance ought not to be placed in data gathered from so small a number of stocks. Certain it is, however, that the Marianna proved superior in this single experiment.

Table 10.—Showing condition of budded Marianna stocks, treated and untreated, as regards foliage and measurements.

Section.	NUMBER, KIND, AND TREATMENT OF STOCKS.	Average number of leaves fallen October 11.	Average height above ground September 28. Ft.	In.	Average caliper three inches above union, October 15.
Aa1	9 budded Early Prolific stocks, ammoniacal, five treatments	98.8	3	3	15.5
Aa2	14 budded Early Prolific stocks, ammoniacal, six treatments	63.3	3	6	16.3
Ab1	14 budded Early Prolific stocks, Bordeaux, five treatments	99.6	4	4	20.2
Ab2	5 budded Early Prolific stocks, Bordeaux, six treatments	71.6	3	2	18.5
D-I	10 budded Early Prolific stocks, untreated	311.2	3	7	15.9
Ba1	17 budded Purple Egg stocks, ammoniacal, five treatments	39.1	5	5	21.2
Ba2	23 budded Purple Egg stocks, ammoniacal, six treatments	45.1	4	7	20.6
Bb1	17 budded Purple Egg stocks, Bordeaux, five treatments	42.7	5	0	21.3
Bb2	21 budded Purple Egg stocks, Bordeaux, six treatments	26.9	5	1	20.2
DII	14 budded Purple Egg stocks, untreated	148.2	5	0	20.5
*DIII	12 budded Purple Egg stocks, untreated	177.2	4	11	19.2
Ca1	19 budded Italian Prune stocks, ammoniacal, five treatments	16.8	3	6	17.2
Ca2	24 budded Italian Prune stocks, ammoniacal six treatments	17.5	4	0	14.5
Cb1	20 budded Italian Prune stocks, Bordeaux, five treatments	11.0	4	7	20.0
Cb2	19 budded Italian Prune stocks, Bordeaux, six treatments	12.2	4	2	19.0

As regards the effects of the treatments, the only fairly deducible conclusion is that the Bordeaux mixture and ammoniacal solution prevented the disease to a notable degree, sufficient, it is believed, to warrant further extended trial in nursery practice. Although not evident from the table, the ammoniacal solution is in reality inferior to Bordeaux, as it injures the foliage of the treated "buds." On this account it can not be recommended for the treatment of plum stocks. Plates 27 and 28 show the treated and untreated "buds" as they appeared in the experiments.

* By another mistake in budding, those stocks which should have received Italian Prune buds were budded with Purple Egg buds.

APPLE POWDERY MILDEW (*Podosphæra oxyacanthæ* [DC] Winter?)

Seedling apples sometimes suffer quite severely from this disease, which attacks their young shoot tips, often stunting the growth of the seedlings and preventing them from attaining a suitable size the first season. Compared with the injury caused by the apple thrips, however, that brought about by the mildew is surely insignificant and, in New York State at least, hardly warrants any expensive measures in its prevention. The disease usually appears late in September, when the principal growth has been made, and seldom, if ever, spreads to vigorously growing budded stocks, even when these are in close proximity to diseased seedlings. The malady was not observed on bearing trees in the neighborhood of Geneva.

The experiments in the prevention of this disease comprised in 1891 about 1,000 American stocks and the same number of French stocks, besides 500 seedlings. As stated in a previous publication,* the results of the first season's treatment of the stocks was entirely negative and the treatments of seedlings which were made on May 21, June 3, 24, July 9, 24, and August 8, as well as the early treatments made on the first three dates mentioned, failed entirely to prevent the appearance of mildew the first week in September. Bordeaux mixture and ammoniacal solution alone were used, the formulæ being those described on pp. 670, 671. This failure of the fungicides is considered by the author merely as additional testimony to the fact observed, that the mixtures were largely washed off before the disease appeared. On August 7 the French and American stocks were budded with Twenty Ounce, Fameuse and Early Strawberry buds, as described in detail on p. 667, and in the season of 1892 the budded, and such of the stocks as were left unbudded, were treated with Bordeaux mixture and ammoniacal solution at dates the same as for all other stocks, viz.: May 27, June 16, 23, July 7, 21, and August 5. One-half the treated stocks were sprayed five times on the first five dates mentioned, the other half were sprayed six times.

No powdery mildew appeared during the course of the season, and in October the results of the treatments were entirely nega-

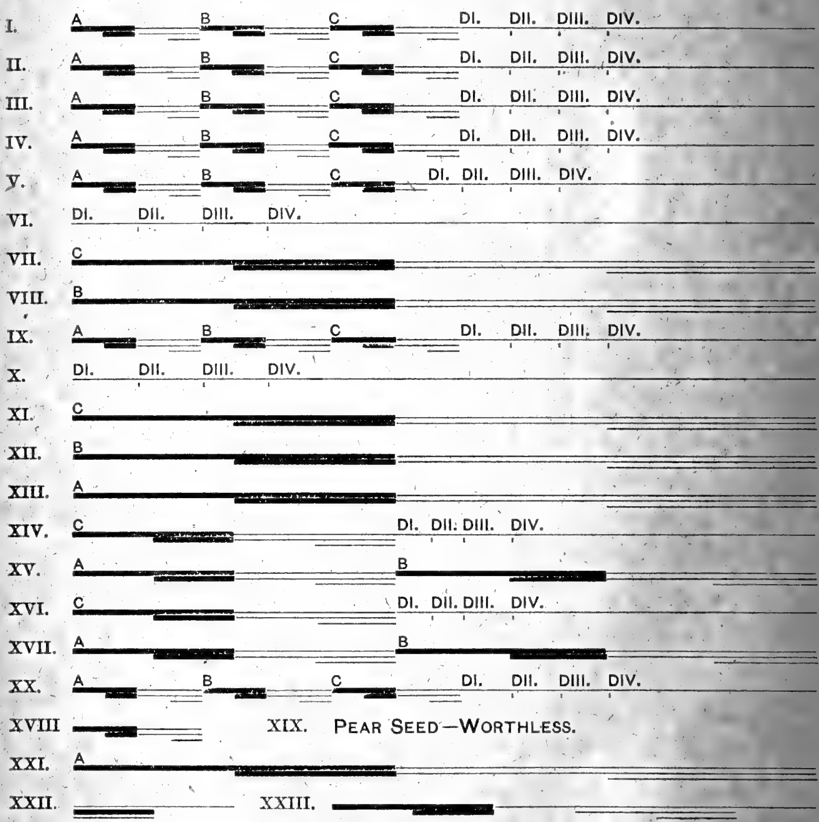
* Bull. No. 3, l. c., p. 60.

tive. The apple thrips, however, attacked the budded and unbudded stocks, and injured them severely. The mixtures had, as might be expected, no effect upon these insects.

DETAILS OF THE EXPERIMENTS.

The following pages comprise the details of the experiments, which are removed from the general account in order to render the latter more comprehensible. They will prove of interest only to specialists on the subject.

DIAGRAM 2.—*Plan of nursery experiment at Geneva, N. Y.*



Treated 3 to 5 times with ammoniacal solution (a 1).
Treated 6 to 7 times with ammoniacal solution (a 2).
Treated 4 times with mixture No. 13.
Untreated.
Treated 3 to 5 times with Bordeaux (b 1).
Treated 6 to 7 times with Bordeaux (b 2).

The actual proportions of the experimental field do not admit of any but a diagrammatic representation. The location of the field is designated in the records of the Station as "main farm plat B." The rows ran east and west, the west end of each row being indicated by a Roman numeral. These numerals are for convenience of reference (see account following). The capital letters heading the sections of each row refer to the budding. For example: Row I, Section A, was budded with Windsor; Row I, Section B, with Yellow Spanish, precisely as set forth below. The treatments with fungicides which each section and subsection received are indicated by the key below Diagram 2.

The sections of the various rows were budded as below described:

Row I. Mahaleb cherry stocks budded August 5, 1891.

Section A with Windsor.
B with Yellow Spanish.
C with Montmorency.
DI with Montmorency.
DII with Yellow Spanish.
DIII with Windsor.
DIV unbudded.

Row II. Mazzard cherry stocks budded August 5, 1891.

Section A with Windsor.
B with Yellow Spanish.
C with Montmorency.
DI with Windsor.
DII with Yellow Spanish.
DIII with Montmorency.
DIV unbudded.

Row III. Myrobolan plum stocks budded September 10, 1891.

Section A with Early Prolific.
B with Purple Egg.*
C with Italian Prune.
DI with Early Prolific.
DII with Purple Egg.*
DIII with Italian Prune.
DIV unbudded.

Row IV. Marianna plum stocks budded September 10, 1891.

Section A with Early Prolific.
B with Purple Egg.*
C with Italian Prune.
DI with Early Prolific.
DII with Purple Egg.*
DIII with Purple Egg.†
DIV unbudded.

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* A variety of recent introduction originated on the Hudson river.

† The budder's blunder in inserting these in place of Italian prune.

Row V. Angers quince stocks budded August 6, 1891.
Section A with Duchess.
B with Anjou.
C with Flemish Beauty.
DI with Duchess.
DII with Anjou.
DIII with Anjou.
DIV unbudded.

Row VI. French Pear stocks budded August 7, 1891.
Section DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row VII. French Pear stocks budded August 7, 1891.
Section C with Flemish Beauty.

Row VIII. French Pear stocks budded August 7, 1891.
Section B with Anjou.

Row IX. Japan Pear stocks budded August 5, 1891.
Section A with Duchess.
B with Anjou.
C with Flemish Beauty.
DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row X. American Pear stocks budded August 7, 1891.
Section DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row XI. American Pear stocks budded August 7, 1891.
Section C with Flemish Beauty.

Row XII. American Pear stocks budded August 7, 1891.
Section B with Anjou.

Row XIII. American Pear stocks budded August 7, 1891.
Section A with Duchess.

Row XIV. American Apple stocks budded August 7, 1891.

Section C with Twenty Ounce.
DI with Fameuse.
DII with Early Strawberry.
DIII with Twenty Ounce.
DIV unbudded.

Row XV. American Apple stocks budded August 7, 1891.

Section A with Fameuse.
B with Early Strawberry.

Row XVI. French Apple stocks budded August 7, 1891.

Section C with Twenty Ounce.
DI with Fameuse.
DII with Early Strawberry.
DIII with Twenty Ounce.
DIV unbudded.

Row XVII. French Apple stocks budded August 7, 1891.

Section A with Fameuse.
B with Early Strawberry.

Row XVIII. French Apple seeds.

Row XIX. French Pear seeds which did not germinate.

Row XX. Peach seedlings which remained healthy.

Row XXI. French Pear stocks budded August 7, 1891.

Section A with Duchess.

Row XXII. Plum seedlings of *Prunus domestica*.*

Row XXIII. Horse chestnut seedlings.*

* The results of treatments of plum and horse chestnut seedlings are reserved for future publication.

Table II.—Showing the number of budded stocks in each treated and untreated section.

[Note.—The small letter *a* indicates that the stocks were treated with ammoniacal solution, the letter *b* that they were sprayed with Bordeaux. The small Arabic numeral 1 indicates that the stocks were treated five times, the number 2 that they were treated six times. The sections marked I-IV were not treated.]

Row.	KIND OF STOCK.	Section.	Variety of bud.	Number budded.	Number left unbudded.
I	Mahaleb	Aa1	Windsor	17	3
		Aa2	Windsor	18	4
		Ab1	Windsor	*13	2
		Ab2	Windsor	20	0
		Ba1	Yellow Spanish	21	2
		Ba2	Yellow Spanish	22	1
		Bb1	Yellow Spanish	22	0
		Bb2	Yellow Spanish	20	2
		Ca1	Montmorency	18	2
		Ca2	Montmorency	20	2
		Cb1	Montmorency	23	0
		Cb2	Montmorency	18	2
		DI	Montmorency	11	1
		DII	Yellow Spanish	11	0
		DIII	Windsor	8	0
		DIV	Not budded	.....	40
II	Mazzard	Aa1	Windsor	28	0
		Aa2	Windsor	30	0
		Ab1	Windsor	27	0
		Ab2	Windsor	25	0
		Ba1	Yellow Spanish	29	1
		Ba2	Yellow Spanish	29	0
		Bb1	Yellow Spanish	31	0
		Bb2	Yellow Spanish	31	1
		Ca1	Montmorency	27	1
		Ca2	Montmorency	23	4
		Cb1	Montmorency	29	1
		Cb2	Montmorency	29	0
		DI	Windsor	14	1
		DII	Yellow Spanish	15	0
		DIII	Montmorency	15	0
		DIV	Not budded	.....	62
III	Myrobolan	Aa1	Early Prolific	14	11
		Aa2	Early Prolific	20	9
		Ab1	Early Prolific	21	5
		Ab2	Early Prolific	19	4
		Ba1	Purple Egg	17	8
		Ba2	Purple Egg	24	6
		Bb1	Purple Egg	18	8
		Bb2	Purple Egg	16	7
		Ca1	Italian Prune	13	12
		Ca2	Italian Prune	17	11
		Cb1	Italian Prune	13	7
		Cb2	Italian Prune	18	7
		DI	Early Prolific	13	6
		DII	Purple Egg	13	2
		DIII	Italian Prune	14	1
		DIV	Not budded	.....	71
IV	Marianna	Aa1	Early Prolific	17	6
		Aa2	Early Prolific	22	6
		Ab1	Early Prolific	20	5
		Ab2	Early Prolific	15	7
		Ba1	Purple Egg	19	6
		Ba2	Purple Egg	27	0
		Bb1	Purple Egg	17	6
		Bb2	Purple Egg	22	5
		Ca1	Italian Prune	22	5
		Ca2	Italian Prune	25	5
		Cb1	Italian Prune	24	5
		Cb2	Italian Prune	23	5
		D-I	Early Prolific	13	1
		DII	Purple Egg	14	0
		DIII	Purple Egg†	14	0
		DIV	Not budded	.....	80
V	Angers quince	Aa1	Duchess	15	16
		Aa2	Duchess	15	15

* Five buds of the Montmorency were inserted by mistake of the budder.
† Should have been Italian Prune — mistake of budder.

Table II — (*Concluded*).

Row.	KIND OF STOCK.	Section.	Variety of bud.	Number budded.	Number left unbudded.
V	Angers quince	Ab1	Duchess	15	15
		Ab2	Duchess	15	17
		Ba1	Anjou	15	15
		Ba2	Anjou	14	16
		Bb1	Anjou	14	15
		Bb2	Anjou	15	17
		Ca1	Flemish Beauty	15	16
		Ca2	Flemish Beauty	15	14
		Cb1	Flemish Beauty	15	16
		Cb2	Flemish Beauty	15	0
		DI	Duchess	15	0
		DII	Anjou	14	1
		DIII	Anjou*	15	0
		DIV	Not budded	......	97
VI	French pear	DI	Duchess	58	3
		DII	Anjou	59	2
		DIII	Flemish Beauty	58	2
		DIV	Not budded	......	251
VII	French pear	Ca1	Flemish Beauty	59	51
		Ca2	Flemish Beauty	64	59
		Cb1	Flemish Beauty	59	55
		Cb2	Flemish Beauty	62	69
VIII	French pear	Ba1	Anjou	63	62
		Ba2	Anjou	61	63
		Bb1	Anjou	59	63
		Bb2	Anjou	61	60
IX	Japan pear	Aa1	Duchess	15	9
		Aa2	Duchess	11	11
		Ab1	Duchess	14	13
		Ab2	Duchess	12	8
		Ba1	Anjou	14	7
		Ba2	Anjou	12	12
		Bb1	Anjou	13	9
		Bb2	Anjou	14	9
		Ca1	Flemish Beauty	16	8
		Ca2	Flemish Beauty	17	11
		Cb1	Flemish Beauty	13	13
		Cb2	Flemish Beauty	12	13
		I	Duchess	11	0
		II	Anjou	13	0
		III	Flemish Beauty	14	0
		IV	Not budded	......	62
X	American pear	I	Duchess	29	3
		II	Anjou	28	5
		III	Flemish Beauty	33	2
		IV	Not budded	......	202
XI	American pear	Ca1	Flemish Beauty	71	10
		Ca2	Flemish Beauty	58	11
		Cb1	Flemish Beauty	57	10
		Cb2	Flemish Beauty	70	11
XII	American pear	Ba1	Anjou	56	13
		Ba2	Anjou	58	8
		Bb1	Anjou	49	10
		Bb2	Anjou	63	17
XIII	American pear	Aa1	Duchess	64	21
		Aa2	Duchess	38	33
		Ab1	Duchess	39	16
		Ab2	Duchess	47	14
XIV	American apple†				
XV	American apple†				
XVI	French apple†				
XVII	French apple†				
XVIII	French apple seedlings†				
XIX	French pear seed†				
XX	Peach seedlings †				
XXI	French pear	Aa1	Duchess	53	39
		Aa2	Duchess	46	37
		Ab1	Duchess	31	48
		Ab2	Duchess	27	57

* Should have been Flemish Beauty — mistake of budder.
† As no disease appeared in the apple buds, data is not valuable. Apple seedlings were not budded; peach showed no disease; none of pear seed germinated.

Soil, stocks and buds.— The soil upon which the nursery was planted is considered by practical nurserymen as well suited to the growing of plums and cherries, but as lacking somewhat in the qualities which go to make up the best soil for pears and apples, being of insufficient depth and a trifle too light. Immediately previous to the experiment the soil had been planted to corn, but what fertilizers had been used, if any, and what crops were grown anterior to that season, I have not been able to ascertain. No fertilizer was applied before putting in the stocks, and the only treatment the soil received was a dressing in November and December of 1891, of thirty-three wagon loads of well-rotted barnyard manure from the Station manure platform, evenly distributed between the rows.

The stocks were furnished by various nursery firms, as stated in a previous article,* and the different lots were of apparently equal vigor — first grade, with the exception of American pear stocks, which, owing to the lateness of the season, were third grade. In the planting, which was done between the dates of April 27 and May 3, care was taken that each stock was firmly pressed into the soil. Stocks of the same kind, from different nursery firms, were thoroughly mixed together. In all respects the normal nursery methods were followed out as nearly as possible. The budding was done on the dates above recorded by two experienced budders employed by the Station. The scions for cherry, pear and apple buds were cut from trees growing in the nursery rows † of Selover and Atwood. Plum scions were furnished by Maxwell & Bros., from their bearing orchard.

Treatment with fungicides.— Only the two well-known fungicides, ammoniacal solution of copper carbonate and Bordeaux mixture were used. The formulæ used in 1891 were those in common use throughout America. The Bordeaux mixture was diluted in the treatments for 1892, and prepared after the manner first proposed by Dr. G. Patrigeon.‡

The formulæ are given below:

Ammoniacal solution of copper carbonate, formula used in 1891.

Five ounces of cupric basic carbonate (copper carbonate) dissolved in ammonia (three to four pints of 26° B.) and added to fifty gallons of water. Care was taken that all the carbonate was dissolved in the ammonia, enough being added for the solution.

Ammoniacal solution of copper carbonate, formula used in 1892.

Identical with the above in strength. The carbonate was wetted with one pint of water, previous to adding the ammonia, to facilitate the solution.

Bordeaux mixture, formula used in 1891.

Six pounds of cupric sulphate (copper sulphate or bluestone) dissolved in twelve gallons of water. Four pounds of stone lime slaked in a small quantity

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* Bull. No. 3, Div. Veg. Path., p. 57.

† A practice much in vogue among nurserymen, but certainly not founded upon a knowledge of the laws governing bud variation. The selection of buds from individual bearing trees of known vigor and productiveness is insisted upon by the best cultivators.

‡ Patrigeon, G. *Revue Viticole*, Journ. d' Agric. Pratique, 1890, t. I. 54e année, p. 701.

of water and made up to three or four gallons of thin milk. The lime was added slowly to the cupric sulphate and the whole made up to twenty-two gallons.

Bordeaux mixture, formula used in 1892.

Two pounds cupric sulphate dissolved in fifteen gallons of water. Two pounds Rhode Island stone lime slaked in small quantity of water and made up to five gallons. The lime was added slowly to the cupric sulphate, testing the mixture frequently during the addition with a few drops of a concentrated solution of potassium ferrocyanide (yellow prussiate of potash) and ceasing the addition of the lime when no red color was given to the drops of the ferrocyanide. For convenience this may be called a sixty-gallon formula, as it requires that amount of water to contain as much copper sulphate as the standard strength, viz., six pounds.

The treatments were begun in 1891, about three weeks after planting, when the first leaves were nearly three-fourths grown. The dates upon which the applications were made were May 21, June 3, June 24, July 9, July 24, August 8, and August 28. As indicated above in the plan, half of each section was treated three times. Those treated three times were sprayed on the first three dates mentioned.

In 1892, the treatments were begun on May 26, when the leaves had attained full size, and the first appearance of the disease was observed. The dates of treatment are, May 26–27, June 15–16, June 23, July 6–7, July 21, and August 5. In order to apply the mixture more thoroughly the spray was passed rapidly over the plants and the operation repeated after the first spraying had dried.* This method insured as near a complete coating of the fungicide as possible, and it was found that the Bordeaux mixture of this weak strength adhered with remarkable tenacity, being plainly visible twelve weeks after application.† Care was taken to spray the under side of the leaves on the cherry and plum stocks, but pear, quince and apple stocks were sprayed from above.

The treatments of 1892 were not continued so late in the season as those of 1891, and the different sections received respectively five and six sprayings, instead of three and six as in 1891. Those receiving five sprayings were treated on the first five dates mentioned above. The actual amount of the fungicides used will be of little value in estimating the quantities that will be necessary in treatments on a large scale, but, for the convenience of other experimenters, it may be roughly estimated to equal three and one-half to four and one-half gallons of solution per 1,000 one-year-old stocks and proportionately more for budded stocks. By one-year-old stocks is meant stocks previous to budding.

The spraying was done with a W. & B. Douglass "Perfection" knapsack sprayer, which proved moderately satisfactory, although a hand-wheel machine would undoubtedly have been better.

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* Suggested first by N. A. Cobb, Dialogue concerning the manner in which a poisonous spray does its work in preventing or checking blight. *Agricultural Gazette, N. S. Wales,* vol. II., pp. 779-786.

† These double sprayings were made on the first, fourth, fifth and sixth treatments only.

DESCRIPTION OF PLATES.*

PLATE 20. French pear stocks, planted in 1891 and treated seven times with Bordeaux mixture, full strength; left unbudded in the fall and treated six times with Bordeaux, one-third strength, in 1892. These could properly be called three-year-old seedlings. Situation of stocks, Row VIII, east end.

21. French pear stocks, similar to those in Plate 20, but without treatment either in 1891 or 1892. Situation of stocks, Row VI, east end. Showing defoliation caused by *Entomosporium.*

22. French pear stocks, similar to those in Plate 20, but treated seven times in 1891, and six times in 1892 with ammoniacal solution. Situation of stocks, Row VIII, near center.

23. Angers quince stocks, planted as cuttings in 1891, and treated seven times with Bordeaux full strength the first season, left unbudded in the fall, and treated six times with Bordeaux one-third strength in 1892. These could properly be called three-year-old cuttings. Situation, Row V, near east end.

24. Angers quince stocks, similar to those in Plate 23, but without treatment either in 1891 or 1892. Situation, Row V, east end, one rod east of those in Plate 23. Showing defoliation by *Entomosporium.*

25. Windsor "buds," on Mahaleb. The Mahaleb stocks were treated seven times in 1891 with Bordeaux mixture, and the "buds" were treated six times in 1892 with Bordeaux one-third strength. Situation, Row I, near west end.

26. Windsor "buds," on Mahaleb. Similar to those in Plate 25, but untreated both in 1891 and 1892. Situation, Row I, near east end, showing defoliation by *Cylindrosporium.*

27. Early Prolific "buds," on Myrobolan. The Myrobolan stocks were treated seven times in 1891 with Bordeaux and the "buds" were treated six times with Bordeaux one-third strength in 1892. Situation, Row III, west end.

28. Early Prolific "buds," on Marianna. Similar to those in Plate 27, but untreated both in 1891 and 1892. (The difference of stocks upon which budding was done made no difference as regards the leaf-blight; hence the fact that the "buds" in Plate 27 were on Myrobolan stocks and in Plate 28, were on Marianna does not affect the comparison.) Situation, Row IV, east end.

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* All plates are reproduced from photographs taken eight feet from the stocks on September 29 and October 11.

