U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 51.

B. T. GALLOWAY, *Chief of Bureau.*

MISCELLANEOUS PAPERS.

I. THE WILT DISEASE OF TOBACCO AND ITS CONTROL.

By R. E. B. McKENNEY, *Physiologist.*

II. THE WORK OF THE COMMUNITY DEMONSTRATION FARM AT TERRELL, TEX.

By SEAMAN A. KNAPP, *Special Agent.*

III. FRUIT TREES FROZEN IN 1904.

By M. B. WAITE, *Pathologist.*

IV. THE CULTIVATION OF THE AUSTRALIAN WATTLE.

By DAVID G. FAIRCHILD, *Agricultural Explorer.*

V. LEGAL AND CUSTOMARY WEIGHTS PER BUSHEL OF SEEDS.

By EDGAR BROWN, *Botanist in Charge of Seed Laboratory.*

VI. GOLDEN SEAL.

By ALICE HENKEL, *Assistant*, and
G. FRED KLUGH, *Scientific Assistant.*

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BUREAU OF PLANT INDUSTRY.

B. T. GALLOWAY,
Pathologist and Physiologist, and Chief of Bureau.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.
ALBERT F. WOODS, *Pathologist and Physiologist in Charge,*
Acting Chief of Bureau in Absence of Chief.

BOTANICAL INVESTIGATIONS AND EXPERIMENTS.
FREDERICK V. COVILLE, *Botanist in Charge.*

GRASS AND FORAGE PLANT INVESTIGATIONS.
W. J. SPILLMAN, *Agrostologist in Charge.*

POMOLOGICAL INVESTIGATIONS.
G. B. BRACKETT, *Pomologist in Charge.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.
A. J. PIETERS, *Botanist in Charge.*

ARLINGTON EXPERIMENTAL FARM.
L. C. CORBETT, *Horticulturist in Charge.*

EXPERIMENTAL GARDENS AND GROUNDS.
E. M. BYRNES, *Superintendent.*

J. E. ROCKWELL, *Editor.*

JAMES E. JONES, *Chief Clerk.*

3

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

MISCELLANEOUS PAPERS.

B. P. I.—69. V. P. P. I.—104.

I.—THE WILT DISEASE OF TOBACCO AND ITS CONTROL.[a]

By R. E. B. McKenney, *Physiologist, Vegetable Pathological and Physiological Investigations.*

THE DISEASE.

The wilt type of disease is a well-known one, affecting cotton, watermelon, cowpea, tomato, and other crops. Until the present there has been no publication bearing on tobacco wilt, although the writer has been acquainted with the disease for a number of years and some of the North Carolina growers have been troubled by it for at least ten

Fig. 1.—Field of bright tobacco in Granville County, N. C., affected with wilt disease.

years. Accordingly, before considering the control of the wilt it will be necessary to give a brief description of the disease and its cause.

[a] During the past few years specimens of tobacco suffering from what appeared to be a true wilt disease have been received by the Department from a number of tobacco districts. During the past summer, however, in a certain section of North Carolina the disease was found so destructive that it is deemed necessary to make this *preliminary* statement concerning the disease and its control.

A. F. Woods, *Pathologist and Physiologist.*

Office of Vegetable Pathological and Physiological Investigations,
Washington, D. C., September 12, 1903.

So far as known the wilt disease does not make its appearance until the tobacco has attained about a third of its growth. The first evidence the grower has of the disease is the sudden wilting, or drooping, of one or more of the leaves. This wilting is not a temporary one caused by intense sunlight and excessive heat, but a permanent one, followed by withering of the wilted leaves. In some cases only a few of the leaves are killed. As a rule, though, the wilting of a few leaves is followed by wilting and the subsequent withering of all the leaves of the plant. (Fig. 1.) Later the base of the stem blackens and rots. An examination of the roots at this stage of the disease shows them likewise to be blackened, and usually soft and mushy. As a rule, the first diseased plants are found in the washes and lower parts of the field. In the sections where it is just making its appearance the disease may be confined to a few plants in the field. At times nearly the entire field will go down with the disease during the first year. In almost all cases the second crop planted on such infected fields is sure to be practically a complete loss.

CAUSE OF THE DISEASE.

Although the disease has not been studied to the same extent as the wilts of cotton, watermelon, and cowpea, still the history of the wilt in the field and the microscopic examination of diseased plants show this disease to be of the same type as the wilts of cotton, watermelon, and cowpea already worked out by Dr. E. F. Smith and Mr. W. A. Orton, of the Department of Agriculture. Microscopic examination of wilted tobacco always reveals the presence of a fungus belonging to the genus *Fusarium* (*Neocosmospora*). This is found in the woody parts of roots and stem. The black lines running up through the wood of the stem readily reveal to the naked eye when cut or broken across the passage of the fungus up the stem.

As shown by the work on other wilt diseases, the *Fusarium* is a soil fungus, and gains entrance to the plants through the *fine roots*. It rapidly spreads into the larger roots and up into the stem. The path of the fungus is through the woody vessels which conduct the sap upward. In many cases the growth of the fungus is so great that the woody vessels are almost, if not completely, plugged up. The flow of crude sap up to the leaves is either very much decreased or entirely stopped. Since there is no supply of water from the roots to replace that evaporated from the surface of the leaf, the leaf wilts and dies.

CONTROL OF THE DISEASE.

Once a plant becomes affected by the disease there is no hope of its recovery, and when the larger part of the field is affected the crop is a total loss to the grower. Sudden droughts have been said to arrest the progress of the disease, but they do not save the crop. The treatment of the wilt must be one of prevention—that is, the spreading of the disease must be prevented, and an effort made to rid the infected fields of it. In treatment of the disease, it is of the greatest importance that the long-lived character of the moldlike threads of the fungus in the soil and its manner of reproduction, or, more popularly speaking, of seeding itself, be borne in mind.

The Fusarium has been known to live in the soil for a number of years and still be able to produce the disease. This is particularly true in districts with mild winters. It is therefore useless to plant tobacco on infected fields until they have been rested for a period of from five to eight years, depending upon the amount of disease present. During this resting period sorghum, corn, wheat, oats, or any other crop of the grass family may be planted with safety, since these are not subject to this disease. Sorghum and corn are particularly recommended. Tomato and eggplant also suffer from a wilt disease. That the tobacco wilt is the same as that affecting these plants has not yet been proved, but the relations of the tomato and eggplant to tobacco make it not improbable that all three may suffer from the same disease.

In order to eradicate the disease, it is necessary that all source of infection of new fields be destroyed. All diseased plants should therefore be *burned on the field where they were grown*. The burning of the plants does not mean any loss to the grower, because the chief fertilizing value of the tobacco stems lies in the amount of potash which they contain. In the burning the potash is not lost, but is retained in the ash, and has fully as much value as before burning. If the diseased plants are not burned, they are scattered about and serve to inoculate new fields. Plows and other tools used on the infected lands should be cleaned where used. Since the growth is favored by acid substances and hindered by alkaline substances, washing the tools with soap and water is advised, since the slight alkalinity of the soap acts injuriously on the fungus. None of the diseased tobacco should be mixed with manure or compost heaps, since the fungus spreads rapidly through the manure, and when that is placed on the land, of course the land becomes infected with the disease. Manure barns in which diseased tobacco has been placed should be burned and barns erected on new land. A number of cases are known where the disease has lived in the manure sheds for years.

As an additional means of getting rid of the fungus it is advised that the tobacco stubble be plowed up in the *autumn* and burned on the field. The reason for this is twofold. In the first place, this stubble is a good breeding place for the fungus during the winter; secondly, of the three kinds of fruiting or seedlike bodies formed by the Fusarium the one most difficult of destruction is produced on the roots during the autumn and winter. By turning up the stubble in *autumn* and burning it these seedlike bodies are either prevented from forming or are largely destroyed, if already formed. Tobacco suffering from wilt will rarely set seed, but should such happen the seed should not be used, because it would be poorly formed and yield only weak seedlings.

The most successful method of combating wilt diseases has been found to be the selection and breeding of resistant varieties. For the cowpea and cotton this has been accomplished by Mr. W. A. Orton of this Department. The writer has selection experiments under way which may yield a variety of tobacco resistant to the disease. Until such a resistant variety is obtained, however, it is essential that the precautions just advised be taken. If they are not taken the ravages of the disease will become greater, whereas if they are followed the disease may be prevented from spreading to new fields and probably to a large measure may be eradicated from old fields.

As an additional precaution it is recommended that no fertilizers containing kainit or muriate of potash be used. These are not only believed to make conditions favorable for the continuance of the disease, but they also give the leaf poor texture and bad burning quality. In soils deficient in lime an application of 50 bushels to the acre may prove advantageous. Care must be taken, however, not to use too much lime, since that also causes the leaf to burn poorly.

Observations and experiments on this disease will be continued, and it is hoped that a surer method of control may be obtained in the near future.

II.—THE WORK OF THE COMMUNITY DEMONSTRATION FARM AT TERRELL, TEXAS.[a]

By Seaman A. Knapp, *Special Agent in Charge of Farmers' Cooperative Cotton Demonstration Work.*

INTRODUCTION.

The work of the Porter Demonstration Farm at Terrell, Tex., for 1903 having been completed, I take pleasure in submitting a detailed report of its operations and results.

Acting upon instructions, I visited Terrell and organized the farm upon a practical basis.

A committee of business men and farmers was appointed to carry out the plans agreed upon. This committee was composed of W. E. Flower (president), B. T. Childress, J. B. Porter, Walter C. Porter, J. N. Stallings, F. B. McKay (secretary), W. E. Henderson, and C. T. McGinnis. Great credit is due these gentlemen for their judicious management and intelligent services.

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[a] In connection with the work of the United States Department of Agriculture in Texas and Louisiana in demonstrating the possibility of growing diversified crops with greater profit than results from confining attention to a single farm product, and also in showing the value of better cultural methods, it seemed desirable to make special demonstrations in certain communities of the benefits which would be derived from the rotation of crops, thorough cultivation, the intelligent use of fertilizers, etc.

The citizens of Terrell, Tex., offering to pay the expenses of such a demonstration, Dr. Seaman A. Knapp, Special Agent in Charge of Farmers' Cooperative Cotton Demonstration Work, was sent to that city and organized a farm on the general basis outlined in this report.

It is believed that, though only simple tests were made, results of sufficient value to justify calling special attention to them have been obtained. The statement of the season's work is not presented as a contribution to the science of agriculture, but merely as a record of what was done by one farmer acting under the directions of a representative of the United States Department of Agriculture, together with that farmer's testimony that he found decided financial benefit resulting from following those directions.

Every good farmer can do work of this sort, and every wide-awake community can organize a demonstration farm to show the people in its section that marked financial advantages will accrue if better methods of soil culture, etc., are followed.

B. T. Galloway, *Chief of Bureau.*

United States Department of Agriculture,
Bureau of Plant Industry,
Washington, D. C., January 29, 1904.

The demonstrations were under the immediate management of Mr. Walter C. Porter, one of the most capable farmers in north Texas, while the general control of the experiments was placed in my hands.

The object of all such demonstrations is to test or prove some important fact bearing upon agricultural conditions. If these demonstrations are conducted in such a way that few persons see the result or learn about it, little is accomplished. The plan adopted by the committee at Terrell involved keeping in touch with the work on the part of the large number of business men and farmers who had subscribed to the guarantee fund, and who accordingly made frequent inspections of the farm in order to see how the work was progressing, a personal interest being taken in learning for themselves that the methods followed were in accordance with the best agricultural practices.

RESULTS ACCOMPLISHED.

Upon the final settlement for the operations of the Demonstration Farm for the season, Walter C. Porter, the farm manager, announced that he had cleared $700 more than would have been made under the ordinary methods of farming employed in that section, and he stated that in 1904 he should work his entire farm, about 800 acres, upon the basis of the same cultural methods which had been followed on the experimental plats. Many of the owners of large farms in that section of the State made similar announcements.

Hon. E. H. R. Green, of Terrell, Tex., became greatly interested in observing the results accomplished on this Demonstration Farm, and his interest took a practical direction when, in November, 1903, he purchased 410 acres of land lying adjacent to the city of Terrell and at once invested a large amount of money in improvements, with the intention of establishing one of the most complete demonstration farms in the United States.

METHODS EMPLOYED.

The methods employed by the citizens of Terrell in establishing this Demonstration Farm may be summarized as follows:

(1) Eight practical men were selected to act as an executive and advisory committee, with full authority.

(2) The citizens subscribed a sum of money sufficient to guarantee that any contract made by the committee would be carried out.

(3) One of the best farmers in the section was chosen to conduct the demonstrations upon his own farm. He was to follow strictly all instructions given by the representative of the Department of Agriculture, and if the result showed financial losses owing to changes from the methods formerly employed he was to be fully reimbursed out of the fund subscribed by the citizens.

It was the intention the first season merely to test varieties and to investigate the effect of fertilizers, methods of cultivation and planting, etc., leaving any special effort to produce large crops for subsequent years after the soil conditions had been accurately determined. It was considered wise to restrict the tests to the ordinary farm crops of the section.

DESCRIPTION OF THE FARM.

The demonstrations were made on a tract of about 70 acres of moderately rolling, light, sandy loam upland, underlaid with clay at a depth of about 2½ feet.

This land had been planted to cotton or corn every season for twenty-eight years without the use of a commercial fertilizer and without employing any renovating crops, except upon Plat No. 2, which was planted in corn and cowpeas the preceding year. Nearly all the humus had been removed from the soil of this farm by successive cropping until both the corn and cotton grown upon it indicated an impoverished condition of the soil.

The entire tract had been plowed in January about 4½ inches deep with an ordinary turning plow. This was prior to the establishment of the Demonstration Farm.

FERTILIZERS USED.

The basis of all fertilizers used was the following compound:

Available phosphoric acid, 10 to 12.
Total phosphoric acid, 12 to 15.
Bone phosphate of lime, 26 to 32.
Potash sulphate, 8 to 12.
Potash KO_2, 4 to 6.

To this compound was added one-third of its weight of cotton-seed meal, the resulting fertilizer being known as mixture No. 2. On Plats 1, 4, 6, and 8, 200 pounds of this mixture were sown broadcast upon the land after planting. On Plats 3, 5, 7, and 9, no fertilizer was used. On Plat 2, 200 pounds of mixture No. 2 were used per acre, dropping it equally on each side of the rows of cotton at the time of the first plowing. Plat 2, as stated, had been planted in corn and cowpeas the preceding year. The method of applying the fertilizer to this field was precisely like the others.

The following table shows the yield of cotton per acre on the fertilized and unfertilized plats:

No.	Acres.	Variety of cotton planted.	Fertilized or not.	Planted.	Yield in pounds of seed cotton per acre.	Yield in pounds of lint cotton per acre.	Pounds of lint cotton to 100 pounds of seed.
1	4	Rowden	Fertilized	Apr. 18 to 21	920	326.6	35½
2	15	do	do	do	1,167.32	414.4	35½
3	4	do	Not fertilized	do	730	259.15	35½
4	3	Gibson	Fertilized	do	826	279.84	34
5	3	do	Not fertilized	do	631	215.56	34
6	2	Russell Big-Boll	Fertilized	do	790	221.2	28
7	2	do	Not fertilized	do	711	199	28
8	3	Stormproof	Fertilized	do	718	226.15	31½
9	3	do	Not fertilized	do	670	211	31½

Two hundred pounds of this fertilizer—the amount used per acre—cost $1.54. With cotton at 12 cents per pound, the result of using the fertilizer is shown below. The first column of figures shows the gain in pounds of seed cotton by the use of fertilizers; the second column shows the value of this increased product; the third column, the cost of the fertilizer per acre, while the fourth column shows the net profit per acre.

Variety of cotton planted.	Gain in pounds of seed cotton per acre.	Gain in value per acre.	Cost of fertilizer per acre.	Net gain per acre.
Rowden, Plat 1	190	$8.11	$1.54	$6.57
Rowden, Plat 2	729.16	31.05	1.54	29.51
Gibson	192	7.71	1.54	6.17
Russell Big-Boll	79	2.66	1.54	1.12
Stormproof	48	1.81	1.54	.27

If all the gain in Plat 2, 729.16 pounds of seed cotton, was credited to the fertilizer, this would show a value of $31.05 per acre, at a cost of $1.54. It is evident, however, that some allowance must be made in this case for the crop of cowpeas grown during the previous year and for the consequent better cultural condition of the plat on which this cotton was produced.

COTTON.

Some 37 acres in all were planted in cotton, divided into nine plats or fields.

Just before planting, the land was disked, cross-disked, and harrowed. The cotton seed was planted 1 inch deep in rows 3½ feet apart, the planting drill being followed by a roller which pressed the soil after the seed was covered. The cotton came up in five or six days after planting. From May 1 to May 3 the fields were harrowed, and in about twelve days they were side harrowed and cultivated. From May 15 to May 18 the soil was chopped to 18 inches and then plowed, it being plowed thereafter once every twelve days until August 1. All plats received the same cultivation.

The bollworm in great numbers attacked the entire crop of cotton and reduced the yield at least one-half.

On the east of the Porter farm is an adjoining field of precisely similar soil and drainage, except that it had produced but three crops from a virgin state. This tract has been designated as Field A. It was in excellent condition, and was planted to Rowden cotton and well cultivated in the ordinary way without the use of fertilizers. The yield on this 30-acre tract was 10 bales of 500 pounds each, or 166⅔ pounds of lint cotton per acre, as against 326.6 pounds per acre on Plat 1 and 414.4 pounds on Plat 2 of the Demonstration Farm, showing a gain of 160 pounds per acre, worth $19.20, on Plat 1, and of 249.74 pounds, worth $29.86, on Plat 2, due to better cultivation and the moderate use of fertilizers. These amounts per acre would stand to the credit of the demonstration fields without modification, provided the soils were of equal fertility; but, as stated, the adjacent field was comparatively new and rich in humus and far better than either Plat 1 or Plat 2.

On the northwest of the Demonstration Farm is another tract of land, a rich sandy loam, which had been in cultivation only about four years, designated in the following table as Field B. It was planted to Rowden cotton and given good common cultivation, but no fertilizers were used. The product was 21 bales from 65 acres, or 161.54 pounds of lint cotton per acre, showing a gain in favor of Plat 1 of 165.12 pounds per acre, worth $19.81, and in favor of Plat 2 of 252.81 pounds, worth $30.34, due to intense cultivation and the use of some fertilizer.

A comparison of the results obtained on the Demonstration Plats and on Fields A and B further shows the proportion of this gain due to cultural methods and to fertilizers. The total gain in Plat 1 over Field A was $19.20 and over Field B $19.81 per acre. It has been shown that the amount to be credited to fertilizer on Plat 1 is $8.11 per acre. Deducting this, it leaves $11.09 credited to Plat 1 as compared with Field A, and $11.71 credited to Plat 1 as compared with Field B on account of better tillage. The culture values as compared with Plat 2 can not be made, because the effects of culture and fertilizer on Plat 2 were not separately tested.

The results for the Rowden cotton may be tabulated as follows:

Plat or field.	Character of culture.	Fertilized or not.	Total pounds of lint cotton per acre.	Pounds of gain per acre over Field A.	Gain in value over Field A.	Pounds of gain per acre over Field B.	Gain in value over Field B.	Increase in value due to fertilizer.	Increase in value due to culture over Field A.	Increase in value due to culture over Field B.
1	Improved..	Fertilized	326.66	160	$19.20	165.12	$19.81	$8.11	$11.09	$11.71
2	.....do......	.....do	414.4	242.74	29.86	252.86	30.34	....	....	....
3	.....do......	Not fertilized.	259.15	92.49	11.09	77.61	11.71	....	....	....
A	Common...	.....do	166.65	....	....	....	....	....	....	....
B	.....do......	.....do	161.54	....	....	....	....	....	....	....

It is noticeable that the fertilizer and cultural methods employed had a much greater effect upon some kinds of cotton than upon others, the Rowden and the Gibson varieties proving much more satisfactory in this respect than the Russell Big-Boll and the Stormproof. Fertilizing hastened maturity about ten days.

CORN.

The land planted to corn received precisely the same preparatory treatment as that given to the cotton fields. On March 28 it was disked, cross-disked, and harrowed, and from April 4 to April 8 it was planted in corn, 2 inches deep, with rows 5 feet apart.

The following varieties were used: Native Texas corn, White Wonder, Reed's Yellow Dent, and White Pearl.

The corn came up on April 12. On this date there was a heavy hailstorm, which damaged it badly. Cultivation commenced on May 1. The corn was thinned to a stand of 18 inches in the row, and cultivation was repeated once every ten days till June 15. At this date the stalks averaged 4½ feet high, when a severe wind blew fully 50 per cent of them flat across the rows, preventing all further cultivation. Most of the stalks blown down did not recover and were a total loss, besides preventing any further test of cultural methods.

Three hundred pounds of fertilizer per acre were applied to a portion of the farm. This fertilizer was composed of equal parts of cotton-seed meal and of the compound before mentioned. It was applied at three different periods—100 pounds at the time of planting (drilled in with the seed); 100 pounds at the time of the first cultivation (on the sides of the rows); and 100 pounds about June 1 (in the middle of the rows).

The results in the case of corn are not considered of great value because of the heavy loss entailed by the June windstorm and the impossibility of continuing cultivation after that time. Further, the instructions to plant cowpeas between the rows could not be carried out except to a limited extent, on account of the prostrate corn.

A summary of the principal results obtained in the experiments with corn will be found in the following table:

Variety of corn.	When planted.	When up.	Date of first cultivation.	Date of roasting ears.	Date of maturity.	Yield per acre.		Fertilized or not.
						Bush.	*lbs.*	
1. Native Texas ..	Apr. 4 to 8	Apr. 12	May 1	Aug. 1	Aug. 15	41	9	Fertilized.
2. Native Texas ..	......do......	....do...	....do...	Aug. 10	Aug. 25	30	18	Not fertilized.
3. White Wonder.	......do......	....do...	....do...	July 12	July 27	32	0	Fertilized.
4. White Wonder.	......do......	....do...	....do...	July 22	Aug. 7	23	15	Not fertilized.
5. Reed's Yellow Dent.	......do......	....do...	....do...	Aug. 1	Aug. 15	22	18	Fertilized.
6. Reed's Yellow Dent.	......do......	....do...	....do...	Aug. 10	Aug. 25	18	0	Not fertilized.
7. White Pearl ...	......do......	....do...	....do...	....	....	23	10	Fertilized.
8. White Pearl ...	......do......	....do...	....do...	....	....	19	16	Not fertilized.

The fertilized corn was of considerably better quality than that grown without fertilizer. The results obtained by fertilizing would, of course, have been much greater had it not been for the storm referred to. All the corn in the field was gathered from October 1 to October 10.

It should be noted that the White Wonder corn was earlier than the other varieties tested. An acre of White Wonder corn was planted in rows 3½ feet apart and thinned to 28 inches in the row. The product under the same cultural treatment was 3½ bushels per acre less than where the rows were 5 feet apart.

III.—FRUIT TREES FROZEN IN 1904.[a]

By M. B. Waite, *Pathologist in Charge of Investigations of Diseases of Orchard Fruits, Vegetable Pathological and Physiological Investigations.*

INTRODUCTION.

The severe cold weather of the past winter, especially the intense cold of January 4 and 5, resulted in very serious damage by freezing to orchards in New York and New England, especially in the Hudson and Connecticut valleys. The damage was found to be mainly to peach, Japanese plum, and pear trees, and the most serious harm was largely confined to the lower levels and pockets. The writer recently visited the orchards around Marlboro and Milton on the Hudson River, and also those located at South Glastonbury, Conn. In conversation with the growers, it was found that, as a rule, they overestimated the damage. In several cases orchards were already cut down which would probably have recovered if given proper treatment.

DAMAGE TO BEARING PEACH ORCHARDS.

In the bearing peach orchards the trees most injured by freezing show the bark entirely blackened and dead, more or less separated from the trunk, and the wood turned a very dark brown color. The injury extends far up onto the limbs, although the bark usually has not separated on the branches. Such trees are dead beyond all question and should be treated accordingly. Scarcely 10 per cent of the orchards visited were found to be in this completely frozen condition. Even on these, the bark on the branches and small limbs still retained its vitality. Such trees were largely confined to cold, low, flat places, or to pockets at very moderate elevations. Sometimes a rise of 10 or 15 feet resulted in the trees being less seriously injured.

[a] In the hope of being of some service to the fruit growers of New York and New England whose orchards have been severely damaged by the extreme cold of the past winter, it has been thought desirable to publish from the Department a brief explanation of the damage done, with advice as to how to treat the injured orchards.

A. F. Woods, *Pathologist and Physiologist.*

Office of Vegetable Pathological and Physiological Investigations,
Washington, D. C., March 28, 1904.