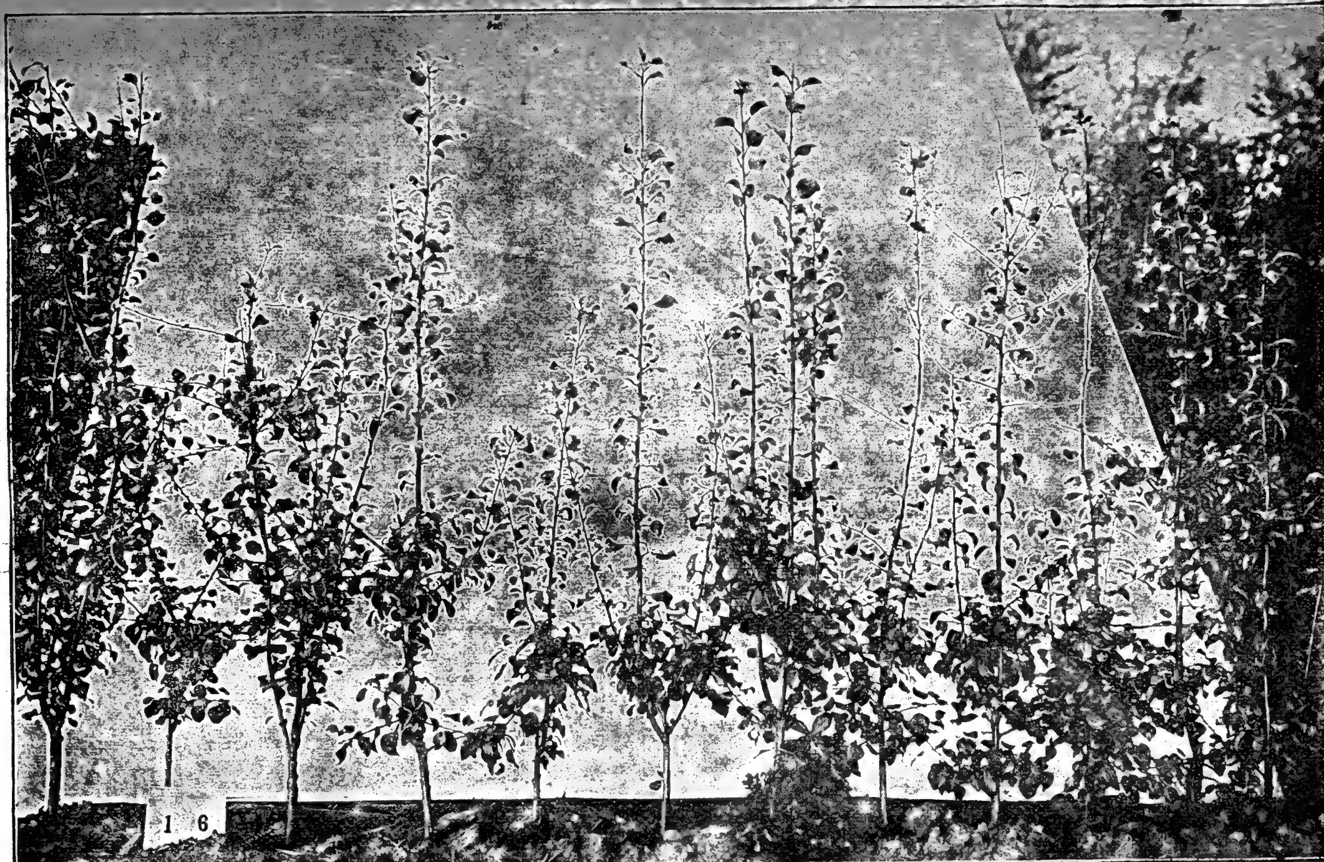

Plate 20.

Pear Leaf-blight.

French pear stocks. Treated with Bordeaux mixture. (Fairchild.)

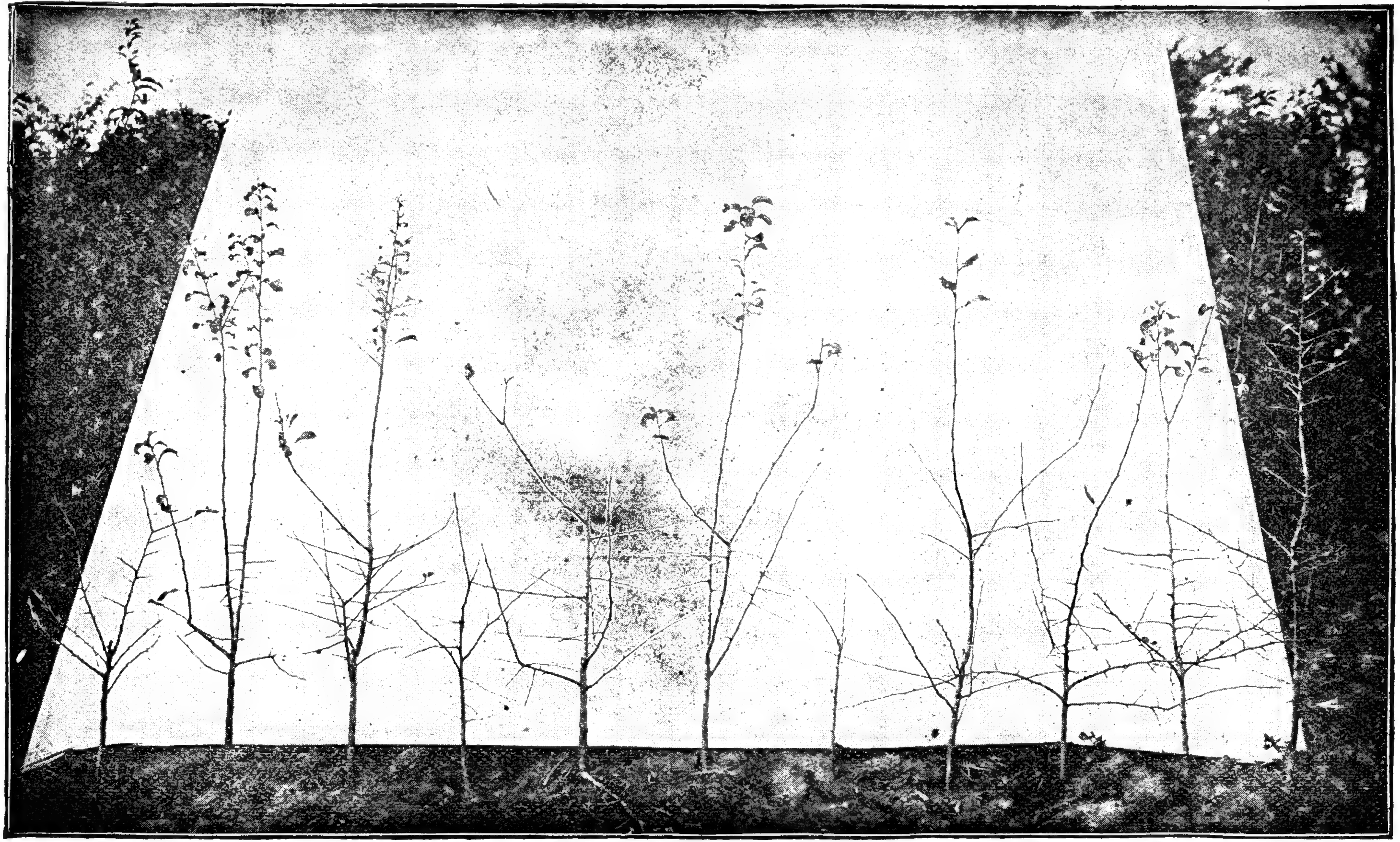

Plate 21.

Pear Leaf-blight.

French pear stocks. Untreated. (Fairchild.)

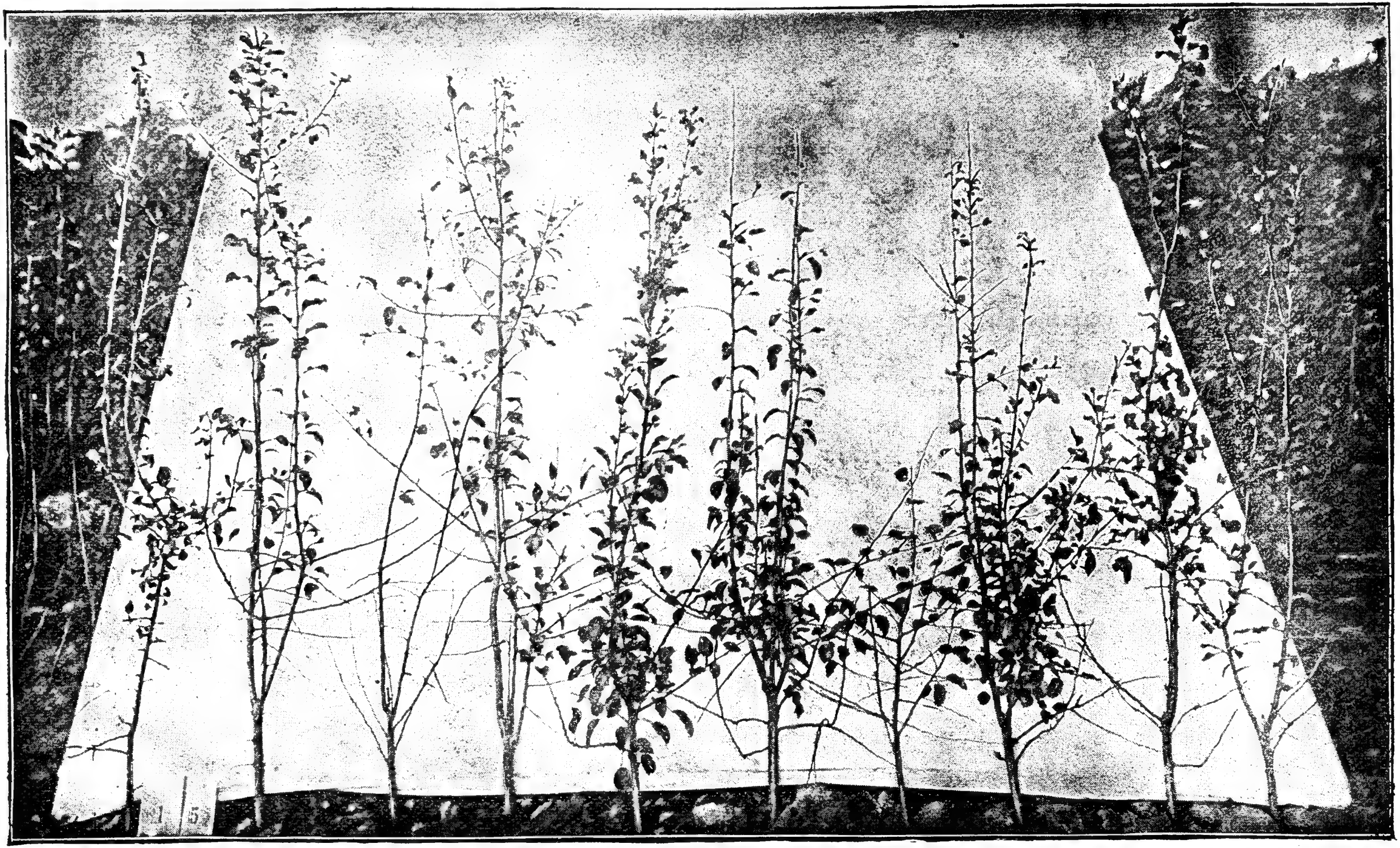

PLATE 22.

PEAR LEAF-BLIGHT.

French pear stocks. Treated with Ammoniacal solution. (Fairchild.)

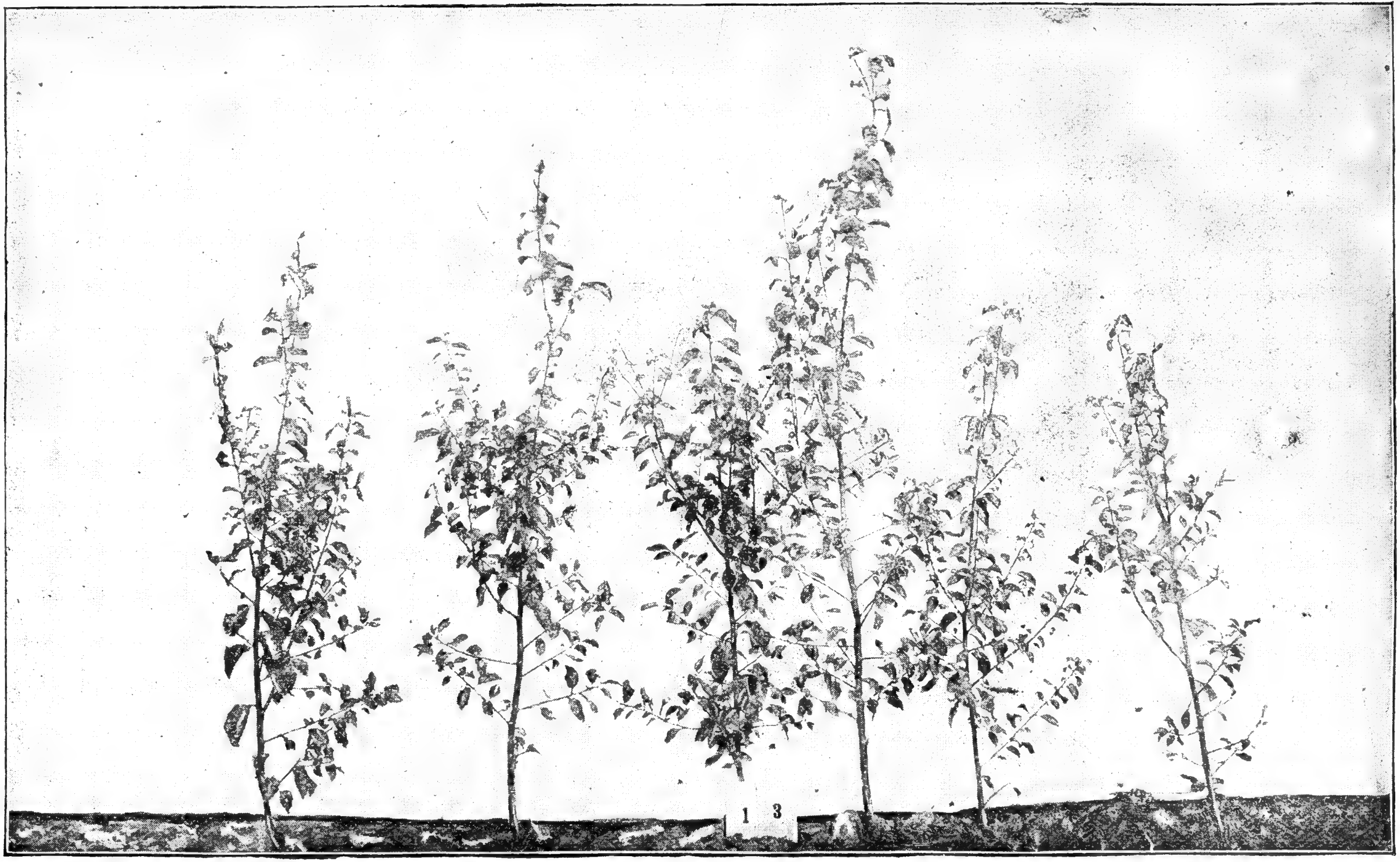

PLATE 23.

QUINCE LEAF-BLIGHT.

Angers quince stocks. Treated with Bordeaux mixture. (Fairchild.)

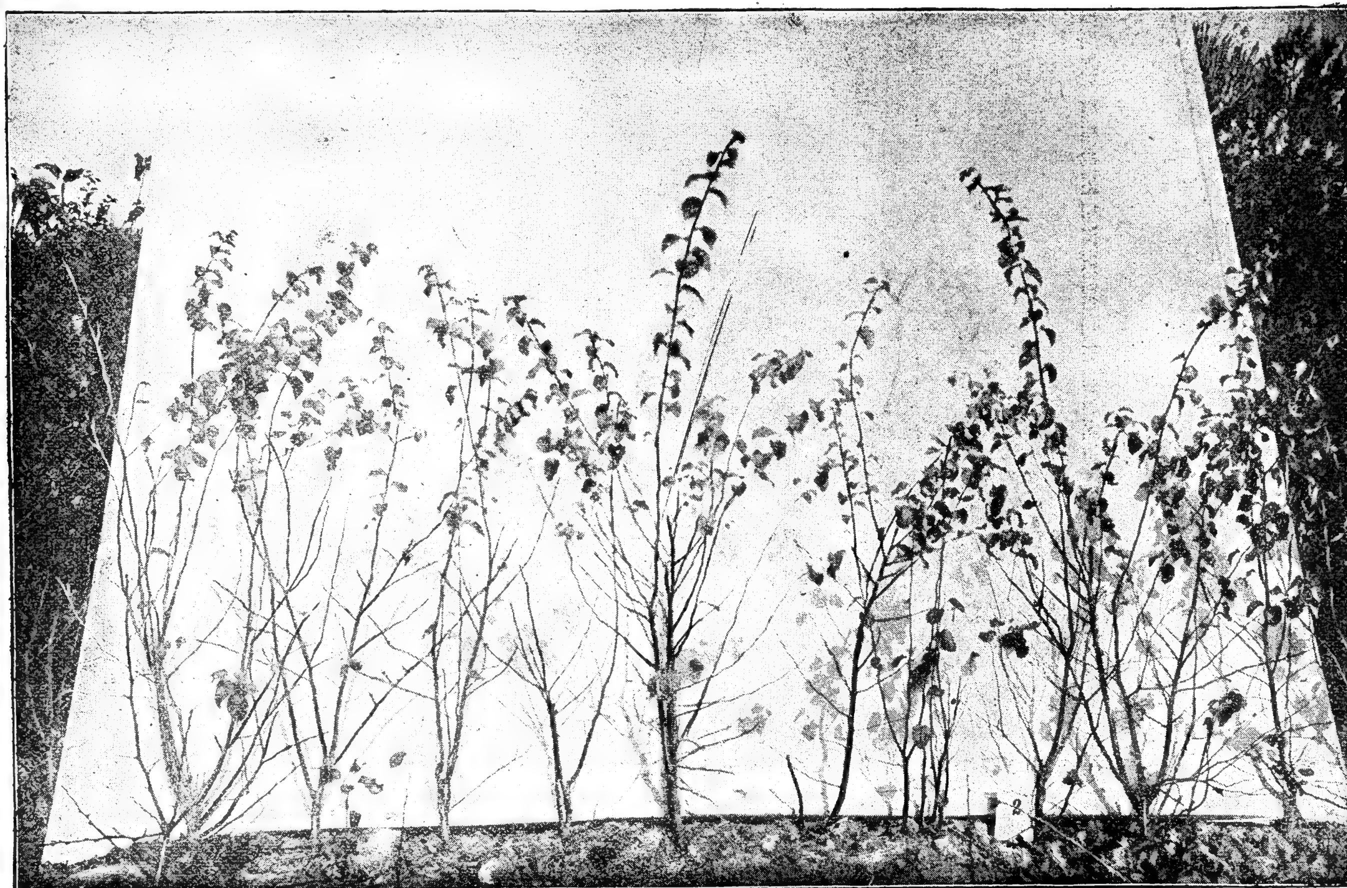

PLATE 24.

QUINCE LEAF-BLIGHT.
Angers quince stocks. Untreated. (Fairchild.)

PLATE 25. CHERRY LEAF-BLIGHT.
Windsor buds on Mahaleb stocks. Treated with Bordeaux mixture. (Fairchild.)

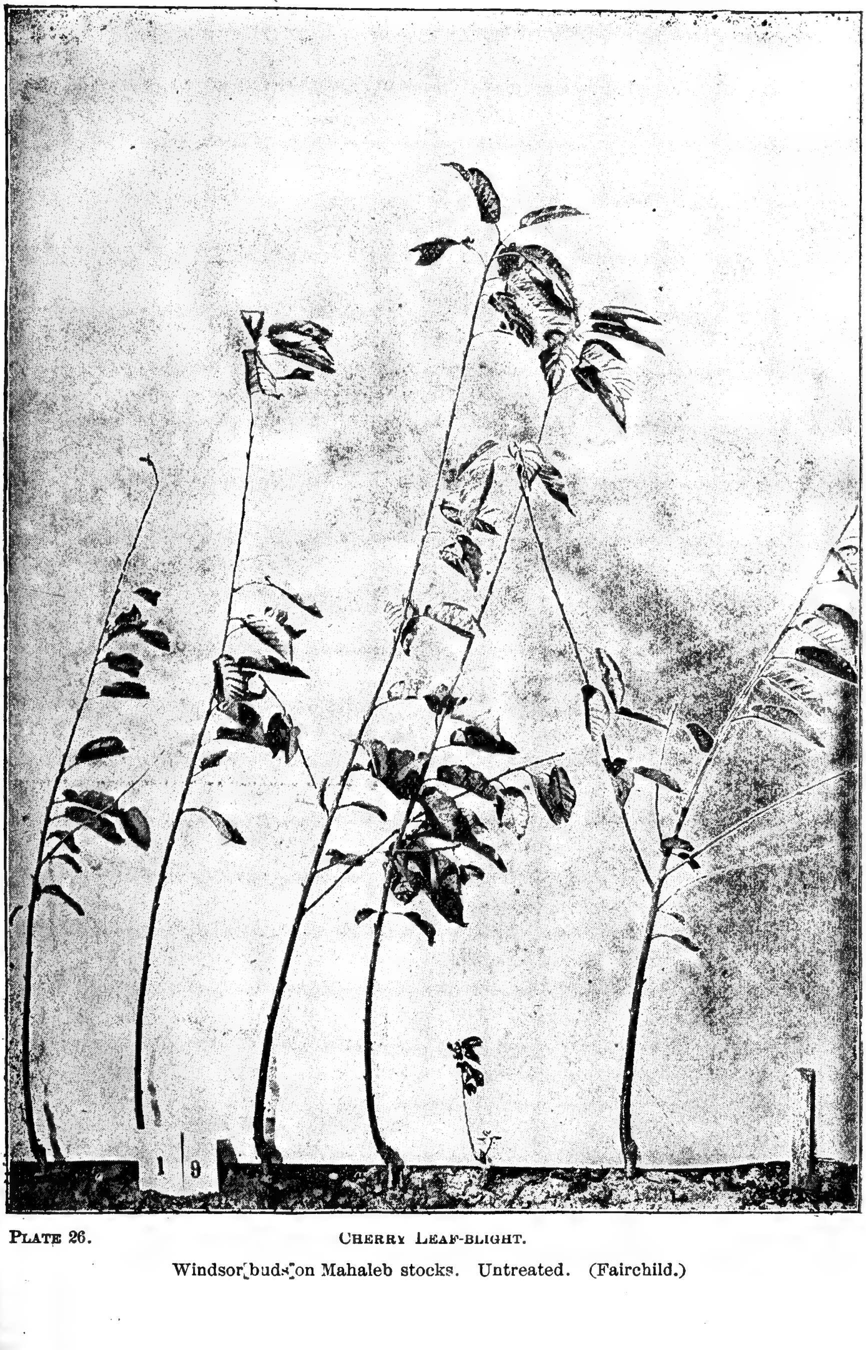

PLATE 26. CHERRY LEAF-BLIGHT.

Windsor buds on Mahaleb stocks. Untreated. (Fairchild.)