15476—No. 51—05——3

With many peach trees, however, the bark is lightly separated from the wood, which is of a dark walnut color next the cambium and brown throughout. Though still alive, the bark is somewhat browned and discolored, the youngest or outer layer of wood has been frozen until it is now of a dark walnut color, and the wood of the trunk is blackened throughout. Many of these trees are of questionable vitality, and will probably succumb. Others have enough vitality to enable them to pull through. Where the bark is adhering or only partially separated from the trunk, the chances for recovery are good. The tops of such trees are usually found in fair condition, the wood brownish, but the white cambium layer uninjured, though lying immediately in contact with the brown, dead wood. The twigs, especially the one-year wood, sometimes have been frozen so badly that they will not be able to push the leaf buds. In severe cases the leaf buds themselves are killed, but, as a rule, they are still alive. Of course on all such trees the fruit buds are killed. The most injured part is the trunk just above the snow line. About one-half of the orchards examined were in this condition.

A third class, which may be described as the moderately frozen trees, in which the wood above the snow line is blackened but the bark not separated from the wood and with the cambium still apparently alive, although water-soaked and injured, frequently has minute brown streaks in the bark immediately in contact with the cambium. Such trees will almost invariably recover. Where orchards are in this condition, only the trees in the low situations, where there was an excess of moisture and drainage nitrogen and which also afforded basins in which the cold air was caught, may be expected to die. All such moderately frozen trees, even though the wood is blackened throughout, may be expected to yield abundant crops for several years in the future.

Nearly every tree in the entire Michigan fruit belt was frozen in February, 1899, so that the wood was blackened and dead clear to the bark. A new layer of live, white wood formed inward from the live bark, the trees made a fairly good growth, having no fruit crop to carry, and bore the year following a record fruit crop. Moderate pruning back, say from one-third to not over one-half the tops, gave the best results on trees of this character. No pruning at all gave much better results than too severe cutting back. Many trees were cut back to the large branches, or "dehorned," and failed to push out. Similar trees moderately pruned pulled through and made a fine growth.

On the higher levels aud ridges in both the Connecticut Valley and the Hudson Valley there are orchards in which some of the fruit buds have survived and in which the trees were only moderately frozen. The fruit buds apparently are more hardy than the youngest, tender sapwood. In fact, the most hardy portions of the tree are the cambium layer—an extremely thin film of very vital tissue between the bark and the wood—and the leaf buds. That portion of the tree having the most life or protoplasm in it, fortunately, is the most resistant. Young trees in orchards from one to three years old were injured less than older bearing trees. Nursery trees, on the contrary, were frozen dead to the snow line. These are entirely one-year wood, of course, and are of a rather forced, tender, sappy nature.

HOW TO TREAT THE PEACH ORCHARDS.

The orchardist should be cautious about pulling out damaged trees. Unless for some other reason than the present injury from frost he is willing to dispense with the orchard, he should give the trees an opportunity to show what they will do before condemning them. Almost all the trees in which the bark is stuck tight at the critical point—about two feet from the ground—may be expected to pull through, and many which have the bark partially loosened may recover. Moderate pruning back, followed by good cultivation and, unless the land is in very good condition, with a moderate amount of fertilizing, will be the best course to pursue. If the buds can push out in the tops, growth will extend downward, resulting in many cases in a complete covering of new, sound, white wood, even over the most injured part on the trunk. The frozen dead wood can conduct the crude sap as long as it remains moist. If the bark remains alive it will carry the elaborated sap downward from the leaves. This shell of new wood will be sufficient to maintain the tree in profitable bearing and will, of course, be added to annually. Nearly all the peach trees in Michigan, notwithstanding the fact that they have a dead, black heart, as well as many of those similarly affected in Missouri, Maryland, and Georgia, have been bearing good crops of fruit.

The aim should be, with good cultivation and fertilization, to grow the tree out of the injury. Stable manure will probably answer the requirement in some cases. Nitrate of soda at the rate of 200 pounds per acre may be preferable in other cases. The choice of the writer would be a complete fertilizer, consisting of nitrate of soda, acid phosphate or bone meal, and muriate of potash. Such a fertilizer applied just at the time growth is starting would result in the best possible benefit from the nitrate.

INJURY TO PLUM TREES.

The Japanese plums have behaved essentially the same as the peach trees. The young wood is discolored in the same manner, while the bark remains alive on very many of the badly injured trees. Their treatment should be essentially the same as that of the peaches. The Domestica plums are very little hurt, being almost as hardy, in fact, as the apples. Some injury was noted on the grapes. Two-year vines which reached above the snow line were apparently killed in some cases, but no special study was made of the injury to the grapevines.

INJURY TO NURSERY TREES.

In the nurseries, peach trees were frozen down to the snow line so as to make that portion above the line without value. However, they are entirely unharmed below the snow line and should be treated as though they had been cut off at that point. Those who prefer a high head may object to planting such trees. The choice of the writer, however, is in favor of a low headed tree, and such trees will give excellent results even though they may not have more than six or eight inches of sound wood above the bud. The writer would not hesitate to plant them. Where the trees have less than six inches of wood, probably as good a way as any would be to allow only one sprout to grow and to train up a new tree from this sprout after planting in the orchard. Where the nursery trees are not dug and sold, they may be cut off an inch or so above the bud and a single sprout trained into a tree according to the usual methods of nurserymen. It will, of course, be desirable to withhold part of the cultivation on such trees to avoid their growing too large.

The Japanese plum, as stated, has behaved essentially like the peach tree and should be treated in the same way. The apple is hardier than either of these fruits, and of the apple trees examined in the nursery only a few varieties seemed to be hurt sufficiently to cause their rejection. These frozen trees might be treated in the same way as the frozen peach trees—by cutting them off and allowing a new tree to grow from a bud.

DAMAGE TO PEAR TREES.

In the Hudson Valley the pear trees are very severely damaged. In many cases the pear orchards were placed, as is customary, on the lower, richer ground, which is naturally from its location more subject to intense cold. As far as a hasty examination went, the pear orchards seemed to be more severely hurt than the peach trees. At any rate, they were injured to about the same extent, and they have not by any means the same ability as the peach trees to outgrow the injury.

Another factor which has entered into the problem in the case of pears is a severe attack of *Psylla*. A very unusual attack of this pest last season had greatly weakened the vitality of the trees. Most of the pear orchards examined were still crusted with the black fungus which grows on the honeydew secreted by the *Psylla*. These *Psylla*-infested and weakened pear trees were in poor condition to resist the severe freeze.

Many handsome specimens 25 to 30 years old of Bartlett, Seckel, and other choice varieties were frozen outright. Several fine orchards of 8 or 10 acres in extent which the writer examined were completely killed or practically so. Here again, as with the peaches, the difference of a few feet in elevation frequently made the difference of life or death to the trees. The young pear trees are rather less hurt than the older trees, as in the case of the peach, but it should be noted in this connection that young pear trees having the wood blackened, although they will push out their leaves and make a start, are very apt to decline or else maintain their life in a very feeble manner as a result of the dead wood at the heart. They have not the ability to recover by depositing a thrifty layer of sapwood. Pear trees under 3 or 4 years of age which are badly frozen and which show blackened or discolored wood, even though the bark may look normal from the outside and may appear to be alive and quite fresh when cut into, should be cut off below the snow line and allowed to sprout. All the sprouts that start may be permitted to grow the first year, and, if a tall head is preferred, they may be pinched back, except the one which is to form the new stem, when they have grown a foot or so. The foliage from these pinched shoots will help contribute to the life and vigor of the tree. In case of badly frozen bearing trees, where the tree is dead and the bark is discolored, of course they should be dug out, but where there is any vitality left in the bark it may be well to allow the trees to remain at least the first season until it can be determined to what extent they are injured. It takes several years to bring a pear tree into bearing—at least two or three times as long as a peach tree—and one should therefore be correspondingly cautious in cutting down pear trees. Unfortunately, the writer can not hold out the same chances for recovery in the case of the pear orchards that are possible with the peach trees, but still moderately frozen pear trees have recovered in Michigan, and afterwards, by pruning out the weakened limbs, pretty fair bearing tops of vigorous young wood have been secured. No severe pruning, however, should be attempted this season.

IV. THE CULTIVATION OF THE AUSTRALIAN WATTLE.[a]

By David G. Fairchild, *Agricultural Explorer, Seed and Plant Introduction and Distribution.*

The bark of the Australian black wattle tree (*Acacia mollissima* Willd.) has long been in use for tanning purposes. It does not give the leather as fine a bloom as the bark of the American oaks or the acorn cups of the valonia oak, but it tans more quickly and is in good demand for the common grades of leather.

Formerly the supply of this tan bark came from the forests of Australia, but within the last five or six years the plantations of Natal have begun to supply a large proportion of the bark, and the writer was informed by residents of that colony that wattle growing is the most profitable plant industry in the country.

A short stay in the region was not enough to put the writer in possession of all the ins and outs of this new culture, but the facts gathered during a visit to one of the largest and best managed estates in Natal may be of interest to Americans in Hawaii and elsewhere.

Hon. G. M. Sutton, a member of the legislative council of the colony, is given the credit of first agitating the question of wattle growing, and as early as 1892 he wrote urging planters to sow the seed of this Australian tree and start forests of it for its tan bark.

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[a] This brief presentation of the culture of the wattle tree and the harvesting of the bark for tanning purposes will, it is hoped, again call the attention of American tanners to this possible source of tanning material. As Mr. Fairchild points out, considerable of this bark is already being produced in South Africa, and, although it is probable that few parts of the United States proper are sufficiently free from frost to make the culture of the wattle tree profitable, it is successfully grown in the Hawaiian Islands, where it is regarded as a promising industry. A tract of 5 acres of thirteen-year-old trees at the Hawaii Experiment Station has been under experiment for a number of years, and a bulletin describing the growth of the trees and the market value of the products is now in preparation.

We are indebted to Mr. Barbour Lathrop for this paper, as the observations it contains, which were kindly placed at the disposal of the Department, were made by Mr. Fairchild during the last of Mr. Lathrop's expeditions in search of valuable seeds and plants.

A. J. Pieters, *Botanist in Charge.*

Office of Seed and Plant Introduction and Distribution,
Washington, D. C., June 25, 1904.

It had been demonstrated previously that the wattle grew unusually well upon the hillsides in certain parts of the country, so that when the price of wattle bark rose to the unusual figure of £17 sterling per ton ($82.79), which rise is attributed to successive bad harvests of the valonia oak (*Quercus ægilops* L.) in Greece and Asia Minor, it was not difficult to convince people that the experiment of its culture was worth making.

The Town Hill plantation, which covers 2,400 acres of the hilly uplands near Pietermaritzburg (Pl. I, fig. 1), is one of the largest estates in the colony. It lies about 2,700 feet above sea level, and the dark green effect of its foliage on the landscape is almost as beautiful as that produced by the cryptomeria forests of Japan.

The wattle-growing districts of Natal are scattered through the central part of the colony, especially along the railroad from Pietermaritzburg to Greytown, and one of the most important shipping centers is Dalton.

According to information given the writer by the assistant manager of the estate, the first plantings were made in 1892, and in the beginning profits were looked for only from the sale of the tan bark and firewood; but the poles which are left after the bark has been peeled from them have proved to be more desirable for mining props than those made from eucalyptus timber, and their sale adds very materially to the net receipts of the culture.

The starting of a forest of black wattles is a simple enough business operation. The virgin grass land of the rolling country is broken up about Christmas time and thoroughly harrowed. In February, rows 12 feet apart are laid out and the seed is planted 6 feet apart in the rows and lightly covered with soil, when it is left to take care of itself. Indian corn, which is called "mealies" in Natal, is sometimes sown in the 12-foot spaces between the rows of young wattle plants, and the constant stirring of the ground in cultivation is said to be of benefit to the young seedlings.

No nursery seed beds are used and no laborious planting is necessary. The following March, which is autumn in Natal, the soil between the rows is plowed for the benefit of the roots of the young trees and to guard against "grass fires," or prairie fires, as they are called in America, which are common in the grassy uplands.

In ten years from seed sowing the wattle trees are in their prime, but by the seventh year many individuals are large enough to be barked.

At ten years of age on the Town Hill plantation, trees attain a diameter of 10 inches, but the rate of growth is largely influenced by the character of the soil and probably also by individual variations in the seed.

The soil on which the Town Hill plantation is situated is a light red, friable loam, rich in iron, but considered poor in quality for cropping purposes. A layer of gravel and sand overlies a clay subsoil two to three feet below the surface, and, though supplied with plenty of moisture, the situation is a well-drained one. The wattle roots are surface feeders, and the soil in which the moisture lies very deep, it is said, is not suitable for wattle culture.

When an area of forest is old enough the harvesting of the bark is begun. This work can be carried on at all times of the year in Natal, for the bark peels easily in any season. Sixty indentured Indian coolies do all the manual labor on the Town Hill estate and are skillful enough to peel, dry, and cut the bark and to pack it in bags for export.

It is interesting to watch the process of stripping off the bark, and one is surprised at the rapidity with which it is done. With a short-handled ax the coolie clears away the dead twigs and leaves at the base of the tree, cuts through the bark as close to the ground as possible, lifts a broad strip of it high enough to get hold of it with his hands, and, with a series of strong jerks, peels off a broad strip as long as the height from the ground to the first branches of the tree (Pl. II, fig. 2). Strip after strip is pulled from the trunk in this way until it stands as bare as a telegraph pole, save the tuft of branches at the top. The tree is then felled and the work of stripping completed on such parts as, lying between the branches, could not be peeled when it was standing.

The fresh bark is thrown over poles to dry (Pl. III, fig. 3), and the tree trunks are cut into 6 or 12 foot lengths for mining timber.

A portable tramway, which is laid through the plantation (Pl. II, fig. 3) to such places as are being stripped, carries the bark to the drying sheds (Pl. III, figs. 1 and 2), which are simple but ingenious galvanized-iron affairs, so arranged that each can shelter 6 tons of the fresh bark. The long strips of bark are hung over long poles, much as the macaroni makers of Italy hang their freshly made paste out to dry, and the ends of these poles are put through rings in two heavy chains that hang from two parallel elevated bars. A series of these poles loaded with bark is fitted to the rings a foot or two apart in the chains, and one by one they are put across the parallel bars with their ends resting upon them.

In fair weather these poles, with their tan bark over them, remain hanging on the long bars, like miniature elevated railways, which extend from the sheds up the slope of the hillside. On the approach of rain a yoke of oxen is attached to the chain of poles by a wire rope, and, like shutting up the bellows of an accordion, these poles are drawn close together down the parallel bars into the shelter of the corrugated-iron roof. With the return of sunny weather the oxen again spread out the chain of poles.

The value of the bark depends largely upon its color, and it is said that the sun-dried product is best.

Once dried, the bark is chopped into short chips, packed into sacks, and is then ready for export.

From an acre of 10-year-old wattles 5 or 6 tons of bark can be taken, and at the present market prices in Natal, £6 12s. 6d. ($32.26) a ton, the gross receipts would be from $161.20 to $193.58 per acre. The cost of stripping, drying, and packing the bark amounts to £1 10s. ($7.30) per ton. To arrive at the net earnings, to this cost of harvesting, etc., must be added the cost of ten years of care, with interest on the price of the virgin land, which was valued by the assistant manager of the estate at £1 5s. to £1 10s. per acre.

To the proceeds from the sale of the bark must be added the revenue from the mining timbers, and, although the figures given can not be vouched for and will be no guide to anyone wishing to grow wattles in a country where only high-priced labor is obtainable, they support the opinion that the wattle industry pays handsomely in Natal and explain why new plantations are being put in.

A wattle forest replants itself. If one walks through the shady avenues between the rows of fully grown trees in February (Pl. II, fig. 1) the thousands of seed pods that are scattered over the carpet of dead leaves crackle under his feet, and he is prepared to understand the rapidity with which an area once cleared of trees grows up again.

On a field which had been cleared of wattles two and one-half months before, countless seedlings were springing up and some of them were already more than a foot and a half high. These naturally sown seedlings are allowed to grow until they form a thick mass covering the field, when they are thinned out most severely, and only rows 12 feet apart are left standing.

Although there may be some reproduction by sprouts from the stumps of the felled trees, the writer was informed that these sprouts were not counted on as important in the re-formation of the forest.

In fifteen months these somewhat irregular rows of trees are 18 feet high and present an appearance such as is shown in Plate I, figure 2. In four years from the time that the old forest is cut down, these rows of seedlings will have grown to such a height that they will require thinning out, and among the trees cut out in this process there are many which yield a fair quantity of bark.

Although at first thought this habit of natural seeding might seem a great advantage, it is said, on the contrary, that the cost of thinning out the seedlings is greater than the expense of planting a fresh plantation.

The greatest enemy of the wattle grower is the "grass fire." From the surrounding prairie such fires spread into the plantations and destroy them. To prevent this, nearly 50 miles of fire breaks made by plowing broad strips of prairie have been constructed about the

FIG. 1.—VIEW OF THE GRASSY UPLANDS OF NATAL WHERE WATTLES ARE GROWN.

FIG. 2.—YOUNG WATTLE PLANTATION, SELF-SOWN, FIFTEEN MONTHS OLD.

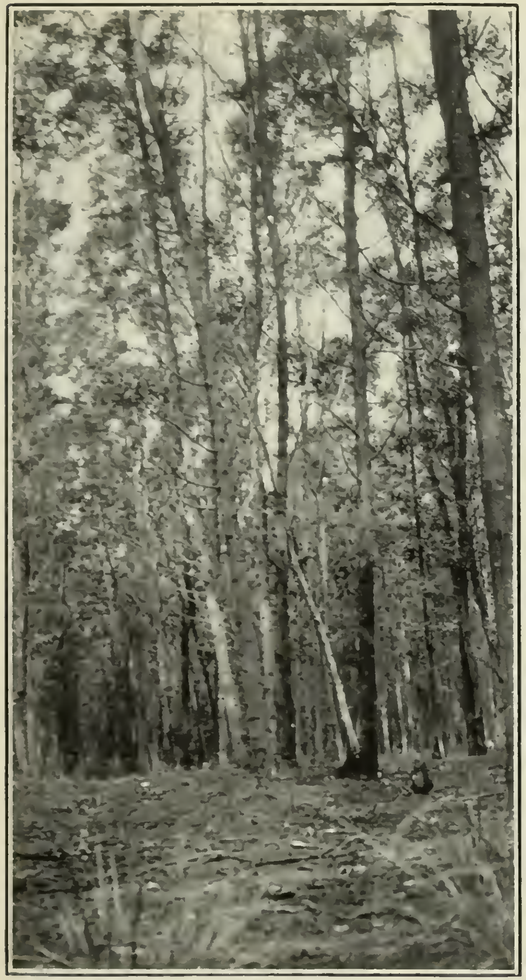

FIG. 1.—NINE-YEAR-OLD WATTLE FOREST.

FIG. 2.—STRIPPING THE BARK FROM A NINE-YEAR-OLD TREE.

FIG. 3.—THE RAILWAY THAT HAULS THE BARK.

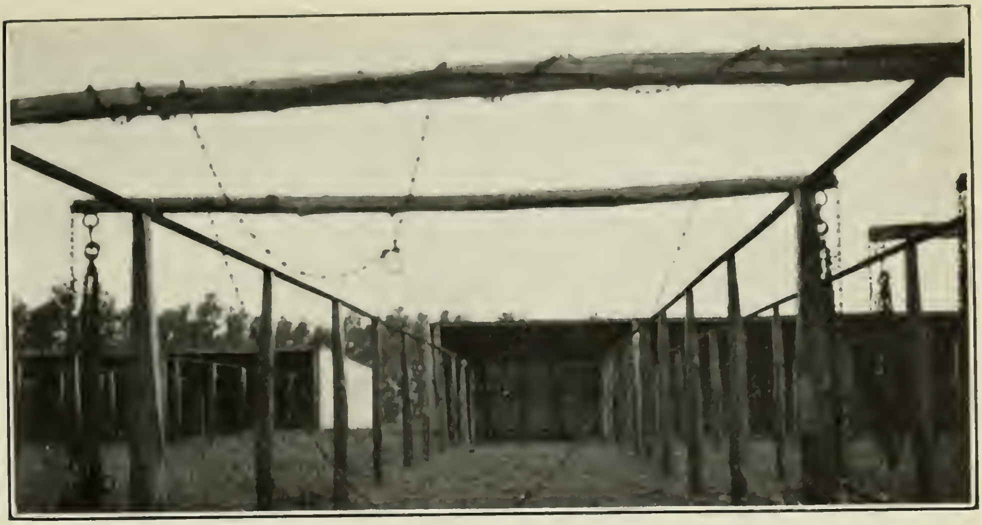

FIG. 1.—THE DRYING SHED, WITH ITS RUNWAYS FOR THE POLES.

FIG. 2.—THE RUNWAYS, WITH THEIR CHAINS AND POLES.

FIG. 3.—FRESHLY STRIPPED BARK HUNG UP TO DRY ON THE EDGE OF A CLEARING.

forests, and the expense of this adds materially to the original cost of establishing a wattle estate.

Two insect enemies of the wattle are a bagworm, which destroys great quantities of foliage and checks the growth of the trees, and the more destructive locust, which has retarded for over a year the growth of the trees on the Town Hill plantation. The former insects are collected and burned, and the plague of locusts is prevented by spreading about their breeding places poisoned molasses for the young to feed upon. A special locust expert is employed by the Natal government, and with his corps of laborers he poisons all the principal breeding places of the pest.

An industry which pays so well in the new country of Natal, and does not require a large amount of hand labor, sixty men being sufficient for 2,400 acres, is worthy of the attention of American cultivators. The climatic conditions seem favorable in Hawaii, but whether they are as favorable as they are in Natal, where it is claimed that the species grows more luxuriantly than in its native land, may be a question.

V. LEGAL AND CUSTOMARY WEIGHTS PER BUSHEL OF SEEDS.[a]

By Edgar Brown, *Botanist in Charge of Seed Laboratory, Botanical Investigations and Experiments.*

INTRODUCTION.

While the selling of seeds by the measured bushel has largely disappeared in the trade, the weight per bushel still has an important value in determining grade, especially in grass seeds, which vary greatly in quality. Redtop seed weighing 10 pounds per bushel is composed largely of chaff and contains a very small percentage of good seed, while fancy seed, containing from 85 to 95 per cent of pure seed, weighs from 35 to 40 pounds per bushel. Similar variations in weight exist in connection with the handling of other common grass seeds, such as bluegrass, orchard grass, brome-grass, rye-grass, and the fescues. The weights per bushel of grains do not vary as much as do those of grass seeds, but nevertheless the weight per bushel is an important factor to be considered in grading.

LEGAL WEIGHTS PER BUSHEL.

The weights per bushel for all seeds for which weights per bushel have been established by law are given in Table I. These have been taken from the latest statutes and have been verified by the secretary of state of each State. In several instances the legal weights are obviously misleading and should be changed. There is evidently an error in the Louisiana statute which gives the weight for both barley

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[a] The varying use in weights of our common field and garden seeds in different States must necessarily lead to confusion. It is hoped that a more widely disseminated knowledge of this varied usage, such as is pointed out in this paper, will tend to lessen the confusion and bring about greater uniformity. Furthermore, by calling attention to the present unsatisfactory conditions it may aid in preparing the way for the general introduction of the metric system now used in nearly all other civilized countries.

Lyster H. Dewey, *Acting Botanist.*

Office of Botanical Investigations and Experiments,
Washington, D. C., September 7, 1904.

and rye as 32 pounds. The weights for buckwheat vary from 40 to 52 pounds in different States. The legal weights for oats should be made more nearly uniform. In Pennsylvania and West Virginia the legal weight is 32 pounds; in Virginia 30 pounds, and in Maryland 26 pounds. The legal weight for Kentucky bluegrass and redtop in all States where a legal weight has been established is 14 pounds. This weight was established before the present methods of cleaning came into general use and while the seed was sold in the chaff. Cleaned seed of good grade weighs from two to three times as much, as recorded in detail in Table I, and the legal weights should be changed accordingly.

CUSTOMARY WEIGHTS PER BUSHEL.

In numerous instances the customary weights per bushel of seeds used by the trade are not the same as the legal weights. The boards of trade and chambers of commerce in the principal cities have reported the customary weights used by them, and where these differ from the legal weights they are given in the footnotes to Table I.

Seedsmen handle a large number of grass and forage plant as well as other seeds, for few of which legal weights per bushel have been established. Table II shows the customary weights per bushel used for these seeds by representative seedsmen in the different States. In most instances two weights are given, indicating the differences in quality recognized in the trade. Well-cleaned seed of good quality will weigh approximately as much as the higher weight given.