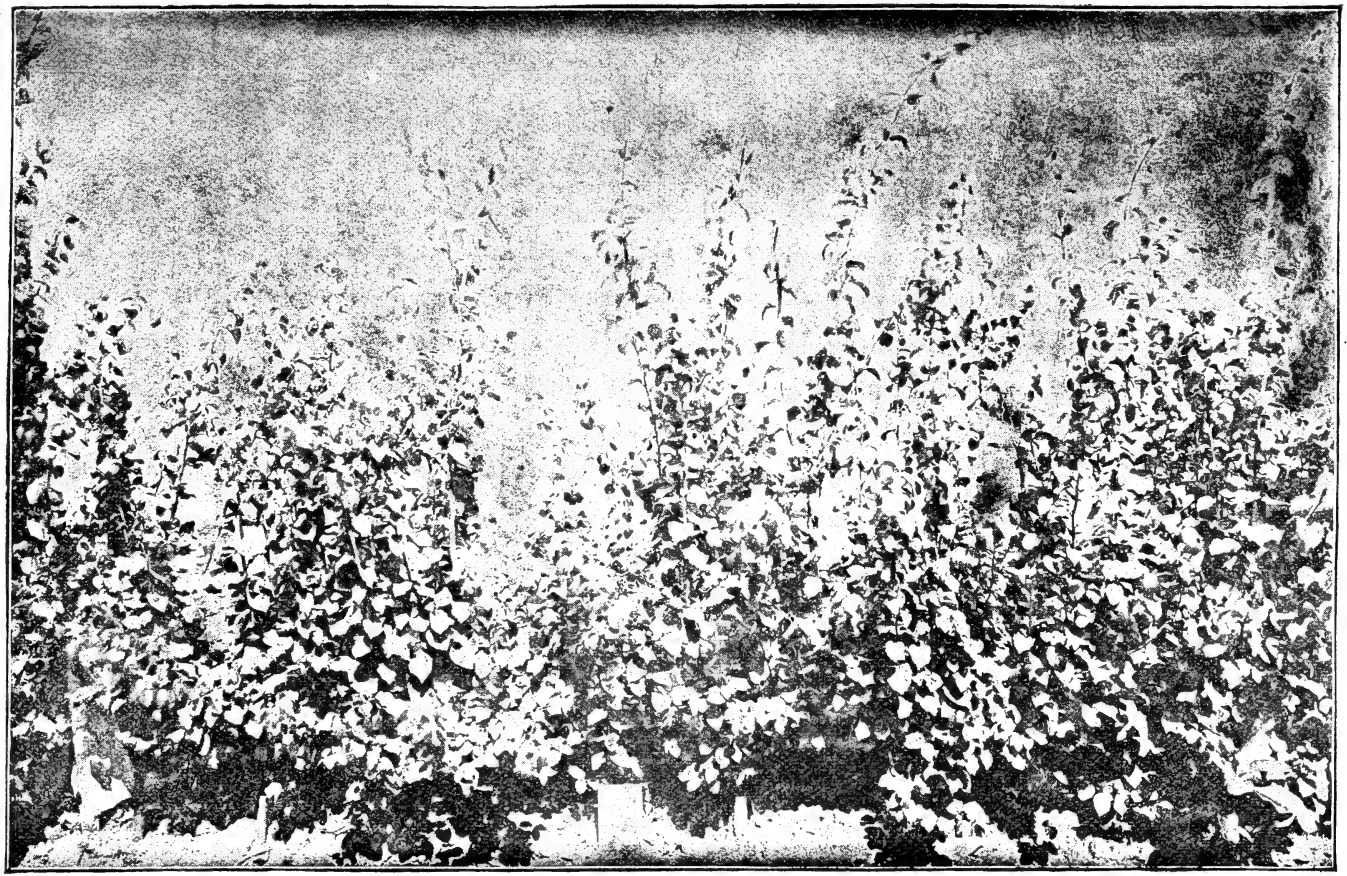

PLATE 27.

PLUM LEAF-BLIGHT.

Early Prolific buds on Myrobolan stocks. Treated with Bordeaux mixture. (Fairchild.)

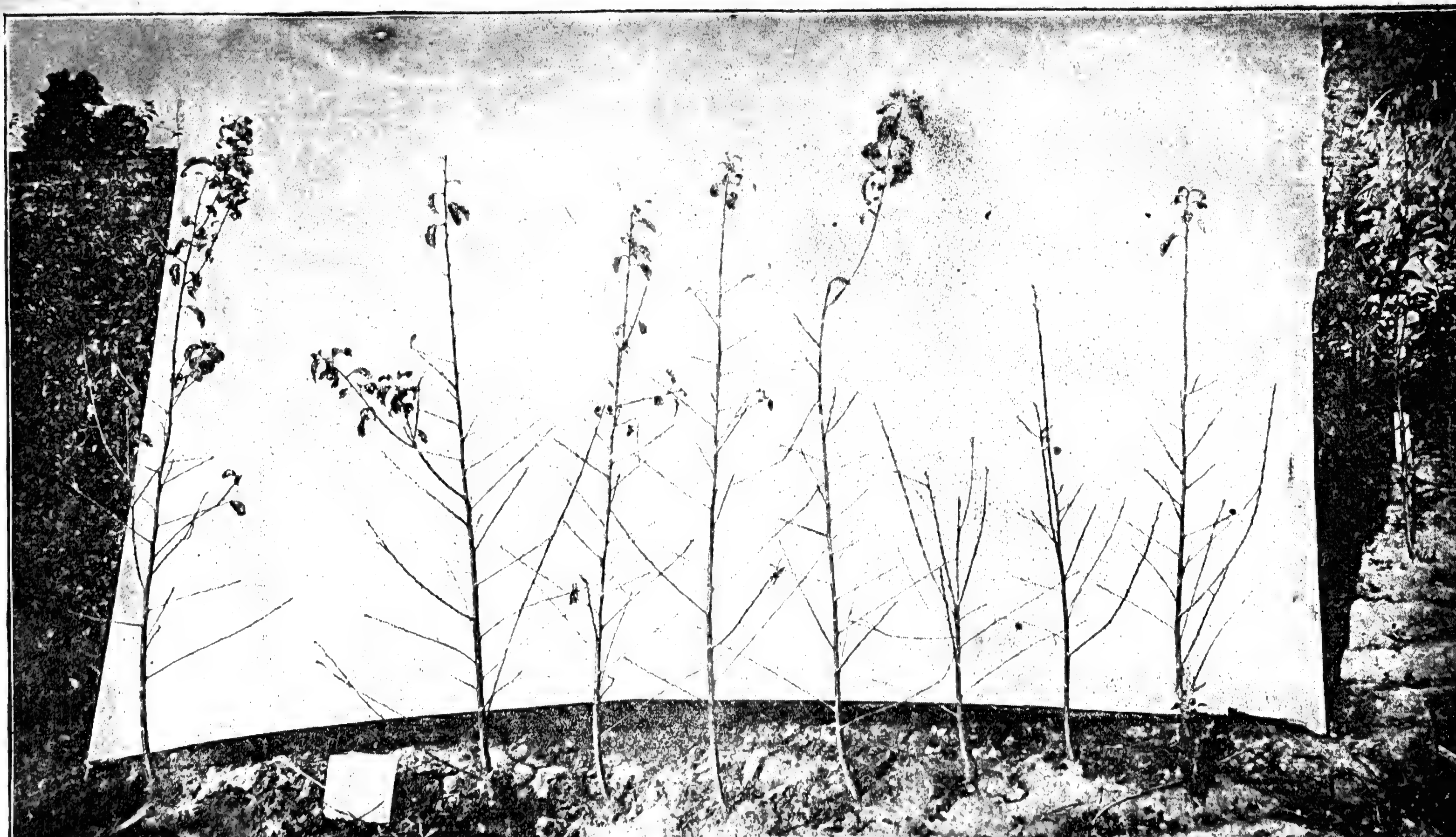

PLATE 28.

PLUM LEAF-BLIGHT.

Early Prolific buds on Marianna stocks. Untreated. (Fairchild.)

LEAF-BLIGHT OF PEAR SEEDLINGS.

An extended experiment with pear seedlings in the seed-bed was carried on in 1892 in co peration with Prof. S. A. Beach, the botanist of the New York State Agricultural Experiment Station. This experiment was designed to test twenty-five preparations, most of which were new, with a view of ascertaining their value as preventives of leaf-blight. These preparations were carefully compounded at the Department, the best theoretical proportions being worked out by laboratory experiments.

Compounds of copper, iron and zinc were employed, each 1,000 parts of water used being calculated to have in it one part of copper, two parts of zinc, or two parts of iron, according to the metal forming the base of the preparation. The metals were present in the mixtures only as compounds. It should be understood that the term "mixture" is here used to designate the whole preparation as thrown upon the plant, and consisted in each case of the insoluble compound of copper, iron or zinc suspended in the water holding in solution the soluble salt of the alkali used. The following is a list of the various mixtures with their formulae. In all cases when not otherwise stated the two ingredients were simply dissolved each in one quart of water and poured together, the quantity being then made up to one gallon.

1. **Basic cupric acetate mixture:**

Basic cupric acetate (refined powder)............. grams 11.90

Wet up as a thick paste and allowed to stand twenty-four hours or more before dilution in one gallon (3,783 grams) of water.

2. **Copper borate mixture:**

Cupric sulphate (bluestone)	grams	14.90
Sodium borate (borax)	grams	16.39
Water	gallon	1.00

3. **Copper basic carbonate mixture:**

Cupric sulphate (bluestone)	grams	14.90
Sodium carbonate (sal soda)......................	grams	14.90
Water	gallon	1.00

4. **Ammoniacal copper carbonate solution:**

Cupric basic carbonate (copper carbonate)	grams	7.03
Water (added to make the carbonate into a thin paste)	c. c.	50.00
Aqua ammonia 26 B. (stronger water of ammonia),	c. c.	150.00
Water	gallon	1.00

The carbonate wet up with water is allowed to stand a few minutes to become thoroughly wet before the ammonia is added.

5. **Cupric ferrocyanide mixture:**

Cupric sulphate (bluestone)	grams	14.90
Potassium ferrocyanide (yellow prussiate of potash),	grams	22.35
Water	gallon	1.00

6. **Cupric hydrate, black mixture:**

Cupric sulphate (bluestone)	grams	14.90
Potassium hydrate (caustic potash)	grams	14.90
Water	gallon	1.00

(The cupric sulphate and potassium hydrate are dissolved each in one quart of water, and after mixing are allowed to stand until black before diluting.)

7. **Cupric hydroxide mixture:***

Cupric sulphate (bluestone)	grams	14.90
Potassium hydrate (caustic potash)	grams	29.80
Water	gallon	1.00

Prepared as No. 6, but put on before turning black.

8. **Cupric hydroxide mixture:***

Cupric sulphate (bluestone)	grams	14.90
Potassium hydrate (caustic potash)...............	grams	26.82
Water	gallon	1.00

Prepared precisely as No. 7.

* These two mixtures do not differ essentially, because of a miscalculation in the amounts of KHO added. Intended to have been 14.90: 7.45 not 14.90: 29.80, and 14.90: 8.27 not 14.90: 26.82.

9. **Tricupric orthophosphate mixture:**

Cupric sulphate (bluestone)	grams	14.90
Sodium phosphate	grams	26.07
Water	gallon	1.00

10. **Cupric polysulphide mixture:**

Cupric sulphate (bluestone)	grams	14.90
Potassium sulphide (liver of sulphur)	grams	14.90
Water	gallon	1.00

11. **Copper sucrate mixture:**

Cupric sulphate (bluestone)	grams	14.90
Cane sugar	grams	14.90
Potassium hydrate (caustic potash)	grams	14.90
Water	gallon	1.00

(The cupric sulphate and sugar are added together in one quart of water and brought to boiling; then the potassium hydrate dissolved in one pint of water is added and the whole made up to one gallon.)

12. **Copper silicate mixture:**

Cupric sulphate (bluestone)	grams	14.90
Sodium silicate (water glass)	grams	44.70
Water	gallon	1.00

13. **Cupric sulphate, ammonia and soap mixture (soap eau celeste):**

Cupric sulphate (bluestone)	grams	14.90
Aqua ammonia (ammonia water 26 B.)	c. c.	.75
Palm soap	grams	44.70
Water	gallon	1.00

The cupric sulphate is first dissolved in water and the ammonia added; then the soap dissolved in warm water is added and the solution well mixed.

14. Cupric oxychloride mixture (form A):

Cupric sulphate (bluestone)	grams	14.90
Chloride of lime	grams	29.80
Water	gallon	1.00

15. Cupric oxychloride mixture (form B—Tribasic):

Cupric sulphate (bluestone)	grams	14.90
Chloride of lime	grams	21.28
Water	gallon	1.00

16. Copper sulphite mixture:

Cupric sulphate (bluestone)	grams	14.90
Sodium hyposulphite	grams	37.25
Water	gallon	1.00

17. Ferric chloride and phenol mixture:

Ferric sesquichloride (iron chloride)	grams	36.46
Phenol (carbolic acid)	grams	36.46
Water	gallon	1.00

18. Ferrous ferrocyanide mixture:

Ferrous sulphate exsiccatus (iron sulphate, dried)	grams	22.94
Potassium ferrocyanide (yellow prussiate of potash),	grams	45.88
Water	gallon	1.00

19. Iron borate mixture:

Ferrous sulphate exsiccatus (iron sulphate, dried)	grams	22.94
Sodium borate (borax)	grams	91.76
Water	gallon	1.00

20. Ferric hydrate mixture:

Ferrous sulphate exsiccatus (iron sulphate, dried)	grams	22.94
Potassium hydrate (caustic potash)	grams	11.47
Water	gallon	1.00

21. Iron sulphide mixture:

Ferrous sulphate exsiccatus (iron sulphate, dried)	grams	22.94
Potassium sulphide (liver of sulphur)	grams	91.76
Water	gallon	1.00

22. Zinc borate mixture:

Zinc sulphate	grams	33.36
Sodium borate (borax)	grams	33.36
Water	gallon	1.00

23. Zinc ferrocyanide mixture:

Zinc sulphate	grams	33.36
Potassium ferrocyanide (yellow prussiate of potash),	grams	66.72
Water	gallon	1.00

24. Zinc silicate mixture:

Zinc sulphate	grams	33.36
Sodium silicate (water glass)	grams	58.38
Water	gallon	1.00

25. Zinc sulphide mixture:

Zinc sulphate	grams	33.36
Potassium sulphide (liver of sulphur)	grams	66.60
Water	gallon	1.00

Six treatments were made with each of the above preparations and the effects on the seedlings carefully noted. The leaf-blight was present in sufficient quantity to test them thoroughly, and without going into details it may be said that only a comparatively small number gave results which would encourage further trials. None were successful in entirely preventing leaf-blight. The test points more strongly than ever to the remarkable nature of the cupric compound as found present in Bordeaux mixture as a preventive of the disease. The details of this test will be published in a forthcoming number of the Journal of Mycology, together with full account of the preparation and composition of the various mixtures.

REPORT

OF THE

ASSISTANT HORTICULTURIST.

C. E. HUNN.

Report of Assistant Horticulturist.*

This Report treats in a brief manner of the newer strawberries tested on the trial grounds of this Station. The older varieties are described and reported on in Bulletins Nos. 24 and 36, and Annual Reports for 1889, 1890 and 1891, copies of which can be obtained from this Station.

The past fruiting season has been a fairly favorable one. Although the yield of fruit in this vicinity has fallen below the average of several years, the prices have been kept up by the help of a local canning factory that contracts for a large share of the products of the surrounding country at a price that well pays the grower who has from one to ten acres and who is able to get pickers at fair wages, thus making the market steady throughout the season. Reports from other sections of the State show a good crop and paying prices, and as the supply to a great extent creates a demand, there is but little danger of overdoing the strawberry business for many years. Of the varieties tested for two or more seasons, the Beder Wood leads in productiveness. As reported in a previous bulletin the berries of this variety are not of the largest, but hold to a good market size throughout the picking season. The foliage is healthy and the plants multiply by runners rapidly. The Greenville follows the Beder Wood in point of productiveness, and has the advantage of being larger and would probably sell for more per quart than the former. The Burt, which for three years gave the best yield of any variety tested, falls this year to third place in point of productiveness, and for the first time shows signs of disease on its foliage. We should feel at a loss without this variety, as it seems to fill the place of the Wilson in more respects than any other. The Middlefield still holds its own as a fine, showy garden variety. Its uniformity of size and shape, its fine color and excellent flavor combine to make it a favorite wherever grown. The Van Deman, while ripening its first fruits one day

* C. E. Hunn.

later than the Michel's Early, ripens a larger part of its crop in an extremely short space of time, and on account of its brilliant color and firmness, outranks the Michel's Early as a market berry. The Enhance has dropped back for two years to a place among the medium productive varieties, but comes up to fourth place this season, and as its fruits are large, showy scarlet, firm and extra fine flavor, it is a variety that should be grown more extensively. The Warfield, Eureka and Haverland are good standard varieties, extensively grown by fruit-growers in many sections, and all of them prove profitable.

The seedling strawberry plants resulting from crosses made in the Station greenhouse, as mentioned in former publications, have many of them fruited this season, and the results far exceed our expectation. A large per cent of these seedling plants show in foliage, fruit and lateness of fruiting the characteristics of one of the parents, also in some cases the strong individuality of the mother plant, in others those of the pollen plant.

The strawberry leaf blight has been very severe this season, attacking varieties that have heretofore escaped the ravages of this disease, notably the Burt and Haverland. There is no doubt of the efficacy of the Bordeaux mixture as a preventive, and we now practice and advise others to begin spraying young plantations as soon as possible after the plants have become established, with Bordeaux mixture half the strength of the old formula, i, e., two pounds of lime and three pounds of copper sulphate to twenty-two gallons of water. This mixture should be applied three or four times the first season and at least twice before fruiting the second season.

Complaints reach this Station in regard to the ravages of the rose beetle, which insect has become a source of considerable loss to those having newly set plantations. This is the insect that has been so destructive to roses, grapes and other plants. A great many remedies have been tried, but without any degree of success. The following in regard to the life history of this insect is copied from Saunder's Insects Injurious to Fruits:

"This beetle, commonly known as the rose-bug, attacks the rose, and is also very injurious to the grape-vine, apple, cherry, peach, plum, etc. The body is a little more than one-third of an inch long, slender and tapering a little towards each extremity. Its color is dull yellowish when fresh, arising from its being covered with a grayish-yellow down or bloom and its long sprawling legs are of a dull pale-reddish hue, with the joints of the feet tipped with black and armed with very long claws. The down on the body of the bettle is easily rubbed off, producing quite a change in its appearance, the head, thorax and under side of its body becoming of a shining black.

"These beetles sometimes appear in swarms about the time of the blossoming of the rose, which in the northern United States and Canada is usually during the second week in June; they remain about a month, at the end of which period the males become exhausted, drop to the ground and perish, while the females burrow under the surface, deposit their eggs, then reappear above ground and shortly afterwards die also.

"Each female lays about thirty eggs, which are buried in the earth to the depth of from one to four inches; the eggs are about one-thirtieth of an inch in diameter, whitish and nearly globular. In about three weeks they hatch, and the young larvæ at once begin to feed on such tender roots as are within their reach. They attain full growth in the autumn, when they are about three-quarters of an inch long and about an eighth of an inch in diameter, of a yellowish-white color with a tinge of blue toward the hinder extremity, which is thick, obtuse, and rounded; the head is pale red and horny, and there a few short hairs scattered over the surface of the body. In October the larva descends below the reach of frost, and passes the winter in a torpid state; in the spring it approaches the surface and forms for itself a little oval cell of earth within which it is transformed to a pupa during the month of May.

"In form the pupa bears some resemblance to the perfect insect, and is of a yellowish-white color, its whole body being inclosed in a thin film that wraps each part separately. In June this filmy skin is rent, when the enclosed beetle withdraws its body and limbs, bursts open its earthen cell, and forces its way to the surface of the ground, thus completing its various stages within the space of one year.

"Although these insects have many natural foes, such as carniverous ground bettles, insectiverous birds, domestic fowls, toads, etc., they often need the intervening hand of man to keep them within due bounds. When numerous, they may be detached from the vines with a sudden and violent jar, falling on sheets spread below to receive them. They are naturally sluggish, do not fly readily, and are fond of congregating in masses on the foliage they are consuming, and hence, in the morning, before the day becomes warm, they can be easily shaken from their resting places, collected and destroyed. This insect is very partial to the Clinton grape, and where this is to be had will congregate on it in preference to other varieties, a peculiarity which may be made use of by planting Clinton vines as a decoy, and thus materially lessening the labor involved in the destruction of the beetles."

A BRIEF DESCRIPTION OF THE NEWER VARIETIES TESTED THIS SEASON.

Bowman. S.–Growth stocky; foliage dark green; leaf stalks short and stiff; leaves large; fruits medium to large, obtuse conical, light-red; flesh light pink, soft; quality fine; fruits Jersey Queen type.

Boynton. P.—Growth vigorous; leaf stalks long, slender; medium green foliage; fruits medium size, dark red, large clusters, soft; quality good.

Eclipse (Barton's). P.—Growth rank; foliage light green; leaf stalks long and stiff; leaves large; fruits large to very large, conical, rounding in large specimens, dark red, showy, medium firm; quality fine.

Feichts No. 3. P. — Growth vigorous; foliage light green; leaves medium size, on long slim leaf stalks; fruit stalks long and stiff, but not strong enough to hold fruit from ground. Makes a moderate number of runners; fruits cubical, large specimens coxcombed, average large, bright red; flesh white, firm; quality fine.

Feichts No. 2. S. — Growth very rank; foliage dark green, new leaves lighter, leaves large, deeply serrated, on long stiff leaf stalks; fruit stalks stiff. Makes runners very freely. Fruits obtuse conical average large, bright red; flesh pink, firm; quality extra fine; firm.

Gov. Hoard. S.—Growth stocky; foliage dark green; leaf stalks short, stiff; fruits large and showy, of fine quality.

Great Pacific. P.—Growth very rank; foliage dark green, leaves large on long leaf stalks; fruit held well up by stout fruit stalks. Makes a quantity of runners; fruits conical, a large number on each truss, bright red, firm, sub-acid, quality good.

Gillispie. P.—While this variety made a good growth, it threw out but few runners; fruit same shape as Haverland, but with longer neck and of lighter color, soft and of indifferent quality; season medium.

Hazelton's No. 4. P.—Growth rank, makes a large number of runners; foliage a dark green; fruit stalks short; berries dark scarlet of medium size, firm; flavor acid.

Hatfield. S.—Growth moderate; foliage a healthy green; fruits of fair size and pleasant sub-acid flavor.

Martha. P.—Growth stocky; foliage very dark green; fruits dark scarlet of moderate size and of fine quality.

Laxton's Noble. S.—Growth moderate; foliage dark green; leaves medium size; leaf stalks slim; fruit stalks short; makes very few runners; fruits almost round, very dark red, large, soft when ripe; quality fine.

Lovett's Early. S.—This is a vigorous growing variety bearing a moderate crop of very fine appearing berries, of fairly good quality, but soft; not extra early here.

Mount Holyoke. S.—Growth rank; foliage light; green; blossoms very profusely, but fails to develop over one-half of its crop.

Shaw. S.—Growth vigorous, but does not make runners freely; fruits of good size and fine flavor.

Piper's No. 4. S.—Growth low but vigorous; foliage dark green; leaves small on short stalks; fruit stalk short, makes a moderate number of runners; fruits conical, dull red, medium size, firm, of poor quality.

Sadie. P.—Growth strong; foliage light green; leaves medium size on long stalks; fruit stalks weak and short; fruits average small and a large number on each stalk, fine in stool row, obtuse conic; color bright red, moderately firm, tart; good quality.

Saunders. S.—This has the same faults as the Shaw, but has a larger fruit. A good home berry.

Woolverton. S.—Growth vigorous; foliage healthy; fruits of medium size; flavor good.

Walton. P.—Growth moderate; foliage light green; leaves moderate size; leaf stalks long and slim; fruit stalks long and stiff; makes a moderate number of runners; fruits conical, small to medium size, bright red, soft; quality good.

Walden. P.—Growth rank; foliage light green; leaves medium size, held on medium leaf stalk; leaf stalks medium length and stiff; makes but a moderate number of runners; fruits rounding to obtuse, conical, large to very large, color bright red, moderately firm, quality fine.

Westbrook. P.—Growth moderate; foliage light green; leaf stalks long and slender; leaves large; fruit small, conical, very many imperfect berries, tart, quality poor.

Yale. S.—Growth stocky; foliage light green; leaf stalks short; fruit stalks short; fruits obtuse conic, very dark scarlet with conspicuous yellow seeds; quality fair; late.

TABLE No. I—YIELD.

Name of variety.	Date of first bloom. May.	Date of first ripe fruit. June.	Length of picking season. Days.	Yield of fruit in ounces.
Advance	18	15	15	131
Auburn	24	17	15	243
Banquet	17	16	6	47
Beder Wood	10	12	18	567
Bessie	21	16	15	182
Belmont	24	24	8	126
Bowman	16	14	17	61
Bomba	16	17	15	*88
Bubach	20	13	13	186
Burt	20	23	15	349
Boynton	17	14	13	175
Captain Jack	19	23	15	*146

* Beds in fruiting three years.