TABLE I.—*Legal weights per bushel of seeds.*

States and Territories.	Field crops.																	
	Wheat.	Corn, shelled.	Corn in ear.	Corn in ear, unshucked.	Oats.	Barley.	Rye.	Buckwheat.	Beans.	Peas.	Cotton, Upland.	Cotton, Sea Island.	Pop corn, shelled.	Pop corn in ear.	Hemp.	Flax.	Rice, rough.	Peanuts.
Alabama	60	56	70	75	32	47	56	....	60	60	32	....	....	....	....	....	...	....
Arizona	60	54	......	...	32	45	56	....	{ff60 / 55}	}	....	....	....	....	....	....	...	....
Arkansas [a]	60	56	70	74	32	48	56	52	gg 60	60	33⅓	....	....	....	....	56	...	....
California [b]	60	b52	......	...	b32	b50	b54	b40	......	....	....	....	....	....	....	....	...	....
Colorado [c]	60	56	70	...	32	48	56	c52	60	(c)	....	....	....	....	44	(c)	...	....
Connecticut	60	56	......	...	32	48	56	48	60	60	30	44	....	....	....	55	45	....
Delaware	60	56	......	...	....	....	....	....	......	....	....	....	....	....	....	....	...	....
District of Columbia [cc]	....	....	......	...	....	....	....	....	......	....	....	....	....	....	....	....	...	....
Florida	60	56	......	70	32	48	56	....	60	....	32	46	....	....	....	....	...	22
Georgia [d]	60	56	70	...	32	47	56	52	gg 60	60	30	....	....	....	44	56	43	....
Idaho	60	56	......	...	36	48	56	42	......	....	....	....	....	....	....	56	...	....
Illinois [ef]	60	56	70	...	32	48	56	52	gg 60	....	....	....	....	....	44	56	...	....
Indiana [g]	60	56	dd 70	...	32	48	56	50	60	....	....	....	(g)	70	44	....	...	....
Indian Territory [cc]	....	....	......	...	....	....	....	....	......	....	....	....	....	....	....	....	...	....
Iowa	60	56	70	...	32	48	56	52	60	....	....	....	....	....	44	56	...	....
Kansas	60	56	70	...	32	48	56	50	60	....	....	....	56	....	44	56	...	....
Kentucky [h]	60	56	ee 70	...	32	h47	56	56	gg 60	60	....	....	....	....	44	56	...	....
Louisiana [i]	60	i56	(i)	...	32	i32	i32	(i)	(i)	(i)	....	....	....	....	(i)	(i)	...	....
Maine	60	56	......	...	32	48	....	48	62	60	....	....	....	....	....	....	...	....
Maryland [j]	(j)	(j)	(j)	...	j26	(j)	(j)	(j)	(j)	(j)	....	....	....	....	(j)	(j)	...	(j)
Massachusetts [k]	60	56	......	...	32	48	56	48	60	60	30	44	....	....	....	55	45	....
Michigan	60	56	70	...	32	48	56	48	60	60	....	....	....	....	44	56	...	....
Minnesota [lm]	l60	56	70	...	32	m48	56	50	60	60	....	....	....	....	50	(l)	...	....
Mississippi [n]	60	56	72	...	32	48	56	48	gg 60	60	n32	....	....	....	44	56	...	....
Missouri [o]	60	56	70	...	32	48	56	52	60	60	33	....	....	....	44	56	...	(o)
Montana	60	56	70	...	32	48	56	52	60	60	....	....	....	....	44	56	...	....
Nebraska [p]	60	56	70	...	32	48	56	52	gg 60	60	....	....	....	....	44	56	...	....
Nevada [cc]	....	....	......	...	....	....	....	....	......	....	....	....	....	....	....	....	...	....
New Hampshire	60	56	......	...	32	....	56	....	62	60	....	....	....	....	....	....	...	....
New Jersey	60	56	......	...	30	48	56	50	60	60	....	....	....	....	....	55	...	....
New Mexico [cc]	....	....	......	...	....	....	....	....	......	....	....	....	....	....	....	....	...	....
New York [qr]	60	56	......	...	32	48	56	48	60	60	30	44	....	....	....	r55	45	....
North Carolina	60	56	......	...	32	48	56	50	......	60	30	....	....	....	....	55	44	....
North Dakota	60	56	70	...	32	48	56	42	60	60	....	....	....	....	....	56	...	....
Ohio [stu]	60	56	68	...	32	48	56	50	60	u60	....	....	....	t42	44	56	...	(u)
Oklahoma	60	56	70	...	32	48	56	42	60	60	....	....	....	....	....	56	...	....
Oregon	60	56	......	...	32	46	56	42	......	....	....	....	....	....	....	....	...	....
Pennsylvania [v]	60	56	......	...	32	v47	56	48	......	....	....	....	....	....	....	....	...	....
Rhode Island	60	56	70	...	32	48	56	48	60	60	30	44	....	....	44	56	...	....
South Carolina [w]	....	....	......	...	....	....	....	....	......	....	30	w42	....	....	....	....	...	....
South Dakota	60	56	70	...	32	48	56	42	60	60	....	....	....	....	....	56	...	....
Tennessee	60	56	70	74	32	48	56	50	60	60	28	....	....	70	44	56	...	23
Texas [xy]	60	56	70	72	32	48	56	42	gg 60	....	32	....	....	....	44	56	...	....
Utah [cc]	....	....	......	...	....	....	....	....	......	....	....	....	....	....	....	....	...	....
Vermont	60	56	......	...	32	48	56	48	62	60	....	....	....	....	....	....	...	....
Virginia [z]	60	56	70	...	z30	48	56	52	gg 60	....	32	....	....	....	44	56	...	22
Washington [aa]	60	56	......	...	32	48	56	42	......	....	....	....	....	....	....	56	...	....
West Virginia	60	56	......	...	32	48	56	52	60	....	....	....	....	....	....	56	...	....
Wisconsin [bb]	60	56	(bb)	...	32	48	56	50	60	60	30	44	....	....	44	56	45	....
Wyoming [cc]	....	....	......	...	....	....	....	....	......	....	....	....	....	....	....	....	...	....

TABLE 1.—*Legal weights per bushel of seeds*—Continued.

States and Territories.	Grass and forage plants.													
	Clover.	Timothy.	Herd's grass.	Hungarian grass.	Millet.	Japanese barnyard millet.	Canary seed.	Bluegrass.	Redtop.	Orchard grass.	Amber cane.	Sorghum.	Kafir corn.	Johnson grass.
Alabama	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Arizona	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Arkansas[a]	60	60	....	....	50	....	....	14	14	14	....	50	....	28
California[b]	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Colorado[c]	60	45	....	(c)	(c)	....	....	14	(c)	(c)	(c)	....	(c)	(c)
Connecticut	60	45	45	....	....	....	....	....	....	....	....	....	....	....
Delaware	....	....	....	....	....	....	....	....	....	....	....	....	....	....
District of Columbia[cc]	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Florida	....	....	....	....	50	....	....	....	....	....	....	56	....	....
Georgia[d]	60	45	....	....	....	....	....	14	....	....	....	....	....	....
Idaho	60	....	....	....	....	....	....	....	....	....	....	....	....	....
Illinois[ef]	60	45	....	....	....	....	....	14	....	....	....	....	....	....
Indiana[g]	60	45	....	....	50	....	....	14	....	14	....	....	....	....
Indian Territory[cc]	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Iowa	60	45	....	50	50	....	....	14	....	....	....	30	....	....
Kansas	60	45	....	50	50	....	....	14	....	....	....	56	56	....
Kentucky[h]	60	45	....	50	50	....	....	14	....	14	....	....	....	....
Louisiana[i]	(i)	(i)	....	(i)	(i)	....	(i)	(i)	....	(i)	....	(i)	....	(i)
Maine	....	....	45	....	....	....	....	....	....	....	....	....	....	....
Maryland[j]	(j)	(j)	....	(j)	(j)	....	....	(j)	(j)	(j)	....	....	....	....
Massachusetts[k]	60	45	45	....	....	35	....	....	....	....	....	....	....	....
Michigan	60	45	....	50	50	....	....	14	14	14	....	....	....	....
Minnesota[lm]	60	45	....	48	48	....	....	14	14	14	....	57	....	....
Mississippi[n]	60	45	....	50	50	....	....	14	....	....	....	42	....	....
Missouri[o]	60	45	....	48	50	....	....	14	14	14	....	42	....	....
Montana	60	45	....	50	....	....	....	14	....	....	....	....	....	....
Nebraska[p]	60	45	....	50	50	....	....	14	....	....	....	[p]30	....	....
Nevada[cc]	....	....	....	....	....	....	....	....	....	....	....	....	....	....
New Hampshire	....	....	....	....	....	....	....	....	....	....	....	....	....	....
New Jersey	64	....	....	....	....	....	....	....	....	....	57	....	....	....
New Mexico[cc]	....	....	....	....	....	....	....	....	....	....	....	....	....	....
New York[qr]	60	45	45	....	....	....	....	(r)	(r)	(r)	....	....	....	....
North Carolina	60	....	....	....	....	....	....	....	....	....	....	....	....	....
North Dakota	60	42	....	....	50	....	....	....	....	....	....	....	....	....
Ohio[stu]	60	45	....	[s]50	[u]50	....	(u)	(u)	(u)	(u)	(u)	(u)	(u)	....
Oklahoma	60	42	....	....	....	....	....	....	....	....	....	....	....	....
Oregon	60	....	....	....	....	....	....	....	....	....	....	....	....	....
Pennsylvania[v]	60	....	....	....	....	....	....	....	....	....	....	....	....	....
Rhode Island	60	45	....	50	50	....	....	....	....	....	....	....	....	....
South Carolina[w]	....	....	....	....	....	....	....	....	....	....	....	....	....	....
South Dakota	60	42	....	....	....	....	....	....	....	....	....	....	....	....
Tennessee	60	45	....	48	[hh]50	....	60	14	14	14	....	50	....	....
Texas[xy]	60	45	....	48	50	....	....	....	....	....	....	....	....	....
Utah[cc]	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Vermont	60	45	45	....	....	....	....	....	....	....	....	....	....	....
Virginia[z]	60	45	....	48	50	....	....	14	12	14	....	....	....	....
Washington[aa]	60	....	....	....	....	....	....	....	....	....	....	....	....	....
West Virginia	60	45	....	....	....	....	....	....	....	....	....	....	....	....
Wisconsin[bb]	60	45	....	48	50	....	....	....	....	....	....	....	....	....
Wyoming[cc]	....	....	....	....	....	....	....	....	....	....	....	....	....	....

TABLE 1.—*Legal weights per bushel of seeds*—Concluded.

States and Territories.	Grass and forage plants.								Miscellaneous.								
	English bluegrass.	Italian rye-grass.	Velvet grass.	Rape.	Soy beans.	Cowpeas.	Velvet beans, in hull.	Beggar weed.	Broom corn.	Spelt.	Castor beans.	Osage orange.	Indian wheat.	Apple seed.	Chestnuts.	Hickory nuts.	Walnuts.
Alabama																	
Arizona																	
Arkansas [a]									48								
California [b]																	
Colorado [c]	(c)								(c)								
Connecticut																	
Delaware																	
District of Columbia [cc]																	
Florida							78	62			48						
Georgia [d]																	
Idaho																	
Illinois [ef]											46						
Indiana [g]											46	33					
Indian Territory [cc]																	
Iowa									30		46	32					
Kansas	22										46						
Kentucky [h]	14										45						
Louisiana [i]	(i)	(i)		(i)		(i)			(i)		(i)	(i)					
Maine																	
Maryland [j]																	
Massachusetts [k]					58												
Michigan											46	33					
Minnesota [lm]				50					57								
Mississippi [n]											46						
Missouri [o]											46	36				(o)	(o)
Montana																	
Nebraska [p]											46	32					
Nevada [cc]																	
New Hampshire																	
New Jersey																	
New Mexico [cc]																	
New York [qr]																	
North Carolina																	
North Dakota									30	48							
Ohio [stu]									(u)		(u)	(u)					
Oklahoma									30								
Oregon																	
Pennsylvania [v]																	
Rhode Island											46			40			
South Carolina [w]																	
South Dakota									30								
Tennessee		20	7						42		46	33		40	50	50	50
Texas [xy]																	
Utah [cc]																	
Vermont													46				
Virginia [z]						60						34			57		
Washington [aa]																	
West Virginia																	
Wisconsin [bb]				50													
Wyoming [cc]																	

[a] The Little Rock Board of Trade uses the legal weights per bushel for the State of Arkansas.

[b] The Merchants' Exchange of San Francisco uses the legal weight per bushel for the State of California for wheat. It also uses the following weights per bushel for the commodities named below:

	Pounds.
Barley:	
Brewing	46
Chevalier	53
Feed	41
Buckwheat	50
Corn, shelled	56
Oats:	
Black feed	30
Red feed	33
White feed	35
White milling	37
Rye	58

c The Denver Chamber of Commerce and Board of Trade uses the legal weights per bushel for the State of Colorado, except for buckwheat. It also uses the following weights per bushel for the commodities named below:

	Pounds.
Alfalfa	60
Amber cane	50
Broom corn	46
Buckwheat	50
Flax	56
Hungarian millet (Hungarian grass)	48
Johnson grass	25
Kafir corn	56
Meadow fescue (English bluegrass)	24
Millet	50
Orchard grass	14
Peas	60
Redtop	14
Redtop, fancy	32
Sweet corn	50

d The Columbus Board of Trade uses the legal weights per bushel for the State of Georgia.

e The Chicago Board of Trade uses the legal weights per bushel for the State of Illinois.

f The Peoria Board of Trade uses the legal weights per bushel for the State of Illinois.

g The Indianapolis Board of Trade uses the legal weights per bushel for the State of Indiana. It also uses 56 pounds as the weight per bushel for shelled pop corn.

h The Louisville Board of Trade uses the legal weights per bushel for the State of Kentucky, except for barley, for which it uses the weight per bushel of 48 pounds.

i The New Orleans Board of Trade uses the legal weights per bushel for the State of Louisiana for wheat, shelled corn, and oats. It also uses the following weights per bushel for the commodities named below:

	Pounds.
Alfalfa	60
Barley	48
Beans	60
Broom corn	46
Buckwheat	48
Bur clover	8
Canary seed	60
Castor beans	46
Clover:	
Alsike	60
Crimson	60
Red	60
White	60
Corn:	
In ear	70
Shelled, Adams	50
Cowpeas	60
Flax	56
Hemp	44
Hungarian grass	48
Japan clover	25
Johnson grass	25
Kentucky bluegrass	14
Meadow fescue (English bluegrass)	15
Meadow oat-grass	14
Millet:	
German	50
Italian	50
Mustard	58
Orchard grass	14
Osage orange	33
Peas, English:	
Smooth	60
Wrinkled	56
Radish	50
Rape	50
Rescue grass	14
Rye	56
Rye-grass:	
English	20
Italian	20
Sorghum	50
Sunflower, Russian	24
Teosinte	59
Timothy	45
Turnip	58
Vetch	60

j The Baltimore Chamber of Commerce uses the following weights per bushel for the commodities named below:

	Pounds.
Barley	48
Beans	62
Beans (State)	60
Bluegrass	14
Buckwheat	48
Clover	60
Corn:	
On cob	70
Shelled	56
Flax	56
Hemp	44
Hungarian grass	48
Millet:	
American	50
German	50
Oats	32
Oats (State)	26
Orchard grass	14
Peanuts:	
African	32
Virginia	22
Wilmington	28
Peas	60
Peas (State)	56
Redtop:	
Chaff	14
Fancy	32
Rye	56
Timothy	45
Wheat	60

k The Boston Chamber of Commerce uses the legal weights per bushel for the State of Massachusetts.

l The Duluth Board of Trade uses the legal weights per bushel for the State of Minnesota. It also uses the following weights per bushel for the commodities named below:

	Pounds.
Flax	56
Macaroni (durum) wheat	60

m The Minneapolis Chamber of Commerce uses the legal weights per bushel for the State of Minnesota, except for barley, for which it uses the weight per bushel of 50 pounds.

n The Meridian Board of Trade uses $33\frac{1}{3}$ pounds as the weight per bushel for cotton seed.

o The Merchants' Exchange of St. Louis uses the legal weights per bushel for the State of Missouri and also uses the following weights per bushel for the commodities named below:

	Pounds.
Hickory nuts	50
Peanuts, dry southern	22
Walnuts	50

p The Omaha Board of Trade uses the legal weights per bushel for the State of Nebraska, except for sorghum, for which it uses the weight per bushel of 50 pounds.

q The Buffalo Merchants' Exchange uses the legal weights per bushel for the State of New York.

r The New York Produce Exchange uses the legal weights per bushel for the State of New York, except for flax. It also uses the following weights per bushel for the commodities named below:

	Pounds.		Pounds.
Bluegrass	14	Orchard grass	14
Flax	56	Redtop	14

s The Cincinnati Chamber of Commerce and Merchants' Exchange uses the legal weights per bushel for the State of Ohio, except for Hungarian grass, for which it uses the weight per bushel of 48 pounds.

t The Cleveland Chamber of Commerce uses the legal weights per bushel for the State of Ohio, except for pop corn, in ear, for which it uses the weight per bushel of 40 pounds.

u The Columbus Board of Trade uses the legal weights per bushel for the State of Ohio. It also uses the following weights per bushel for the commodities named below:

	Pounds.		Pounds.
Bluegrass	14	Osage orange	33
Broom corn	46	Peanuts	24
Canary seed	60	Pearl millet	56
Cane	50	Peas, wrinkled	56
Castor beans	46	Redtop	14
Japan clover	20	Sorghum	50
Kafir corn	50	Sweet vernal grass	10
Meadow foxtail	25	Tall meadow oat-grass	12
Orchard grass	14	Wood meadow grass	14

v The Philadelphia Produce Exchange uses the legal weights per bushel for the State of Pennsylvania, except for barley, for which it uses the weight per bushel of 48 pounds.

w The Columbia Chamber of Commerce uses the weight per bushel of 45 pounds for Sea Island cotton seed.

x The Galveston Cotton Exchange uses the legal weights per bushel for the State of Texas.

y The Fort Worth Board of Trade uses the legal weights per bushel for the State of Texas.

z The Richmond Grain and Cotton Exchange uses the weight per bushel of 32 pounds for oats.

aa The Seattle Chamber of Commerce uses the legal weights per bushel for the State of Washington.

bb The Milwaukee Chamber of Commerce uses the legal weights per bushel for the State of Wisconsin. For corn, on cob, it also uses the weight per bushel of 75 pounds from harvest to January 1 and 70 pounds after January 1.

cc No legal weights.

dd "From harvest until December 1, 70 pounds; after December 1, 68 pounds."

ee "From November 1 to May 1, 70 pounds; from May 1 to November 1, 68 pounds."

ff "Small white beans, 60 pounds; other beans, 55 pounds."

gg "White beans."

hh "German, Tennessee, and Missouri millet."

TABLE 11.—*Seedsmen's customary weights per bushel of seeds.*

Kind of seed.	Pounds per bushel.
Alfalfa	60
Amber cane	45–60
Bent grass:	
Creeping	10–20
Rhode Island	10–15
Bermuda grass	24–36
Bird's-foot clover	60
Bitter vetch	60
Bluegrass:	
Canada	14–20
Kentucky	14–30
Texas	14
Broad bean	50–60
Brome, awnless	10–14
Broom corn	45–60
Bur clover:	
Hulled	60
Unhulled	8–10
Spotted	60
Castor bean	46–60
Clover:	
Alsike	60
Crimson	60
Egyptian	60
Mammoth	60
Red	60
White	60
Cowpea	56–60
Crested dog's-tail	14–30
Fescue:	
Hard	12–16
Meadow	14–24
Red	12–15
Sheep's	12–16
Tall	14–24
Various leaved	14–18
Flat pea	50–60
Flax	48–56
Hemp	40–60
Japan clover:	
Hulled	60
Unhulled	18–25
Johnson grass	14–28
Kafir corn	50–60
Lentil	60
Lupine, white	50–60
Meadow foxtail	7–14
Meadow grass:	
Fowl	11–14
Rough-stalked	14–20
Meadow grass—continued.	
Wood	14–24
Millet:	
Barnyard	30–60
Broom corn	45–60
Common	48–50
German	48–50
Golden Wonder	48–50
Hungarian	48–50
Pearl	48–56
Milo maize	50–60
Oat-grass:	
Tall	10–14
Yellow	7–14
Orange cane	45–60
Orchard grass	10–18
Pea:	
Field	60
Garden, smooth	60
Garden, wrinkled	56
Peanut	20–30
Rape, winter	50–60
Redtop:	
Chaff	10–14
Fancy	25–40
Rescue grass	12–28
Rice	43–45
Rye-grass:	
English	10–30
Italian	14–25
Sainfoin	14–32
Serradella	28–36
Soy bean	58–60
Spelt	40–60
Sunflower	24–50
Sweet clover:	
Hulled	60
Unhulled	33
Sweet corn (according to variety)	36–56
Sweet vernal, perennial	6–15
Teosinte	40–60
Timothy	45
Velvet bean	60
Vetch:	
Hairy	50–60
Spring	60
Water grass, large	14
Wild rice	15–28
Yellow trefoil	60

VI.—GOLDEN SEAL.[a]

By Alice Henkel, *Assistant*, and G. Fred Klugh, *Scientific Assistant, Drug and Medicinal Plant Investigations, Botanical Investigations and Experiments.*

HISTORY.

As in the case of many other native medicinal plants, the early settlers learned of the virtues of golden seal through the American Indians, who used the root as a medicine and the yellow juice as a stain for their faces and a dye for their clothing.

The Indians regarded golden seal as a specific for sore and inflamed eyes, and it was a very popular remedy with the pioneers of Ohio and Kentucky for this affection and also for sore mouth, the root being chewed for the relief of the last-named trouble. In the herbarium collected by Captains Lewis and Clark on their expedition to the source of the Missouri and across the country to the Pacific coast, a specimen of golden seal collected May 24, 1804, bears some notes in the handwriting of Captain Lewis concerning the use of this plant in "Kentucky and many other parts of the western country." He states that it is said to be a sovereign remedy for sore eyes, describing the nature of this disorder and giving also the method of preparing and applying this remedy. He states, further, that it makes an "excellent mouth water."

[a] The increasing use of golden seal in medicine has resulted in a wide demand for information about the plant, its identification, geographical distribution, the conditions under which it grows, methods of collecting and preparing the rhizomes, relations of supply and demand, and the possibilities of its cultivation. This paper, with the exception of the part relating to cultivation, was prepared (under the direction of Dr. Rodney H. True, Physiologist in Charge of Drug and Medicinal Plant Investigations) by Miss Alice Henkel, Assistant in Drug and Medicinal Plant Investigations; and Mr. G. Fred Klugh, Scientific Assistant in the same office, in charge of cultural experiments in the Testing Gardens, furnished the part treating of the cultivation of this plant. In the preparation of this paper, which was undertaken to meet the demand for information relative to golden seal, now fast disappearing from our forests, many facts have been obtained from Lloyds' Drugs and Medicines of North America.

Lyster H. Dewey, *Acting Botanist.*

Office of Botanical Investigations and Experiments,
Washington, D. C., September 7, 1904.

Barton, in his "Collections for an Essay towards a Materia Medica of the United States," 1804, speaks of the use of a spirituous infusion of the root of golden seal as a tonic bitters in the western part of Pennsylvania, and of the employment of an infusion of the root in cold water as a wash for inflammation of the eyes.

According to Dr. C. S. Rafinesque, in his Medical Flora in 1828, the Indians also employed the juice or infusion for many "external complaints, as a topical tonic," and that "some Indians employ it as a diuretic, stimulant, and escharotic, using the powder for blistering and the infusion for the dropsy." He states further that "internally it is used as a bitter tonic, in infusion or tincture, in disorders of the stomach, the liver," etc.

It was not until a demand was created for golden seal by the eclectic school of practitioners, about 1847, that it became an article of commerce, and in 1860 the root was made official in the Pharmacopœia of the United States, which place it has held to the present day.

HABITAT AND RANGE.

Golden seal occurs in patches in high open woods where there is plenty of leaf mold, and usually on hillsides or bluffs affording natural drainage, but it is not found in very moist or swampy situations, in prairie land, or in sterile soil. It is native from southern New York to Minnesota and western Ontario, south to Georgia and Missouri, ascending to an altitude of 2,500 feet in Virginia. It is now becoming scarce throughout its range. Not all of this region, however, produced golden seal in abundance. Ohio, Indiana, Kentucky, and West Virginia have been the greatest golden-seal producing States, while in some localities in southern Illinois, southern Missouri, northern Arkansas, and central and western Tennessee the plant, though common, could not be said to be sufficiently plentiful to furnish any large amount of the root. In other portions of its range it is sparingly distributed.

COMMON NAMES.