Name of variety.	Date of first bloom. May.	Date of first ripe fruit. June.	Length of picking season. Days.	Yield of fruit in ounces.
California	17	18	11	78
Cloud	20	21	13	*81
Coleman's No. 1	12	15	15	*89
Crawford	19	15	15	207
Crescent	16	13	10	214
Dawley	19	20	11	186
Daisy	22	17	15	225
Duboise	17	21	11	26
Eclipse (Barton's)	16	15	13	231
Edgar Queen	17	16	11	195
Enhance	18	18	7	290
Eureka	18	14	17	228
Excelsior	17	16	15	138
Farnsworth	16	12	16	251
Feichts No. 2	10	14	11	139
Feichts No. 3	10	16	15	185
Felton	18	18	13	41
Foster's Seedling	17	18	10	*22
Gandy	26	27	10	*198
Garden	18	20	15	165
Gillespie	18	16	11	40
Gipsy	17	16	7	23
Great Pacific	19	18	15	202
Greenville	17	18	12	458
Gov. Hoard	20	22	14	239
Hampden	19	16	11	243
Hatfield	17	16	10	36
Haverland	11	13	11	222
Hazleton's No. 1	16	16	13	141
Hazleton's No. 4	24	20	10	110
Hinman	24	25	11	111
Hoffman	12	12	6	96
Hulburt	16	16	13	243
Itaska	17	16	7	203
Ivanhoe	17	16	15	179
Jessie	17	14	11	86
Johnson's Late	27	July 1	11	140
Kimsey's No. 49	13	June 12	17	202
Laxton's Noble	16	16	13	64
Leonard's Seedling	18	15	13	117
Lady Rusk	17	16	15	*160
Lincoln	10	14	11	244
Lovett's Early	16	15	14	128
Lyon's Seedling	17	16	9	276
Logan	17	17	15	189
Manchester (Improved)	12	17	17	311

Name of variety.	Date of first bloom. May.	Date of first ripe fruit. June.	Length of picking season. Days.	Yield of fruit in ounces.
Martha	17	18	14	189
Marvel	16	16	15	86
May King	17	15	13	136
Michel's Early	10	10	7	166
Mineola	24	18	15	109
Middlefield	17	23	8	257
Monmouth	14	15	10	*78
Mrs. Cleveland	17	14	12	118
Mt. Holyoke	16	16	17	109
Mt. Vernon	17	21	11	160
New Dominion	17	18	10	289
No. 19 Slaymaker	19	14	11	25
Ohio Centennial	19	16	11	105
Oliver	24	16	11	51
Old Iron Clad	16	14	10	84
Ontario	18	21	6	117
Parker Earle	17	24	15	119
Pearl	19	21	15	118
Phillip's Seedling	16	14	16	227
Piper's Seedling	17	23	6	71
Primo	17	21	10	181
Prince of Berries	24	25	8	217
Piper No. 4	10	15	17	147
Sadie	13	14	13	278
Saunders	27	20	11	185
Shaw	19	22	10	46
Seedling from Crawford	17	22	10	109
Stayman's No. 1	24	16	15	*51
Stayman's No. 2	17	19	18	*141
Smith's No. 77	16	16	18	*109
Shuster Gem	16	12	17	121
Sharpless	23	18	8	199
Summit	25	17	10	52
Sov. de Bossuet	17	17	15	329
Street's Seedling	17	19	7	88
Tippecanoe	16	16	13	191
Van Deman	12	11	13	166
Viola	15	21	15	200
Walton	17	20	14	171
Waldon	24	17	14	120
Warfield	18	17	17	255
Westbrook	14	12	18	100
Windsor Chief	18	17	15	63
Woolverton	26	19	14	162
Yale	27	30	7	65

TABLE No. II.— THE MOST PRODUCTIVE TWENTY VARIETIES IN ORDER OF THEIR PRODUCTIVENESS.

Beder Wood.
Greenville.
Burt.
Enhance.
New Dominion.
Sov. de Bosseut.
Lyon's Seedling.
Farnsworth.
Middlefield.
Warfield.
Hulburt.
Hampden.
Eureka.
Phillip's Seedling.
Daisy.
Haverland.
Crescent.
Gov. Hoard.
Great Pacific.
Viola.

TABLE No. III.— LIST OF VARIETIES PLANTED THE SPRING OF 1892.

Accomack.
Advance.
Advancer.
Alabama.
Allen's No. 1.
Allen's No. 3.
Alpha.
Anna Forest.
Arkansaw Traveller.
Belle.
Beverly.
Cameronian.
Chair's Favorite.
Cheyenne.
Clyde.
Clark's Early. (*Early Idaho.*)
Crosby's No. 10.
Crosby's No. 27.
Crosby's No. 91.
Dayton Early.
D and D.
Dew.
Early Idaho. See Clark's Early.
Edward's Favorite.
Engle's No. 1.
E. P. Roe.
Everbearing.
Gandy Belle.
Galerson.
Gen. Putnam.
Glenfield.
Hall's Seedling.
Holcomb's Seedling.
Herbert.
Jucunda.
Kinck's Seedling.
Latest of All.
Laxton's Captain.
Magnate.
Muskingum.
Oregon Everbearing.
Pawnee.
Princeton Chief.
Princess.
Primate.
Sandoval.
Smith's Seedling.
Southard.
Stayman's No. 3.
Sunny Side.
Swindle.
Thompson's No. 9.
Thompson's No. 60.
Townsend's No. 2.
Townsend's No. 3.
Townsend's No. 9.
Townsend's No. 20.
Townsend's No. 22.
Triomphe de Gand.
West Lawn.
Wilton.
Yankee Doodle.

RASPBERRIES.

Several of the new varieties tested here give promise of being additions to the popular varieties now in the market. Amongst them, the Columbian is probably the best in the purple class. This variety resembles in a marked degree the Shaffer, and it would necessitate a thorough knowledge of each variety for one to distinguish the fruits of them, one from the other. The growth of the Columbian is, however, more vigorous than the Shaffer, and with one season's test more productive; as its season is later, it will probably be a desirable variety to plant with Shaffer, thereby lengthening the fruiting season in sections where the latter is grown for canning purposes. The originator of the Columbian claims that this variety does not shrink as badly as others in the operation of canning, and is, therefore, very desirable for that purpose. It retains its peculiar rich flavor when canned, and on the whole, is well worth trial.

The Royal Church, as tested here, has many good qualities to recommend it. The growth of canes is abundant, the foliage a rich dark green; leaves crinkled, resembling very much some foreign varieties. The fruits are of large size, quite firm, a beautiful dark red, and of extra quality. If it proves as productive as it gives promise, it will become a prominent variety.

Cardinal, a Kansas berry, resembles Shaffer in color, but is not so vigorous or productive. It may be able to stand extremes of weather better than the latter, but longer trial is necessary in order to recommend it above other well-known varieties.

Of the Blackcaps, three seedlings from Charles Mills, of Fairmount, N. Y., Nos. 1, 7, and 15, each of them a pedigree variety, give promise of being valuable sorts. They are crosses between the Gregg and the Tyler. No. 1 yields fruit of good size and quite firm, but was not extra productive this season. No. 7 bears enormous berries, jet black, firm as Gregg and same season. This, I think, will become a valuable acquisition. No. 15 is a very vigorous grower and fairly productive; berries of good size, extra flavor, and very sweet.

Of the older, well-tested raspberries, the Cuthburt seems to be still the most popular and, undoubtedly, will flourish over a larger territory than any other productive red variety. The Pomona has always given satisfaction here, producing above the average, while the berries are of the largest, bright red and very firm. Stayman's No. 5 and Parry's Nos. 1 and 2 are also good varieties, and in favorable seasons the Reder, Turner, and Supberb will prove profitable. In certain sections the Marlboro is still grown with profit. The Muskingum is of the same type as the Shaffer, more stocky in growth, and while the yield often excels the Shaffer, the fruits are smaller and more liable to crumble.

In Blackcaps, the Carman still leads as the best early variety, with Lovett next, Hilborn and Smith's Prolific being the best for the main crop.

The ten most productive red and yellow raspberries in order of their productiveness:

Columbian.	Parry's No. 2.
Muskingum.	Cuthburt.
Shaffer.	Reder.
Stayman's No. 5.	Caroline.
Superb.	Golden Queen.

The ten most productive black raspberries in order of their productiveness:

Hilborn.	Lovett.
Smith's Prolific.	Mills' No. 15.
Carman.	Farnsworth.
Spray's Early.	No. 101.
Mills' No. 7.	Mills' No. 1.

RASPBERRIES—TABLE OF YIELD.	Date of bloom.	Date of first picking.	Length of picking season.	Yield of fruit in ounces.
RED, PURPLE AND YELLOW RASPBERRIES.	June.	July.	Days.	Ounces.
Brandywine	14	25	20	20
Caroline	7	15	30	94
Clark	14	20	25	70
Crimson Beauty	8	18	27	43
Cuthburt	13	18	27	104
Carpenter's No. 1	9	12	19	55
Columbian	13	19	24	220
Golden Queen	11	18	27	80
Marlboro	11	11	20	38
Miller's Woodland	13	12	27	61
Montclair	9	11	28	69
Muskingum	13	18	24	177
Philadelphia	13	15	19	57
Pomona	11	16	18	83
Parry's No. 1	8	18	24	87
Parry's No. 2	11	15	27	118
Quinby's Favorite	13	18	27	84
Rancocas	6	11	12	36
Reder	13	13	26	101
Reliance	13	15	19	46
Stayman's No. 5	13	18	24	151
Shaffer	14	15	19	153
Superb	11	15	27	144
Thompson's Early Pride	9	11	23	43
Thompson's Early Prolific	9	11	23	43
Turner	13	13	22	70
BLACKCAPS.				
Carman	8	11	12	90
Farnsworth	9	14	9	48
Hilborn	10	12	9	166
Lovett	6	11	14	75
Mills' No. 1	10	19	8	44
Mills' No. 7	11	19	8	84
Mills' No. 15	10	19	8	59
No. 101 Brackett	11	14	11	47
Smith's Prolific	8	12	10	119
Spray's Early	6	11	9	86

Table showing the spring condition of each variety of raspberry, with the effect of a severe late freeze; also the susceptibility of the varieties to the attack of anthranose.

	Spring condition April 1.	Per cent canes injured after freeze of April 21.	Anthracnose at fruiting season.
Brandywine	Good	60	Slight.
Caroline	Fine	50	Very slight.
Champlain	Tops killed	100	Bad.
Clark	Fine	50	Slight.
Crimson Beauty	Tops killed	20	Bad.
Crystal White	One-half dead	90	Bad.
Cuthbert	Fine	70	Very bad.
Golden Queen	Fine	70	Slight.
Hansell	One-third dead	80	Very slight.
Lost Rubies	Good	50	Very slight.
Marlboro	Good	40	Slight.
Meredith Queen	Good	85	Slight.
Miller's Woodland	Fine	8	Slight.
Montclair	Good	25	Bad.
Naomi	Good	100	Bad.
Orange	Good	100	Bad.
Philadelphia	Fine	10	Slight.
Pomona	Fine	80	Bad.
Rancocas	One-third dead	20	Very slight.
Reder	Good	33	Bad.
Reliance	Good	50	Slight.
Shaffer	Fine	70	Very bad.
Silver Queen	Good	100	Very bad.
Superb	Fine	10	Slight.
Thompson's Early Pride	Good	6	Bad.
Thompson's Early Prolific	Fine	5	Bad.
Turner	One-third dead	33	Slight.
Scarlet Gem	Good	100	Slight.
Genesee	Fine	100	Bad.
Carpenter's No. 1	Fine	5	Slight.
Coleman's No. 1	Fine	90	Slight.
Muskingum	Good	5	Very bad.
Parry's No. 1	Fine	0	Bad.
Parry's No. 2	Fine	0	Bad.
Stayman's No. 5	Fine	0	Bad.
BLACKCAPS.			
Ada	Good	45	Very bad.
Carman	Fine	0	Bad.
Farnsworth	One-third dead	7	Slight.
Hilborn	Fine	8	Bad.
Lovett	Good	0	Bad.
No. 101 Brackett	Good	5	Bad.
Smith's Prolific	Fine	12	Very bad.
Spray's Early	Fine	0	Slight.

BLACKBERRIES.

Of the numerous varieties of blackberries tested here for the past five years, but few have been found that are productive enough to recommend for field culture. Among those that have given satisfactory yields, the Agawam holds first place, having for several years given a fine crop. Ancient Briton also gives good results, while Dorchester and Barnard, two varieties of later introduction, are proving to be desirable. The Erie also is worthy of more common culture, as its immense, showy fruits will realize the highest prices in market.

On light soil the Snyder seems to thrive and produces a large crop of good-sized fruits and is certainly very hardy, but the quality of the fruits is inferior.

CURRANTS.

The demand for black currants is still on the increase, both as to fruit in the markets and plants from nurseries, as consumers are beginning to understand the value of them for culinary and medicinal purposes. In the past, any variety that was black seemed good enough, but now only the best are wanted. The Black English, Baldwin's Black, or Ogden's Black Grape will, any of them, give good satisfaction.

Nothing new in the way of red currants has been tested here for a period long enough to give any definite results, although several of those under test are highly spoken of. The old standards, Fay's Prolific, Cherry, Versailles and Prince Albert are, all of them, profitable varieties and, with White Grape, will be a satisfactory collection.

GOOSEBERRIES.

This Station has become so well satisfied that the culture of the gooseberry has a great future, that last spring it imported 187 varieties of English gooseberries in order to become thoroughly acquainted with the best varieties for market purposes. Its collection now comprises 220 varieties and a special study will be made of the merits of each as to productiveness and liability to mildew.

Of the well-tested sorts described in previous reports, the Triumph, Wellington's Glory, Whitesmith and Roesche's are the best of the large fruiting, light colored varieties, with either Crystal or Pearl for a smaller fruiting kind, the Crystal being exceptionally fine flavored. Of the red fruiting varieties, our preference is in favor of the Crown Bob, as the growth of the plants is more upright than the Industry, thus being easier to spray, and at this Station the fruits of the Crown Bob average larger than those of the Industry.

BEANS.

Each season a large number of new varieties, or old varieties under new names, appear, a few of which excel in some localities the older well-tested sorts, but seldom is a variety introduced that will supercede the old well-tested varieties, such as the Kidney, Refugee, etc. The most noted advance in the improvement of the bean, has been made in the cultivation of the dwarf type of the Lima. Of this type, we now have Burpee's Bush Lima and Dreer's, or Kumerle, Bush Lima, the former bearing a fair number of pods, well-filled with large-sized beans of true Lima shape, the latter having about an equal number of pods, which are quite thick and containing beans of the shape of the well-known Dreer's Improved Lima, a pole bean introduced several years ago. The Burpee's Bush Lima was reported on last year as being a valuable variety where the season would be long enough to develop all the pods. This year, while the plants continued growing for a longer period and the product was correspondingly increased, we think that a warmer climate and certainly a light soil are the requisites to a profitable yield. The Dreer's Bush Lima, however, seems to adapt itself to this climate and although of a more spreading growth than Burpee's, is a first class variety, and we can see no reason why these two varieties should not supercede the pole varieties in all gardens.

Beans, yield of varieties.	No. of pods on 10 plants.	No. of beans in 100 pods.
Blue Podded Butter	160	472
Burpee's Saddle Back	165	460
Challenge	125	372

Beans, yield of varieties.	No. of pods on 10 plants.	No. of beans in 100 pods.
Goddard	118	366
Golden Cluster	170	530
Hemisphere	162	440
No. 40	224	444
Perfection Wax	128	404
Red Marrow	210	402
Burpee's Bush Lima	250	350
Dreer's Dwarf Lima	260	400
Kumerle Dwarf Lima	275	400
Henderson's Bush Lima	500	268

Fertilizer experiment with beans.

Plat C.	FERTILIZER.	ESTIMATED YIELD PER ACRE.	
		Bushels, 1891.	Bushels, 1892.
Section 9	Bone black	18 2/3	22 1/3
" 10	Sulphate potash	28	27
" 11	Nitrate soda	22 1/4	28
" 12	Check	25 3/4	29 1/4
" 13	Muriate potash	20 1/3	25 2/3

BORDEAUX MIXTURE USED TO PREVENT POTATO BLIGHT.

Continuing the work of last year, we have satisfied ourselves, and a large number of farmers, of the efficacy of Bordeaux mixture as a preventive of potato blight, and hope to demonstrate the practicability of using this mixture by showing the cheapness of the application and the value of the crop saved. In previous writings* it has been suggested that Bordeaux mixture could be used in connection with Paris green or London purple, and the tests made this year clearly prove the desirability of doing so. When one considers the absolute necessity of fighting the potato beetle with one of the arsenites, either in water or mixed with ashes, land plaster or some other like substance, it is evident that if water is the agent through which the arsenites are distributed

* Tenth Annual Report, page 487, Bulletin 41, page 46.

the cost of applying Bordeaux mixture is reduced to the actual cost of the ingredients and the labor of mixing them. As the Bordeaux mixture is simply a preventive and as the disease is liable to make its appearance at any time when the atmospheric conditions are suitable, it is recommended that the application of the mixture begin soon after the vines begin to grow, certainly as soon as the usual time for applying Paris green. For the first two sprayings the mixture may be reduced to one-half the standard strength, i. e., six pounds of sulphate of copper and four pounds of lime to forty-four gallons of water. As four sprayings should usually be made, it would be advisable to make the last two of full strength, as at the time they are usually applied the conditions are generally such that if the disease obtains a foothold it quickly spreads over the entire field unless the presence of copper acts as a bar to its further progress. As mentioned before,* the conditions which are favorable to the development of the blight are excessive rainfall accompanied by an average temperature of less than 75 degrees F.,** conditions which often prevail during the month of September. During the past season experiments have been made to find some substance which added to the Bordeaux mixture would cause it to adhere to the foliage, thus lessening the number of times necessary to spray, and it was found that when soap was added to the Bordeaux mixture applied to beans as a preventive of the bean anthracnose, § the result was that the mixture spread in a thin film over the leaf surface and remained visible for weeks after the application was made. The amount of soap used was, in this case, one pound of bar soap dissolved in hot water and added to eight gallons of the mixture.

M. Girard, a French scientist, recommends the use of molasses at the rate of five pounds to twenty-two gallons of the mixture§§ also in Gardeners' Chronicle, March 12, 1892, p. 339, is the state-

* Bulletin 41, page 45.

** Prof. F. L. Scribner, Tennessee Rep't, 1889, pp. 34, 35.

§ Bulletin 48, pp. 314, 315.

§§ Gard. Chronicle, July 16, 1892, p. 71.

ment that the saccharine copper-lime compound (probably the same as above) resists the action of rains in a remarkable degree.

These observations show that some substance may probably be used in the future to obviate frequent spraying. As the cost of spraying an acre of potatoes four times will vary with the mode of application and the cost of labor, the following table (No. 1) will enable one to estimate the expense. It will be understood that there is a vast difference between the cost of applying the mixture with a sprinkling pot or with an automatic pump. Our estimate is based on labor at one dollar and thirty-five cents a day, using a knapsack sprayer and Vermorel nozzle, spraying two acres a day and using about ninety gallons of mixture per acre. The first two sprayings will not require this quantity of liquid if economy is used in applying it and the latest improvements in nozzles used. In treating large plantations the cost can be reduced very materially if a geared pump is used with horse power or increased to an unprofitable amount if applied with a watering pot in a wasteful manner. The copper sulphate can be bought by the quantity for about six cents per pound and the lime for about one-half cent per pound. It will be seen that Table No. 1 gives an estimate of about six dollars per acre, for four sprayings. Other investigators have estimated the cost at from five to ten dollars, always with results that more than compensate for the outlay. The Vermont Station saved in 1890 the enormous amount of seventy-nine bushels per acre, by two sprayings.* The Rhode Island Station increased the crop the same year forty-eight per cent.§ The results obtained at this Station for the past two seasons confirm the results of others and justify the statement that those who lose a crop of potatoes through neglect to spray simply broaden the avenue towards profit for the grower who practices spraying.

Table No. 2 gives the results of an experiment in spraying on a one-half acre plat of one variety of potatoes. Each row both treated and untreated ran the full length of the plat causing equal conditions as to soil for both treated and untreated vines. Every fifth row of this plat received four sprayings between July

* Vermont Bulletin No. 24, p. 29. § Third Annual Report R. I. Station, p. 145.

second and September twenty-first. By referring to this table it will be seen that the sprayed portion contained nearly 1,000 more merchantable tubers per acre than the untreated portion with practically the same number of small tubers. This is at variance with the results obtained here last year and at other Stations in numerous tests, in which cases the larger yield was obtained by the increased size of tubers and not by the larger number of merchantable tubers. These results, however, do not affect the commercial aspect as an increase of forty bushels as shown by Table No. 2 well pays for the outlay of from five to eight dollars.

The United States Department claim to have had has as good results with Bordeaux mixture used at half strength as with full strength, but the results obtained at this Station favor the use of the full strength mixture for the last two sprayings.

Table I.— Showing cost of spraying per acre.

	Copper sulphate at six cents per pound.	Lime at one-half cent per pound.	Gallons of water.	Cost of labor, cents
First spraying with Paris green	$0 72	$0 08	88	*
Second spraying with Paris green	72	08	88	*
Third spraying with Bordeaux, full strength	1 54	16	88	75
Fourth spraying with Bordeaux, full strength	1 54	16	88	75

Total cost $6 50

Table II.

	Number of merchantable tubers.	Weight of merchantable tubers, pounds.	Number of small tubers.	Weight of small tubers, pounds.
Sprayed, five rows	3,725	1,466	1,880	238
Estimated yield of tubers per acre	14,900	....	7,520	....
Estimated yield of pounds per acre	....	5,860	......	940
Estimated yield of bushels per acre	....	196⅔	......	15⅔
Untreated, fifteen rows	9,745	3,225	5,227	608½
Estimated yield of tubers per acre	13,920	....	7,540	
Estimated yield of pounds per acre	....	4,700	......	960
Estimated yield of bushels per acre	....	156⅔	......	16
Sprayed in bushels	....	196⅔	......	....
Untreated	....	156⅔	......	....
Increase by spraying	....	40 bu	......	....

* The labor to be charged against spraying with Paris green.

POTATOES.

A list of varieties tested in order of their productiveness

Seneca Red Jacket.
Restaurant.
Rural New Yorker.
Monroe Seedling.
American Wonder.
Summit.
Fill Basket.
Rural Blush.
New Queen.
Chicago Market.
Late Puritan.
Badger State.
Dandy.
Money Maker.
Beauty of Hebron.
Green Mountain.
Ottawa Rose.
Bill Nye.
Rochester Rose.
Vick's Early.
Polaris.
Snow Drop.
Negro.
Late Puritan.
New Queen.
Seneca Beauty.
Vaughan.
Freeman.
Harbinger.
White Prize.
Early Puritan.
Woodbury White.
White Superior.
Vick's Early.
Chicago Market.
Randall's Beauty.

TOMATOES.

Table showing the numerical productiveness of each variety tested in order of their yield:

Cook's Favorite.
Thorburn's Long Keeper.
Early Ruby.
Advance.
Ten Ton.
Mayflower.
Potomac.
Money Maker.
Matchless.
Ignotum.
Dwarf Champion.
Baltimore Prize Taker.
Trucker's Favorite.
New Jersey.
Livingston's Stone.
Atlantic Prize.
Horner's New.
Turner's Hybrid.
Livingston's Royal Red.
Logan's Giant.
Finche's Imp. Tree.
Dwarf Tree.
Mammoth Prize.
Ponderosa.
Station

METEOROLOGY FOR 1892.*

The record of all the wind strong enough to turn a vane has been recorded accurately as to the direction and time.

The record of sunshine has been continued uniform with the first method adopted by Dr. Babcock, and a summary follows the record for 1892 showing a comparison of the sunshine for each year it has been recorded by the Neggretti and Zambra instrument.

The different tables follow in their order:

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* R. D. Newton in charge.

PRECIPITATION BY MONTHS SINCE 1882.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1882	....	....	....	....	....	3.69	2.42	2.37	1.25	0.62	1.22	0.55	....
1883	0.48	1.44	0.88	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.83	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.58	2.49	4.64	5.02	2.11	2.88	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.13	1.92	2.92	4.41	2.86	2.31	1.39	3.48	1.24	27.87
1887	0.18	2.17	0.48	1.37	0.46	2.01	6.37	3.03	0.75	1.74	1.58	1.35	22.29
1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99+	4.02	2.73	3.47	2.02	1.24+	27.48
1889	2.99+	0.25	0.66+	3.28	1.21	7.47	4.57	1.98	2.50	3.32	3.44	1.62	32.28
1890	2.16	1.45	2.16	2.20	5.49	5.26	1.07	4.34	5.81	4.54	2.40	....	36.88
1891	1.44	1.57	3.25	1.63	0.49	4.31	3.52	3.16	0.47	3.65	0.74	3.29	27.52
1892	0.57	0.88	0.55	0.67	4.04	3.95	1.89	4.77	1.12	1.34	2.67	0.72	23.17

WIND RECORD FOR 1892.