Many common names have been applied to this plant in different localities, most of them bearing some reference to the characteristic yellow color of the root, such as yellowroot, yellow puccoon, orangeroot, yellow paint, yellow Indian paint, Indian paint, golden root, Indian dye, curcuma, wild curcuma, Ohio curcuma, wild turmeric, Indian turmeric, jaundice root, and yellow eye; other names are eyebalm, eyeroot, and ground raspberry. Yellowroot, a popular name for it, is misleading, as it has been applied to other plants also, namely, to goldthread, false bittersweet, twinleaf, and the yellowwood. The name golden seal, derived from its yellow color and the seal-like scars on the root, has been, however, generally adopted.

DESCRIPTION OF THE PLANT.

Golden seal (*Hydrastis canadensis* L.) belongs to the same family as the buttercup, namely, the crowfoot family (Ranunculaceæ). It is a perennial plant, and the thick yellow rootstock sends up an erect, hairy stem about a foot in height, around the base of which are two or three yellowish scales. The stems as they emerge from the ground are bent over, the tops still remaining under ground, and sometimes the stems show some distance above the surface before the tops are brought out from the soil. The yellow color of the roots and scales extends partly up the stem so far as it is covered by soil, while the portion of the stem above ground has a purplish color. Golden seal has only two leaves (rarely three), the stem bearing these seeming to fork at the top, one branch supporting a large leaf and the other a smaller one and a flower. Occasionally there is a third leaf, much smaller than the other two and stemless. The leaves are prominently veined on the lower surface, and are palmately 5 to 9 lobed, the lobes broad, acute, sharply and unequally toothed. The leaves are only partially developed at flowering time and are very much wrinkled, but they continue to expand until they are from 6 to 8 inches in diameter, becoming thinner in texture and smoother. The upper leaf subtends or incloses the flower bud. (Pl. IV, fig. 1.)

Early in spring, about April or May, the flower appears, but few ever see it, as it lasts only five or six days. It is greenish-white, less than half an inch in diameter, and has no petals, but instead three small petal-like sepals, which fall away as soon as the flower expands, leaving only the stamens—as many as 40 or 50—in the center of which are about a dozen pistils, which finally develop into a round, fleshy, berry-like head. The fruit ripens in July or August, turning a bright red and resembling a large raspberry, whence the common name *ground raspberry* is derived. Each fruit contains from 10 to 20 small, black, shining, hard seeds. (Pl. IV, fig. 2.)

If the season has been moist, the plant sometimes persists to the beginning of winter, but if it has been a dry season it dies down soon after the fruit is ripe, so that by the end of September no trace of the plant remains above ground. In a patch of golden seal there are always many sterile stems, simple and erect, bearing a solitary leaf at the apex, but no flower.

Mr. Homer Bowers,[a] of New Ross, Ind., who propagated golden seal from the seed for the purpose of studying its germination and growth, states that the plant grown from naturally sown seed often escapes observation during the first year of its existence owing to the fact that in this entire period nothing but two round seed leaves are

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[a] A Contribution to the Life History of Hydrastis Canadensis, Bot. Gaz., 16:73–82, 1891.

produced (fig. 2), and at this stage the plant does not look materially different from other young seedlings. During its second year from seed one basal leaf is sent up (fig. 3), followed in the third year by another smaller leaf and the flower.

DESCRIPTION OF THE RHIZOME, OR ROOTSTOCK.

The rhizome (rootstock) and rootlets of golden seal, or hydrastis, as it is also known in the drug trade, are the parts employed in medicine. The full-grown rhizome, when fresh, is of a bright yellow color both internally and externally, about 1½ to 2½ inches in length and from one-fourth to three-fourths of an inch in thickness. Fibrous yellow

FIG. 2.—Golden seal seedling at the end of the first season's growth.

FIG. 3.—Golden seal, second year from the seed.

FIG. 4.—Rhizome, or rootstock, of golden seal.

rootlets are produced from the sides of the rhizome. (Fig. 4.) The fresh rhizome contains a large amount of yellow juice, and gives off a rank, nauseating odor. When dry the rhizome measures from 1 to 2 inches in length and from one-eighth to one-third of an inch in diameter. It is crooked, knotty, wrinkled, of a dull brown color outside, and breaks with a clean, short, resinous fracture, showing a lemon-yellow color if the root is not old. If the dried root is kept for a long time it will be greenish yellow or brown internally, and becomes inferior in quality. On the upper surface of the rhizome are several depressions, left by former annual stems, which resemble the imprint of a seal; hence the name golden seal. The fibrous rootlets become very wiry and brittle in drying, breaking off readily and leaving only small protuberances, so that the root as found in commerce is sometimes almost bare. The dried rhizome also has a peculiar, somewhat narcotic, disagreeable odor, but not so pronounced as in the fresh material; an exceedingly bitter taste; and a persistent acridity which causes an abundant flow of saliva when the rhizome is chewed. The most important constituents of the rhizome are the three alkaloids—hydrastin, berberin, and canadin. It contains also starch, albuminous matter, resin, sugar, fatty matter, and inorganic salts.

Hydrastis acts chiefly upon the mucous membranes and glandular system, and to some extent upon the nervous system. It is a valuable drug in disordered conditions of the digestive organs and in catarrhal affections of any of the mucous membranes when unaccompanied with acute inflammation. In the various diseases of the mucous membranes it is administered both internally and locally. Hydrastis imparts its properties to water, glycerin, or alcohol.

COLLECTION AND PREPARATION OF THE ROOT.

The root should be collected in autumn after the plants have matured seed. Spring-dug root shrinks far more in drying and always commands a lower price than the fall-dug root. After the roots are removed from the earth they should be carefully freed from soil and all foreign particles. They should then be sorted, and small, undeveloped roots and broken pieces may be laid aside for replanting. After the roots have been cleaned and sorted they are ready to be dried or cured. Great care and judgment are necessary in drying the roots. It is absolutely necessary that they should be perfectly dry before packing and storing, as the presence of moisture induces the development of molds and mildews, and of course renders them worthless. The roots are dried by exposure to the air, being spread out in thin layers on drying frames or upon a large, clean, dry floor. They should be turned several times during the day, repeating this day after day until the roots are thoroughly dried. If dried out of doors they should be placed under cover upon indication of rain and at night, so that they may not be injured by dew. After the roots are thoroughly dried they may be packed as tightly as possible in dry sacks or barrels, and they are then ready for shipment.

DIMINUTION OF SUPPLY.

Although, perhaps, in some secluded localities golden seal may still be found rather abundantly, the supply is rapidly diminishing, and there is a growing scarcity of the plant throughout its range. With the advance of civilization and increase in population came a growing demand for many of our native medicinal plants and a corresponding decrease in the sources of supply. As the rich forest lands of the

Ohio Valley and elsewhere were required for the needs of the early settlers they were cleared of timber and cultivated, and the golden seal, deprived of the shelter and protection necessary to its existence, gradually disappeared, as it will not thrive on land that is cultivated. Where it was not destroyed in this manner the root diggers, diligently plying their vocation, did their share toward exterminating this useful little plant, which they collected, regardless of the season, either before the plants had made much growth in spring or before the seeds had matured and been disseminated, thus destroying all means of propagation. The demand for the root appears to be increasing, and the time seems to be not far distant when this plant will have become practically exterminated, so far as the drug supply is concerned. The cultivation of golden seal seems now to have become a necessity in order to meet the demand and save the plant from extinction. Prior to 1900 there seemed to be no one, so far as the Department of Agriculture could ascertain, who had ever attempted the cultivation of golden seal for the market. From that time on, many inquiries were directed to the Department by persons who were quick to note the upward tendency of prices for golden seal, and there are now several growers in different parts of the country who have undertaken the cultivation of golden seal on a commercial scale.

CULTIVATION.

The United States Department of Agriculture has been carrying on experiments in the cultivation of golden seal on a small scale at Washington, D. C., since the spring of 1899, in the hope that methods might be worked out according to which this valuable wild drug plant could be grown on a commercial scale. In these experiments the aim has been to imitate the natural conditions of growth as closely as possible. The results that have thus far been obtained, while not as complete in some respects as would be desirable, seem to justify the conclusion that golden seal can be successfully cultivated. The methods of operation described apply to the conditions at Washington, and the treatment may need to be somewhat modified under other conditions of soil and climate.

NECESSARY SOIL CONDITIONS.

The soil conditions should imitate as closely as possible those seen in thrifty deciduous forests. The soil should contain an ample supply of humus, well worked into the ground, to secure the lightness and moisture-retaining property of forest soils. The best form of humus is probably leaf mold, but good results may be obtained by mulching in the autumn or early winter with leaves, straw, stable manure, or similar materials. After the soil has been prepared and planted, it is well to add a mulch in the fall as a partial protection to the roots during the winter, and the decay of this material adds to the value of the soil by the time the plants appear in the spring. The forest conditions are thus imitated by the annual addition of vegetable matter to the soil, which by its gradual decay accumulates an increasing depth of a soil rich in materials adapted to the feeding of the plants and to the preservation of proper physical conditions. The growth of weeds is also hindered to a considerable extent. If sufficient attention is given to the presence of this mulch, the nature of the underlying soil is of less importance than otherwise. In the case of clay the thorough incorporation of a large amount of decayed vegetable matter tends to give lightness to the otherwise heavy soil, facilitating aeration and drainage. Since the roots of the golden seal do not grow well in a wet soil, thorough drainage is necessary. A lighter, sandy soil is improved by the addition of humus, since its capacity to hold moisture is thereby increased and the degree of fertility is improved. The looser the soil, the easier it is to remove the roots in digging without breaking or injuring them. Before planting, the soil should be thoroughly prepared to a depth of at least 6 or 8 inches, so as to secure good aeration and drainage. The good tilth thus secured will be in a degree preserved by the continued addition of a mulch. A further advantage of a careful preparation is seen in a decrease in the amount of cultivation required later.

FERTILIZERS.

The fertilizers that may be used with profit in the growing of golden seal have not yet been determined, but it is probable that potash and phosphates would increase the yield, especially if the soil is light. So far as is known, no preference can be given to any particular compounds of either potash or phosphoric acid. Two hundred pounds of kainit, or 50 pounds of muriate of potash and from 200 to 300 pounds of superphosphate per acre would in all probability prove useful. The nitrogen is supplied by the humus and need not be added in concentrated form.

ARTIFICIAL SHADE.

Since the golden seal grows naturally in the woods, it must be protected from the full light of the sun by artificial shade. That used in connection with the experiments of the Department was made of ordinary pine plastering lath nailed to a suitable frame elevated on posts. The posts were of cedar 8½ feet long, set 2½ feet in the ground in rows 11 feet apart, and 16 feet distant from each other in the rows. Supports 2 by 4 inches were set on cedar blocks 2 feet long sunk below the soil surface in the middle of the 16-foot spaces. Pine pieces 2 by

4 inches were nailed edgewise to the tops of the posts and supports. The posts were notched to receive the 2 by 4 inch sticks. Pieces 2 by 4 inches were nailed across these at intervals of 4 feet. The laths were nailed to these, leaving spaces about an inch wide.

This shade has been found to be satisfactory, as it is high enough above the ground to allow such work as is necessary in preparing and cultivating the land. If the lathing is extended 2 or 3 feet beyond the posts on the sunny sides, injury from the sun's rays at the edges of the area will be prevented. The sides may be protected by portable board walls about 2 feet high set around the edges. Protection from injury by winds when the tops are large may be thus secured. Too much dampness should be guarded against in the use of the board sides, since conditions might be developed favorable to the damping-off fungus and to aphides during the hot rainy periods.

The cost of lath shade over a tenth of an acre, at Washington, was probably considerably greater than will be necessary in districts where lumber is cheaper. The lumber will probably cost from $500 to $700 per acre, and the labor of the farm can be utilized at times when other work is not pressing.

USE OF TREES AS SHADE.

Trees may be used for shade, but this is in some ways to be regarded as unsatisfactory. When the shade produced is of the right density, the use of the moisture and raw food materials of the soil by the trees is an undesirable feature.

ATTENTION REQUIRED.

The cultivation of golden seal is simple. Having secured a deep, loose soil, rich in humus renewed annually by the application of a new mulch, the removal of weeds is the chief care. The soil, if properly prepared, will tend to maintain itself in good condition. The manner of treatment is very similar to that required by ginseng, which is also a plant of the moist woods. If the ground is thoroughly prepared, beds are not absolutely necessary. The plants may be grown in rows 1 foot apart and 6 inches apart in the rows. Beds may be thought by some to be more convenient, enabling the grower to remove the weeds and collect the seed more readily. If beds are used, they may be made from 4 to 8 feet wide, running the entire length of the shade, with walks from 18 inches to 2 feet wide between. Boards 6 or 8 inches wide are set up around the sides of the beds, being held in place by stakes driven on each side of the boards in the center and at the ends. These beds are filled with prepared soil, and the plants are set 8 inches apart each way.

METHODS OF PROPAGATION.

There are three possible ways of propagating the plant: (1) By seed; (2) by division of the rhizomes; (3) by means of small plants formed on the stronger fibrous roots (fig. 5). Thus far no success has been attained in growing golden seal from the seed. The second and third methods have given better results.

EXPERIMENTS WITH SEEDS.

Seeds just after ripening were planted in sandy soil mixed with well-rotted stable manure and mulched lightly with manure. Other lots were kept over winter in a dry condition and planted in the spring in potting soil in a greenhouse. No seedlings have appeared, but a long rest period may be demanded and the seed may yet germinate.

FIG. 5.—Plant formed from bud on fibrous root of golden seal.

EXPERIMENTS WITH DIVIDED RHIZOMES.

In the spring of 1902, 40 plants were secured and planted under a shade of a temporary character, but the season was too far advanced to permit of much growth during that year. In 1903, proper shade was supplied, all other conditions were better, and the plants made a good growth. The crop was dug about the middle of November, 1903; the roots were weighed and divided. They were again planted, and in May, 1904, there were found to be 150 strong plants and a few smaller ones as a result of this division, an increase of 275 per cent. This method of propagation seems to be the most important and the other two of secondary importance. The processes are simple and no skill is needed. The plant dies down in late summer and the stem decays, leaving a scar in its place on the rhizome. Two or more buds are formed on the sides of the rhizome and these accumulate energy for growth the following spring. If the root is cut into as many pieces as there are buds, giving each plant a portion of the rhizome, some fibrous roots, and one or more buds, the number of the plants can be doubled. The roots are planted and mulched and the process is complete. The rains pack the soil around the roots and they are ready to grow when spring comes. The process may be repeated every year and the number of roots increased indefinitely.

EXPERIMENTS WITH PLANTS FROM FIBROUS ROOTS.

The stronger fibrous roots of the larger plants dug in the autumn of 1903 were found to contain buds, which were formed from a few inches to a foot from the rhizome. (Pl. V.) Some were about half an inch long, but the majority of them were smaller. The larger ones need no special treatment and may be planted with the main crop. The smaller ones should be planted in boxes or beds of well-prepared soil at a distance of about 3 inches apart, mulched with a thin coating of leaf mold, or similar material, and grown in shade until large enough to transplant to the shelter with the larger plants. They will probably require at least three years to reach their full development. If they could be left undisturbed in the beds where they are formed they would receive nourishment from the older rhizomes and perhaps grow faster, but it is probably best to divide the older roots every year where propagation alone is desired, planting the smaller roots and the plants made by division of the rhizomes. The larger roots are marketed to more advantage than the smaller ones, so it is best to have the surplus consist of the larger roots. The frequent working of the soil allowed by this treatment will keep it in better condition than if left undisturbed for a longer period.

YIELD OF ROOTS.

The yield from the small plat grown by the Department was 4 pounds of green roots to an eighth of a square rod of soil, or 5,120 pounds per acre. This, when dried, would give about 1,500 pounds of marketable roots. The conditions were not very good, the shade being too close to the plants, and the plants being set too far apart. The yield will probably be larger with the shade now in use. The 150 roots obtained by dividing the above crop now occupy less than one-fourth of a square rod, and are set in rows 1 foot apart and 6 inches apart in the rows.

TIME NECESSARY TO MATURE CROP.

The number of years necessary to produce the largest crop has not been definitely determined, but the roots begin to decay after the fourth year, and the central and largest part of the root decays at the oldest scar, leaving two or more plants in place of the old one. No advantage can be gained by growing the plants more than three years, and probably very little by growing them more than two years. For propagation alone one year will give good results, while for maintaining a constant area and producing a crop, two or three years, depending upon the growth made, will give a good crop of large, marketable roots.

MARKET CONDITIONS.

Golden seal is a root the price of which has fluctuated widely, because of the alternate oversupply and scarcity, manipulation of the market, lack of demand, or other influences. High prices will cause the diggers to gather the root in abundance, thus overstocking the market, which the next season results in lower prices, at which diggers refuse to collect the root, thus again causing a shortage in the supply. Lack of demand usually brings about a shrinkage in price, even though the supply is light, while an active demand will cause prices to advance in spite of a plentiful supply. The arrival of spring-dug root has a weakening effect on the market, although the fall-dug root is always preferred. For the past few years, however, high prices have been steadily maintained, and there appears to be but one cause for this, and that is, as already pointed out, that the forests no longer yield unlimited quantities of this valuable root, as in former years, and the scanty supply that can be had is inadequate to meet the constantly increasing demand.

HIGHEST AND LOWEST PRICES.

The following table, taken from files of the Oil, Paint, and Drug Reporter, shows the highest and lowest prices quoted for golden seal in the New York market each month during the past ten years, and also the highest and lowest points touched each year from 1894 to 1903, inclusive. The figures are based on the closing quotations of each successive week:

Month.	1894.		1895.		1896.		1897.		1898.		1899.		1900.		1901.		1902.		1903.	
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.
January	23	23	18½	18	22½	22½	27	25	40	38	43	43	60	60	57	55	50	50	54	52
February	23	22	18	18	22½	22	27	25	45	40	70	43	60	58	56	55	50	50	54	54
March	22	22	18	17¼	22	22	30	26	42½	38	70	62½	57	54	55	53	52	48	54	54
April	22	21	18½	17½	22	21	27	27	45	40	70	68	54	54	52	50	52	50	54	54
May	21	21	17½	17½	21	20	27	26	50	45	75	60	54	53	49	49	52	50	54	54
June	21	19	17½	17½	20	20	26½	25	48	40	60	55	50	50	47	45	52	51	54	53
July	19	19	17½	17	20	20	25	25	40	35	53	49	50	47½	57½	43	52	51	53	53
August	19½	19	17	17	20	19½	25	24	50	38	52	50	54	47½	58	57½	52	52	57½	53
September	19½	19	18½	17	19½	19½	27	24	45	45	52	50	60	55	58	50	54	52	75	70
October	19	18½	20	18	24	21	62½	35	50	45	58	56	55	55	54	50	54	54	75	74
November	19	18½	22	20	29	24	50	45	52	47½	60	58	58	55	52	52	53	52	74	74
December	18½	18½	23	22½	28	27	45	40	47½	45	62½	60	58	57	52	52	52	52	74	74
Whole year	23	18½	23	17	29	19½	62½	24	50	35	75	43	60	47½	58	43	54	48	75	52

According to the market reports contained in the Oil, Paint, and Drug Reporter, the year 1904 opened with a quotation of 74 to 75 cents, which soon advanced (in one week early in February) from 76 cents to 95 cents. A still further advance occurred about the end of February, when the price went up from $1 to $1.25 per pound. In March the market was almost destitute of supplies, but lack of interest brought the price down to $1.10. In May the price advanced again to $1.25, and it was stated that the local supplies were being held by a small number of dealers, although it was believed that together they held not more than 1,000 pounds. About June 1 the arrival of spring-dug root caused the market to sag, prices ranging from $1.10 to $1.18 during that month, and in July from 90 cents to $1.10. In August the lowest price was $1.15 and the highest $1.50, no discrimination being made between the fall dug and the spring-dug roots. From September 1 to October 15 the price of golden seal varied but little, $1.35 being the lowest and $1.40 the highest quotation. No supplies worth mentioning can be obtained in the West; the stock in New York is short, and the demand, especially for export, is increasing. It is impossible to ascertain the exact annual consumption of golden seal root, but the estimates furnished by reliable dealers place these figures at from 200,000 to 300,000 pounds annually, about one-tenth of which is probably used for export.

It will be observed that the price of this article is very sensitive to market conditions, and it seems probable that the point of overproduction would be easily reached if a large number of golden seal growers were to meet with success in growing large areas of this drug.

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FIG. 1.—GOLDEN SEAL, FLOWERING PLANT.

(*Reduced one-half.*)

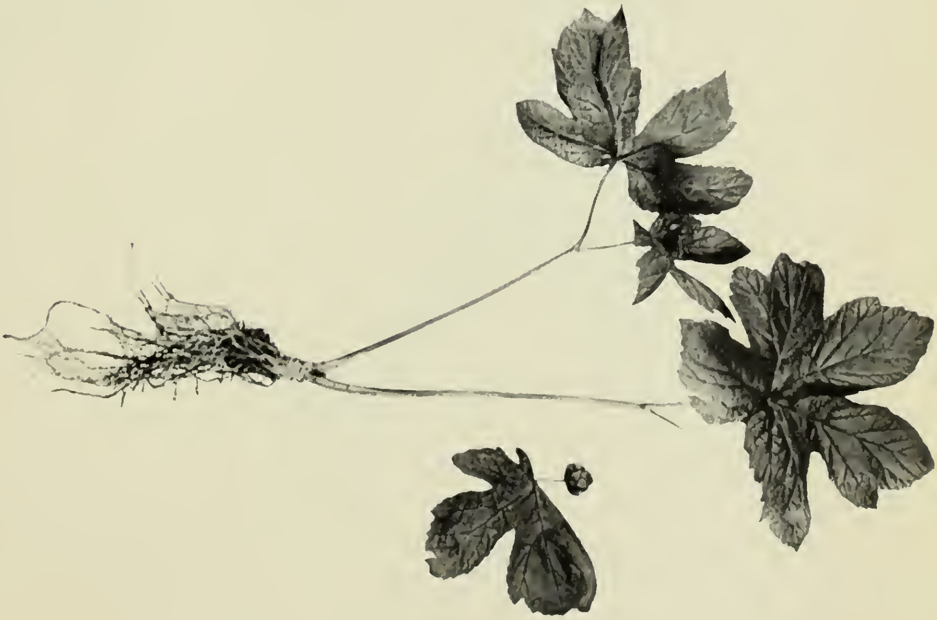

FIG. 2.—GOLDEN SEAL, FRUITING PLANT, WITH FRUIT AND LEAF DETACHED.

(*Reduced one-half.*)

GOLDEN SEAL, SHOWING BUD ON FIBROUS ROOT.

(*Natural size.*)

A

Fig. 1. Anthracnose of Lime.

Fig. 2. Wither-Tip of Lime.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN No. 52.

B. T. GALLOWAY, *Chief of Bureau.*

WITHER-TIP AND OTHER DISEASES OF CITROUS TREES AND FRUITS

CAUSED BY

COLLETOTRICHUM GLŒOSPORIOIDES.

BY

P. H. ROLFS,
Pathologist in Charge of Subtropical Laboratory.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

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BUREAU OF PLANT INDUSTRY.

B. T. Galloway, *Chief.*

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., October 8, 1903.

Sir: I have the honor to transmit herewith a paper entitled "Wither-Tip and Other Diseases of Citrous Trees and Fruits Caused by Colletotrichum Glœosporioides," and respectfully recommend that it be published as Bulletin No. 52 of the series of this Bureau.

This paper was prepared by Mr. P. H. Rolfs, Pathologist in Charge of the Subtropical Laboratory of this Bureau, under the direction of the Pathologist and Physiologist, by whom the paper was submitted with a view to publication. The accompanying six plates, three of which are colored, are believed to be necessary for a complete understanding of the subject-matter under discussion.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

The diseases of citrous fruits described in this report have caused within the past four or five years considerable loss to the cultivators of these fruits, especially in the more humid regions. A fungus (*Colletotrichum glœosporioides* Penzig) has long been known as the cause of a disease on orange, pomelo, and lemon twigs, commonly called "wither-tip," and the same fungus causes a serious disease of the leaves, known as "leaf-spot," on these and other citrous trees. Mr. Rolfs has now demonstrated that anthracnose of lime blossoms and young fruits and of lime and lemon twigs, "spot" of ripe lemons, and "canker" of limes are all caused by this same fungus. A knowledge of this fact should be of great value to citrus growers in combating these diseases.

By proper pruning and fungicidal treatment, as recommended in this report, all of these troubles may be easily prevented or controlled.

Thanks are due to Mr. F. D. Waite, general manager of the Manatee Lemon Company, for many courtesies shown during the progress of these investigations.

ALBERT F. WOODS,
Pathologist and Physiologist.

OFFICE OF VEGETABLE PATHOLOGICAL
AND PHYSIOLOGICAL INVESTIGATIONS,
Washington, D. C., October 3, 1903.

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURE.

B. P. I.—72. V. P. P. I.—105.

WITHER-TIP AND OTHER DISEASES OF CITROUS TREES AND FRUITS CAUSED BY COLLETOTRICHUM GLŒOSPORIOIDES.

INTRODUCTION.

The group of diseases discussed in this bulletin was unknown in Florida until a comparatively recent time. At first recorded as of merely passing interest, the attacks of the fungus *Colletotrichum glœosporioides* have since increased in severity until they are now assuming serious proportions in various citrous crops. The amount of damage done by lemon-spot is often sufficient to eliminate the profits of the shipments in which the disease occurs. As wither-tip it repeatedly kills back the new growth of young trees until their vitality is exhausted. On large trees the small twigs are cut off, thus preventing the tree from producing the bloom necessary to set a heavy crop. As anthracnose and canker of lime it has caused an almost total destruction of the crop where the disease has gained a foothold.

The fact that the attack of this fungus manifests itself in various diseases has greatly complicated the work and added immensely to the labor of demonstrating its identity. The results of the miscroscopic work indicated that these various diseases—wither-tip, leaf-spot, lemon-spot, canker, and anthracnose—were produced by one species of fungus. It remained for cross inoculation with pure cultures to confirm this supposition. In most cases these cross inoculations took readily, while in others it was difficult to induce the fungus to make an attack. This was especially the case in attempting to produce lemon-spot. Infection at the stigma of lime blossoms is one of the inoculations most easily accomplished.

Leaf-spot is easily produced artificially on foliage infested with purple mites. To produce such an infection a leaf must be washed carefully to free it from danger of natural infection, and then spores from a pure culture should be applied to the epidermis, after which a moist atmosphere is necessary.

DISTRIBUTION OF THE DISEASES.

The diseases known as wither-tip, anthracnose, leaf-spot, and canker extend through a large portion of Florida, the West Indies, South America, Australia, and Malta, and it seems probable that they occur in all parts of the world where the orange is cultivated, especially in the more humid regions. The drier regions are more exempt from leaf and branch inhabiting fungi.

In Florida the diseases seem to be increasing in severity. Prof. L. M. Underwood[a] wrote, in 1891:

> This disease [wither-tip] was found at only one point in Lake County. Dr. Martin found it in 1886 at Green Cove Spring. It does not seem to be widespread nor at present of much importance, but is recorded here that attention may be called to it, so that its nature may be known and its progress watched.

Professor Hume[b] has collected specimens of the disease in several places in Florida. He also mentions that some pomelo seedlings lost nearly all of their leaves as a result of the attack of the fungus in question.

Miss Stoneman[c] found that this fungus attacked orange trees in conservatories.

Penzig[d] mentions this fungus as being destructive to citrous plants, attacking the foliage mainly.

McAlpine[e] found this fungus on the orange near Melbourne, Australia, in 1892, and in 1898 it was found by Troyon to be destructive to lemon leaves in Queensland.

In Brazil it seems to be quite generally distributed. Noack[f] found it especially severe at São Paulo, where it was recognized not only on the leaves, but also on the smaller twigs. The latter were killed as far as the fungus penetrated, showing a very decided demarcation between the sound and the diseased areas.

GENERAL METHOD OF ATTACK.

The initial lesion is usually at the tip (see Pl. V, fig. 1) or an edge of a leaf. More rarely is a leaf attacked at the midrib or some other interior portion. The part attacked becomes light green, then turns brown. Then the acervuli form; at first light brown, then dark brown or nearly black. They may develop on either surface and in various arrangements.

EXTENT OF INJURY.

All sizes of trees, from those located in the nursery (even seedlings in the seedling beds) to the oldest trees in a grove, are subject to attack. Budded trees less than a year old are rarely attacked except in the leaves. Where such infections are allowed to remain on the trees the diseased area extends into the growing twigs and causes the typical

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[a] Jour. Myc., VII: 35, 1891.

[b] Bul. Fla. Agr. Exp. Sta., 53: 172, 1900.

[c] Bot. Gaz., XXVI: 87, 1898.

[d] Funghi Agrumicoli, p. 66. Padova, 1882.

[e] McAlpine, D. Fungus Diseases of Citrus Trees in Australia, 102, 1899.

[f] Noack, Fritz. Zeitschrift f. Pflanzenkrank., X: 329, 1900.

"wither-tip." (See Pl. V, fig. 2.) In such cases the tip dies back for a distance, or the disease may go as far as the trunk and then stop. A bud below the diseased portion then pushes forward, but unless preventive measures are used the second sprout withers back like the first. In this way the disease may prevent the tree from making any growth, and even kill it in four or five years. (See Pl. VI.)

The initial attack in older trees is the same as in trees in the nursery rows. The fungus gains entrance to the tissues of the leaf and from this grows down into the fruiting twigs. This cuts off much of the younger growth in severe cases and thus prevents blooming to a large extent. Such cases are frequently mistaken for blight, but a more common error is to attribute the injury to die-back. It may be readily distinguished from blight by the fact that only small twigs die off, and these do so without any wilting of leaves. Even the leaves that are so badly diseased that they fall do not wilt, while in the case of blight the leaves wilt with no visible sign of injury. It may be distinguished from die-back by the absence of multiple buds, of gum pockets, or of dark excrescences. One or more of these characters always accompany die-back. Die-back twigs may be attacked by this fungus, but in such cases wither-tip must be regarded as the secondary disease. This disease may be also present in a blighted tree. Any agency that lowers the vitality of a tree, whether fertilizer, weather, or condition of soil, predisposes it to an attack of wither-tip, but trees that are in the most healthy condition possible are also attacked when exposed to infection. The damage caused by this disease is very largely overlooked from the fact that it occurs upon the smaller twigs and is often attributed to other diseases, as previously stated. Whereever pruning is practiced the infected branches are usually cut off before the nature of the disease becomes fully apparent.

VARIETIES ATTACKED.

All varieties and species of citrous trees and fruits cultivated in Florida are more or less subject to attack. Since the parts attacked and the parts most greatly damaged differ considerably, the measures adopted for relief must be varied according to the different diseased conditions.

LIME.

ANTHRACNOSE.

The lime is the most severely attacked of the citrous species. It sustains its greatest loss during the time of most rapid growth, which is usually during the spring and early summer. The effect of the fungus in the young growing shoots is somewhat peculiar, as it resembles the result of an attack from biting insects, and by many persons it is attributed to this cause. (See Pl. I, fig. 1.)

The infection usually takes place at the axil of a leaf or some other place where the spore may find lodgment, and the fungus then cuts off the stem, causing the upper part to fall over and hang lifeless beside the other portion, or it may fall away; in this manner simulating the effects of insect depredations. In such cases gum quickly forms at the wound and prevents the fungus from forcing its way down the twig.

Besides the young growing twigs and leaves, the blossoms, the unopened buds, and the young fruit are attacked. When the fungus attacks an unopened bud the latter fails to develop and the entire outer portion becomes covered with spores. In the opened blossom the most common point of attack is the stigmatic surface of the pistil. (Pl. II, fig. 1.) The fungus grows in the stigma and finally destroys the entire fruit; this, however, usually falls off before the fungus has time to penetrate below the calyx. By attacking the blossoms the fungus may render the whole tree entirely fruitless, the calyxes remaining until the normal time of ripening, giving the branch a very peculiar appearance. (See Pl. II, fig. 1, representing various stages in the development of the disease.)

In addition to attacking the open bud, the spores frequently find a place for infection in the nectaries. The development of the fungus here causes the fruit to fall, and the resulting appearance is much the same as when the infection took place in the stigma.

WITHER-TIP.

When the fungus gains entrance from the terminal bud or from leaf infection the formation of the gum previously mentioned does not take place, and the disease may extend down the twig, resulting in a case of wither-tip similar to that encountered in other species of citrus. (See Pl. I, fig. 2.)

FRUIT CANKER.

If the bloom escapes, the young fruit may be attacked at almost any subsequent period. (Pl. II, figs. 2, 3, and 4.) The attack on the young fruit frequently causes a portion to be taken out as though bitten by a grasshopper or some other gnawing insect. This causes a large percentage of the young fruit to fall. Fruits after they are about half developed are not usually attacked. When the fruit has reached considerable size (about that shown in Pl. II, fig. 4) before it has been attacked, corky tissues form and a development takes place resembling scab or verrucosis. (See Pl. IV.)

LEMON.

LEAF-SPOT AND WITHER-TIP.

Lemon leaves are attacked in the typical way, causing leaf-spot, and from these the disease extends into the twigs, causing the wither-tip. For a description of the characteristics of this attack see page 10.

LEMON-SPOT.

The disease causes the most serious damage to the mature fruit. The fungus finds entrance through some slight bruise or abrasion of the skin, or it may be that infection takes place through the uninjured skin under conditions not known at present. Attempts at artificial inoculation through the uninjured skin of the lemon failed uniformly. Even so slight an abrasion as rubbing the fruit together in a packing crate or handling it roughly gives sufficient opening for the fungus to enter. The results of applying spores from pure cultures to the epidermis confirmed this conclusion. When the fungus has once found its way into the epidermis a dark spot is produced. (See Pl. II, fig. 5.) This continues to enlarge until a definite brown spot is made. (See Pl. III, fig. 1.) The development then continues until the entire rind of the lemon is browned. Ordinarily the diseased skin hardens, so that the actual usefulness of the lemon has not been materially impaired by the attack, but since it is not salable its value has been destroyed.

The injury from this disease is the greater because of the fact that infection to a large extent occurs during the handling of the fruit, especially during the coloring period, so that the fruit is sent off to market before the disease is visible. The diseased spots continue to enlarge, and when the fruit arrives in the market they may be the size represented by the figures of Plate III. This of course makes the fruit unsalable, and it becomes necessary for the merchant to repack, discarding all fruit that shows infection. Spores are rarely produced on such lemons, except when the fruit is kept in a moist place, in which case they are produced in great profusion, as illustrated by figure 2 of Plate III.

The peculiar way in which lemons have to be handled for market makes them especially liable to attack. The fruit is picked from the tree when still green. The growers allow the lemons to mature sufficiently to develop in them a certain amount of citric acid. When they have attained the proper size (and this must be learned by experience) so that they will shrink in the course of curing to the size demanded by the market, they are picked and placed in a coloring house, or they may be placed in a large heap, which is then covered with hay or similar material to keep out the light and to keep them at a uniform temperature. It therefore happens that the lemon groves must be picked over several times during the ripening season, the largest and most fully developed specimens being taken off usually in August or September, according as experience dictates. In handling these it is almost impossible to keep them from being bruised or slightly scratched or even pricked by thorns. Such abrasions in the epidermis, however slight, are sufficient to permit the entrance of the fungus.

THE COLORING HOUSE.

The coloring houses for the lemons are small structures, usually about 12 feet wide by 14 feet long and 10 or 12 feet high. They are double walled and built with a steel roof. The sun shining on this roof causes the temperature of the building to rise. By means of ventilation at the bottom and top the cool air is allowed to enter at the floor and the hot air to pass out at the ridge of the roof. By means of these ventilators the temperature is kept from reaching too high a degree. At night the openings which permit the cold air to enter are closed, and if the outdoor temperature happens to be quite cool the ventilators in the roof are also closed. In this way the temperature of the coloring house causes a very rapid ripening of the lemons, the fruit turning yellow in a few days. The evaporation from the lemons causes the air to become humid, creating a most admirable condition for germinating any *Colletotrichum* spores that may be adhering to the fruit. Spores that happen to be near an abrased place in the epidermis of the lemon will find an entrance and produce the disease in the fruit. The drying of the fruit which occurs at the latter end of the coloring period causes the affected portions to become depressed brown areas when the disease has progressed sufficiently.

When the lemons have been permitted to mature rather fully the process in the curing house is of short duration. No matter how short it is, however, it is always sufficiently long to permit fungus infection. When the period between infection and removal of the fruit from the coloring house is of short duration, the spots have not had time to collapse and become brown, making it impossible to detect the disease when the fruit is being graded and put into crates; consequently a considerable percentage of lemons infected with *Colletotrichum* is packed and shipped to the markets and the diseased spots develop in transit.

Experiments with infected lemons show that the fungus continues to develop, even if they are placed in the dry atmosphere of a living room, and that a spot is produced, as shown in Plate III, figure 1. These spots when examined under a microscope showed no fungus spores, and only a few mycelia were found in the tissues of the lemon rind adjoining the blackened area. On lemons under normal conditions, such as those in a crate on the way to market or in a storeroom, these spots develop very rapidly. Freight cars or the holds of vessels are usually superheated, bringing the temperature up to that needed for the most rapid development of the fungus. Crates of lemons that were started out from the packing house during August, 1902, without the slightest visible speck, were found to have from 5 to 25 per cent of specked fruit when they arrived in the Boston market. Specimens taken to the laboratory and kept under conditions similar to those of lemons packed in a crate developed spots varying in size up to three-fourths of an inch in diameter. Every lemon thus spotted is rendered worthless for commercial purposes; nor is the entire loss represented by the percentage of specked lemons, since a crate of lemons containing even a small percentage of specked fruit can not be sold except at a liberal discount or after the additional expense of repacking.

When specked lemons are placed in a moist chamber the fungus develops very rapidly and produces a great quantity of spores, as shown in Plate II, figure 2. The lemons under these conditions give out a peculiar moldy citric odor. It not infrequently happens that sufficient moisture is produced in transit to market to permit a very full development of spores. In storage especially this is true.

THE COLORING BED.

The very considerable loss sustained as the result of curing lemons in a house caused it to be suspected that the curing house was at fault in this matter. Curing beds were therefore prepared. These are made by selecting a position that is high and dry, clearing off the land, and smoothing the surface. This is then covered with hay or some other soft material. The picked lemons are placed upon this bed to a depth of a foot or more, and are covered with hay or similar material to a sufficient depth to keep out the light. In this bed the lemons go through a curing process very similar to that of the curing house. The temperature being much lower and the possibility of regulating it being removed, the process is much less certain and less satisfactory than in the curing house, the lemons not curing uniformly. In these curing beds the spotting of the lemons goes on in very much the same way as in the curing house. The time elapsing between placing the lemons in the curing bed and removing them from it is considerably longer than in the curing house; consequently a greater percentage of the lemons infected with *Colletotrichum* show spots, and the fungus has time to develop larger spots, which makes it less difficult to detect the diseased lemons. As a consequence, fewer lemons infected with the fungus pass the graders and packers, and a smaller percentage is lost after being shipped.

ORANGE AND POMELO.

LEAF-SPOT.

The first point of attack is in the leaf. The development of the fungus takes various peculiar forms. At times the acervuli are distributed in a more or less regular way from a center, resembling "fairy rings." At other times the infection takes place in the tip of the leaf, which gradually withers back to the stem. Small trees may be defoliated and the fungus continue to develop in the twigs (see Pl. V).

WITHER-TIP.

The smaller twigs of the sweet orange and pomelo are very frequently and severely attacked. In a great many cases the death of twigs from an attack of wither-tip is supposed to be the result of die-back. This may, however, be easily distinguished from die-back, as indicated on page 11. It not infrequently happens that die-back and wither-tip occur on the same twig. Any material weakening of the health of the tree is very likely to induce an infection; this, however, is not a necessary antecedent to infection. The fruit of these two varieties appears to be exempt from attack.

DESCRIPTION OF THE FUNGUS.

Acervuli located on the surface of the leaf, twig, or fruit; 90–270μ in diameter, erumpent, superficial. Shape various, not uniform, occurring on either surface of citrous leaves; disposed irregularly or in more or less concentric lines; pale to dark colored. On tender lime twigs, tender lemon twigs, lemon fruits, and lime fruits, pale colored, dull red in masses (see Pl. V), confluent. Epidermis breaks irregularly.

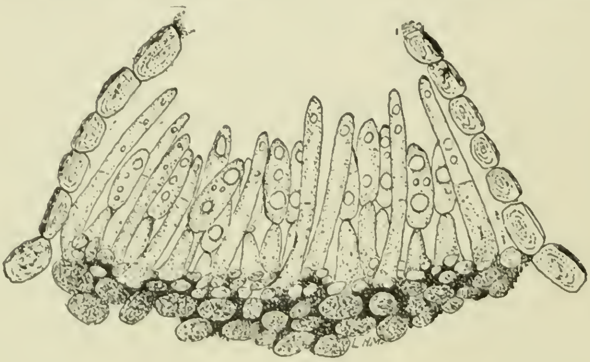

FIG. 1.—Section of acervulus. (Drawn by L. H. McCullough.)

Setæ fuliginous, ranging in length from 60 to 160μ, frequently once or twice septate, disposed at margin of acervuli. Frequently absent, and on tender lime twigs, tender lemon twigs, lemon fruits, and lime fruits usually absent.

Conidia broadly oval or oblong, 10–16μ by 5–7μ, hyaline; size variable in same acervulus, usually with one or two oil drops. Developing from a well-defined stroma; basidia, 3–18μ. In moist chamber the conidia stream from the break in the epidermis.

Intra-basidial setæ, variable 8–30μ by 3–6μ, cylindrical or sometimes enlarged at distal end; hyaline.

SYNONYMY.

Colletotrichum glœosporioides Penzig.

Vermicularia glœosporioides Penzig. Funghi Agrumicoli, No. 90, p. 66, fig. 1188, Padova, 1882.

Phyllosticta adusta, E. & M. Jour. Myc., II, p. 130, November, 1886.

Colletotrichum glœosporioides Penzig. Botanici Agrumi e sulle piante affini. Ann. d' Agria, p. 384, Plate XXXVIII, figs. 3 and 4, 1887.

Colletotrichum adustum, Ell., Jour. Myc., VII, p. 35, May, 1891.

PREVENTIVE AND REMEDIAL MEASURES.

TREATMENT TO PREVENT LEMON-SPOT.

The loss from spotting of lemons may be greatly reduced, if not entirely prevented, by spraying with fungicides, such as potassium sulphid, ammoniacal solution of copper carbonate, and Bordeaux mixture.

The particular fungicide to be used will depend on the specific form in which the disease manifests itself. For lemon-spot sulphur spray[a] may be used after the lemons have been picked.

The spraying may be done by first placing a layer of lemons one or two deep on the curing bed, then spray this thoroughly, place upon these another layer of lemons one or two deep and again spray, continuing the placing of lemons and spraying until the amount of fruit needed to fill the bed has been supplied. After this the lemons should be allowed to dry thoroughly before the cover is placed upon the bed. It is quite probable that the sulphur spray or the potassium sulphid[b] will also be helpful in the process of coloring the lemons. Sulphur spray and potassium sulphid being mild fungicides, there is no danger of producing rot by their use.

Ammoniacal solution of copper carbonate[c] may also be used to prevent spotting, but the solution should be applied to the fruit a week or ten days before picking. The spraying should be done thoroughly and care should be exercised to get the mixture on the fruit. The amount, if at all apparent, will be so small that it will not interfere with its

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[a] *Preparation of sulphur spray.*—Place 30 pounds of flowers of sulphur in a wooden tub large enough to hold 25 gallons. Wet the sulphur with 3 gallons of water; stir it to form a paste. Then add 20 pounds of 98 per cent caustic soda (28 pounds should be used if the caustic soda is 70 per cent) and mix it with the sulphur paste. In a few minutes it becomes very hot, turns brown, and becomes a liquid. Stir thoroughly and add enough water to make 20 gallons. Pour off from the sediment and keep the liquid as a stock solution in a tight barrel or keg. Of this solution use 4 quarts to 50 gallons of water.

[b] Use 1 ounce of potassium sulphid to 2 gallons of water.

[c] *To prepare ammoniacal solution of copper carbonate.*—Put 3 gallons of water in a wooden or an earthen vessel, pour 3 pints of ammonia (26° B.) in this, and stir it to mix the two evenly. Take 8 ounces of copper carbonate and shake it into the ammonia water, stirring the liquid for a while. If a considerable part of the copper carbonate remains undissolved, the liquid may be left to settle; if, however, all or nearly all of the copper carbonate is dissolved, more of it should be added in the manner previously described until a considerable amount remains undissolved; then it is set aside as stated before. After the precipitate has settled, use the clear blue liquid. The undissolved copper carbonate may then be treated with more ammonia and water, fresh copper carbonate being added whenever the residue becomes less than an ounce. The solution should not be kept for more than a day or two, and when used 1 gallon should be diluted with 15 or 20 gallons of water.

selling quality. Bordeaux mixture can not be used to good advantage on lemons, because it adheres very tenaciously to the fruit, and so reduces its selling value.

TREATMENT OF LIME TREES.

During the past year experiments performed by Mr. M. S. Burbank, of Cocoanut Grove, Fla., at the Red Mill fruit farm, with a view to protecting lime trees from the attacks of this fungus, brought out some interesting results. One tree under observation had been producing limes for a number of years in a most prolific manner, but during the three years preceding 1902 the crop had been a total failure, owing to the attacks of *Colletotrichum glœosporioides*. Spraying with Bordeaux mixture[a] was begun in September, 1902, and was continued at intervals as thought advisable, and in less than a year the disease had been almost entirely subdued and the tree bore a heavy crop of fruit. Other trees were also treated, as well as trees in other groves, with good results.

THE EFFECT OF PRUNING.

In a small orchard, or in the case of an isolated tree, especially in a young orchard, much good can be done by cutting out diseased twigs and picking off the diseased leaves. Where this is practiced with thoroughness the disease can be reduced to a point where it does only a small amount of damage, or it may be eradicated; but pruning and picking must be done at frequent intervals and very thoroughly. This would probably be an effective method of keeping the fungus under control in the case of small orange and pomelo orchards.

Where pruning is practiced the weak limbs are taken out. The spurs that have dropped their leaves are also cut out, and in this way much of the hold-over wither-tip is removed. All wood that has withered is also taken away. This pruning reduces in a large measure the number of spores left in the grove and hence greatly diminishes the extent of the infection.

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[a] Bordeaux mixture may be prepared by dissolving 6 pounds of copper sulphate (blue stone) in 25 gallons of water. If the powdered copper sulphate be used, it may be dissolved in an hour or so by suspending it in a feed sack just under the surface of the water. In another vessel, slake 4 or 5 pounds of lime in a small quantity of water. When slaked, dilute to 25 gallons. Strain through coarse sacking into a 50-gallon barrel, to remove all the matter that might clog the nozzle of the spraying machine. Pour the copper-sulphate solution into the lime solution, stirring the mixture vigorously during the process and for two or three minutes afterward. During the stirring the paddle should be made to go back and forth. Use the mixture at once.

CULTIVATION AND FERTILIZATION.

Thorough cultivation and fertilization are among the effective ways of keeping the fungus from becoming established in an orchard. A properly cultivated and well-fertilized tree will produce new growth so rapidly and in such quantity that the amount of wood that is killed by the fungus and the number of leaves destroyed will form only a small percentage of the total number of leaves and twigs present. The same number of leaves and the same quantity of twigs destroyed on a tree of only indifferent growth would form a much larger percentage and, consequently, weaken the constitution of the tree to such an extent that it would actually die before the atmospheric conditions would become adverse to the disease. Seedlings and nursery trees not carefully attended are frequently killed in this manner. (See Pl. VI.) It is thus possible for a tree that has been properly fertilized and cultivated to withstand an attack that would prove fatal to one not in the best physical condition. While it does not seem possible to render a tree proof against attack excepting by the use of fungicides, the probability of infection and the damage to the tree can be greatly reduced by putting it in the most healthy condition possible.

FERTILIZERS.

In choosing fertilizers to aid in warding off these diseases a large percentage of potash should be used in the compound. The source of potash does not seem to be important, but sulphate of potash has proved a general favorite among growers of citrous fruits.

Sulphate of ammonia is somewhat slower in acting than nitrate of soda, but gives a firmer leaf. Nitrate of soda will produce a very quick growth and a large leaf, but it is especially subject to attack from the fungus unless well balanced by a generous supply of potash. Organic ammonia in the form of dried blood, cotton-seed meal, and bone meal should not be used in combating this trouble, as it is very likely to produce die-back in addition to the softening of the wood, and so lay the tree doubly open to attack.

SUMMARY.

(1) Wither-tip was not known to exist in Florida until 1886. In 1891 it was recorded as only of passing interest, but it is now present in every citrus-growing region of the State, as well as in many citrus-growing countries. Such is the severity of the disease that many requests for advice as to remedies have come to the Department of Agriculture from extensive growers.

(2) The diseases caused by the fungus *Colletotrichum glœosporioides* Penz. manifest themselves as wither-tip on orange, pomelo, and lemon twigs; as leaf-spot on leaves of various citrous species; as anthracnose on lime blossoms, recently set limes, lime twigs, and lemon twigs; as lemon-spot on ripe lemons, and as canker of limes.