DATE.	January. Northerly, N. W. to N. E.	January. Easterly, N. E. to S. E.	January. Southerly, S. E. to S. W.	January. Westerly, S. W. to N. W.	February. Northerly, N. W. to N. E.	February. Easterly, N. E. to S. E.	February. Southerly, S. E. to S. W.	February. Westerly, S. W. to N. W.	March. Northerly, N. W. to N. E.	March. Easterly, N. E. to S. E.	March. Southerly, S. E. to S. W.	March. Westerly, S. W. to N. W.	April. Northerly, N. W. to N. E.	April. Easterly, N. E. to S. E.	April. Southerly, S. E. to S. W.	April. Westerly, S. W. to N. W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	....	7.0	17.0	....	3.0	....	....	8.0	15.0	5.0	2.0	....	....	....	19.0	....
2	....	....	22.0	....	....	4.0	....	5.0	17.0	....	....	....	....	....	24.0	....
3	....	....	....	22.0	....	....	6.0	17.0	4.0	....	....	10.0	....	....	17.0	7.0
4	....	....	....	24.0	3.0	....	....	16.0	....	....	....	10.0	....	2.0	....	4.0
5	....	....	....	3.0	....	....	....	14.0	....	....	....	15.0	1.0	....	15.0	....
6	4.0	3.0	....	....	....	....	6.0	3.0	....	....	....	24.0	....	....	....	24.0
7	....	2.0	....	14.0	....	....	....	17.0	....	....	....	23.0	....	....	2.0	9.0
8	....	....	6.0	18.0	....	....	....	18.0	....	....	7.0	2.0	....	....	....	20.0
9	....	....	9.0	11.0	....	....	5.0	14.0	....	1.0	3.0	8.0	1.0	....	....	23.0
10	....	....	....	13.0	....	....	9.0	4.0	....	4.0	....	3.0	....	....	....	24.0
11	....	1.0	9.0	....	....	....	8.0	12.0	....	....	....	19.0	....	....	....	24.0
12	....	....	24.0	....	....	....	....	19.0	....	....	....	18.0	....	....	....	24.0
13	2.0	....	3.0	2.0	....	....	4.0	11.0	6.0	....	....	18.0	4.0	....	....	20.0
14	5.0	....	....	....	....	....	18.0	3.0	....	....	....	24.0	....	3.0	....	14.0
15	....	....	....	8.0	....	....	....	24.0	....	....	....	24.0	19.0	5.0	....	....
16	7.0	....	....	....	....	....	....	24.0	....	....	....	24.0	5.0	....	....	19.0
17	....	....	6.0	4.0	....	....	....	17.0	5.0	....	....	....	6.0	....	4.0	8.0
18	....	....	22.0	....	2.0	....	6.0	....	2.0	2.0	....	....	5.0	1.0	....	12.0
19	14.0	....	3.0	....	....	1.0	2.0	....	3.0	....	....	19.0	18.0	....	....	....
20	8.0	....	....	....	....	....	20.0	....	....	....	....	24.0	8.0	3.0	....	....
21	....	....	9.0	9.0	....	....	3.0	....	....	....	....	24.0	....	4.0	9.0	....
22	....	....	10.0	12.0	....	4.0	....	....	....	....	10.0	7.0	....	....	17.0	....
23	....	....	3.0	20.0	....	....	....	....	....	....	12.0	....	....	....	4.0	18.0
24	....	....	2.0	12.0	....	....	3.0	....	....	....	....	24.0	....	....	....	20.0
25	....	....	....	24.0	....	....	16.0	....	....	....	....	16.0	10.0	....	2.0	....
26	....	....	....	24.0	....	....	13.0	6.0	2.0	....	2.0	3.0	5.0	....	....	3.0
27	8.0	....	....	16.0	22.0	....	....	....	....	4.0	....	....	5.0	....	5.0	....
28	....	....	....	22.0	6.0	....	8.0	....	8.0	....	....	16.0	....	....	24.0	....
29	....	....	4.0	15.0	....	....	23.0	....	5.0	....	....	19.0	3.0	....	....	14.0
30	....	....	....	2.0	....	....	....	....	7.0	....	2.0	1.0	4.0	....	....	19.0
31	5.0	....	....	10.0	....	....	....	....	....	10.0	9.0	....	....	....	....	....
Total hours of movement	63.0	13.0	149.0	285.0	36.0	9.0	150.0	232.0	74.0	26.0	47.0	375.0	94.0	18.0	142.0	306.0
Per cent. of time in each direction	12.4	2.5	29.2	55.9	8.4	2.1	35.1	54.4	14.2	5.0	9.0	71.8	16.8	3.2	25.4	54.6

WIND RECORD — (*Continued*).

DATE.	May.				June.				July.				August.			
	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs	Hrs.	Hrs	Hrs.	Hrs.	Hrs.	Hrs.
1	5.0	....	11.0	......	......	....	18.0	......	....	....	......	9.0	2.0	3.0	......	......
2	....	....	9.0	3.0	......	....	5.0	6.0	....	....	4.0	5.0	6.0	3.0	2.0	......
3	....	....	3.0	6.0	11.0	....	1.0	1.0	....	....	16.0	3.0	4.0	....	......	5.0
4	1.0	2.0	6.0	12.0	6.0	2.0	9.0	......	10.0	....	......	5.0	1.0	...	1.0	8.0
5	...	4.0	....	15.0	......	....	23.0	......	7.0	....	......	4.0	....	....	......	17.0
6	2.0	4.0	....	......	......	....	3.0	11.0	2.0	....	2.0	......	2.0	....	2.0	10.0
7	4.0	....	....	16.0	5.0	....	......	12.0	...	2.0	......	......	2.0	....	......	10.0
8	9.0	....	....	15.0	5.0	....	10.0	...	4.0	2.0	......	4.0	....	....	8.0	2.0
9	10.0	....	....	7.0	......	1.0	11.0	......	6.0	....	......	10.0	1.0	....	7.0	7.0
10	6.0	....	4.0	......	10.0	5.0	......	......	6.0	....	......	5.0	....	....	4.0	8.0
11	....	....	22.0	......	6.0	....	3.0	1.0	1.0	....	......	8.0	....	....	2.0	12.0
12	....	....	1.0	20.0	......	1.0	3.0	6.0	4.0	....	......	3.0	12.0	....	......	5.0
13	3.0	....	4.0	9.0	......	....	......	11.0	....	1.0	2.0	9.0	16.0	....	......	......
14	....	5.0	9.0	......	......	....	2.0	14.0	3.0	....	5.0	14.0	2.0	....	......	14.0
15	....	....	24.0	......	2.0	....	......	10.0	6.0	....	4.0	2.0	....	....	......	20.0
16	....	4.0	....	17.0	......	3.0	10.0	......	....	....	......	18.0	4.0	....	3.0	......
17	....	....	....	13.0	3.0	....	1.0	3.0	....	....	......	11.0	....	....	1.0	4.0
18	....	3.0	....	7.0	5.0	3.0	......	......	....	....	......	20.0	....	....	3.0	3.0
19	....	15.0	2.0	......	......	7.0	13.0	2.0	....	....	4.0	8.0	....	....	3.0	1.0
20	....	....	24.0	......	......	....	7.0	15.0	5.0	....	......	19.0	5.0	....	......	12.0
21	....	6.0	11.0	......	......	....	......	16.0	6.0	....	......	4.0	5.0	....	......	3.0
22	11.0	12.0	....	......	......	....	......	16.0	....	....	3.0	7.0	5.0	....	......	1.0
23	12.0	....	....	2.0	......	....	3.0	7.0	...	6.0	......	6.0	....	6.0	3.0	......
24	7.0	....	....	15.0	3.0	....	......	13.0	4.0	....	2.0	1.0	....	....	19.0	1.0
25	....	....	7.0	12.0	......	....	2.0	11.0	....	....	1.0	16.0	....	....	19.0	......
26	....	....	4.0	13.0	......	....	......	19.0	1.0	....	......	17.0	11.0	....	......	2.0
27	....	....	....	20.0	5.0	....	6.0	......	6.0	7.0	......	......	....	6.0	......	......
28	....	....	....	24.0	......	....	13.0	......	2.0	2.0	......	6.0	....	....	......	3.0
29	1.0	....	9.0	6.0	......	....	6.0	8.0	....	....	5.0	10.0	3.0	....	3.0	......
30	....	....	8.0	......	......	....	9.0	4.0	18.0	....	......	8.0	....	4.0	8.0	......
31	5.0	2.0	5.0	......	......	....	......	......	7.0	....	......	......	....	....	16.0	7.0
Total hours of movement	76.0	57.0	163.0	232.0	61.0	22.0	158.0	186.0	93.0	20.0	48.0	232.0	81.0	22.0	104.0	155.0
Per cent. of time in each direction	14.4	10.8	30.9	43.9	14.3	5.2	37.0	43.6	23.7	5.1	12.2	59.0	22.4	6.1	28.7	42.8

WIND RECORD — (*Concluded.*)

DATE.	September.				October.				November.				December.			
	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
	Hrs.	Hrs.	Hrs.	Hrs	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs.
1	2.0	....	....	22.0	6.0	....	......	18.0	2.0	....	......	5.0	12.0	....	......	7.0
2	....	....	2.0	6.0	11.0	....	......	3.0	2.0	2.0	10.0	......	....	....	......	24.0
3	....	....	10.0	......	3.0	....	10.0	......	....	....	......	10.0	....	....	......	11.0
4	....	....	14.0	......	1.0	....	......	23.0	....	....	......	4.0	....	....	......	24.0
5	....	....	20.0	......	13.0	....	......	10.0	....	....	......	24.0	....	....	......	21.0
6	....	....	....	22.0	3.0	....	......	21.0	....	....	2.0	10.0	....	....	12.0	10.0
7	....	....	....	12.0	......	....	6.0	11.0	....	....	24.0	......	....	1.0	......	15.0
8	....	....	3.0	4.0	......	....	13.0	......	....	....	13.0	......	....	....	24.0	......
9	....	....	10.0	......	......	1.0	......	12.0	1.0	....	......	21.0	....	....	......	21.0
10	....	....	16.0	......	5.0	....	......	17.0	1.0	8.0	......	......	....	....	13.0	......
11	....	....	24.0	......	......	....	......	14.0	....	....	......	21.0	....	....	......	16.0
12	....	....	20.0	......	3.0	....	3.0	2.0	....	....	10.0	9.0	....	....	2.0	8.0
13	....	....	15.0	9.0	......	....	3.0	2.0	....	....	3.0	14.0	....	....	3.0	8.0
14	....	....	24.0	......	......	....	......	7.0	....	....	24.0	......	....	....	22.0	2.0
15	....	....	....	21.0	......	....	3.0	5.0	....	....	13.0	......	....	....	......	13.0
16	....	....	....	18.0	......	....	......	17.0	....	....	3.0	3.0	....	....	......	19.0
17	....	....	....	12.0	5.0	....	......	6.0	....	....	6.0	10.0	....	....	......	8.0
18	....	....	....	9.0	2.0	....	13.0	......	....	....	21.0	2.0	2.0	....	2.0	......
19	9.0	1.0	....	......	......	....	17.0	7.0	....	....	10.0	10.0	....	....	......	24.0
20	....	....	6.0	3.0	......	....	......	13.0	....	1.0	......	21.0	4.0	....	......	20.0
21	....	2.0	12.0	......	......	....	......	20.0	....	....	15.0	3.0	....	....	......	15.0
22	....	....	19.0	......	......	....	3.0	8.0	....	....	1.0	23.0	....	....	......	24.0
23	....	....	21.0	......	......	....	......	14.0	....	....	......	24.0	....	....	......	24.0
24	....	....	15.0	1.0	......	....	......	24.0	....	....	......	24.0	1.0	....	......	23.0
25	....	....	3.0	2.0	......	....	......	24.0	....	....	......	24.0	6.0	....	......	18.0
26	....	....	2.0	17.0	......	....	......	24.0	3.0	....	......	10.0	....	....	......	18.0
27	....	....	....	24.0	......	....	......	24.0	....	4.0	......	......	3.0	....	......	14.0
28	....	....	....	24.0	......	....	......	12.0	....	....	21.0	......	....	....	......	18.0
29	6.0	....	....	3.0	......	....	11.0	9.0	1.0	1.0	1.0	......	16.0	2.0	......	4.0
30	....	1.0	5.0	......	......	....	......	24.0	23.0	....	......	......	....	....	......	21.0
31	....	....	....	......	......	....	......	13.0	....	....	......	......	....	....	1.0	3.0
Total hours of movement	17.0	4.0	241.0	209.0	52.0	1.0	82.0	384.0	33.0	16.0	177.0	272.0	44.0	3.0	79.0	433.0
Per cent. of time in each direction	3.6	.8	51.2	44.4	10.0	0.2	15.8	74.0	6.6	3.2	35.6	54.6	7.9	0.5	14.1	77.5

SUMMARY OF DIRECTION OF WIND FOR 1892.

	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
January	63.0	13.0	149.0	285.0
February	36.0	9.0	150.0	233.0
March	74.0	26.0	47.0	375.0
April	94.0	18.0	142.0	306.0
May	76.0	57.0	163.0	232.0
June	61.0	22.0	158.0	186.0
July	93.0	20.0	48.0	232.0
August	81.0	22.0	104.0	155.0
September	17.0	4.0	241.0	209.0
October	52.0	1.0	82.0	384.0
November	33.0	16.0	177.0	272.0
December	44.0	3.0	79.0	433.0
Total hours of movement	724.0	211.0	1,540.0	3,301.0
Per cent. of time from each direction	12.5	3.7	26.7	57.1

SUNSHINE RECORD FOR 1892 BY NEGGRETTI AND ZAMBRA INSTRUMENTS.

DATE.	January: Before 9 A. M.	January: 9 to 12.	January: 12 to 3.	January: After 3 P. M.	January: Total hours.	January: Hours, sunrise to sunset.	February: Before 9 A. M.	February: 9 to 12.	February: 12 to 3.	February: After 3 P. M.	February: Total hours.	February: Hours, sunrise to sunset.
	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.
1	0 00	0 00	0 00	0 00	0 00	9 08	0 00	0 00	0 00	0 00	0 00	10 00
2	0 00	2 00	1 00	0 00	3 00	9 09	0 00	0 00	0 00	0 00	0 00	10 02
3	0 00	0 00	0 00	0 00	0 00	9 10	0 00	0 00	0 00	0 00	0 00	10 04
4	0 00	1 45	1 00	0 00	2 45	9 11	0 00	0 30	2 15	1 30	4 15	10 07
5	0 00	2 00	3 00	0 00	5 00	9 12	0 00	2 00	3 00	2 40	7 40	10 09
6	0 00	0 00	0 00	0 00	0 00	9 14	1 00	3 00	3 00	1 30	8 30	10 12
7	0 00	0 00	1 00	0 00	1 00	9 15	0 00	0 00	0 00	0 00	0 00	10 14
8	0 00	0 00	0 00	0 00	0 00	9 16	0 00	1 00	0 00	0 00	1 00	10 17
9	1 00	3 00	3 00	1 00	8 00	9 17	0 00	0 00	1 00	0 00	1 00	10 19
10	1 00	3 00	3 00	0 00	7 00	9 18	0 00	0 00	0 00	0 00	0 00	10 21
11	0 00	0 00	0 00	0 00	0 00	9 19	0 00	2 00	3 00	0 00	5 00	10 24
12	0 00	0 00	0 00	0 00	0 00	9 22	1 00	2 30	1 00	0 00	4 30	10 27
13	0 00	0 00	0 00	0 00	0 00	9 23	0 15	3 00	3 00	2 30	8 45	10 29
14	0 00	0 00	0 00	0 00	0 00	9 24	0 00	0 00	0 00	0 00	0 00	10 31
15	0 30	3 00	1 00	0 00	4 30	9 26	0 00	0 00	0 30	0 00	0 30	10 35
16	0 00	1 00	0 00	0 00	1 00	9 27	1 45	3 00	3 00	2 00	9 45	10 37
17	0 00	0 00	0 00	0 00	0 00	9 29	0 00	0 45	1 30	2 45	5 00	10 41
18	0 00	0 00	0 00	0 00	0 00	9 30	0 30	3 00	3 00	2 00	8 30	10 43
19	0 00	0 00	0 00	0 00	0 00	9 33	0 00	0 00	0 00	0 00	0 00	10 46
20	0 30	3 00	3 00	1 30	8 00	9 35	0 00	0 00	0 00	0 00	0 00	10 49
21	0 15	0 45	2 00	1 00	4 00	9 36	0 00	0 00	0 00	0 00	0 00	10 52
22	0 00	0 00	0 00	0 00	0 00	9 38	0 00	3 00	3 00	1 30	7 30	10 55
23	0 00	1 00	1 00	0 00	2 00	9 41	0 00	0 00	0 00	0 00	0 00	10 58
24	0 00	0 00	0 00	0 00	0 00	9 42	0 45	3 00	1 00	2 00	6 45	11 01
25	1 15	3 00	3 00	1 00	8 15	9 44	0 00	1 00	2 00	2 00	5 00	11 04
26	0 00	1 00	1 30	0 00	2 30	9 46	0 00	0 00	0 00	0 00	0 00	11 06
27	0 00	0 00	0 00	0 00	0 00	9 49	1 45	1 30	1 00	0 00	4 15	11 10
28	0 00	0 15	2 00	0 00	2 15	9 51	2 00	3 00	3 00	2 15	10 15	11 12
29	0 30	3 00	3 00	0 30	7 00	9 53	0 00	0 00	0 00	0 00	0 00	11 13
30	0 00	1 00	0 00	0 30	1 30	9 56	....	....	....	....	....	....
31	0 30	2 00	1 30	1 00	5 00	9 58	....	....	....	....	....	....
Total hours	5 30	30 45	30 00	6 30	72 45	294 12	9 00	32 15	34 15	22 40	98 10	296 05
Per cent. of possible	11.2	33.1	32.3	11.0	24.7	....	15.7	37.1	39.4	32.2	33.7	....

SUNSHINE RECORD — (*Continuea*).

DATE.	March.						April.					
	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.	Before 9 A. M.	9 to 12.	12 to 3.	After 3 P. M.	Total hours.	Hours, sunrise to sunset.
	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.	Hrs. m.
1	0 00	0 00	0 00	0 00	0 00	11 15	2 15	3 00	3 00	0 00	8 15	12 41
2	0 00	0 00	0 00	0 00	0 00	11 17	0 00	3 00	3 00	1 00	7 00	12 42
3	1 45	3 00	3 00	2 15	10 00	11 20	1 00	2 00	1 00	1 00	5 00	12 46
4	0 00	1 00	2 00	2 20	5 20	11 23	2 00	3 00	1 00	0 00	6 00	12 48
5	0 00	1 00	2 00	1 00	4 00	11 25	0 00	0 00	1 00	1 30	2 30	12 51
6	1 00	3 00	3 00	2 30	9 30	11 28	0 00	0 00	1 00	1 30	2 30	12 54
7	2 15	3 00	3 00	2 30	10 45	11 31	2 15	3 00	1 30	0 00	6 45	12 56
8	0 00	0 00	0 00	0 00	0 00	11 33	2 00	3 00	0 30	0 00	5 30	12 59
9	0 00	0 30	1 00	0 00	1 30	11 36	0 30	1 30	1 00	0 00	3 00	13 02
10	0 00	0 00	0 00	0 00	0 00	11 39	0 00	0 00	0 00	0 00	0 00	13 04
11	0 00	0 00	0 00	0 00	0 00	11 42	0 00	0 00	0 00	0 00	0 00	13 08
12	0 00	0 00	0 00	0 00	0 00	11 45	2 30	3 00	3 00	2 00	10 30	13 11
13	1 30	3 00	3 00	2 45	10 15	11 48	2 30	3 00	3 00	2 30	11 00	13 13
14	2 00	2 00	1 00	0 30	5 30	11 51	0 00	0 00	0 00	0 00	0 00	13 16
15	2 00	3 00	1 30	2 45	9 15	11 53	2 30	3 00	3 00	2 00	10 30	13 19
16	1 00	3 00	2 00	2 30	8 30	11 56	2 30	3 00	3 00	1 00	9 30	13 21
17	0 00	1 00	0 00	0 00	1 00	12 00	1 45	2 00	3 00	1 00	7 45	13 24
18	0 00	0 00	0 00	0 00	0 00	12 03	2 00	3 00	0 00	0 00	5 00	13 27
19	0 00	3 00	2 00	0 30	5 30	12 05	2 00	3 00	3 00	0 30	8 30	13 30
20	1 00	1 30	1 30	2 45	6 45	12 08	2 30	3 00	3 00	1 00	9 30	13 33
21	2 00	3 00	3 00	2 45	10 45	12 11	0 00	0 00	0 00	0 00	0 00	13 35
22	0 00	0 00	0 00	0 00	0 00	12 14	0 00	0 00	0 00	0 00	0 00	13 38
23	0 00	1 00	0 30	0 00	1 30	12 16	2 00	3 00	3 00	2 00	10 00	13 40
24	2 15	3 00	0 45	0 00	6 00	12 19	0 00	3 00	3 00	2 15	8 15	13 43
25	2 00	3 00	3 00	2 30	10 30	12 22	0 00	2 00	2 00	1 00	5 00	13 45
26	2 00	3 00	3 00	3 00	11 00	12 25	2 30	3 00	3 00	2 15	10 45	13 48
27	0 00	0 00	0 00	0 00	0 00	12 27	2 30	3 00	2 00	0 00	7 30	13 50
28	1 45	3 00	3 00	3 00	10 45	12 30	0 00	0 00	0 00	0 00	0 00	13 54
29	2 15	3 00	3 00	1 30	9 45	12 33	0 45	1 00	1 30	1 30	4 45	13 56
30	00	3 00	3 00	1 00	9 00	12 36	0 00	2 45	2 15	0 45	5 45	13 59
31	1 00	0 00	0 00	0 00	1 00	12 39	....	....	....	....	....	....
Total hours	27 45	50 00	44 15	36 05	158 05	370 10	36 00	59 15	50 45	24 45	170 45	401 13
Per cent. of possible	31.7	53.8	47.6	37.3	42.7	....	35.8	65.8	56.4	22.3	42.5	....

SUNSHINE RECORD — (*Continued*).

DATE.	May. Before 9 A. M. Hrs.	m.	9 to 12. Hrs.	m.	12 to 3. Hrs.	m.	After 3 P. M. Hrs.	m.	Total hours. Hrs.	m.	Hours, sunrise to sunset. Hrs.	m.
1	0	00	0	00	0	00	0	00	0	00	14	06
2	0	00	0	00	0	00	0	00	0	00	14	08
3	0	00	0	00	0	00	0	00	0	00	14	11
4	2	15	1	45	0	00	0	00	4	00	14	13
5	2	15	2	00	0	00	0	00	4	15	14	15
6	0	00	0	00	0	00	0	00	0	00	14	17
7	0	00	1	00	3	00	2	50	6	50	14	20
8	0	00	0	45	3	00	2	00	5	45	14	22
9	2	15	3	00	3	00	2	30	10	45	14	25
10	2	00	3	00	3	00	1	00	9	00	14	27
11	0	00	0	00	1	00	0	00	1	00	14	29
12	0	00	0	00	0	00	0	00	0	00	14	31
13	1	00	3	00	3	00	2	30	9	30	14	33
14	0	00	1	00	2	00	1	30	4	30	14	35
15	0	00	0	30	2	30	0	00	3	00	14	37
16	2	30	3	00	3	00	2	00	10	30	14	39
17	2	15	3	00	3	00	2	40	10	55	14	41
18	1	30	2	00	2	45	2	00	8	15	14	43
19	0	00	1	20	0	00	0	00	1	20	14	45
20	2	00	1	00	2	00	0	30	5	30	14	47
21	0	00	0	00	0	00	0	00	0	00	14	49
22	0	00	0	00	0	00	0	00	0	00	14	51
23	0	00	0	00	0	00	0	00	0	00	14	52
24	0	00	1	00	2	00	2	00	5	00	14	54
25	0	00	0	00	0	45	1	30	2	15	14	56
26	0	00	0	00	0	00	0	00	0	00	14	57
27	1	45	2	30	1	00	2	00	7	15	14	58
28	2	30	3	00	3	00	2	30	11	00	15	00
29	0	00	0	00	0	00	0	00	0	00	15	01
30	2	30	3	00	3	00	2	00	10	30	15	03
31	2	15	3	00	3	00	2	45	11	00	15	04
Total hours	27	00	38	50	44	00	32	15	142	05	453	29
Per cent. of possible	20.0		41.8		47.3		24.5		31.3		....	