(3) On the orange and pomelo the fungus causes the most severe damage by defoliating young twigs and causing these to die, thus reducing the amount of wood that may produce bloom in the bearing trees and cutting back seriously the growth of young trees. In lemon groves the most severe damage is done to matured fruit, while in lime groves the greatest loss occurs during the blooming season, the disease often causing all the bloom to fall. Trees less severely attacked often have over 80 per cent of the fruit cankered, and consequently its market value is much reduced.

(4) Remedial measures are effective, but these must be varied to suit particular manifestations of the fungus. Wither-tip and leaf-spot are best controlled by pruning out diseased twigs and then by spraying with Bordeaux mixture. The spotting of lemon may be controlled by spraying the fruit before picking with ammoniacal solution of copper carbonate and with sulphur spray while in the coloring bed or coloring house. Canker of limes may be prevented by cutting out wither-tip before the blooming period and then by spraying with Bordeaux mixture.

PLATES.

DESCRIPTION OF PLATES.

PLATE I. Frontispiece. Fig. 1.—Anthracnose of rapidly growing lime, infected at the angle of a leaf. The further progress of the disease has been arrested by the formation of gum. (Natural size.) Fig. 2.—Wither-tip of lime twig, infected at terminal bud, the fungus continuing to grow down the twig to the larger branches.

PLATE II. Fig. 1.—Anthracnose of young lime fruits, infection occurring in the stigma. The disease has been arrested by the shedding of young fruits before the fungus had extended below the calyx, the calyx continuing to remain on the fruiting branch. (Natural size.) Figs. 2, 3, and 4 show various stages of development. Fig. 2.—A newly set lime infected on the side. (Natural size.) Fig. 3.—Further development, lime infected on the side. (Natural size.) Fig. 4.—Lime several weeks old, infected on the side. (Natural size.) Fig. 5.—Lemon-spot as it appears in most advanced cases coming from a coloring house or a coloring bed, usually showing only one point of infection. (Natural size.)

PLATE III. Fig. 1.—Lemon-spot well developed but without spores. (Natural size.) A lemon affected with this disease for ten days or perhaps a week usually arrives in the market in the condition illustrated. Fig. 2.—Lemon-spot with spores fully developed under a bell jar. (Natural size.)

PLATE IV. Limes affected with cankers. The two fruits in the middle at the left, with small cankers, are ripe, while the other limes are green. The upper lime at the right shows attacks in three places. (Natural size.)

PLATE V. Fig. 1.—Leaf-spot on orange leaf infected at tip, with the disease gradually extending to the petiole. Acervuli have formed near the tip, but no acervuli are present in the more recent extension of the browned area. (Natural size.) Fig. 2.—Wither-tip on an orange twig infected through a diseased leaf. Three tips of recent growth are dead; acervuli have formed; the earlier growth is still green but infected. (Natural size.)

PLATE VI. Orange seedling 4 years old repeatedly killed back by wither-tip, making its fourth and last effort. Last growth 13 inches. (Negative by L. H. McCullough.)

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FIGS. 1, 2, 3 AND 4. ANTHRACNOSE OF YOUNG LIME FRUITS.

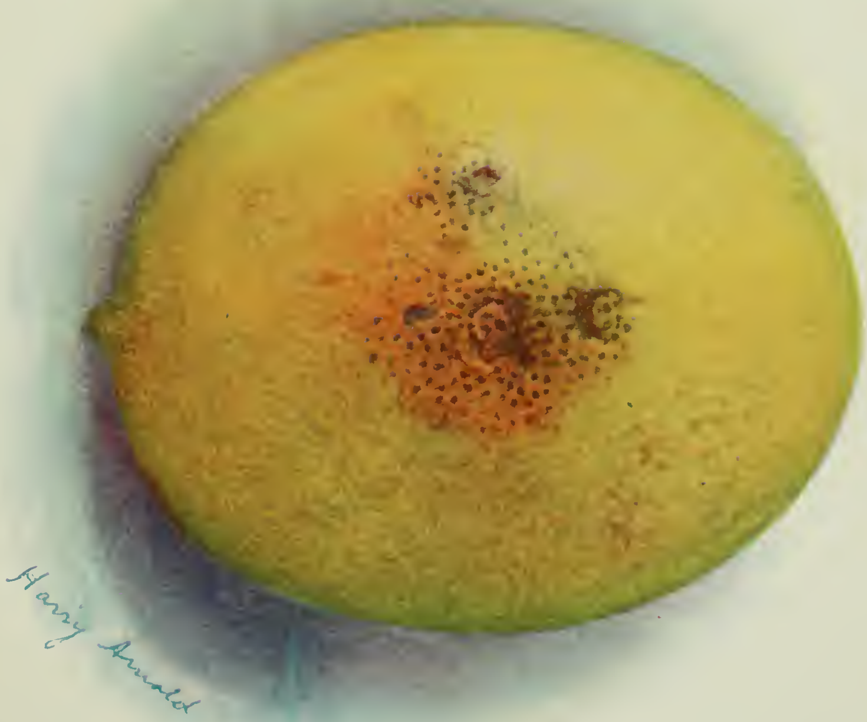
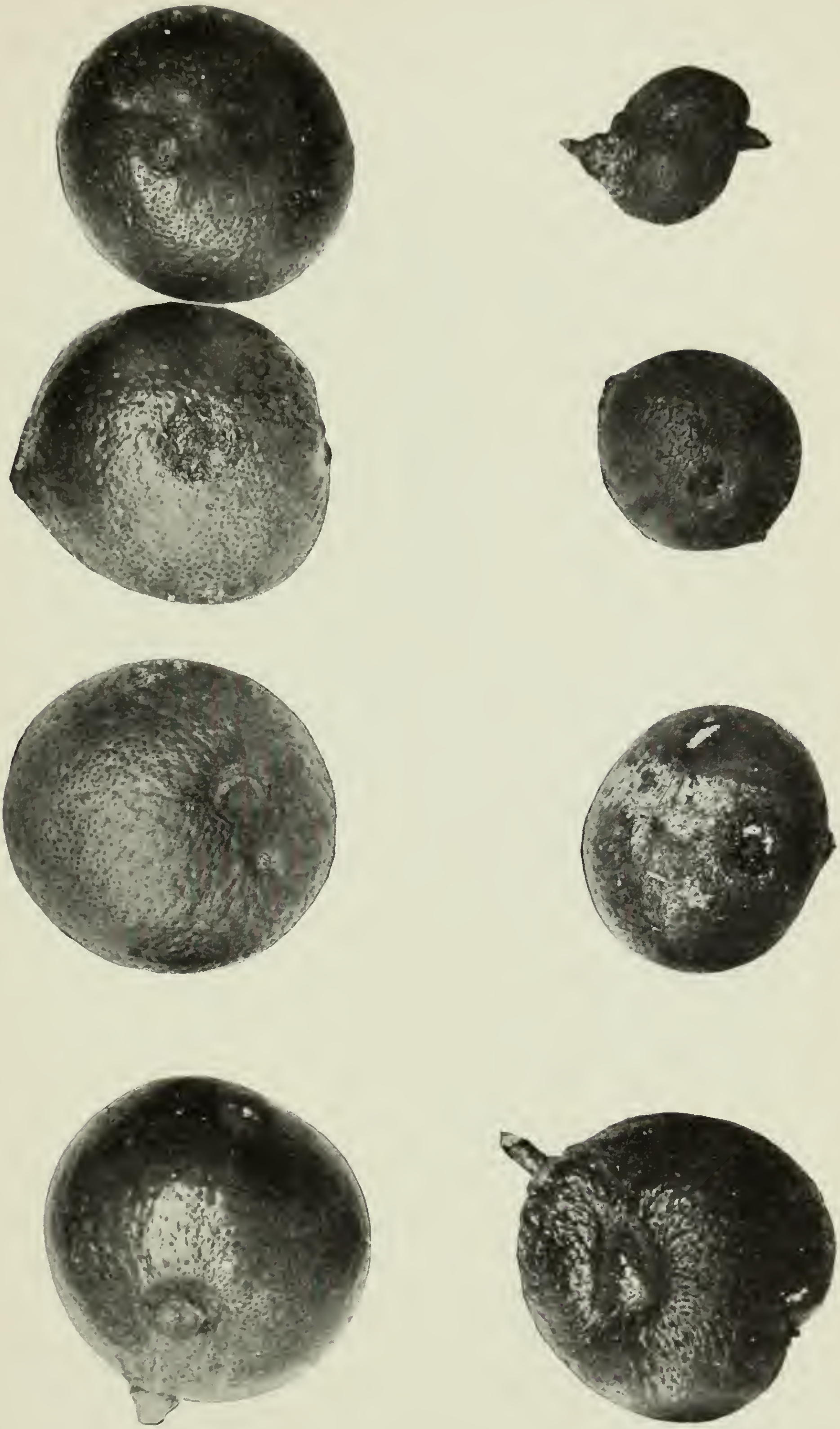


FIG. 5. LEMON SPOT.

FIG. 1. LEMON SPOT.

FIG. 2. LEMON SPOT. SPORES DEVELOPED.



LIMES AFFECTED WITH CANKERS. NATURAL SIZE.

FIG. 1.—LEAF-SPOT ON ORANGE. NATURAL SIZE.

FIG. 2.—WITHER-TIP ON ORANGE TWIG.

SEEDLING ORANGE FOUR YEARS OLD, REPEATEDLY KILLED BACK BY WITHER-TIP.

OLD DATE PALMS AT HERMOSILLO, NORTHERN MEXICO.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 53.

B. T. GALLOWAY, *Chief of Bureau.*

THE DATE PALM

AND

ITS UTILIZATION IN THE SOUTHWESTERN STATES.

BY

WALTER T. SWINGLE,

PHYSIOLOGIST IN CHARGE OF LABORATORY OF PLANT LIFE HISTORY.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

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[a] Detailed to the Bureau of Forestry.
[b] Detailed to Botanical Investigations and Experiments.

3

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., September 15, 1903.

Sir: I have the honor to transmit herewith a paper entitled "The Date Palm and its Utilization in the Southwestern States," and recommend that it be published as Bulletin No. 53 of the series of this Bureau.

This paper was prepared by Mr. Walter T. Swingle, in charge of the plant life history work in the Office of Vegetable Pathological and Physiological Investigations, and was submitted by the Pathologist and Physiologist with a view to publication.

This Bulletin is the first of a series of life history studies of crop plants, treating the crop from every possible standpoint and bringing together all useful information regarding successful cultivation. The importance of such thorough study and complete treatment of the subject will be at once apparent. The illustrations, which comprise twenty-two full-page plates and ten text figures, are considered necessary to a full understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

5

PREFACE.

The following bulletin by Mr. Walter T. Swingle on the date palm embodies the results of an investigation of the climatic, soil, and cultural needs of this fruit tree, which he has had the opportunity to study both in the Sahara Desert and in our own Southwest.

It is shown that no heat is too great and no air too dry for this remarkable plant, which is actually favored by a rainless climate and by hot desert winds. It is also shown that the date palm can withstand great quantities of alkali in the soil—more than any other useful plant. This demonstration is of special interest now that water has been brought into the Salton Basin, or Colorado Desert, in southeastern California, rendering it possible to irrigate some hundreds of square miles of very rich land where the climate is probably even more favorable for the culture of the choicest sorts of dates than in the Sahara. Recent researches of the Bureau of Soils have shown that a large proportion—over half—of the soils in the irrigable part of the Salton Basin is too alkaline to support any ordinary crop. It is shown in this bulletin that the date palm can be grown without difficulty on four-fifths of the irrigable lands of this basin, and that on fully one-quarter of the area it is probably the only profitable crop plant that can succeed permanently. It will take considerable time, however, to bring the industry to a paying basis.

The date palm will be of prime importance in many other irrigated desert areas in the Southwest, where the alkalinity of the soil is too great to permit the culture of other crop plants. It is, moreover, confidently believed that date culture, far from being a last resort for lands unfit for anything else, is one of the most profitable fruit industries, and that it will pay to plant date palms on the best lands and give them the most careful attention.

The conditions for the proper utilization of the date palm in this country have been determined by means of a very careful study into its life history requirements. This bulletin will show clearly the importance of life history investigations, of which Mr. Swingle is in charge. Such investigations are being extended to other important crop plants.

The work covered by this report has been carried on in cooperation with the Office of Seed and Plant Introduction and Distribution, through which all of the important date importations have been made. The investigations relating to soil conditions have been carried on in cooperation with the Bureau of Soils.

ALBERT F. WOODS,
Pathologist and Physiologist.

OFFICE OF VEGETABLE PATHOLOGICAL
AND PHYSIOLOGICAL INVESTIGATIONS,
Washington, D. C., August 14, 1903.

CONTENTS.

9

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

THE DATE PALM AND ITS UTILIZATION IN THE SOUTHWESTERN STATES.

INTRODUCTION.

The purpose of this bulletin is to call attention to the peculiar suitability of the date palm for cultivation in the hottest and most arid regions in the Southwestern States and to its remarkable ability to withstand large amounts of alkali in the soil. The most intense heat, the most excessive dryness of the air, the absence of all rainfall for months at a time during the growing season, and even the hot, dry winds that blow in desert regions are not drawbacks, as in almost all other cultures, but positive advantages to the date palm, enabling it to mature fruit of the highest excellence.

The growing of the best sorts of dates where the climate is favorable promises to be more profitable than any other fruit culture possible in such regions, and this industry would long ago have been carried on extensively had the climatic and soil requirements of this plant been better known, and had there not been general ignorance as to the methods of propagation, as well as a lack of the best sorts to propagate.

The date palm has the unusual power of resisting large amounts of alkali, the most dangerous foe to agriculture in the arid regions, both in the soil and in the irrigating water. This will permit it to be grown profitably on lands so salty as to prevent the culture of any other paying crop, and thereby render feasible the reclamation of hundreds of square miles of the most fertile lands in the Southwest which, at great expense, have been put under irrigation.

Thanks to the hearty cooperation of Prof. Milton Whitney, Chief of the Bureau of Soils, it has been possible to investigate thoroughly the ability of the date palm to withstand alkali in the soil. Samples of soils were selected by the writer in date plantations in the oases in several different regions in the Sahara Desert (see map, Pl. II, p. 76) with especial reference to a determination of the effect of alkali on the growth and fruitfulness of the date palm. Analyses of these soil samples, made by Mr. Atherton Seidell, were placed at the disposition of the writer by Professor Whitney, and have rendered it possible to determine with some degree of accuracy the alkali resistance of this remarkable plant, which important point in its life history is here considered in detail for the first time.

One of the principal reasons for publishing this bulletin is the completion of a system of canals which will irrigate a considerable portion of the Salton Basin,[a] or Colorado Desert, in southeastern California, from the Colorado River, some 60 miles away. Water was first brought in, after great expense had been incurred and no inconsiderable engineering difficulties overcome, in June, 1891, and since then the development of the new country has been very rapid. Before the end of the year 1891 some 125,000 acres of this land had been taken up. This desert lies mostly below sea level and is characterized by having the hottest and driest climate known in North America.

As soon as water was put on it was evident that some of the land was alkaline, and researches made by the Bureau of Soils of the Department of Agriculture[b] have shown that over half the lands now irrigable are too salty to permit the culture of any but alkali-resistant plants. Probably one-fourth of these lands will not support permanently any other profitable crop than the date palm. Now, it happens that the climate of this desert is better adapted than that of any other region in North America for the culture of the best sorts of dates and is even better than that of the northern part of the Sahara Desert, whence are exported the choicest dates that now reach the markets of Europe and America. The advantages of this region over any others in the United States or Mexico for the growing of the best late varieties of dates, such as the Deglet Noor, are so great as to give it almost a natural monopoly of the production of these dates, the most expensive dried fruit on our markets.

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[a] In the United States the term "desert" is applied only to unirrigated or uncultivated arid regions, and as fast as such areas are reclaimed and put to profitable culture by means of irrigation they cease to be called deserts and receive some other name. The appellation "desert" is a hindrance to real-estate transactions and is felt to be unjust and opprobrious by those who live in the midst of flourishing fruit orchards and alfalfa fields. Doubtless the same change of name will take place in case of the Colorado Desert, and indeed the misleading term "Colorado delta" has already been applied to the newly irrigated lands about Imperial and Calexico. The true delta of the Colorado River lies to the southward, where this stream enters the Gulf of California. The region in question might very appropriately be called the Salton Basin, inasmuch as it is a true basin, an area surrounded on all sides by mountains or higher lands and depressed far below sea level in the center, where its most prominent topographical feature, Salton Lake or Salton Sink, is located. Throughout this bulletin Salton Basin is used instead of Colorado Desert to designate the lower parts of the lands sloping toward Salton Lake, a region limited on the north by the San Bernardino Mountains, on the west by the San Jacinto Mountains, and extending southward into Mexico to the line beyond which the delta lands slope toward the Gulf of California.

[b] Means, Thos. H., and Holmes, J. Garnett. Soil Survey around Imperial, Cal. Circular No. 9, Bureau of Soils, U. S. Dept. of Agriculture, 1901.

There exists, therefore, an unusual combination of circumstances, in that the opportunity for introducing a most profitable new industry into this region coincides with the pressing needs of a new country for some crop which can withstand alkali.

The resistance of the date palm to alkali is so much greater than that of other crop plants that it will be indispensable for the more alkaline areas through the Southwest wherever the climate is hot and dry enough to permit even the less valuable early sorts to mature. Already date palms are being planted on alkali lands in the Salt River Valley, Arizona, and as a result of the demonstration of the feasibility of growing them the price of such land has more than quadrupled within the last five years. Doubtless within a decade date culture will be much extended in Arizona, and it probably will become the most important fruit industry in the Salton Basin in California.

It becomes a matter of great importance to show what the climatic requirements of the date palm are and to determine how much alkali it can withstand, as well as to indicate how date palms are propagated and how their culture is carried on. This exposition is especially necessary in case of this plant, as its needs as to climate and soil are unlike those of any other plant commonly grown, and the methods followed in its propagation and culture are widely different from those employed for other crop plants.

It is believed that these data, here presented in detail,[a] will serve to facilitate the establishment and the extension of a new industry in this country.

WHAT IS THE DATE PALM?

The date palm was one of the first plants to be cultivated, and has been grown for at least four thousand years along the Euphrates and Tigris rivers. It has been for ages and is still the most important food plant of the great deserts of the Old World, and many regions in Arabia and in the Sahara would not be habitable were it not for this tree. Not only does it yield a delicious fruit of great food value, but it also furnishes in many regions the only timber suitable for use in the construction of houses and for making a thousand and one necessary objects. Its leaves furnish a partial shade, under which it is possible to cultivate other fruit trees which could not exist were they exposed to the direct rays of the sun and the burning winds in the desert; thousands of fig, almond, pomegranate, and peach trees and grapevines, forming veritable orchards, are cultivated in the palm-covered oases, especially in the northern Sahara. For centuries the transportation of dates has been the chief motive for the formation of the great

[a] Many of the facts here presented were summarized by the writer in a previous article, entitled "The date palm and its culture," Yearbook of the Department of Agriculture, 1900, pp. 453–490; also reprinted.

caravan routes which run in every direction through the deserts in Africa and Arabia. The exportation of dates to Europe and to America is an important industry both in North Africa and in the countries bordering the Persian Gulf.

The value of the dates imported into the United States alone averaged for the ten years ended June 30, 1900, $402,762 per annum, as appraised at the exporting point, but the real value when received at the American port was doubtless 50 per cent greater, or $600,000 a year. This value is now exceeded only by the imports of two other dried fruits—Zante currants, $916,908 in 1900, and Smyrna figs, $513,895, in 1900. Inasmuch as California has been producing large quantities of second-class dried figs for some years, and since 1900 also Smyrna figs of the best quality,[a] it is likely that in the near future the value of the imports of figs will fall below that of dates, which will then rank second in value among imports of dried fruits.

The date palm, as its name indicates, belongs to the great family of palms. Like the majority of its relatives, it has but a single bud at the top of the trunk, and if this bud be destroyed the tree usually dies. The date palm, however, unlike the cocoanut palm and unlike the majority of palms, produces offshoots, or "suckers," at the base of the stem (see Pl. XVII, fig. 2, and Yearbook, 1900, Pl. LIX, fig. 4),[b] at least during the first decade of its existence. Old date palms which are in full bearing do not produce such offshoots, and if the terminal bud be destroyed the whole plant will die, since offshoots are very seldom, if ever, produced at the top of the trunk. The date palm, like most other members of this family, has a trunk which remains of the same diameter, no matter how old it may be, there

[a] This gratifying result was brought about by the introduction of the fig insect (Blastophaga), which the writer accomplished in the spring of 1899 by sending from Algeria the winter galls of the male fig tree containing these insects. The Blastophaga fertilizes the flowers of the Smyrna type of figs, which, unlike ordinary figs, do not set fruit unless pollinated. The large orchard of Smyrna figs at Fresno, Cal., belonging to Mr. George C. Roeding, which had produced but a few dozen figs pollinated by hand during the twenty years it had been planted, began to yield abundant crops as a result of the introduction of this beneficent insect, and in 1901 produced some 70 tons of dried figs. The success of this orchard has led to a renewed interest in fig culture, and several other large plantations have been set out near Fresno, while many orchards of inferior varieties are being grafted to the Smyrna fig.

[b] Throughout this bulletin references have been made to plates published by the writer in his paper, "The date palm and its culture," in the Yearbook of the Department of Agriculture for 1900, pp. 453–490, Pls. LIV–LXII. This publication is accessible in all libraries, and it has been arranged to send a reprint of the paper with the present bulletin to all applicants in the Southwest who live in regions where date culture is feasible. This will render it possible for all interested to refer to the plates in this previous paper. In order to shorten the references to these plates they are cited as "Yearbook, 1900," with the number of the plate. Inasmuch as the plates of this Yearbook article were numbered from LIV to LXII and those of the present bulletin are numbered from I to XXII, confusion is impossible.

being no secondary increase in diameter with increasing age such as occurs in ordinary fruit and forest trees. In consequence, the age of a palm tree can be roughly estimated from its height, but never from the diameter, nor, as is customary among woodsmen, by counting the rings of annual growth, for the simple reason that the date palm has no such rings.

The leaves of the date palm (frontispiece and fig. 1, p. 16) are feather shaped and very large, frequently from 12 to 18 feet long. The ancient Egyptians had a tradition, held also by some tribes of modern Arabs, that the date palm produces twelve leaves in a year. It is an interesting fact that the Egyptian hieroglyphic which signified a month represented a single leaf of the date palm, and the sign for a year pictured a crown of leaves of the date palm.[a] Of course, there is no such fixed interval of time between the unfolding of successive leaves, but it is true that the date palm usually produces from twelve to twenty leaves in a year.

These leaves remain alive and green for several years, but finally lose their color and bend downward toward the trunk. (See the lower leaves on the tall palm in Pl. XIX, fig. 2.) Travelers who have seen date palms growing remote from human habitations in the Sahara Desert report that in such situations the old leaves remain attached to the trunk permanently, the palm being crowned with living green leaves and the trunk clothed to the ground by the reflexed dead leaves. Furthermore, in such conditions, where the date palm is left to grow uncontrolled by man, the offshoots produced by the young palms grow unhindered and often rival in size the parent trunk, and they in turn give rise to other offshoots, even after the parent stem has passed the age when it would produce offshoots. The result of this is that instead of a single palm tree, the traveler sees a great thicket composed of a few tall trunks (the original palm and the oldest offshoots), surrounded at the base by a tangled mass of younger offshoots, struggling upward and outward. Such a clump is shown in Yearbook, 1900 (Pl. LIX, fig. 4). All of these trunks retain their dead leaves permanently, so that such a clump of palm shoots is well nigh impenetrable. To those who have traveled in countries where the date palm is the commonest cultivated tree, the description given above will seem very strange. In all such countries the date palm is well cared for and the dead leaves removed, leaving a clean trunk, crowned with a tuft of living leaves. (See frontispiece and Yearbook, 1900, Pl. LX.) Besides this, the Arab cultivators are careful to remove the offshoots as soon as they are large enough to plant, or to destroy them when young in case they do not desire to propagate the variety. Such

[a] Fischer, Th. Die Dattelpalme, Ergänzungsheft No. 64. In Petermann's Mittheilungen. Gotha, 1881, p. 4.

offshoots, ready to remove, are shown on Plate XVII, figure 2, and offshoots removed and ready to transplant on Plate VI, figure 3.

Unlike most fruit trees, the date palm has the male and the female flower on separate individuals. If grown from seed, about half of the resulting palms are male and about half female. If such trees be allowed to grow to maturity in this proportion enough pollen is blown by the wind to fertilize all the flowers properly. It would be, however, a very expensive method of culture to irrigate and cultivate such a large proportion of male trees. The Arabs—and before them the

Fig. 1.—A young Deglet Noor date palm at Biskra, Algeria; below a flower cluster just opening; above two young fruit clusters, the larger still bound about with the cord used to attach the male flowers in pollinating. May, 1900. (After negative by the writer.)

Assyrians—learned to pollinate the palm artificially, and from a small proportion of male trees to fertilize the flowers of a very great number of female trees. At the present time the proportion followed in commercial planting is that of about one male tree to a hundred female trees.

The date palm blooms in the early spring, producing from six to twenty flower clusters, according to the age and vigor of the tree (see fig. 1). Each flower cluster on the female tree produces a bunch of dates, consisting of numerous fruits, borne on slender twigs, which branch from a main stalk (Pl. XXII and Yearbook, 1900, Pl. LX). Such a bunch may bear from 10 to 40 pounds of dates, and a vigorous tree is commonly allowed to produce from eight to twelve such bunches. The date itself is, of course, familiar to everyone; it is an oval fruit from 1 to 3 inches long, and one-half or one-third as wide, containing a single seed surrounded by a half dry and very sweet pulp, usually amber colored. There are very many varieties of dates, differing widely as to character and quality, as will be explained more in detail farther on.

DATE CULTURE BY THE ANCIENTS.

The date palm is one of the oldest cultivated plants. It is fully described on the clay tablets of the ancient Assyrians. It was undoubtedly one of their most important food plants, and every detail of its culture, the operation of pollinating the flowers, and even the serving of the fruit at the tables of the wealthy were delineated with great accuracy on their monuments and wall sculptures. It is probable that the date palm was first extensively grown in the valleys of the Euphrates and Tigris rivers. It was apparently little known and but slightly esteemed in ancient Egypt before 3000 B. C., although as early as 2000 B. C. it had already become a well-known fruit tree. Not much is known as to the origin of the date palm, although everything points to its being native in some of the ravines bordering the deserts of northern Africa or Arabia. It is probable that it was first cultivated by the Assyrians, afterwards by the Egyptians, and that very early its culture became almost a national industry with the Arabs. It is true that the date palm existed in ancient Africa before the arrival of the Arabs. It was, however, comparatively unimportant, at least in the western Sahara, and the varieties were probably inferior. When the Arabs invaded the western Sahara and the Barbary States during the seventh century, and at various intervals until the twelfth century, they introduced the use of the camel and thereby rendered it possible for the inhabitants of the oases to satisfy all their wants, simply by growing an abundance of dates, since the camels could carry the dates to the more fertile regions bordering the Mediterranean, where they could be exchanged for the wheat and barley needed in the Sahara for making bread. In consequence of this economic revolution, the culture of the date palm speedily became, and is still, the most important interest throughout the Sahara Desert.

The Moors undoubtedly introduced the date palm into Spain, where, in spite of the unfavorable climate, it was extensively planted during the Saracen domination. The first date palms in the New World were grown from seeds carried from Spain by the missionaries who accompanied the Spaniards on their voyages of discovery and conquest.

PROPAGATION OF THE DATE PALM.

SEEDLING PALMS.

Date palms may be grown from seed and are generally so grown in Mexico and in India, but if so propagated something over half the palms are males, which produce no fruit whatever, while of the remaining female plants probably, on the average, not more than one in ten produces good fruit. This would mean that in planting 100 seeds, on the average only four or five palms bearing good dates would be secured and probably as many more of second quality, or in all some 10 per cent of the number planted would yield edible fruit. It should be said that in Arizona, and even in Mexico, very many of the seedling sorts do not reach maturity because of the insufficient summer heat; but if grown in the Salton Basin, where all the sorts could mature, a larger proportion, possibly 15 per cent, would produce fruit that could be used.

SEEDLING DATE PALMS FOR THE SALTON BASIN.

In view of the scarcity of offshoots of the best varieties and the pressing need for date palms for many parts of the Salton Basin, it would be well worth while to plant orchards of seedlings, and when they are in bearing the worthless sorts could be cut out and their places gradually filled by taking offshoots from the seedlings yielding good fruit. It would be possible to begin thinning out the excess of males as soon as the flowers begin to show, some four to six years after planting. The trees could be planted, say, 12½ feet apart, in rows 25 feet apart, giving about twice the number that should be left, because nearly half the total number will prove to be males, to be cut away as soon as recognized. By the sixth or seventh year after planting the quality of the fruit produced by the female plants could be judged and the plants producing the poorest dates could be removed and replaced by offshoots from the best seedlings, which should, of course, be planted where the rows show the largest gaps, resulting from the removal of superfluous males and worthless females. In the course of a few years it would be possible to remove all the less valuable seedlings and replace them with the better sorts. This process could go on indefinitely by continually replacing poorer sorts with better as fast as offshoots were available, until only two or three of the best sorts remained. No outlay would be entailed for offshoots, and if considerable numbers of seedlings were grown from the best dates there certainly would be some sorts of value among them.

If any attempt be made to start seedling date orchards in the Salton Basin it should be borne in mind that the young seedling can not withstand nearly as much alkali as can offshoots or old palms. Prof. R. H. Forbes[a] finds that many of the young plants grown from seeds which

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[a] Oral communication to the writer, 1902.

had been planted at the Cooperative Date Garden at Tempe, Ariz., were killed by alkali shortly after they appeared, while the offshoots growing near by were unharmed. In case alkaline areas are to be planted it would be best to establish a nursery on alkali-free land and transplant the seedlings when they are 1 or 2 years old, or, if the soil is very alkaline, when 3 or 4 years old, to the positions they are to occupy permanently. Where the palms are to be planted on the very worst alkaline lands it would be well to allow the young date palms to flower in the nursery rows, so that the males could be discarded and only females set out, with the precautions for washing out the alkali mentioned below, thus avoiding the expense and trouble of caring for the worthless male plants. It is easy to distinguish the male from the female plants by an inspection of the flowers, which, as is shown in Plate VII, figure 3, are very different in the two sexes. In transplanting young seedlings the leaves should be cut back severely to correspond with the cutting back suffered by the root system.

It is interesting to note in this connection that the date palm requires for its germination not only fresh water, free from any considerable amount of dissolved alkali, but also a large and continuous supply of such water. The young seedling shows curiously enough a whole set of peculiarities of structure which enable it to throw off an excess of moisture. Fritsch, an Austrian botanist, concluded that the seed was adapted for germination during the rainy season, and that it was meant to grow in earth thoroughly saturated with water.[a] Not only are the roots devoid of hairs, resembling in this peculiarity those of plants which grow in swamps and in water, but they have numerous aerating canals, and in other ways show adaptation for growth in very moist situations. There are even pores at the tops of the leaves by which the little seedlings can get rid of superfluous moisture which has been absorbed by the roots.

Seedling dates are nearly always found along irrigating canals or in situations where the earth is kept constantly moist. These are strong indications of the natural habitat of the date palm, which should be expected to grow where the earth is very moist, at least during the rainy season. It is practically impossible for date seedlings to start in unirrigated arid situations, even where cacti and other desert plants grow abundantly.

As is clear from what has been said, the date does not reproduce true to type from seed. This may be in part because no attention has been paid to the pedigree of the male plants used to furnish pollen, so that even the choicest dates may have been pollinated from males of the most worthless character. If it should be found desirable to plant seedling orchards it would be well to arrange to have Deglet Noor

[a] Fritsch, G. Anatomisch-physiologische Untersuchungen über die Keimung der Dattelpalme, in Sitzungsb. d. k. Akad. d. Wiss. Wien, Bd. 93, Abth. I, April, 1886.

dates pollinated from a number of trees in the hope that some of these males would produce seedlings of a superior type. If possible males known to be seedlings of the Deglet Noor or of some other superior sort should be employed in such pollination. It is worthy of note that the male dates in California, and especially those in the Salt River Valley, Arizona, are for the most part the offspring of fairly good soft dates, probably from the Persian Gulf region, purchased in the markets. So Arizona and California dates would be well worth planting, since both parents of the seeds in such dates are the offspring of soft dates, whereas in most regions where the date palm is grown the males are likely to be the product of dry dates (for most of the dates in those countries are of the dry type) dropped by chance in a wet spot where they could grow.

The seedlings of a single sort of date may present the most remarkable variations, and usually the parent type is not exactly reproduced by any of the offspring. This is clearly shown by the experiments of Col. Sam Taylor, of Winters, Cal., who tried to propagate from seed the valuable early ripening Wolfskill date growing on his place. This was done because this palm had ceased to produce offshoots before its value was recognized. Many of these seedling dates have fruited, but none resembles in the slightest degree the parent variety; most of them are much later and consequently fail to mature at Winters, where the summer heat is insufficient to ripen any but the earliest sorts.

PROPAGATION OF THE DATE PALM BY OFFSHOOTS.

In all regions where its culture is an important industry the date palm is almost invariably propagated by removing and planting the offshoots or suckers which spring up around the base of the trunk (Pl. XVII, fig. 2, and Yearbook, 1900, Pl. LIX, fig. 4). These offshoots reproduce the parent variety exactly and have the great advantage of coming into bearing sooner than seedlings. Offshoots are produced abundantly by young date palms, but cease to form when the trees reach the age of 10 to 15 years. Usually three or four are left attached to the parent plant, any in excess of this number being cut away as fast as they form. One offshoot can be removed every year until they cease to be produced. They are cut away from the parent trunk when they are from 3 to 6 years old, after they have begun to develop roots, if as usual they start from below the surface of the ground and have their bases covered with earth. The leaves are all cut away, leaving only the bud in the center protected by the leafstalks (Pl. VI, fig. 3). No roots are left attached to the offshoot, which, when so reduced to a mere stump, can stand much exposure. Some offshoots procured by the writer on May 18 and 19, 1900, at Ourlana, Algeria, in the Sahara Desert, were shipped by camel-back

(Pl. VI, fig. 2) to Biskra, 95 miles away, and from there to Algiers, some 390 miles by rail, with no packing except a little palm fiber about the bases. One box of these offshoots was packed in straw with no moisture whatever except from having been wet twice, once at Biskra and once at Algiers. So packed they were sent to New York by steamer, arriving July 3, then transshipped to New Orleans and finally carried by rail from New Orleans to Tempe, Ariz., where they arrived July 17. They were unpacked July 20, two months after they had been dug up. Prof. R. H. Forbes, under whose personal supervision the palms were planted and cared for, reports that the box of offshoots which had no packing other than the loose dry straw came through as well as those packed in damp moss or in charcoal. Some 80 per cent of these suckers lived.[a]

It is very important that the offshoot be planted out high enough so that the growing bud in the center is never in danger of being covered with water when irrigated. (See fig. 6, p. 42.)

In order to force the offshoots to take root and grow, the chief requisite is that the ground be kept constantly wet about their bases. If the young plants dry out once they are lost, for the delicate new roots that are just forming will be killed. The Arabs water the offshoots every day for the first forty days after planting and then twice a week until winter, after which they are watered as often as may be necessary to keep the ground thoroughly moist.

Another requisite almost as important as the keeping of the base of the plant moist while roots are starting is that the ground be warm when the offshoots are transplanted. It is useless to set out offshoots in autumn or winter; the best season is late in spring or early in summer, when the ground is thoroughly warm and when there is a long hot season after planting, permitting the young palms to become well established before winter. It is not necessary to shade the young offshoots, but they should be protected against cold during the first winter after being set out, by wrapping with burlap, heavy paper, or straw.

Professor Forbes finds (see p. 19) that young seedlings are often killed by alkali where offshoots and old palms grow all right. Strong alkali is probably injurious also to offshoots just striking root, and the following method of preventing the rise of alkali, communicated by Professor Forbes, may be advantageously followed in all cases where there is danger to be apprehended from this source: Throw up a high border on each side of the rows, running in both directions, thus creating a square inclosed space about each palm. This space may be flooded from the irrigating canals with fresh water, which carries away the salts accumulated near the surface down to

[a] Forbes, R. H. Twelfth Annual Report, Arizona Experiment Station, p. 317.

lower level beyond the reach of the young roots. The area about the offshoot inclosed by the borders should then be covered with straw to a depth of a foot. This mulch will hinder evaporation and thereby restrict the rise of alkali, since each application of water washes the alkali down anew and the mulch continues to act as a check on evaporation. Such a method of planting should be adopted in those parts of the Salton Basin where there is danger of a rise of alkali from the subsoil.

DISTANCES BETWEEN TREES.

The Arabs almost invariably plant the date palm without any attempt at placing the young offshoots in definite order. The result is, it is almost impossible for them to be sure of planting the trees at any constant distance from each other, some being close together, others wide apart, as can be seen in Plates XII and XIII.

The unsystematic and frequently careless methods employed by the Arabs in the culture of the date palm can not be taken as models to be followed in introducing the date industry into the Southwest; we should rather follow the example of the French colonists in the Sahara, who plant the date palm in regular rows (see Pl. XVII, fig. 1), and have, as a rule, definitely planned and carefully executed systems of irrigation and drainage. Although the Arabs plant the date palms very close together, the French have found it advisable to place the trees wide apart, and many of the French colonists regret having placed the trees only 20 or 22 feet apart, their opinion now being that date palms should be planted from 26 to 33 feet from each other.

Ben Chabat, an Arab, who is considered an authority on date culture, makes two date palms speak together; one says to the other, "Take thy shadow away from mine and I will produce alone for us two together"[a]—expressing the idea that too close planting is dangerous. At 26 feet apart, which may be taken as an average distance, about 60 palms would be planted on an acre. If the palms are put 30 feet or more apart other crops can be grown between the trees even when old.

The amount of irrigation water available during the hot season and the value of land are factors which must be considered in deciding at what distance the offshoots should be planted. In general the farther apart the palms are, the more heat and light each receives, and the better and the more abundant is their fruit.

Even when planted 26 feet apart or less there are, of course, large strips which lie unused between the palm trees for the first ten or twelve years after planting. It has become a common practice in the Algerian Sahara, copying to some extent after the Arabs, to plant garden or field crops between the trees until the palm trees become large enough to shade the ground. In case the soil is alkaline, it is

[a] Masselot, F. Bul. Direction Agric. et Comm., Tunis, vol. 6 (1891), No. 19, p. 128.

frequently impossible to grow any crop until two or three years of abundant irrigation, coupled with a good system of drainage, have washed the alkali out of at least the top layers of the soil. Barley is usually the first crop grown on alkaline soil. After barley has been grown a year or two, the abundant irrigation being, of course, kept up, the land usually becomes freed from alkali sufficiently to permit horse beans, cowpeas, beets, and other garden crops, and, what is of more importance, alfalfa, to be grown. This Saharan alfalfa (see Pl. XVI, fig. 2), although refusing to grow on soil which produces a fair crop of barley, is, nevertheless, able to withstand without injury a percentage of alkali in the soil which would prevent the growth of ordinary alfalfa.[a]

PROPORTION OF MALE TREES THAT SHOULD BE PLANTED.

It has been found in the date plantations of the Sahara that for every hundred date palms there should be at least one male tree to furnish pollen for use in fertilizing the flower clusters in spring. There is already a large number of male date palms in Arizona and California, so that it has not been thought necessary to introduce more than a very few from the Old World. The ratio of one male for every hundred female palms applies only in the Sahara, where it is possible to secure male palms known to flower at the right time to be used in pollinating. It often happens that many of the seedling male plants flower too late to be of any use.[b] It does not interfere so much with the usefulness of a male date palm to have it bloom too early, since the bunch of male flowers can be preserved for some weeks without serious deterioration. In view of these facts it will be advisable in starting any plantations to put out at least one male palm for every fifty females, or better, one male for every twenty-five females. It will be desirable also to secure offshoots from different male trees in order to avoid getting male trees all of one kind, which might be found to bloom at the wrong season. In case no offshoots of male trees can be secured, a few seeds may be planted and the male palms saved to furnish pollen. When the trees begin to flower it will be possible to see readily which male trees flower at the right season; the others can be destroyed and offshoots from female trees planted in their places.

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[a] After much correspondence with the Arab caids in the interior of the Sahara, a small quantity of the seed of this valuable alfalfa was obtained for the writer in the spring of 1901. It is earlier than ordinary alfalfa and resists heat and alkali better. It has been planted in the Cooperative Date Garden at Tempe, Ariz., and it is hoped that it will prove as valuable in the Southwest as it is in the Sahara.

[b] Out of six date palms which had flowered up to 1898 at the San Joaquin Valley substation of the California Experiment Station, three were female and three male, but two of the male palms did not flower until the female trees had ceased blooming.

VARIETIES OF MALE DATE PALMS.

Some male trees produce more pollen than others, and are much preferable to use in pollinating. When once good sorts of males are found they should be propagated by offshoots in the same manner as the female plants. In most parts of the Algerian Sahara no particular attention is paid to the propagation of suitable male palms, and in consequence pollen is sometimes scarce early in the flowering season and again later on, which often renders it necessary to procure pollen from neighboring orchards or even from other oases, sometimes at considerable trouble and expense. In Tunis there is a male variety propagated by offshoots called the Deglaoui used to pollinate late-blooming sorts. Another called the Dakar majahel was secured by Mr. D. G. Fairchild in Egypt, and has been sent to the Cooperative Date Garden at Tempe, Ariz. It is said to be the only male palm which produces pollen at the right time to be used on all of the eight varieties of female dates grown about Ramley, Egypt.

The chief requisite of a male date palm is that it shall produce an abundance of pollen at the right time to be used in pollinating the female sorts that are grown. If date palms were propagated from seed, and still more if any attempt should be made to breed new and better sorts, it would be very desirable to secure male sorts capable of transmitting desirable characteristics to their offspring. (See p. 20.)

Schweinfurth has recently put forth the claim[a] that the male sort used for pollinating the flowers has a decided influence on the shape and, what is more important, on the size of the seed of the dates which result. If this were true it would be very important to secure male sorts which when used for pollination would produce small seeds. Schweinfurth's supposition is, however, without doubt erroneous, for in spite of his assertion that the observed variability of the seed in dates of the same variety[b] is a proof of the effect of the different sorts of pollen used to fertilize the flowers, the fact is that the seeds of any one sort are so uniform in size and shape as to furnish good characters for use in distinguishing varieties, and are regularly so employed by both Europeans and Arabs. The only part of the seed which could be affected directly by the male parent is the embryo, which in the date occupies so small a fraction of the bulk of the seed that it is not surprising that there is no observable effect of the pollen on the seed and much less on the pulp which surrounds it.

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[a] Schweinfurth, Dr. Georg. Ueber die Kultur der Dattelpalme. In Gartenflora, vol. 50, 1901, p. 513.

[b] Naturally the seeds are not all exactly alike, even on the same tree, and some varieties of dates have seeds which vary appreciably in shape and even in size; but this range of variation is itself a varietal character. Of course the incorrect identifications of dates often made offhand by the Arabs may easily lead to erroneous ideas as to the extent of variation in a sort through a confusion of varieties similar in external appearance, but differing in seed characters.

Male date palms generally have stouter trunks and more leafy crowns than female trees (see Pl. V, fig. 2), and some have said that even the young plants could be distinguished—a matter of much importance where dates are propagated from seed, when it is desirable to recognize and destroy as soon as possible the superfluous male plants. It has not been found possible to depend on any of the signs given for distinguishing young male plants, and they can be recognized with certainty only when they are in flower. An inspection of figure 3 on Plate VII will show how different the male flowers are from the female and render it easy to determine the sex of the palms as soon as they show flowers.

CARE TO BE GIVEN DATE PALMS.

The chief care required by date palms is that they be irrigated as often as needful. The soil should be kept in a proper state of tilth, which is usually done by growing some crop between the rows, especially when the palms are young. The leaves are trimmed off as they die, and care is taken not to allow too many offshoots to grow at the base of the stem, for they draw on the strength of the parent plant. In general not more than three or four offshoots should be allowed to grow at once. At least one should always be left attached to the mother plant to be used to replace it in case of accident.[a]

Old palms, ten to fifteen years after planting, which have developed a good trunk 4 to 10 feet high, do not produce offshoots, and such trees require no attention other than the cutting away of the dead leaves, the pollination of the flowers, and the gathering of the fruit.

THE AGE AT WHICH DATE PALMS BEGIN BEARING.

The age at which palms come into bearing depends much upon the climate and soil; where planted in rich soil, watered abundantly, and where the summer heat is intense and long continued, the date may begin to fruit when very young. Trees have been known to bear in Arizona within four years after the seed was planted; however, such palms are too small to bear more than a very few fruits, and seedling trees are generally considered not to yield paying quantities of fruit until they are at least 6 or 8 years old (see Yearbook, 1900, Pl. LVII, fig. 1). When date culture is practiced scientifically, practically no seedlings are grown, but instead orchards are started by planting fairly large offshoots, which soon strike root, and which often bear

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[a] Many valuable seedling dates have been lost in this country because the suckers were kept closely trimmed off until the trees were in bearing. Only then was their value discovered after it was too late to propagate them. If an offshoot is always left attached at the base of the palm it may in turn be allowed to produce suckers after the parent plant ceases to produce them, and in this way a continuous supply of offshoots may be produced even at the base of old palms, and no variety need be lost.

abundantly four or five years after being transplanted (see Pl. XXII). However, in the large plantations made in Algeria by the French colonists it is not considered advisable to allow the palms grown from offshoots to bear fruit until five or six years after they are set out, and the trees are not in full bearing until eight or ten years after they are planted. They continue bearing, if well cared for, until they are a hundred years or more old, a good tree producing an average of from 60 to 200 pounds of fruit a year,[a] although some trees have been known to produce as much as 400 or 600 pounds[b] when grown in rich soil and abundantly irrigated. The tree shown in a previous paper (Yearbook, 1900, Pl. LVII, fig. 1) is a demonstration of the capabilities of Arizona as a date-producing country. It was only 8 years old from the seed when photographed, and yet bore some 400 pounds of dates. Again, an Amreeyah palm, grown from an offshoot imported by the Department of Agriculture from Egypt in 1889, yielded in 1900 over 300 pounds of dates (see Yearbook, 1900, Pl. LXII, fig. 1). A little palm growing on the grounds of the University of Arizona, at Tucson, where the winters are often cold, bore, nevertheless, when it had been transplanted five years, two bunches of fruit weighing together some 30 pounds (see Yearbook, 1900, Pl. LVII, fig. 2). The large Deglet Noor palm growing at Biskra, Algeria, shown in the foreground of Plate LX, Yearbook, 1900, bore over 15 bunches of fruit, and the young Deglet Noor palm shown in Plate XXII, grown from a sucker set out only three years before, bore 3 bunches of fruit.

POLLINATION OF THE DATE PALM.

In a wild state the date palm is undoubtedly pollinated by the wind, and about one-half of the trees are males. It is probable that pollination would be incomplete unless the proportion of male trees was something like one-half, for, although enormous quantities of pollen are produced, only a very small part of wind-blown pollen ever reaches the female flowers. The artificial pollination of the date palm was doubtless discovered by the ancient Assyrians, and has been practiced probably for three or four thousand years at least. Because of the great economy of pollen brought about by this practice, one male tree suffices to pollinate from fifty to a hundred females.

The male flower cluster of the date palm consists of a stalk bearing

[a] M. Masselot has published a list of all the important varieties of dates grown in the Tunisian Sahara (Bul. Direc. Agric. et Comm., Tunis, Vol. 6, No. 19, Apr., 1901), and gives the average yield per tree of 92 sorts. The Loozee variety has the lowest average yield, 55 pounds, and the Areshtee and Hamraya the highest, 220 pounds; the average yield of all the 92 varieties is 116.5 pounds per tree.

[b] In the oasis of Tebbes, the northernmost in Persia, it is reported that a full-grown tree may yield 200 man (of 3½ pounds). Bunge, Petermann's Mittheilungen, 1860, p. 214.

a considerable number of short twigs to which the flowers are attached, the whole contained in a sheath at first entirely closed, but which finally ruptures, disclosing the flowers. (Pl. VII, figs. 1 and 3.) The Arabs cut the male flower clusters from the trees shortly before the flowers have fully opened, at a somewhat earlier stage than shown in Plate VII, fig. 1. The separate twigs to which the male flowers are attached (Pl. VII, fig. 3, twig below) are from 4 to 6 inches long, and bear anywhere from 20 to 50 male flowers, each containing 6 anthers full of pollen. One of these twigs suffices to pollinate a whole female flower cluster, and to bring about the development of a bunch of dates.

FIG. 2.—Date flower cluster after artificial pollination; a sprig of male flowers has been inserted among the female flowers and tied fast with a palm-leaf fiber. (One-third natural size.) From negative by the author.