DATE.	June. Before 9 A. M. Hrs.	m.	9 to 12. Hrs.	m.	12 to 3. Hrs.	m.	After 3 P. M. Hrs.	m.	Total hours. Hrs.	m.	Hours, sunrise to sunset. Hrs.	m.
1	2	30	3	00	3	00	0	45	9	15	15	05
2	0	00	0	00	0	00	0	00	0	00	15	06
3	0	00	0	00	0	00	0	00	0	00	15	08
4	0	00	0	00	0	00	0	30	0	30	15	09
5	0	00	0	00	0	00	0	00	0	00	15	09
6	0	20	1	30	3	00	2	15	7	05	15	10
7	2	00	3	00	3	00	2	00	10	00	15	11
8	0	00	0	00	0	00	0	00	0	00	15	12
9	0	00	2	10	3	00	0	00	5	10	15	13
10	0	00	3	00	3	00	3	00	9	00	15	14
11	1	30	3	00	2	00	1	00	7	30	15	15
12	2	30	3	00	3	00	1	50	10	20	15	15
13	2	40	3	00	3	00	2	45	11	25	15	16
14	3	00	3	00	3	00	2	15	11	15	15	16
15	2	45	3	00	3	00	3	00	11	45	15	16
16	1	45	3	00	1	00	0	00	5	45	15	17
17	3	00	3	00	3	00	2	00	11	00	15	18
18	3	00	3	00	3	00	1	35	10	35	15	17
19	3	10	3	00	0	00	0	00	6	10	15	17
20	3	00	3	00	3	00	2	45	11	45	15	17
21	2	45	3	00	3	00	2	00	10	45	15	17
22	3	00	3	00	3	00	2	30	11	30	15	17
23	0	00	0	00	0	00	0	00	0	00	15	17
24	2	30	3	00	3	00	0	20	8	50	15	17
25	2	35	3	00	3	00	2	45	11	20	15	16
26	2	40	3	00	3	00	2	15	10	55	15	16
27	0	00	0	00	0	00	0	00	0	00	15	15
28	2	00	1	00	0	30	1	00	4	30	15	15
29	0	35	2	35	0	00	0	00	3	05	15	15
30	0	00	0	00	0	00	0	00	0	00	15	15
31	....		....		....		....		....		....	
Total hours	47	15	61	10	54	30	36	30	199	25	457	23
Per cent. of possible	34.2		68.0		60.6		26.4		43.6		....	

SUNSHINE RECORD — (*Continued*).

DATE.	July.												August.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sun-set.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sun-set.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	2	40	3	00	3	00	2	45	11	25	15	13	2	40	3	00	3	00	2	50	11	30	14	26
2	2	45	3	00	2	00	0	00	7	45	15	12	0	00	0	00	0	30	1	45	2	15	14	24
3	0	00	0	00	0	00	0	00	0	00	15	12	2	45	3	00	3	00	2	45	11	30	14	22
4	1	45	3	00	2	45	3	00	10	30	15	11	0	00	0	00	0	00	0	00	0	00	14	20
5	3	00	3	00	2	00	2	45	10	45	15	10	2	50	3	00	2	30	0	00	8	20	14	17
6	3	10	3	00	3	00	3	15	12	25	15	09	0	30	3	00	3	00	2	20	8	50	14	15
7	3	00	3	00	3	00	3	45	12	45	15	08	2	45	3	00	3	00	2	50	11	35	14	13
8	3	00	2	00	3	00	3	15	11	15	15	07	2	35	3	00	2	50	0	40	9	15	14	11
9	2	15	3	00	2	15	3	20	10	50	15	06	0	00	2	10	3	00	1	00	6	10	14	08
10	3	15	3	00	3	00	3	25	12	40	15	05	2	20	2	00	1	00	0	00	5	20	14	06
11	3	00	3	00	3	00	2	45	11	45	15	04	0	00	0	00	0	00	0	00	0	00	14	03
12	0	00	0	00	0	00	0	00	0	00	15	03	0	00	0	00	0	00	0	00	0	00	14	01
13	2	40	3	00	2	30	3	00	11	10	15	01	0	00	0	00	0	00	0	00	0	00	13	59
14	3	10	3	00	3	00	3	20	12	30	14	59	2	15	3	00	3	00	1	20	9	35	13	55
15	3	15	3	00	2	00	0	00	8	15	14	58	2	10	3	00	3	00	2	15	10	25	13	53
16	2	45	3	00	3	00	3	15	12	00	14	56	2	35	3	00	3	00	2	40	11	15	13	50
17	2	15	3	00	1	00	2	00	8	15	14	55	2	20	3	00	3	00	2	10	10	30	13	48
18	3	00	3	00	3	00	2	20	11	20	14	54	2	00	3	00	2	00	0	35	7	35	13	47
19	0	30	0	15	1	00	1	45	3	30	14	52	2	20	3	00	3	00	2	00	10	20	13	45
20	0	00	2	15	3	00	2	00	7	15	14	50	0	00	1	00	3	00	1	00	5	00	13	43
21	2	20	3	00	3	00	0	40	9	00	14	48	2	30	3	00	3	00	2	20	10	50	13	40
22	2	00	2	00	0	00	0	00	4	00	14	46	2	00	3	00	2	45	0	15	8	00	13	38
23	2	00	3	00	3	00	2	15	10	15	14	45	1	00	2	00	2	30	0	00	5	30	13	35
24	0	00	3	00	3	00	1	10	7	10	14	43	0	00	0	00	0	00	0	00	0	00	13	33
25	1	30	2	35	3	00	2	10	9	15	14	41	0	00	0	00	0	00	0	00	0	00	13	30
26	2	00	2	50	3	00	2	20	10	10	14	39	0	00	0	00	0	00	0	00	0	00	13	27
27	2	35	3	00	3	00	1	15	9	50	14	37	0	00	0	00	0	00	0	00	0	00	13	25
28	2	30	3	00	3	00	0	20	8	50	14	35	0	00	0	00	0	00	1	00	1	00	13	22
29	2	40	2	50	3	00	0	00	8	30	14	33	2	50	3	00	3	00	2	55	11	45	15	19
30	2	35	3	00	3	00	2	00	10	35	14	31	2	30	3	00	1	00	1	30	8	00	13	16
31	0	00	0	00	0	00	0	00	0	00	14	28	2	40	2	00	1	15	0	20	6	15	13	18
Total hours	65	35	77	45	72	30	58	05	273	55	462	11	43	35	57	10	55	20	34	30	190	35	428	47
Per cent. of possible	48.3		83.6		78.0		41.2		59.3		....		36.7		61.5		59.5		28.1		44.4		....	

SUNSHINE RECORD — (*Continued*).

DATE.	September.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	0	00	0	00	1	00	1	40	2	40	13	08
2	3	00	3	00	3	00	2	50	11	50	13	05
3	2	10	3	00	3	00	2	50	11	00	13	02
4	2	20	3	00	3	00	2	10	10	30	13	00
5	0	30	0	00	0	00	0	00	0	30	12	57
6	2	00	1	20	0	00	0	00	3	20	12	54
7	0	00	0	00	2	00	1	00	3	00	12	51
8	2	00	3	00	3	00	1	00	9	00	12	49
9	1	00	2	30	3	00	0	30	7	00	12	46
10	1	45	0	30	2	20	1	00	5	35	12	43
11	2	00	3	00	2	00	1	00	8	00	12	40
12	2	15	3	00	3	00	1	45	10	00	12	38
13	1	15	0	30	1	00	0	00	2	45	12	35
14	1	20	2	30	1	00	0	20	5	10	12	32
15	1	00	2	15	0	00	1	00	4	15	12	28
16	1	30	3	00	3	00	1	50	9	20	12	26
17	1	35	3	00	3	00	2	00	9	35	12	23
18	1	30	3	00	3	00	1	50	9	20	12	20
19	0	00	0	00	0	00	0	00	0	00	12	17
20	2	20	3	00	3	00	1	30	9	50	12	14
21	2	00	3	00	3	00	1	00	9	00	12	12
22	0	00	1	00	2	00	0	00	3	00	12	09
23	0	00	0	45	1	00	0	00	1	45	12	06
24	1	00	2	15	1	10	1	20	5	45	12	03
25	2	00	3	00	3	00	1	30	9	30	12	01
26	2	10	0	20	1	00	2	00	5	30	11	58
27	2	05	3	00	3	00	2	15	10	20	11	55
28	2	00	3	00	3	00	1	45	9	45	11	51
29	2	10	3	00	3	00	2	00	10	10	11	49
30	2	00	3	00	2	50	1	15	9	05	11	46
31	....		....		....		....		....		....	
Total hours	44	55	61	55	62	20	37	20	206	30	373	38
Per cent. of possible	44.9		68.8		69.3		39.5		55.3		....	

DATE.	October.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	1	50	3	00	3	00	2	05	9	55	11	43
2	1	55	3	00	3	00	2	00	9	55	11	40
3	0	00	2	00	0	00	0	00	2	00	11	38
4	0	00	0	00	1	00	0	00	1	00	11	35
5	0	00	0	00	1	30	0	00	1	30	11	32
6	1	00	2	10	2	00	1	20	6	30	11	30
7	1	35	3	00	3	00	2	00	9	35	11	27
8	0	00	1	00	1	20	0	00	2	20	11	24
9	0	00	0	00	1	00	0	45	1	45	11	21
10	2	15	3	00	3	00	2	30	10	45	11	18
11	1	50	3	00	3	00	2	15	10	05	11	15
12	0	00	0	45	3	00	1	50	5	35	11	13
13	1	50	3	00	3	00	1	50	9	40	11	10
14	2	10	3	00	3	00	1	40	9	50	11	07
15	1	30	1	00	1	00	0	00	3	30	11	04
16	1	30	0	40	1	00	0	10	3	20	11	01
17	0	00	0	00	0	00	0	00	0	00	10	58
18	2	10	3	00	3	00	2	00	10	10	10	55
19	2	05	3	00	3	00	0	30	8	35	10	52
20	2	15	3	00	2	00	0	25	7	40	10	50
21	1	30	3	00	3	00	0	10	7	40	10	47
22	1	30	1	00	1	20	0	45	4	35	10	45
23	0	00	0	00	0	00	0	00	0	00	10	42
24	0	00	0	40	2	00	0	00	2	40	10	37
25	0	00	0	00	0	00	0	40	0	40	10	36
26	0	00	0	00	0	00	0	00	0	00	10	34
27	0	00	0	00	1	00	0	00	1	00	10	32
28	0	00	0	00	0	00	0	00	0	00	10	29
29	0	20	0	30	0	00	0	00	0	50	10	26
30	0	30	0	00	1	30	0	40	2	40	10	24
31	0	00	0	00	0	00	0	00	0	00	10	21
Total hours	27	45	42	45	49	40	23	35	143	45	341	49
Per cent. of possible	32.2		46.0		53.4		33.1		42.1		....	

SUNSHINE RECORD — (*Concluded*).

DATE.	NOVEMBER.												DECEMBER.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m	Hrs.	m	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	0	00	0	00	0	00	0	00	0	00	10	19	0	00	0	00	0	00	0	00	0	00	9	17
2	0	00	0	00	0	00	0	00	0	00	10	16	0	00	0	00	0	00	0	00	0	00	9	16
3	0	00	0	00	0	00	0	00	0	00	10	14	0	00	0	00	0	00	0	00	0	00	9	15
4	0	00	0	00	0	45	0	00	0	45	10	12	0	00	1	00	0	00	0	00	1	00	9	14
5	0	00	1	00	0	50	0	30	2	20	10	10	0	00	0	00	0	00	0	00	0	00	9	13
6	0	00	2	00	2	10	0	00	4	10	10	08	0	00	0	00	0	00	0	00	0	00	9	11
7	0	00	0	00	0	00	0	00	0	00	10	05	0	00	0	00	0	00	0	00	0	00	9	10
8	0	00	0	00	0	30	0	15	0	45	10	02	0	00	0	00	0	30	0	00	0	30	9	10
9	0	00	0	00	0	00	0	00	0	00	10	00	0	00	0	00	0	00	0	00	0	00	9	09
10	0	00	0	00	0	00	0	00	0	00	9	57	0	00	1	45	1	30	0	15	3	30	9	08
11	0	00	0	00	0	00	0	00	0	00	9	55	0	00	0	40	0	00	0	00	0	40	9	07
12	0	00	0	00	0	00	0	00	0	00	9	53	0	00	2	00	1	00	0	00	3	00	9	06
13	0	00	2	00	3	00	1	30	6	30	9	50	0	00	0	00	0	00	0	00	0	00	9	06
14	0	00	0	00	0	40	0	00	0	40	9	48	0	00	0	00	0	00	0	00	0	00	9	06
15	0	00	0	40	1	20	1	40	3	40	9	46	0	00	0	00	1	20	0	00	1	20	9	06
16	0	00	0	00	0	00	0	00	0	00	9	44	0	00	1	45	2	00	0	00	3	45	9	05
17	1	00	2	50	1	35	0	00	5	25	9	42	0	00	0	00	0	00	0	00	0	00	9	05
18	0	00	0	00	0	00	0	00	0	00	9	39	0	00	0	00	0	00	0	00	0	00	9	05
19	1	20	2	30	1	30	0	00	5	20	9	38	0	00	0	00	0	00	0	00	0	00	9	04
20	1	00	3	00	1	00	0	00	5	00	9	36	0	00	0	40	1	00	0	00	1	40	9	04
21	0	00	0	00	0	00	0	00	0	00	9	34	0	00	0	00	0	35	0	00	0	35	9	04
22	1	10	3	00	2	50	0	00	7	00	9	32	0	00	0	00	0	00	0	00	0	00	9	04
23	0	00	0	00	0	00	0	00	0	00	9	30	0	00	0	00	0	00	0	00	0	00	9	04
24	0	00	0	00	0	00	0	00	0	00	9	29	0	00	0	45	1	00	0	30	2	15	9	05
25	0	00	0	00	0	00	0	00	0	00	9	27	0	00	0	00	0	00	0	00	0	00	9	05
26	0	00	0	00	0	00	0	00	0	00	9	25	0	00	0	00	0	00	0	00	0	00	9	05
27	0	00	0	00	0	00	0	00	0	00	9	24	0	00	0	00	1	20	0	00	1	20	9	06
28	0	00	0	00	0	00	0	00	0	00	9	23	0	00	0	00	0	00	0	00	0	00	9	06
29	0	00	0	00	0	00	0	00	0	00	9	20	0	00	1	30	1	15	0	00	2	45	9	07
30	0	00	0	00	0	00	0	00	0	00	9	19	0	00	1	00	2	00	0	30	3	30	9	07
31	....		....		....		....		....		....		0	00	0	40	1	00	0	00	1	40	9	08
Total hours	4	30	17	00	16	10	3	55	41	35	293	17	0	00	11	45	14	30	1	15	27	30	283	01
Per cent. of possible	7.		18.9		17.8		7.9		14.2		....		0.0		12.6		15.6		2.7		9.7		....	

MONTHLY SUMMARY OF SUNSHINE RECORD, MAY 1, 1885, TO JANUARY 1, 1893.

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1885	Hours	......	......	......	......	165.2	237.5	284.7	163.5	206.7	134.5	53.2	50.0
	Per cent. of possible	......	......	......	......	36.4	52.0	53.8	38.1	55.3	39.3	18.1	17.6
1886	Hours	43.3	80.0	83.3	144.8	235.8	252.2	243.3	240.2	200.3	142.8	102.0	68.5
	Per cent. of possible	14.3	26.7	22.3	36.3	51.9	54.2	52.6	56.0	56.7	41.8	34.8	24.2
1887	Hours	44.0	61.5	110.7	159.0	265.0	217.8	267.5	235.8	......	......	......	......
	Per cent. of possible	14.5	18.2	29.7	39.9	58.4	47.6	57.9	55.0	......	......	......	......
1888	Hours	......	......	......	......	......	207.2	270.7	200.8	157.1	......	......	......
	Per cent. of possible	......	......	......	......	......	45.7	58.9	46.8	42.1	......	......	......
1889	Hours	65.8	84.6	124.4	164.7	185.2	158.6	255.3	234.2	152.0	106.8	65.4	62.3
	Per cent. of possible	22.4	28.6	33.6	41.0	40.8	34.7	55.2	54.6	40.7	31.3	22.3	22.0
1890	Hours	45.2	66.2	97.0	209.2	150.2	230.8	283.7	194.5	157.2	77.6	64.4	34.3
	Per cent. of possible	15.4	22.3	24.6	52.1	33.1	50.5	61.4	45.4	42.0	22.7	21.9	12.1
1891	Hours	77.8	96.8	155.8	150.7	139.7	220.6	240.2	223.7	220.5	187.6	83.2	104.6
	Per cent. of possible	26.5	32.7	42.1	33.4	30.8	48.6	52.0	52.1	59.0	54.9	28.4	37.0
1892	Hours	72.7	98.2	158.1	170.7	142.1	199.4	273.9	190.6	206.5	143.7	41.6	27.5
	Per cent. of possible	24.7	33.7	42.7	42.5	31.3	43.6	59.3	44.4	55.3	42.1	14.2	9.7

READINGS OF THE

1892	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.			JUNE.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	36.0	43.5	39.0	36.0	34.2	33.0	21.8	18.2	17.0	37.0	52.0	49.0	44.5	49.0	52.0	70.0	82.6	70.0
2	44.5	47.6	33.4	35.2	35.0	26.8	15.2	21.6	15.9	48.1	54.4	59.0	53.0	58.0	59.0	69.0	75.0	69.1
3	20.0	18.5	13.8	28.8	28.1	28.0	7.0	20.0	13.2	48.8	67.8	60.0	51.2	56.0	61.6	54.0	57.4	60.0
4	15.0	19.5	19.0	28.0	31.2	21.0	21.2	30.3	24.4	50.0	62.0	69.0	64.5	65.0	55.0	60.0	61.0	67.0
5	10.3	23.6	18.2	16.7	20.2	11.0	28.0	33.0	29.6	56.0	73.3	74.0	44.2	54.0	43.8	66.0	76.2	66.8
6	16.0	19.0	18.2	5.0	26.0	18.0	25.4	32.0	29.7	45.0	43.0	45.0	45.0	47.0	43.0	63.5	71.0	72.5
7	19.0	25.0	19.4	23.7	33.0	35.0	27.4	39.0	36.0	35.0	58.0	58.2	41.3	48.6	47.2	58.4	71.0	66.0
8	12.0	17.5	20.4	37.0	38.0	33.8	28.9	34.7	34.6	44.5	56.0	43.0	38.2	46.2	51.2	65.0	68.8	63.8
9	10.0	19.9	12.0	28.2	32.5	26.0	35.0	36.9	35.0	32.0	35.2	30.0	47.0	57.5	55.5	62.0	73.2	67.0
10	2.0	16.9	12.0	18.8	27.1	28.8	30.9	31.6	26.0	30.7	34.0	29.6	43.0	62.0	61.2	57.6	69.2	64.7
11	20.0	27.0	32.0	29.0	31.4	28.0	19.2	20.2	18.2	28.9	33.0	32.7	52.0	57.0	57.0	57.0	76.2	77.0
12	37.0	37.3	34.0	14.4	12.5	10.0	18.5	32.7	21.5	30.3	37.0	33.8	52.0	51.4	47.6	68.0	86.0	82.2
13	26.2	27.5	26.0	4.8	11.6	7.0	13.4	17.7	14.0	32.0	44.0	40.2	48.0	63.0	61.4	73.8	88.4	85.6
14	30.5	28.6	26.8	18.0	28.9	34.0	9.0	17.0	15.5	31.8	40.0	36.0	54.7	60.0	53.0	76.0	83.2	76.0
15	19.5	25.2	19.1	23.7	24.0	19.0	12.0	22.4	17.2	34.0	44.2	40.0	50.8	60.0	65.7	62.0	75.0	74.7
16	10.5	19.6	12.4	10.0	18.0	11.6	14.7	21.4	16.2	32.8	44.0	38.8	54.7	62.3	62.0	72.0	84.5	77.5
17	16.0	24.0	25.0	11.4	18.8	15.0	14.7	29.0	22.0	33.2	47.4	43.4	54.5	65.7	64.8	69.9	77.6	67.0
18	26.4	27.4	28.5	15.7	35.7	31.6	17.0	22.5	22.0	35.4	48.8	41.5	53.0	72.0	70.2	61.0	77.0	78.5
19	15.2	13.0	10.2	27.6	35.8	33.0	20.5	27.8	27.3	36.0	46.0	45.0	59.0	64.0	55.2	69.2	79.6	72.0
20	9.7	13.8	6.5	35.0	38.5	36.0	19.4	21.0	20.0	37.8	55.0	52.2	46.7	58.4	55.0	73.4	77.0	78.4
21	22.0	18.0	15.2	34.7	37.4	34.6	15.0	27.5	24.0	44.7	42.0	45.0	45.7	45.8	47.4	76.0	82.5	79.5
22	28.0	35.4	31.0	33.0	39.5	36.0	15.0	30.0	32.2	48.0	58.0	51.5	40.5	44.0	45.0	70.2	77.0	73.5
23	32.0	23.4	21.0	26.4	33.9	30.0	36.5	36.2	33.8	42.9	56.4	56.2	43.0	45.5	48.0	64.8	70.4	64.0
24	28.0	33.0	33.0	24.0	35.0	33.5	30.0	39.0	38.0	32.0	36.0	30.8	49.5	62.7	60.8	66.0	77.0	70.6
25	37.6	34.5	4.0	31.0	36.8	38.0	34.0	41.6	41.0	28.8	40.0	41.2	53.0	54.0	63.0	61.6	69.6	67.0
26	3.0	4.0	7.0	34.0	35.0	29.0	31.6	48.4	44.0	38.0	52.0	50.0	59.0	69.8	57.0	63.1	69.6	60.2
27	11.2	14.5	15.0	11.8	19.0	17.0	32.5	37.8	33.2	39.0	58.6	58.0	50.0	57.8	54.4	65.0	62.0	61.0
28	26.8	30.0	27.2	19.5	29.0	32.5	31.2	40.0	37.0	56.0	58.0	63.5	49.0	57.8	59.2	66.0	64.6	60.4
29	37.6	32.0	26.0	27.0	30.0	32.0	30.7	39.7	37.0	41.6	41.3	44.5	54.0	60.8	65.0	74.0	63.3	62.0
30	36.0	31.0	27.0	.....	.....	.....	30.4	42.4	40.5	35.3	46.0	43.0	61.2	74.0	71.5	62.0	59.0	64.0
31	31.8	31.0	34.2	.....	.....	.....	36.0	45.0	38.6	.....	.....	.....	61.8	81.3	82.0	....	....	....

STANDARD AIR THERMOMETER.

July.			August.			September.			October.			November.			December.		
7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
57.7	67.0	64.5	66.0	81.5	79.0	51.0	53.8	56.0	58.0	56.0	49.3	43.6	45.0	40.2	22.4	24.0	27.0
57.6	71.8	70.0	66 0	65.0	68.4	52.0	67.0	63.8	38.8	55.0	47.0	47.5	54.0	43.8	28.2	32.4	32.7
68.0	64.0	57.0	63.4	78.0	80.0	56.4	75.8	73.2	49.8	72.0	70.2	44.1	45.8	43.5	32.3	39.4	37.0
56.8	68.5	67.0	66.4	74.0	67.0	58.5	77.2	74.0	54.0	51.2	49.8	42.4	44.4	42.0	27.0	31.6	30.2
61.7	70.0	67.0	63.6	74.7	70.0	62.2	68.0	62.0	39.2	41.6	39.0	25.9	28.6	28.4	25.6	27.8	28.2
61.0	72.5	70.2	66.4	76.0	74.1	55.0	61.0	54.5	40.4	52.0	49.8	31.0	41.0	39.0	25.0	30.7	35.0
61.2	76.0	73.4	66.0	78.5	76.0	49.0	63.4	60.4	47.0	58.5	58.0	43.0	47.6	52.4	33.0	35.0	36.0
65.4	79.0	77.0	67.0	83.5	83.0	52.2	69.0	64.8	53.0	60.7	57.6	40.0	38.7	32.0	44.4	47.6	40.8
64.8	78.0	75.0	77.0	91.0	87.0	54.0	70.8	68.8	47.8	47.4	43.7	31.8	33.0	31.5	33.8	34.0	30.7
69.0	79.4	80.5	76.0	89.6	76.2	59.0	72.0	67.0	42.2	55.0	51.2	27.8	36.0	31.6	26.0	32.0	34.2
66.5	86.5	80.7	73.5	77.5	75.0	65.0	70.0	69.0	51.4	64.3	49.0	30.7	38.4	36.0	27.8	31.4	27.3
70.2	85.0	83.5	62.2	64.0	61.0	61.4	74.9	68.8	46.2	57.4	55.0	37.0	39.3	34.7	25.6	33.5	32.0
74.0	77.3	76.0	58.6	60.7	60.5	64.0	68.3	68.0	45.0	70.5	61.3	30.0	40.5	40.2	27.7	33.2	32.2
68.7	77.2	75.6	58.0	74.0	73.7	62.0	67.0	62.6	49.2	70.5	61.2	40.0	51.0	47.6	35.4	39.2	36.8
68.8	85.2	82.3	68.2	76.0	73.3	55.5	66.0	63.0	49.2	68.0	66.8	43 0	52.0	48.8	34.0	36.0	33.0
55.5	61.4	60.0	62.6	79.8	77.0	53.0	62.0	57.0	56.0	62.0	56.5	48.2	51.0	47.0	26.0	35.7	29.7
49.0	73.0	69.0	64.0	84.5	80.0	48.0	68.0	63.4	47.0	49.2	47.0	38.8	52.2	52.7	31.3	30.0	26.2
63.0	78.2	77.5	69.0	85.6	82.5	51.0	78.8	71.7	47.0	64.0	59.0	54.0	42.8	33.9	27.0	34.0	33.2
66.0	79.0	78.0	70.0	90.2	72.0	66.0	58.0	55.0	53.8	59.0	57.0	31.3	30.4	35.8	33.0	37.0	32.0
64.4	71.0	69.6	63.0	76.0	68.6	44.0	64.0	61.0	42.0	57.3	51.8	27.6	31.3	29.8	18.0	19.7	16.0
64.4	81.0	77.0	62.0	76.0	70.0	53.2	68.2	67.2	45.7	56.0	47.7	32.2	40.0	34.8	21.0	22.2	21.0
68.0	86.6	75.0	64.2	76.5	69.8	59.4	69.0	68.0	40.8	63.0	52.0	29.2	32.0	25.0	17.0	22.2	17.0
69.6	84.5	80.0	60.0	77.6	67.0	64.0	75.0	72.0	45.0	49.9	43.2	20.0	24.4	20.2	15.0	18.4	10.0
65.6	83.3	89.8	66.0	73.6	74.7	65.0	79.0	76.0	34.0	42.0	41.2	19.0	23.0	20.0	8.0	11.6	13.0
77.0	89.5	89.0	67.7	74.6	68.3	63.1	83.0	78.0	36.0	43.5	41.0	27.5	28.0	26.6	16.0	18.7	14.2
77.6	87.5	82.0	62.0	68.7	65.0	52.6	55.0	55.0	38.5	44.1	40.0	25.2	28.0	25.2	8.0	5.2	0.4
67.4	90.0	79.0	60.4	66.7	64.2	48.0	60.8	62.4	39.0	44.6	40.0	26.0	26.0	32.0	10.6	20.7	15.0
80.0	93.2	87.2	57.0	64.0	63.4	60.2	68.6	46.5	41.0	48.0	43.6	33.0	32.2	30.0	10.0	11.0	15.3
78.0	93.4	76.0	56.0	73.0	71.0	63.0	56.4	52.4	41.0	45.4	42.0	32.0	29.0	24.2	17.8	24.2	16.2
64.9	74.0	72.2	62.4	75.0	73.7	54.0	79.5	70.0	37.4	43.1	39.1	25.7	28.0	24.2	17.2	27.0	22.0
65.0	77.6	75.0	61.0	66.8	60.0	.....	.....	.....	42.4	49.2	47.8	.....	.....	.....	12.0	25.2	22.8

READING OF MAXIMUM AND MINIMUM THERMOMETERS AT 7 A. M.

1892.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1......	36.0	13.5	35.0	23.0	33.0	21.8	45.8	33.0	48.0	34.6	85.6	61.0	68.0	48.2	80.0	58.0	70.0	50.0	82.0	51.3	51.2	40.3	26.5	22.0
2......	47.0	35.5	37.0	31.5	22.0	14.0	56.0	33.0	53.0	44.0	91.0	61.6	69.0	46.4	84.0	65.0	59.6	44.0	59.7	33.1	48.0	39.0	28.4	21.3
3......	48.0	19.0	42.0	25.0	23.8	6.0	64.0	45.6	62.0	46.4	79.6	53.0	74.6	57.0	70.0	57.2	69.0	51.0	56.1	38.0	56.6	41.0	34.4	28.0
4......	24.5	10.0	31.0	26.0	24.0	6.0	70.0	48.0	75.0	50.8	64.6	53.0	70.8	51.0	83.5	62.0	78.7	55.0	75.3	49.0	49.0	41.0	40.2	26.0
5......	26.3	9.5	33.9	14.0	36.0	20.7	74.0	49.0	71.4	38.4	69.0	56.3	70.6	54.2	77.8	57.0	81.0	57.2	60.0	39.0	44.8	24.0	32.0	24.6
6......	30.0	9.8	23.0	2.8	36.0	23.0	78.0	44.0	54.0	40.6	78.0	63.0	73.0	49.0	78.0	60.0	71.0	52.0	43.0	36.6	31.3	24.2	29.0	24.0
7......	20.0	15.0	28.3	4.0	35.5	24.8	49.0	30.0	48.0	39.0	75.0	54.0	76.0	49.8	78.5	59.0	63.0	44.0	54.7	39.6	43.7	30.0	38.0	24.0
8......	31.0	10.0	39.2	23.0	41.4	23.5	62.0	35.0	50.0	34.6	72.6	56.0	78.2	53.4	80.6	59.0	66.0	44.7	65.6	46.0	56.0	39.0	45.8	31.3
9......	25.8	8.5	39.8	23.0	35.6	28.0	57.0	31.0	52.0	34.2	70.2	59.0	81.8	62.4	88.6	66.4	70.0	49.0	61.0	45.0	40.0	29.8	49.2	33.0
10......	23.5	-5.0	37.6	13.0	30.9	41.0	57.0	28.0	58.4	36.0	75.0	54.0	79.3	57.0	95.5	71.0	73.0	54.0	51.8	38.0	33.8	27.0	35.0	23.6
11......	23.0	14.0	30.2	18.0	34.0	19.0	34.0	28.0	66.6	42.0	70.8	45.8	85.8	58.2	92.4	71.0	75.0	58.0	60.6	41.0	36.2	26.0	38.0	25.0
12......	37.5	19.2	38.0	13.7	23.2	14.5	34.0	27.0	63.8	50.0	81.5	56.4	88.4	62.4	80.0	61.4	74.0	56.0	65.7	41.0	44.0	30.0	33.6	23.4
13	40.3	24.0	18.0	4.0	36.0	12.6	39.0	28.0	53.6	41.4	87.5	64.0	89.2	64.0	64.7	57.7	75.7	59.8	65.0	42.2	39.7	28.7	36.0	25.0
14......	33.6	25.0	18.0	4.0	22.8	8.0	45.0	29.0	67.0	48.0	92.0	67.0	89.0	63.0	64.0	57.2	70.5	60.4	73.0	44.0	42.2	29.0	36.0	27.0
15......	34.0	18.0	44.0	17.4	21.0	8.5	42.5	28.0	61.8	49.0	87.0	55.6	81.7	59.0	77.4	54.4	72.0	48.0	72.7	46.0	53.8	39.0	40.0	33.7
16......	30.0	8.5	28.6	9.0	24.5	12.0	40.0	29.0	68.8	50.0	78.0	60.0	87.5	53.4	79.0	54.8	69.0	48.0	75.0	48.2	55.0	40.2	39.4	25.4
17......	24.7	7.0	29.0	8.5	23.4	11.0	44.5	25.5	68.9	44.0	90.0	65.4	73.4	47.6	85.0	56.6	65.6	43.0	64.0	46.0	51.4	36.0	36.0	25.2
18......	27.0	15.4	25.5	9.5	30.2	15.2	52.8	28.0	68.0	42.4	78.0	53.0	74.6	47.7	87.0	64.0	76.0	46.6	50.0	46.0	56.0	37.2	31.0	25.0
19......	30.2	14.0	43.4	15.0	23.0	15.5	50.0	28.0	74.0	52.6	79.0	60.8	82.0	60.4	89.8	66.2	81.0	57.0	67.5	46.2	60.0	30.0	37.0	26.0
20......	18.5	-4.0	36.0	27.0	32.0	19.4	49.6	27.0	64.6	44.0	82.6	67.2	83.7	61.4	91.2	54.2	67.0	39.0	62.8	37.4	38.0	25.0	38.7	17.5
21......	15.0	-1.9	38.9	33.5	26.4	13.0	58.8	37.6	62.8	45.0	89.8	69.8	73.8	56.0	76.0	58.0	67.7	43.0	59.2	41.0	38.0	27.0	24.0	14.0
22......	28.5	4.0	38.0	32.5	32.3	10.5	48.6	41.0	47.0	38.4	86.0	65.2	83.8	61.4	77.6	54.4	74.0	52.4	58.0	39.0	39.8	28.6	25.0	16.0
23......	36.0	14.5	41.0	26.0	26.5	14.5	60.0	41.2	46.6	39.7	78.5	63.0	87.5	62.0	78.2	58.6	74.8	58.4	64.6	40.0	33.6	19.6	23.6	14.0
24......	35.2	11.0	36.0	23.0	39.6	27.0	60.6	30.7	49.5	42.0	70.2	57.0	87.0	60.4	80.2	65.0	78.0	63.0	53.2	32.6	26.5	18.0	20.0	1.5
25	35.5	20.0	36.8	23.4	41.7	29.5	37.8	21.0	65.7	49.0	79.2	57.0	94.0	64.6	78.0	60.0	83.6	61.4	46.7	33.2	28.0	18.5	18.0	6.6
26......	42.0	-4.0	41.7	30.5	49.0	28.5	45.2	28.0	63.8	49.0	71.6	55.4	94.5	70.4	81.8	59.0	88.0	51.0	46.0	35.2	30.0	23.0	19.0	1.4
27......	8.0	-2.0	36.4	11.0	52.2	29.5	55.0	30.0	72.0	48.0	74.6	58.2	88.8	64.0	69.0	51.0	62.0	44.6	47.0	35.4	28.0	23.5	11.0	-3.7
28......	16.5	5.5	21.8	11.0	38.0	30.0	63.4	38.5	43.4	61.6	73.8	56.8	93.8	68.6	69.0	49.0	67.0	47.0	50.4	36.4	35.2	24.0	22.5	5.6
29......	34.5	12.5	31.6	19.0	42.0	28.0	69.6	39.4	63.8	43.0	68.4	53.0	96.3	69.0	78.6	61.2	68.5	41.2	53.0	39.0	36.2	29.0	18.0	9.0
30......	44.0	23.0	....	....	41.8	24.5	69.4	31.0	65.7	53.0	75.8	59.2	95.0	60.2	77.0	55.0	64.0	46.0	47.8	37.0	32.8	24.0	26.0	15.0
31......	44.4	22.5	....	....	44.8	30.0	....	....	78.0	52.0	....	....	77.0	61.0	77.5	58.0	....	....	45.7	35.2	....	....	27.8	11.0
Avr..	30.7	12.0	33.9	18.0	33.3	19.7	53.8	33.1	60.9	44.7	78.5	58.7	82.2	58.2	79.4	59.4	71.8	50.8	59.3	40.6	42.0	29.7	30.9	19.4

READING OF SOIL THERMOMETERS.

1892.	One Inch			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
April 1	34.5	47.0	47.5	34.6	45.5	47.4	35.0	42.5	46.5	36.0	38.3	42.6	36.5	36.6	39.0	42.0	42.0	42.0
2	44.5	46.8	53.3	44.3	46.4	52.8	43.6	45.4	51.4	41.7	42.7	46.4	40.3	40.7	42.7	43.2	43.4	43.8
3	45.5	60.0	57.6	45.6	58.0	58.5	45.4	53.7	56.8	44.4	46.7	51.8	43.0	43.5	46.8	45.2	45.5	46.9
4	48.8	56.4	59.4	48.7	55.0	58.7	48.6	52.5	57.0	47.4	48.2	51.5	45.9	45.8	47.6	47.4	47.5	47.8
5	59.4	52.4	60.5	52.1	59.0	61.7	51.7	56.3	60.0	49.7	51.0	54.7	47.9	48.1	50.5	49.0	49.3	49.6
6	62.4	42.5	48.6	47.2	46.4	48.7	48.3	46.8	48.8	49.6	49.6	48.0	49.0	47.5	46.9	50.6	50.5	50.4
7	37.4	56.2	55.4	38.0	53.4	55.2	39.0	49.7	54.4	42.2	44.5	50.4	43.5	43.4	46.9	49.5	49.2	49.0
8	43.5	60.4	50.4	44.0	58.0	51.0	45.0	53.6	51.8	46.0	47.8	50.5	45.7	45.7	48.0	49.4	49.5	49.5
9	37.0	41.7	38.4	38.0	41.3	39.2	39.4	40.8	40.5	42.8	42.0	42.4	44.2	43.0	42.7	49.5	49.2	48.6
10	35.0	37.0	36.0	35.7	36.7	36.5	36.8	37.0	37.7	39.3	38.8	39.4	40.4	40.0	39.7	47.7	47.4	47.0
11	34.2	38.9	36.4	34.7	38.2	36.7	35.7	37.4	37.7	37.5	37.7	38.8	38.6	38.4	39.0	46.2	46.0	45.7
12	33.0	40.7	40.4	33.5	39.5	40.5	34.4	37.5	40.7	36.5	36.5	40.0	37.6	37.4	38.8	45.3	45.0	44.8
13	33.5	46.6	47.4	34.0	45.0	47.3	35.0	42.0	46.8	36.8	38.5	43.8	37.8	37.7	40.8	44.9	44.8	44.9
14	35.0	42.4	42.3	35.2	41.7	42.4	36.0	40.5	42.5	38.4	39.4	41.5	39.3	39.0	40.4	45.5	45.5	45.4
15	34.0	50.3	48.7	33.6	48.5	49.0	35.5	44.9	48.7	37.8	40.3	45.7	39.0	39.0	42.4	45.5	45.5	45.4
16	34.8	47.5	48.2	35.3	46.3	47.2	36.4	43.7	47.8	39.0	40.5	45.2	40.2	40.0	42.5	46.1	46.0	46.0
17	34.2	47.2	49.0	34.9	45.9	48.8	36.0	43.8	48.5	39.0	40.5	45.3	40.2	39.8	42.5	46.4	46.3	46.2
18	35.4	52.0	48.4	35.5	50.0	48.5	36.5	46.8	48.5	39.2	41.9	46.0	40.4	40.5	43.5	46.5	46.5	46.5
19	36.2	52.2	53.0	36.3	50.0	54.0	37.0	47.4	53.2	39.7	42.5	42.0	41.0	41.0	45.0	47.0	46.8	47.0
20	37.0	53.0	54.8	37.5	51.4	55.0	38.2	48.4	54.0	41.2	43.9	50.0	42.4	42.4	46.0	47.9	47.8	47.7
21	43.0	41.5	45.0	43.2	43.6	44.8	43.4	44.0	44.7	44.4	44.0	44.2	44.4	43.7	43.5	48.6	48.5	48.2
22	45.0	53.4	51.5	44.6	52.5	51.4	44.3	51.0	51.0	41.0	46.8	49.0	43.5	44.4	46.4	48.3	48.4	48.6
23	43.4	53.2	52.7	44.0	51.6	52.5	44.5	49.8	52.2	45.2	46.5	50.0	45.2	45.0	47.4	49.5	49.4	49.6
24	38.2	39.4	47.0	39.5	39.8	47.4	40.8	44.3	47.8	43.5	45.8	47.4	45.0	45.2	45.7	50.0	50.0	49.6
25	34.0	46.5	51.4	35.4	45.4	51.0	36.8	43.8	50.2	40.0	41.8	47.5	42.0	41.5	44.8	49.2	49.0	48.6
26	36.0	53.2	56.4	37.2	51.2	55.6	38.3	48.8	54.6	41.0	44.5	51.0	42.5	42.8	47.0	49.0	49.0	49.0
27	38.5	54.0	55.4	39.6	52.4	55.0	40.5	50.0	54.2	43.0	46.0	51.0	44.4	44.5	47.5	50.0	49.8	50.0
28	49.3	54.0	56.3	49.4	53.0	55.5	49.5	51.6	51.6	49.0	49.3	51.6	47.6	47.6	49.0	50.8	51.0	51.3
29	45.0	46.9	49.6	45.5	46.3	49.1	46.2	46.5	49.0	47.0	46.7	48.0	47.3	46.5	46.8	51.6	51.4	51.2
30	38.2	52.2	54.2	39.2	50.8	54.0	40.0	49.0	53.5	42.6	45.4	50.7	44.3	44.3	47.5	50.6	50.4	50.3

READING OF SOIL THERMOMETERS — (*Continued*).

1892.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 A. M.	12 M.	6 P. M.	7 P. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
May 1	43.4	47.0	49.5	43.8	47.0	49.2	44.2	46.8	48.7	45.2	46.0	47.4	45.7	45.4	46.0	50.9	50.7	50.5
2	49.6	54.6	56.2	49.4	53.3	56.4	49.0	51.9	55.5	48.0	49.4	52.5	47.0	47.5	49.4	51.0	51.2	51.6
3	50.6	58.6	61.0	50.5	57.0	60.6	50.3	54.9	60.2	49.8	51.9	57.3	49.0	48.3	52.3	52.4	52.6	53.2
4	58.2	65.2	58.3	57.6	63.4	58.6	57.0	61.7	59.0	55.0	56.8	58.0	52.7	53.3	54.8	54.8	55.2	55.6
5	46.8	59.5	51.8	47.5	57.5	52.3	48.2	55.6	52.8	50.0	52.3	53.0	50.8	50.6	51.7	55.6	55.2	55.0
6	47.5	49.8	50.0	47.0	49.7	50.0	48.5	49.8	50.3	49.3	49.7	50.2	49.5	49.4	49.4	54.7	54.4	54.2
7	44.3	52.4	50.8	45.0	51.2	51.0	45.5	49.4	51.2	46.7	48.0	50.5	47.7	47.7	49.0	53.7	53.4	53.3
8	42.0	52.3	57.0	43.4	50.8	56.5	43.6	49.4	55.2	46.3	47.2	52.0	46.7	46.7	49.0	53.0	52.8	53.0
9	44.3	60.0	60.4	45.0	57.0	60.0	45.4	55.4	59.0	46.8	50.8	55.7	47.7	58.4	51.6	53.2	53.2	53.6
10	45.0	59.6	57.8	45.5	57.0	57.3	46.4	54.8	56.8	48.2	50.7	54.5	49.3	49.2	51.5	54.2	54.2	54.3
11	51.5	54.8	56.5	51.6	54.4	56.4	51.8	53.8	56.2	51.6	52.2	54.4	51.0	51.0	52.0	54.9	54.9	55.0
12	51.5	53.4	52.2	51.5	53.0	52.4	51.5	52.8	52.6	51.4	51.8	52.1	51.0	50.8	51.0	55.2	55.0	55.0
13	47.0	62.7	63.2	47.5	49.5	62.3	48.0	57.6	61.0	49.2	53.8	57.2	49.8	50.8	53.4	55.0	54.8	55.2
14	51.7	57.4	54.4	52.0	56.5	54.5	52.2	55.6	54.7	52.4	53.7	54.0	52.0	52.0	52.6	55.8	56.0	56.0
15	51.5	57.0	63.4	51.8	56.2	62.0	52.0	55.4	60.8	52.0	53.3	56.8	51.5	51.7	53.3	56.0	56.0	56.0
16	56.8	63.2	59.4	56.4	61.3	59.7	56.6	60.3	59.8	55.8	57.0	58.5	54.2	54.4	56.0	57.0	57.2	57.5
17	50.5	65.7	63.5	50.7	62.4	63.2	51.0	60.5	61.2	52.3	56.0	60.0	53.0	53.2	56.0	57.6	57.4	57.6
18	51.6	68.4	68.0	51.7	64.3	67.0	52.0	62.0	65.6	53.3	57.0	61.8	54.0	54.3	57.3	58.4	58.3	58.6
19	54.8	60.4	56.2	55.2	59.4	56.5	55.4	58.2	56.9	56.0	56.5	57.0	55.6	55.3	55.8	59.5	59.4	59.2
20	49.0	59.4	61.5	50.0	57.7	61.0	50.7	56.0	60.4	52.2	53.8	57.6	53.0	52.8	54.8	59.4	58.2	58.2
21	49.6	49.5	50.0	50.5	50.2	50.5	51.4	50.8	50.8	53.0	51.7	51.4	53.3	52.4	51.7	58.2	58.0	57.5
22	46.5	50.2	51.4	47.4	50.0	51.5	48.2	49.8	51.6	49.6	50.0	51.2	50.5	50.2	50.6	56.7	56.4	56.2
23	47.0	51.8	51.7	47.5	51.2	51.8	48.0	50.8	52.0	49.0	49.8	51.5	49.7	49.5	50.5	55.8	55.6	55.6
24	47.5	61.2	56.2	48.0	58.0	56.0	48.4	56.4	55.7	49.2	52.5	54.4	49.6	50.3	52.4	55.5	55.5	55.8
25	52.3	53.6	60.0	52.4	53.6	59.0	52.6	53.5	57.8	52.5	52.7	54.7	52.0	52.0	52.6	56.5	56.5	56.6
26	53.4	66.0	59.0	53.3	63.2	58.8	53.0	61.0	58.7	52.9	56.0	57.6	52.4	53.2	55.2	57.0	57.1	57.5
27	51.6	63.0	58.6	52.3	61.0	59.0	52.8	58.7	57.7	53.6	56.0	57.7	53.5	53.8	55.4	58.0	58.0	58.2
28	49.4	64.4	62.6	49.5	61.3	62.3	50.1	58.8	61.7	52.0	55.5	59.0	53.0	53.2	55.7	58.2	58.0	58.2
29	51.0	55.5	58.0	51.4	55.2	57.2	51.7	54.7	56.8	52.8	53.7	55.2	53.5	53.3	54.0	58.8	58.4	58.3
30	56.7	75.4	72.2	56.4	70.7	71.1	56.0	67.0	70.0	55.0	59.7	65.0	54.1	55.5	59.5	58.5	58.8	59.5
31	58.5	74.8	74.0	58.5	70.7	72.8	58.2	68.0	71.3	58.2	62.2	66.7	57.6	58.4	61.6	61.0	61.0	61.7

READING OF SOIL THERMOMETERS — (*Continued*).

1892.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
June 1	64.8	80.0	73.3	64.0	75.8	73.4	63.5	72.1	73.0	62.3	65.6	69.7	60.6	61.3	64.5	63.0	63.0	63.5
2	65.5	71.5	69.5	64.8	70.0	69.2	64.4	68.7	69.0	63.8	65.3	66.8	62.5	62.5	63.8	64.6	64.6	64.7
3	60.3	62.6	65.4	61.0	62.4	65.0	61.6	62.3	65.0	62.4	61.8	63.4	62.0	61.2	61.4	65.2	65.0	64.7
4	60.2	61.5	65.0	60.3	61.4	64.5	60.4	61.0	64.0	60.4	60.5	62.2	60.0	59.7	60.2	64.3	64.0	63.9
5	62.0	71.5	68.0	61.5	69.5	67.8	61.0	67.4	67.4	60.2	63.2	65.5	59.5	60.2	62.7	64.0	63.8	64.1
6	63.3	69.4	71.6	63.3	67.3	71.2	63.4	65.7	70.6	62.7	63.2	67.3	61.5	61.5	63.5	64.8	64.9	65.0
7	60.0	77.5	72.1	60.4	73.0	72.0	61.0	70.1	71.8	62.0	65.0	68.9	62.0	62.0	64.9	65.6	65.6	65.7
8	62.1	66.0	64.5	62.3	65.3	64.8	62.5	64.5	64.9	63.0	63.4	64.3	62.7	62.4	62.7	66.4	66.2	66.0
9	61.7	74.0	68.7	61.8	71.7	68.2	61.7	69.0	67.8	61.5	64.2	65.8	61.1	61.6	63.4	65.7	65.6	65.7
10	61.0	75.0	70.0	61.4	70.5	70.3	61.6	68.0	70.5	62.2	64.0	68.3	62.0	62.0	64.6	66.0	66.0	66.1
11	56.5	74.0	73.8	57.2	70.2	73.0	58.0	67.7	72.0	60.0	63.4	68.2	61.2	61.3	64.2	66.4	66.0	66.0
12	63.0	82.0	78.0	62.7	77.5	77.2	62.8	74.5	76.2	63.1	68.0	72.0	63.0	64.0	67.3	67.0	67.0	67.4
13	67.5	84.6	81.6	67.4	80.5	80.5	67.0	77.5	79.2	66.7	70.8	74.6	66.0	66.6	69.6	68.5	68.6	69.2
14	70.3	80.4	76.6	70.0	78.0	76.2	69.6	76.0	75.5	69.0	71.6	73.2	68.0	68.3	69.9	70.2	70.2	70.4
15	64.0	80.7	77.3	64.2	77.6	76.5	64.9	75.0	75.6	66.0	69.9	72.5	66.4	66.7	69.0	70.4	70.0	70.2
16	66.5	82.0	76.6	66.4	77.8	76.0	66.2	75.0	75.2	66.6	70.0	72.2	66.5	66.9	69.2	70.4	70.2	70.4
17	69.0	83.3	75.0	69.0	80.3	75.4	68.9	67.6	75.5	68.4	71.8	73.3	67.5	68.2	70.0	70.7	70.7	71.0
18	63.0	81.0	77.8	63.5	77.2	76.7	64.2	74.4	75.7	65.7	69.3	73.0	66.4	66.5	68.7	71.0	71.0	70.6
19	68.3	77.2	73.5	68.4	74.3	73.5	68.2	72.8	73.2	68.0	69.0	71.5	67.4	67.6	68.8	70.9	70.8	70.8
20	68.8	79.3	75.6	68.7	76.2	75.2	68.7	74.4	74.5	68.4	70.5	72.2	67.5	67.9	69.4	71.0	71.0	71.2
21	70.0	83.6	79.0	69.7	79.0	78.0	69.4	76.4	77.0	68.5	71.6	74.0	67.7	68.4	70.5	71.3	71.2	71.6
22	70.3	82.2	75.5	70.3	78.8	75.4	70.3	75.8	75.3	70.0	72.6	73.5	69.2	69.5	70.8	72.2	72.1	72.2
23	68.0	72.6	67.4	68.3	71.5	68.4	68.6	70.6	68.8	68.8	69.2	68.7	68.5	68.1	68.0	72.3	72.0	71.7
24	62.2	79.8	73.4	63.0	76.2	73.2	66.6	72.4	72.7	64.7	68.7	70.7	65.4	66.0	68.2	71.0	70.6	70.7
25	63.3	77.3	72.3	64.0	74.0	72.1	64.7	72.0	72.0	65.9	68.5	70.4	66.3	66.5	68.0	71.0	70.7	70.7
26	62.2	74.4	74.2	63.0	74.2	73.2	63.4	72.7	72.8	64.6	64.0	70.4	65.3	66.0	67.6	70.6	70.6	70.3
27	63.9	66.5	66.2	64.4	66.0	66.5	64.8	65.7	66.8	65.6	65.3	66.7	65.7	65.2	65.6	70.4	70.2	70.0
28	61.2	64.3	64.5	61.9	64.0	65.0	62.5	63.8	65.2	63.5	63.7	65.0	64.0	63.5	64.0	69.4	69.1	69.0
29	59.3	70.0	66.6	59.8	68.5	66.7	60.2	67.0	66.6	61.4	65.0	65.5	62.2	62.4	63.8	68.3	68.0	68.0
30	62.5	63.0	66.4	62.7	63.2	66.2	63.0	63.5	66.0	63.2	63.2	64.7	63.8	63.0	63.4	68.0	68.0	67.9

READING OF SOIL THERMOMETERS — (*Continued*).

1892.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
July 1	57.5	72.2	68.0	58.5	69.2	68.3	59.3	68.0	68.2	61.0	63.8	66.7	62.0	62.1	64.4	67.7	67.5	67.6
2	56.6	70.2	67.3	57.6	68.4	67.0	58.4	66.5	66.8	60.4	63.5	65.4	61.7	61.9	63.4	67.7	67.5	67.4
3	65.3	66.6	64.0	65.2	66.3	64.5	65.0	65.8	65.0	64.3	64.8	65.0	63.3	63.6	64.0	67.8	67.8	67.9
4	58.0	71.5	68.4	59.0	69.1	68.3	59.7	67.0	68.2	61.0	63.8	66.5	61.7	62.0	64.2	67.5	67.4	67.5
5	60.0	71.6	69.0	60.5	69.4	68.5	61.0	67.7	68.0	61.7	64.5	66.5	62.2	62.6	64.5	67.6	67.6	67.8
6	58.4	74.6	71.5	59.0	71.4	71.4	59.8	68.8	71.1	61.4	64.6	68.7	62.0	62.5	65.4	67.9	67.6	68.0
7	68.6	76.3	73.4	69.6	72.4	73.0	60.6	69.7	72.7	62.2	65.3	69.8	63.0	63.4	66.4	68.4	68.3	68.5
8	61.6	77.6	75.2	62.2	74.0	74.6	62.8	71.7	74.2	64.0	67.4	71.2	64.4	64.8	67.9	69.2	69.2	69.5
9	65.5	77.2	74.6	66.0	74.2	74.4	66.4	72.4	74.2	66.7	68.5	71.7	66.4	66.4	68.6	70.2	70.3	70.6
10	64.3	76.0	75.7	65.0	74.0	75.2	65.2	72.4	74.9	66.2	68.9	72.5	66.4	66.7	69.2	70.7	70.8	71.0
11	65.0	80.0	78.3	65.4	76.4	77.4	65.8	73.8	76.6	66.5	69.5	73.4	67.0	67.2	70.0	71.3	71.3	71.4
12	67.9	80.2	79.0	68.0	77.0	78.0	68.3	75.0	77.4	68.5	71.0	74.5	68.4	68.6	71.0	72.0	72.0	72.3
13	69.8	81.0	75.0	69.9	78.3	74.6	70.0	76.4	74.2	70.0	72.3	72.5	69.3	69.6	70.5	73.0	72.9	73.0
14	68.0	80.2	77.5	68.5	77.6	77.5	68.9	75.8	77.2	69.3	71.7	75.0	69.0	69.2	71.5	73.0	72.6	73.0
15	66.7	77.5	75.4	67.3	75.4	76.0	67.8	74.4	75.7	68.5	71.2	73.8	69.0	69.0	71.2	73.4	73.2	73.3
16	63.4	66.5	67.0	65.0	66.6	68.0	66.2	66.9	68.5	68.0	67.2	68.6	68.6	67.5	68.0	73.2	72.9	72.4
17	63.0	69.4	69.0	65.0	68.7	69.3	66.1	68.5	69.5	67.0	66.0	68.5	66.0	65.0	66.8	71.2	70.8	70.8
18	61.0	71.4	72.5	61.7	69.7	72.3	62.4	69.0	72.0	64.0	66.4	70.0	64.9	65.0	67.4	70.6	70.5	70.5
19	64.4	71.0	72.5	65.0	70.0	72.3	65.2	69.2	72.0	66.0	67.3	70.0	66.2	66.2	67.7	71.0	71.0	71.0
20	65.0	72.4	72.4	65.6	71.2	72.5	66.0	70.2	72.5	66.6	67.9	71.0	66.7	66.6	68.5	71.3	71.2	71.3
21	63.3	74.1	74.8	64.0	72.3	74.2	64.4	71.2	74.0	65.5	68.3	71.8	66.2	66.5	69.0	71.3	71.3	71.5
22	66.4	74.7	74.8	66.9	72.9	74.5	67.0	71.9	74.0	67.5	69.3	71.9	67.3	67.6	69.3	72.0	71.9	72.0
23	67.4	77.0	77.6	67.5	75.0	77.0	67.7	73.6	76.7	67.9	70.3	74.0	68.0	68.1	70.6	72.3	72.2	72.5
24	67.4	73.6	81.5	68.0	72.2	80.0	68.2	71.5	78.5	68.8	69.7	74.7	68.6	68.4	71.0	72.9	72.8	73.0
25	73.6	82.9	81.7	73.4	80.5	81.0	73.0	78.5	80.4	72.0	74.3	77.4	70.7	71.3	73.5	73.6	73.8	74.2
26	73.5	84.0	82.0	73.5	81.2	81.2	73.3	79.0	80.8	72.8	75.0	78.4	71.8	72.2	74.7	74.9	75.0	75.2
27	69.4	83.9	81.0	69.8	80.7	80.5	70.2	78.5	80.2	71.0	74.3	78.0	71.2	71.5	74.4	75.3	75.1	75.4
28	73.4	85.7	85.0	73.8	82.5	83.6	73.0	80.3	82.7	72.7	75.6	79.5	72.0	72.6	75.5	75.6	75.6	75.9
29	73.5	85.0	80.2	73.6	82.4	80.3	73.7	80.2	80.6	73.6	76.3	79.0	73.1	73.4	75.6	75.6	76.4	76.4
30	69.0	77.7	78.3	70.0	76.5	78.5	71.0	75.8	78.8	72.0	73.5	77.0	72.2	72.0	74.0	76.4	76.1	76.0
31	68.6	77.6	77.0	69.4	76.0	76.9	70.0	75.0	76.8	70.8	72.4	74.8	71.0	71.0	72.4	75.6	75.4	75.3

Reading of Soil Thermometers — (*Continued*).

1892.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
August 1	66.5	76.5	78.4	67.2	75.3	77.7	68.0	74.5	77.3	69.5	72.0	75.2	70.0	70.2	72.3	75.0	74.7	75.0
2	69.4	69.6	72.4	69.6	69.7	72.1	70.0	69.8	72.0	70.6	69.9	70.8	70.5	69.7	69.7	75.0	74.7	74.3
3	65.2	74.0	76.0	66.0	73.0	75.5	66.6	72.2	75.4	67.6	69.9	73.2	68.3	68.5	70.6	74.0	73.6	73.7
4	67.9	71.8	70.0	68.4	71.6	70.6	68.8	71.5	71.0	69.4	70.2	70.8	69.3	69.2	69.7	74.1	74.0	73.8
5	64.0	72.2	73.5	65.0	71.4	73.5	65.8	71.0	73.7	67.2	69.0	72.2	68.0	68.0	70.0	73.5	73.2	73.2
6	66.5	72.4	73.5	67.0	71.7	73.7	67.6	71.1	74.0	68.1	69.4	72.4	68.4	68.3	70.1	73.3	73.2	73.2
7	65.4	73.3	74.4	66.2	72.3	74.3	66.7	71.7	74.2	67.7	69.6	72.4	68.2	68.4	70.0	73.5	73.3	73.4
8	65.0	74.1	74.7	65.7	73.0	74.3	66.2	71.7	74.0	67.4	69.4	72.2	68.0	68.1	70.0	73.3	73.2	73.2
9	72.0	78.4	80.0	71.6	77.0	79.3	71.2	75.5	78.6	70.5	72.4	75.6	69.6	70.2	72.5	73.8	74.0	74.3
10	72.7	80.4	74.7	72.8	78.6	75.0	72.8	77.6	75.0	72.4	74.2	74.2	71.6	72.0	72.8	75.0	75.1	75.3
11	71.5	74.3	74.2	71.9	74.0	74.3	72.0	73.7	74.1	72.0	72.5	73.0	71.3	71.2	71.6	75.3	75.1	75.0
12	68.6	70.3	69.3	69.4	70.4	70.0	70.0	70.5	70.4	70.4	70.2	70.4	70.4	70.0	70.0	74.8	74.6	74.4
13	65.0	67.3	67.5	66.0	67.6	68.0	66.5	67.7	68.4	67.5	67.7	68.2	68.0	67.6	67.7	73.6	73.2	73.0
14	66.0	71.5	72.8	66.6	70.2	72.6	67.2	69.4	72.4	67.8	67.5	70.6	67.9	66.6	68.6	73.2	72.2	72.2
15	66.0	73.4	74.5	66.6	72.2	74.2	67.0	71.1	74.0	67.5	69.2	72.0	67.7	68.0	69.7	72.6	72.7	72.8
16	64.2	73.3	75.3	65.0	72.8	75.0	65.8	71.0	74.4	67.1	68.7	72.2	67.9	67.6	69.8	73.0	72.9	73.0
17	65.0	74.6	76.3	65.7	73.7	76.0	66.4	72.0	75.4	67.8	69.5	73.2	68.2	68.3	70.5	73.3	73.2	73.3
18	68.5	76.0	77.0	69.0	75.0	76.5	69.2	73.4	75.8	69.5	70.8	73.6	69.3	69.5	71.2	74.0	73.9	74.0
19	68.9	78.0	75.5	69.4	77.0	75.8	69.8	75.0	76.0	70.1	72.0	74.5	69.9	70.2	72.2	74.3	74.4	74.5
20	68.2	77.4	75.0	68.9	75.8	74.8	69.4	74.2	74.8	70.0	71.6	73.7	70.0	70.2	71.7	74.6	74.6	74.7
21	64.0	75.5	74.0	65.2	73.5	73.7	66.0	72.2	73.7	68.0	70.0	72.5	69.0	68.8	70.6	74.3	74.0	74.0
22	64.6	75.5	73.3	65.3	73.0	73.0	66.0	71.3	72.8	67.6	69.2	71.7	68.0	68.2	70.0	73.9	73.7	73.6
23	64.0	74.7	70.2	64.6	72.1	70.5	65.4	70.5	70.5	66.9	69.4	70.2	67.6	67.6	69.0	73.4	73.2	73.0
24	65.2	71.0	71.0	65.7	69.7	71.0	66.2	68.8	70.4	67.0	67.7	69.5	67.2	67.0	68.2	73.0	72.7	72.7
25	67.6	71.0	72.3	68.0	70.4	72.0	68.0	69.8	71.8	68.0	68.6	70.3	67.7	67.7	68.7	72.7	72.7	72.7
26	66.6	70.5	68.2	67.6	69.9	68.5	66.7	69.3	68.7	68.0	68.3	68.5	68.0	67.7	68.0	72.9	72.8	72.6
27	65.2	70.0	68.4	65.7	69.2	68.8	66.0	68.6	69.0	66.5	67.5	68.4	66.7	66.7	67.4	72.2	72.1	72.0
28	64.0	67.2	68.2	64.6	66.5	68.2	65.8	66.0	68.0	65.0	65.2	67.1	64.8	65.2	66.0	71.5	71.4	71.2
29	59.4	71.0	72.1	61.0	69.0	71.4	61.7	67.3	70.7	63.5	65.1	68.6	64.5	64.5	66.6	71.0	70.7	70.6
30	62.1	70.4	70.2	63.4	69.2	69.8	64.2	68.0	69.5	65.2	66.4	68.4	65.5	65.5	66.9	71.0	71.0	71.0
31	64.5	68.4	65.9	65.2	68.2	66.7	65.8	67.8	67.3	66.4	66.8	67.4	66.3	66.1	66.6	71.2	71.2	71.2

READING OF SOIL THERMOMETERS — (*Continued*).

1892.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
September 1	60.2	62.0	53.4	61.3	62.7	53.7	62.3	63.2	54.0	63.6	63.6	54.7	64.4	64.0	54.0	70.6	70.3	70.0
2	55.4	66.4	66.6	55.2	64.6	66.1	58.3	63.5	66.8	60.5	62.0	65.0	62.0	62.0	63.6	69.3	69.0	69.0
3	57.3	68.9	68.5	58.5	67.2	68.0	59.3	65.3	67.5	61.0	63.0	66.2	62.0	62.3	64.3	68.8	68.7	68.7
4	59.4	69.4	71 2	60.2	67.7	70.3	61.0	66 0	69.6	62.5	64.0	67.5	63.0	63.0	65.2	69.0	69.0	69.0
5	61.2	64.7	65.0	62.1	64.6	65.3	62.8	64.6	66.6	63.7	64.1	65.2	64.0	63.8	64.3	69.6	69.4	69.2
6	57.4	62.6	61.7	58.4	62.6	62.3	59.3	62.7	69.9	61.2	62.2	63.4	62.3	62.2	63.0	69.0	68.7	68.4
7	52.2	66.5	63.5	53.4	65.2	63.7	54.7	63.7	63.8	57.6	60.6	63.4	59.8	60.0	62.2	67.7	67.2	67.2
8	53.0	66.7	66.1	54.0	65.4	66.0	55.2	63.8	65.8	57.8	61.0	64.8	59.8	60.1	63.0	67.2	67.0	67.0
9	55.2	70.2	70.0	54.2	68.3	69.3	57.0	66.1	68.7	59.2	62.3	66.7	63.0	60.5	61.0	67.2	67.2	67.4
10	59.0	69.5	67.5	59.5	68.0	67.0	60.0	66.5	67.0	61.2	63.5	66.0	64.0	62.0	62.0	67.8	67.7	68.0
11	62.0	68.9	67.7	63.0	67.5	67.8	61.8	66.0	66.3	61.3	63.6	66.4	64.5	62.0	64.5	67.9	68.0	68.1
12	59.0	70.7	68.3	67.4	59.2	68.0	59.8	67.4	67.7	61.0	63.8	66.6	61.7	62.2	64.5	68.0	67.8	68.0
13	62.4	67.5	64.3	62.5	67.0	64.3	62.7	66.3	64.5	63.0	64.7	64.3	63.0	63.2	63.5	68.2	68.0	68.2
14	62.0	67.6	66.5	62.5	67.2	66.5	63.0	66.6	66.7	63.5	64.8	66.3	63.3	63.5	64.6	68.0	68.2	68.3
15	56.7	67.2	65.2	57.8	66.2	65.3	58.5	65.0	65.3	60.5	62.8	64.8	61.6	61.7	63.5	68.0	67.7	67.7
16	56.0	66.4	65.0	57.2	65.1	65.1	58.0	64.0	66.0	60.0	61.7	64.6	61.1	61.0	63.0	67.4	67.2	67.1
17	52 6	69.3	67.3	54.0	67.1	67.4	55.2	65.1	66.9	58.0	61.3	65.6	59.7	60.0	63.0	67.0	66.5	66.6
18	58 0	73.0	70.5	56.0	70.3	69.8	57.0	68.0	69.2	58.4	63.2	67.0	60.0	60.8	64.0	66.4	66.6	66.7
19	61.0	63.0	60.5	61.2	63.0	61.2	61.4	63.0	61.7	62.0	62.6	62.2	62.0	62.0	61.8	67.3	67.0	67.0
20	51.0	67.4	66.5	52.5	65.5	66.2	53.9	63.7	65.8	56.9	60.0	64.6	58.9	59.0	62.2	66.2	65.9	66.0
21	54.5	67.0	67.3	55.5	65.2	66.9	56.0	63.7	66.5	58.0	60.5	61.7	59.1	59.3	62.1	66.0	65.7	65.7
22	60.0	65.0	67.3	60.4	64.2	67.0	60.7	63.2	66.6	61.2	61.7	64.7	61.0	61.0	62.5	66.2	66.3	66.2
23	62.7	71.5	68.7	63.0	70.0	68.6	63.0	68.2	68.6	63.0	64.5	66.8	62.2	62.6	64.6	66.7	67.0	67.3
24	63.8	72.6	74.0	64.0	71.0	73.2	64.2	69.4	72.5	64.0	66.0	69.6	63.5	64.0	66.4	67.8	68.0	68.3
25	64.5	77.0	75.2	65.0	75.0	74.7	65.3	72.8	74.0	65.5	68.0	71.4	65.0	65.5	68.0	69.0	69.3	69.5
26	58.1	58.0	68 2	59.5	59.0	69.3	61.0	60.0	60.2	63.6	62.0	62.0	64.7	63.0	62.5	69.7	69.2	68.3
27	51.0	61.2	60.5	52.5	60.4	60.8	53.8	59.8	61.0	56.5	57.5	61.2	59.0	58.7	60.5	67.0	66.4	66.0
28	56.0	66.5	51.8	56.5	64.5	53.3	57.0	63.5	54.6	58.1	60.7	57.0	59.0	59.5	58.6	65.8	65.7	65.6
29	64.8	61.2	52.4	62.9	61.6	53.5	61.7	61.8	54.3	59.3	61.8	56.3	58.6	60.6	57.8	65.4	65.2	65.0
30	66.5	65.3	60.0	64.0	65.0	60.5	62.4	65.0	60.8	59.0	63.5	61.0	58.0	61.0	60.4	64.8	64.9	65.5

READING OF SOIL THERMOMETERS — (*Concluded*).

1892.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
October 1	64.0	59.5	47.3	63.0	60.3	49.2	62.6	61.0	50.8	61.4	62.2	54.4	60.5	61.3	56.9	65.7	65.5	64.7
2	64.2	57.6	50.9	61.3	58.4	50.5	60.1	59.0	52.2	57.5	59.5	54.1	56.9	58.6	55.6	64.4	64.0	63.3
3	60.0	61.3	62.0	58.4	61.0	61.7	57.2	60.8	60.7	55.9	59.3	58.8	55.7	57.9	58.0	63.2	63.1	63.2
4	56.9	57.5	56.4	57.5	58.0	57.1	58.0	58.8	58.0	58.5	58.8	58.8	58.4	58.3	58.6	63.7	63.7	64.0
5	49.3	52.0	47.7	50.6	52.2	48.2	52.0	52.8	50.3	54.2	54.0	53.2	55.8	55.2	54.7	63.2	62.8	62.3
6	45.0	52.1	51.2	46.3	51.2	51.9	47.2	51.3	52.5	50.0	51.4	53.4	52.2	52.3	53.6	61.0	60.8	60.6
7	46.6	52.1	54.2	47.6	52.0	54.0	48.3	51.9	54.6	50.3	51.5	54.3	52.0	52.0	53.5	60.1	60.0	60.0
8	52.8	57.7	55.3	53.2	56.7	55.8	53.4	56.0	56.0	53.6	54.9	56.0	53.8	54.2	55.4	60.8	60.5	61.0
9	51.0	52.0	51.1	51.6	52.2	52.1	52.2	52.6	53.0	53.4	53.2	54.0	54.2	53.9	54.3	60.8	60.7	60.5
10	46.0	56.4	54.2	46.9	54.6	51.6	47.9	53.8	55.0	50.2	62.3	56.1	52.0	62.2	54.2	60.0	59.8	59.8
11	49.1	59.4	56.2	49.8	57.5	56.8	50.3	56.4	57.1	51.5	53.9	56.9	52.4	53.0	55.2	59.7	59.7	60.0
12	49.9	56.3	57.5	49.7	55.2	57.8	51.2	54.3	57.8	52.3	53.4	57.0	53.3	53.4	55.2	60.1	60.1	60.1
13	50.0	61.6	60.2	50.9	59.4	60.1	51.4	58.0	60.0	53.0	55.0	58.7	53.7	54.0	56.7	60.2	60.4	60.6
14	51.5	62.2	60.5	52.5	60.2	60.5	53.3	59.0	60.4	54.6	56.5	59.5	55.1	55.3	57.5	61.0	61.2	61.3
15	51.6	59.2	60.3	52.7	58.3	60.2	53.4	57.6	60.0	54.8	56.0	59.0	55.5	55.4	57.1	61.5	61.5	61.5
16	56.5	60.7	58.2	57.0	59.7	58.5	57.4	59.1	58.8	57.6	58.0	57.8	57.2	57.1	57.8	62.0	62.1	62.2
17	53.6	55.5	54.0	54.5	55.6	54.6	55.0	55.7	55.2	56.0	56.0	55.7	56.3	56.0	55.9	62.0	61.9	61.7
18	50.2	59.2	58.8	51.3	58.0	59.0	52.2	57.0	59.0	53.6	55.0	57.6	54.5	54.5	56.6	61.2	61.1	61.2
19	56.0	60.5	55.8	56.5	59.0	56.5	56.8	58.5	57.0	56.6	57.0	56.6	56.3	56.3	57.0	61.5	61.7	61.7
20	47.0	56.4	53.2	48.6	55.0	53.7	49.9	54.5	54.0	52.1	53.5	54.7	53.9	53.6	54.5	61.0	60.8	60.5
21	49.2	56.5	52.2	50.1	55.0	54.0	51.0	54.5	54.7	52.2	53.4	55.2	52.2	53.2	54.5	60.1	60.0	60.0
22	47.0	56.5	54.2	48.4	55.3	55.0	49.3	54.5	55.1	51.1	52.8	55.0	52.4	52.4	54.0	59.5	59.4	59.4
23	49.0	51.7	48.8	49.9	51.6	49.9	50.6	51.9	51.0	52.0	52.1	52.2	52.6	52.4	52.6	59.3	59.3	59.0
24	42.4	47.2	46.1	44.4	47.2	47.1	45.4	47.6	48.0	48.4	48.5	49.3	50.3	49.7	50.2	58.2	57.8	57.6
25	42.2	46.6	46.2	44.0	46.7	47.1	45.0	47.0	47.7	47.2	47.6	48.6	48.9	48.6	49.2	57.9	56.6	56.5
26	43.5	46.7	46.4	44.8	46.9	47.3	45.7	47.2	48.0	47.2	47.6	48.9	48.5	48.4	49.1	56.1	56.1	56.0
27	42.9	46.0	45.7	43.1	46.2	46.9	45.0	46.4	47.7	46.7	47.1	48.5	48.1	48.0	48.6	55.7	55.7	55.5
28	43.8	46.3	46.4	44.8	46.4	47.2	45.6	46.5	47.6	46.7	47.2	48.2	47.7	47.7	48.4	55.3	55.3	55.2
29	42.5	45.5	44.9	43.6	45.5	45.6	44.4	45.6	46.2	46.0	46.2	46.2	47.4	47.2	47.6	55.0	54.9	54.9
30	41.0	43.4	43.7	43.0	43.8	44.5	43.8	44.3	45.0	45.5	45.3	46.0	46.8	46.6	46.7	54.5	54.2	54.2
31	42.0	44.5	45.2	42.6	44.6	45.6	43.4	44.7	46.0	44.7	45.0	46.2	46.0	45.8	46.6	53.8	53.7	53.7

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