The female flowers, like the male, are borne inside of sheaths which are at first entirely closed. Finally the sheath is split open by the growth of the flowers within (Pl. VII, fig. 2, twig to left), and at this stage pollination is accomplished. The two tips of the cracked-open sheath are separated and the cluster of female flowers pulled out. (Pl. VIII, fig. 3.) A twig of male flowers is then inserted into the cluster of female flowers and tied in place with a bit of palm leaf or with a string. (Fig. 2 and Pl. VIII, fig. 4.) This completes the operation of pollination. The fruit cluster soon begins to grow rapidly, and in a few weeks the piece of palm fiber or thread with which the male flowers are held in place is broken by the pressure of the growing fruit cluster. Such a fruit cluster, still confined, but which will shortly break the fiber, is shown in figure 1 (p. 16).

In the Algerian Sahara the date begins to flower in April, and sometimes produces flower clusters as late as June 1. The female flower clusters, which may be from five to twenty in number on a single tree, are not all produced at the same time. It is necessary in consequence to pollinate each flower cluster as it appears, and sometimes an interval of several weeks elapses between the appearance of the first and last flower clusters, so the trees must be ascended several times. The Arabs are very expert in doing this work and seldom overlook a tree, even where the palms are planted without any order; indeed, they rarely miss even a single flower cluster. It requires some skill to climb a tall palm tree, as the trunk below is very smooth and it is difficult to pass between the stalks of the lower leaves in order to get at the flowers, since these leafstalks are armed with sharp, rigid thorns. (Fig. 1, p. 16.) The Algerians use no rope or other apparatus to ascend the trees, but climb up with their bare hands and feet. (Pl. VIII, figs. 1 and 2, and Pl. XIII.)

When date culture becomes an important industry in the Southwestern States it is probable that American ingenuity will devise methods of simplifying the work of pollination. For example, it would be easy to find means of marking the trees, and also the flower clusters, to show which have been pollinated. It might be possible, for instance, to tie the male flowers in place with a bright-colored strip of cloth, which would make it easy to see whether all the flower clusters had been pollinated or not. It is possible that in some places Indians will be able to take the place of the Arabs and do this work efficiently. It is absolutely necessary to pollinate all the flowers in order to secure dates of a good quality, although the dates do not fall off even if the flowers are not pollinated.

About the end of June, by which time the fruits are of some size, three fruits will have developed from each flower. Then occurs a remarkable phenomenon. If the flowers have been pollinated, two of the three fruits fall, leaving a single date for each flower. If, on the contrary, the flowers have not been pollinated, all three dates remain attached and continue to grow, becoming closely crowded together and somewhat deformed. Such dates are without seeds, but never properly mature, and are entirely valueless.[a] This peculiar behavior of the date palm enables the cultivator to tell by inspection which bunches have been pollinated and which have escaped attention, and the cutting away of the excess of bunches from too heavily laden trees should be postponed until this time, when it is possible to tell which bunches will mature perfect fruit. As a rule, only one or two clusters should be left on the young date palms which have just begun to bear, and only eight or ten even on old trees. Some varieties do not require much thinning, as they do not produce more bunches than they can nourish properly, whereas other sorts produce twice as many as the tree can support.

It sometimes happens that some of the female flowers appear in spring before any of the male trees have blossomed. To provide a supply of pollen for such flowers the Arabs make a practice of keeping a few bunches of male flowers from the previous year, which are placed in tight paper bags and hung up in a cool, dry place. The pollen is said to keep without deterioration for at least two years. The importance of securing male trees which flower at the right time has been noted on page 24.

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[a] Such unpollinated dates have sometimes been supposed by inexperienced observers to be a superior variety because of their seedlessness.

By an inspection of Plate VII, figure 3, it will be easy for those who possess seedling date palms to determine the sex of the plant as soon as any flowers are formed. Superfluous male trees can then be destroyed and replaced by female trees before they have reached a large size. In case of gardens where there are a few female date palms and no males available to furnish pollen, it will be necessary to secure pollen from a distance—not a difficult matter, since male flowers can be shipped anywhere without deterioration if protected against loss of pollen.

After irrigation the labor of artificial pollination is the most important required in a date orchard. The irrigation, however, is very nearly such as would be given to any fruit trees, whereas the process of pollination is one that is not required by any other commonly cultivated tree. It should, however, be remembered that for the first ten or fifteen years after date palms are planted the flowers are so near to the ground that artificial pollination is performed very easily. The operation becomes difficult only when the palms are old and very tall.

GATHERING, CURING, AND PACKING DATES.

Some varieties of dates require practically no curing, being ready to pack and ship as soon as they have ripened. Other varieties, however, require some preparatory treatment. Dates are borne in bunches, which have a single stem with numerous slender twigs to which the fruits are attached. (Pls. IX and XXII.) A bunch carries from 10 to 40 pounds. It is very rare that all the dates on a bunch ripen at once, and in the case of choice varieties those which first ripen are frequently hand picked and shipped at once in order to get the high prices paid for the earliest shipments. It is also asserted that picking the outer dates of the bunch, which usually ripen first, permits the inner fruit to ripen better. Usually the whole bunch is cut off and hung up in a dry and shady place when most of these dates are ripe and the remainder beginning to ripen. It has been found necessary to remove any dates which have begun to spoil before the bunches are hung up, for if such dates are left the whole bunch may spoil. Usually within a week or two all of the dates ripen,[a] and the bunch is ready for shipment.

The choice varieties of dates are shipped from the Sahara either in bags or more often in long wooden boxes. They are afterwards

[a] In case the dates do not mature because of an exceptionally cool summer, or in regions where the summer heat is inadequate, they can be ripened artificially after being picked by exposing them to the sun during the hot part of the day spread out on blankets, and storing them indoors at night wrapped up in the blankets on which they have been exposed during the day. Mr. Hall Hanlon, near Yuma, Ariz., often ripens considerable quantities of dates in this manner, which is that followed in northwestern Mexico (see p. 135).

repacked in smaller boxes, holding from two-thirds of a pound to 10 pounds. (Fig. 5, p. 34, and Pl. X.) The methods above outlined apply to the Deglet Noor, which is the variety chiefly exported from Algeria and Tunis to Europe. Other varieties, such as the Rhars, which are full of sugary juice when ripe, are not so easily handled. The Arabs usually hang up the bunches and allow the juice to drain off into jars. This juice, which they call date honey, is preserved and used, and the fruit, when it has become somewhat dry, is then packed in boxes or more often in skins. Dates of this class are usually packed tightly, and may keep for many years without deteriorating. Somewhat the same style of packing is practiced at Bassorah and Maskat in Arabia, whence come most of the dates received in American markets. There the dates are packed tightly in layers in wooden boxes for export to America and Europe. The dates containing an abundance of sugary juice have the disadvantage of being sticky when unpacked, and are not suitable to serve as a dessert fruit. As before mentioned, the Deglet Noor does not have this drawback if properly handled. It has, however, the defect of drying rather rapidly, and from the very fact that it is not tightly packed in boxes it doubtless dries all the quicker. With reasonable care, however, it can be kept for some months in a cool, dry, well-ventilated storeroom, and probably no other dried fruit having a value comparable to the Deglet Noor date can be put on the market with so little labor or at so little risk of loss. Practically the only hand labor required is that of arranging the dates in layers in the smaller boxes in which they are sent to the retail trade.

TYPES OF DATES AND VARIETIES SUITABLE FOR CULTURE IN THE UNITED STATES.

THE THREE TYPES OF DATES.

Of the three principal types of dates cultivated by the Arabs, only one is exported to Europe and America. This comprises the dates, so familiar to us, called by the Arabs "soft dates." They contain sometimes as much as 60 per cent of their weight of sugar, and are, in fact, candied on the tree, being preserved from decay by the enormous amount of sugar they contain. They contain more or less of a sirupy juice, which is in some varieties so abundant that it must be allowed to drain off before they can be packed.

The second type comprises sorts very like those just mentioned, but having a much lower percentage of sugar—not enough to keep them from fermenting and turning sour. They do not dry readily and are usually eaten fresh from the tree as a table fruit, being more like grapes than like ordinary dates. The very early sorts are of this category and do not stand shipment to long distances, though they will prove of great value for home consumption and may be sold on the local markets. The Wolfskill date (see fig. 3) from Winters, Cal., is one of these sorts, as is also the Amaree, the earliest date known in the western Sahara, which has been recently introduced into Arizona.

The third category embraces what are known to the Arabs as "dry dates." These are almost entirely unknown to Americans or Europeans, but are very much esteemed by the Arabs, who consider them to be better for every day consumption than the soft dates, which latter they regard rather as a luxury than a staple food. These dry dates are not at all inclined to be soft or sticky when ripe, and are frequently so hard as to be difficult to eat. They are said to drop to the ground as they ripen, and are gathered by simply picking them up from beneath the palms as they fall. If stored in a dry place and protected from weevils, they may be kept for years without deteriorating. Dates of this type are as yet wholly unknown in our markets, but inasmuch as they are often of excellent flavor,[a] and are cleaner, keep better, and are more easily gathered and packed, they can be sold cheaper than soft dates. It is not unlikely that the best sorts of dry dates may become favorably known and may be eaten in place of Deglet Noor dates as a dessert fruit, especially when the latter sort is out of season; say, from April to October.

FIG. 3.—Wolfskill dates grown at Winters, Cal.

Mr. O. F. Cook suggests that dry dates may attain popularity as a result of the modern tendency toward the use of nuts, cereal preparations, and other foods which do not require cooking, since they would be preferable to the sweeter soft dates as a regular article of diet, and could be had at any time of the year in prime condition.

VARIETIES OF DATES SUITABLE FOR CULTURE IN THE UNITED STATES.

When the writer made his last journey to the Sahara in order to secure offshoots for planting in the Cooperative Date Garden at Tempe, in Arizona, and even when his first report[b] on the date palm was pub-

[a] A palm which bears dry dates of excellent quality, though of rather small size, was imported by the Department of Agriculture in 1889, and has fruited for some years in the Salton Basin in southeastern California at Coachilla. This palm is probably a seedling and not an offshoot of a named variety as was at first supposed; it may be called the Coachilla date, and has fruits about $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long and five-eighths inch wide. They are brownish amber in color, much wrinkled, and have a dull meal bloom on the surface. The seed is small, light gray in color, blunt, and with a more or less evident furrow on the back. The flesh, though hard, is free from fiber and of very good flavor, with a persisting and agreeable aftertaste.

[b] "The date palm and its culture," Yearbook of the Department of Agriculture, 1900; also reprinted and distributed separately.

lished, it was doubtful whether the best late-ripening sorts of dates could succeed in any of the arid regions of the Southwest which had then been irrigated, and consequently particular attention was given to early-maturing sorts, sure to ripen fully in most parts of Arizona and California. Many early sorts have been secured by the writer from the Sahara, among them the Amaree, Tedmama, Areshtee, Halloua, Teddala, Timjooert, Rhars, Tennessin, and Bent Keballa, and Mr. D. G. Fairchild has recently secured the Hayani, the earliest sort grown in lower Egypt. Several medium or early sorts already exist in California and Arizona—among others the Seewah, imported from Egypt by the Department of Agriculture some thirteen years ago, and a number of seedlings which have originated in this country, such as the very early Wolfskill (see fig. 3), the moderately early Lount No. 6, and the Bennet date (see fig. 4), which latter has a remarkably low proportion (1 to 11) of pit to flesh. With so many early and medium sorts to choose from, it is probable that some can be found capable of ripening all along the northern range of date culture in Texas, New Mexico, and Arizona, and throughout the interior valley region of California.

Fig. 4.—Bennet date, from Phoenix, Ariz.

The Rhars, in particular, is a promising variety for cooler climates, as the fruit ripens very early and is of good quality, while the plant is very vigorous and easily propagated by offshoots. Its principal drawback is that the fruits are sticky, being so full of sirupy juice that they are difficult to cure, and must usually be packed closely in skins or boxes for shipment. It is not improbable, however, that a good system of curing and packing would get rid of this sirup and leave the dates in a condition like that of the oriental dates commonly sold in America.

A large number of the offshoots of the Rhars variety was obtained in 1900, part being sent to California and part to Arizona.

The Rhars offshoots planted at Tempe in July, 1900, have made a remarkable showing; nearly 10 per cent of the plants (17 out of 176) flowered and bore a small crop of fruit only two years after being set out. "The Rhars proved to be an exceedingly sweet, tender-skinned date, maturing in September and October, and can probably be grown in cooler localities than Salt River Valley."[a] Professor Forbes writes that, "judging from preliminary experience, the Rhars seems to be a good commercial date, being very sweet, and drying in ten days to two weeks time to a firmness permitting of packing and shipping.

[a] Forbes, R. H. Thirteenth Annual Report, Arizona Experiment Station, 1902, p. 243.

They seem to be dry enough to pack when they are down to about 85 to 80 per cent of their fresh weight."[a]

The Teddala is another early sort, having a great advantage over the Rhars in that its fruits can be cured without difficulty. This variety was brought into notice by M. Yahia ben Kassem. It is a very large date, often 3 inches long, and ripens about the same time as the Rhars. It is as yet but little known, even in North Africa, but is a very promising sort. The palm is exceedingly vigorous and bears large crops of fruit. This variety is now growing at Tempe.

It has been noted on page 61 in treating of the heat requirements of the date that hardy rather than early sorts are needed for southern Nevada and southwestern Texas, where the summers are long enough and hot enough to ripen even late sorts, but where the winters are sometimes very cold.

Now that considerable areas in the Salton Basin have been put under irrigation, there is at last open to our enterprising fruit growers a region superior to most parts of the Sahara for date culture, in which even the latest and best sorts will ripen perfectly. It now becomes of great importance to secure these late varieties for trial, as they comprise the choicest sorts which bring the highest prices on the American and European markets.

THE DEGLET NOOR DATE.

Among these late sorts one in particular is worthy of special mention, the famous Deglet Noor.[b]

This sort is of medium or large size, oval in outline, dark amber colored, and translucent, with a small, pointed pit. The flesh is firm, very sweet, and of exquisite flavor and aroma. This date, if properly handled, remains clean, with the skin smooth, unbroken, and dry, so that when served as a dessert fruit it has a most appetizing appearance, very unlike the ordinary sticky, misshapen dates from the Persian Gulf region. A bunch of dates showing how the dates are attached is represented on Plate XXII (see also Yearbook, 1900, Pl. LX), while several dates and a few pits, all natural size, are shown on Plate IX.

The palm which produces these dates has a slender trunk, bearing long, narrow leaves, which stand more upright than those of most other sorts. The bunches of fruit have long, slender stems, which allow them to hang down when the dates are ripe (Pl. XXII). The slender, upright leaves give this variety a characteristic appearance, which enables it to be recognized easily even when growing with other sorts.

[a] Forbes, R. H., in letter to the writer, dated Tucson, January 9, 1903.

[b] In French orthography Deglet Nour; also called Deglet en nour, or Deglat ennour.

The fruits undergo no special preparation for the market, but are simply sorted and packed carefully in boxes suitable for the retail trade. Such boxes are shown in figure 5 and on Plate X. They contain from two-thirds of a pound to 11 pounds, and are especially in demand in Europe for the Christmas markets. The smaller boxes usually reach the larger markets of this country in January and sell at from 30 to 40 cents each retail, or at the rate of 45 to 60 cents a pound for the dates. The writer was assured by some of the largest producers in Algeria that the supply did not equal the European demand and that large American orders were refused, while, on the other hand, at one of the

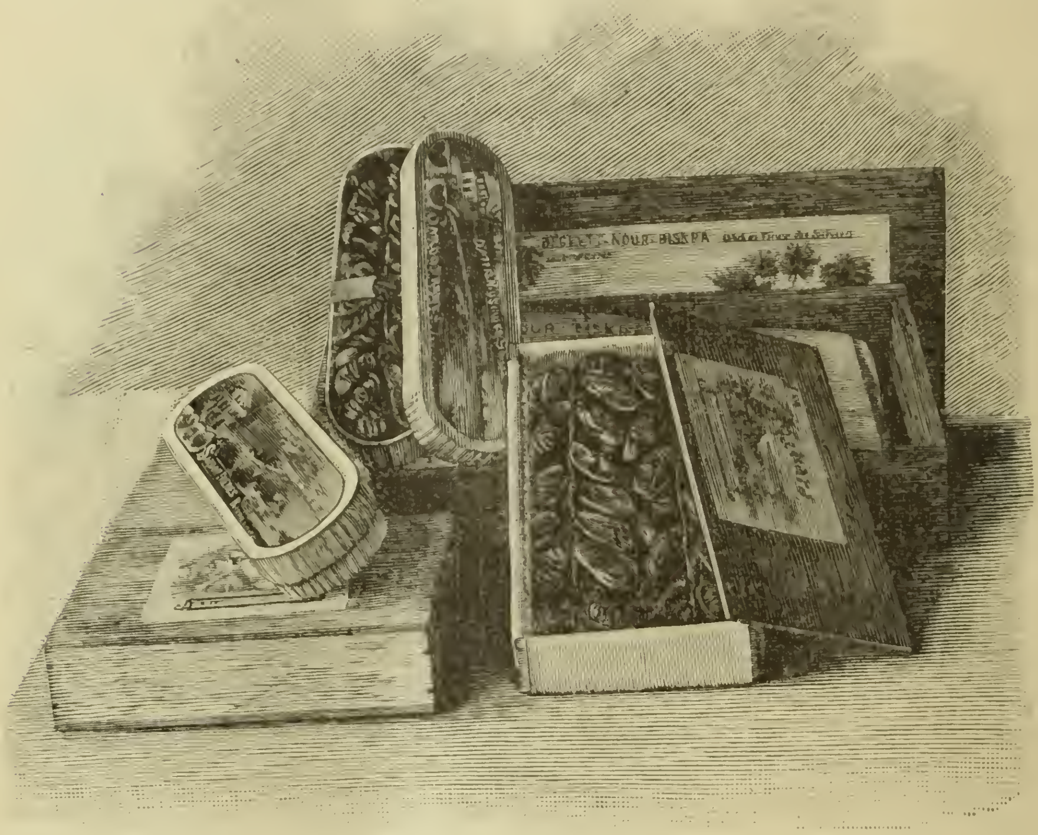

FIG. 5.—Deglet Noor dates from the Algerian Sahara, showing methods of packing for retail trade.

largest wholesale and retail groceries at San Francisco it was said that any quantity could be sold at 35 cents a box (50 cents a pound), if they could be secured before the holidays. At the same time, selected Smyrna figs were selling in 1-pound boxes for 30 cents. It is clear that this date has little in common with the sorts which reach our markets in bulk from Bassorah, at the head of the Persian Gulf, and from Maskat, Arabia. If these Deglet Noor dates could be sold for half what they now bring (which would still be about five to ten times the wholesale selling price of this sort in the Sahara), the consumption could be enormously increased in this country, as they would not compete with the common dates, but would be used as a choice dessert fruit and for confectionery.

The Deglet Noor is a very late variety, which requires an enormous amount of heat in order to mature properly. It does not succeed very well at Biskra, and only in the interior of the Sahara, where the summer temperatures are higher, is it of the best quality. The finest Deglet Noor dates are produced in the sunken gardens "ghitan" (fig. 8, p. 69) of the Souf country in the Algerian Sahara (see map, Pl. II, p. 76), where the heat is doubled by reflection of the sun's rays upon the leaves from the sides and from below, by the sloping sandy sides of the excavations, in the bottom of which the date palms are planted. As is shown in considering the heat requirements of the date palm (pp. 67–69), this sort may not be able to ripen fully in the Salt River Valley, Arizona, but it will surely attain the most complete maturity in the Salton Basin and will probably ripen earlier there than in the Sahara, which will allow the dates to be placed on the markets in ample time for Christmas, while in the warmest situations hand-picked dates probably can be shipped for Thanksgiving. The certainty that this choice variety can now be grown in the United States adds a new interest to date culture, and doubtless many progressive fruit growers will soon be planting Deglet Noor date palms, the culture of which gives every promise of being exceedingly profitable (see p. 136). A full-grown Deglet Noor date palm has been variously estimated to yield from 40 to 60 kilos (88 to 132 pounds) a year on the average, and certain trees in the sunken gardens of the Souf country in the Sahara yield as much as 330 pounds of fruit. In the Oued Rirh country the yield is irregular and a good crop is said to be followed by a poor one and then by a moderate one, making one good and one medium crop every three years. It has been found by the French companies that of the dates yielded by the Deglet Noor palm about one-fourth are of the first grade, suitable for packing in small wooden boxes (see fig. 5, p. 34, and Pl. X), holding from 4½ to 11 pounds, about one-third are second grade and are packed in the two-third pound oval paper boxes, such as reach our markets, and the remainder, a trifle over one-third, are third-class dates to be sold in bulk.

Unfortunately the Deglet Noor variety does not produce very many offshoots and does not grow so rapidly as do most of the less valuable sorts. In 1900 the writer secured 87 offshoots of the Deglet Noor, which were planted at the Cooperative Date Garden at Tempe, Ariz. (See Pls. XXI and XXII). Of these 47 are now alive and growing and in a year or two it will be possible to state with certitude whether this valuable variety will mature in the Salt River Valley.[a]

[a] One Deglet Noor palm at Tempe bloomed in 1902, but did not mature its fruit successfully. (R. H. Forbes, Thirteenth Annual Report, Arizona Experiment Station, 1902, page 243.) Several bloomed in 1903, but still no fruit matured.

It would be desirable to test this sort in the Salton Basin, and if possible some offshoots will be secured by the Department of Agriculture directly from the Sahara, since it will be some two or three years before any can be taken from the plants now growing at Tempe.[a]

The Deglet Noor is by no means common in the Sahara, and according to Masselot[b] it was carried about two hundred and forty years ago from the oasis of Temassin near Tougourt, where it originated, to the oases of southern Tunis. It had then been known in Temassin only about sixty years, so the variety is about three centuries old. Masselot gives the following account of its origin as told by the Arabs: "A revered saint, Lella Noora, had the habit of making daily ablutions at a point in the oasis of Temassin called 'Blidet-Amar.'[c] A seed sprouted fortuitously at this point and produced a palm of a new sort of degal (soft date) which was called degal ennoura or deglat ennour in remembrance of the saint." Most authorities derive the name from the Arabic *noor* "light" and "*degal*" or "*deglet*," "soft date," meaning "the date of the light" or "the transparent date." This is considered by Masselot as an error, as some other sorts are more transparent; he maintains that the name means simply "Noora's date."

THE KHALAS DATE.

Mr. Fairchild has also very recently (summer of 1902) secured at Bahrein offshoots of the famous Khalas, a date from the province of Lahsa or Hassa in eastern Arabia, near the Persian Gulf. Cuinet,[d] in his celebrated work on Turkey, refers to it as the most delicious of known dates.

The celebrated traveler Palgrave mentions this variety as occurring in the province of Hassa between Hofhoof and Mebarraz in east-central Arabia, and says:[e]

Here and for many leagues around grow the dates entitled "Khalās"—a word of which the literal and not inappropriate English translation is "quintessence"—a species peculiar to Hassa, and the *facile princeps* of its kind. The fruit itself is rather smaller than the Kassem date, of a rich amber color, verging on ruddiness, and semi-transparent. It would be absurd to attempt by description to give any idea of a taste, but I beg my Indian readers at least to believe that a "Massigaum" mango is not more superior to a "Jungalee" than is the Khalās fruit to that current in the Syrian or Egyptian marts. In a word, it is the perfection of the date. The tree that bears it may by a moderately practiced eye be recognized by its stem, more slender than that of the ordinary palm, its less tufted foliage, and its smoother bark. * * * Its

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[a] An experimental date orchard has been established very recently in the Salton Basin at Mecca (Walters), Cal. Several large Deglet Noor palms have been transplanted from Tempe to Mecca and many Deglet Noor offshoots have been ordered from the Sahara. (See footnote, p. 110.)

[b] Masselot, F. Les dattiers des oasis du Djerid. in Bulletin de la Direction de l'Agriculture et du Commerce, Tunis, vol. 6, No. 19, April, 1901, pages 117–118.

[c] Bled et Ahmar near Temacin (Map, Pl. II, p. 76).

[d] Cuinet, La Turquie, Vol. III, p. 233.

[e] Palgrave, William Gifford. Narrative of a Year's Journey Through Central and Eastern Arabia, Vol. I, London, 1865, pp. 172–173.

cultivation is an important item among the rural occupations of Hassa, its harvest an abundant source of wealth, and its exportation, which reaches from Mosoul on the northwest to Bombay on the southeast, nay, I believe to the African coast of Zanzibar, forms a large branch of the local commerce.[a]

Mr. Fairchild says Europeans and Arabs in that region agree in considering it to be the best date in the world. He further says:

I do not hesitate to pronounce it second or third only to the *Deglet Noor*, which it even surpasses in *date* flavor. I have always thought the Deglet Noor a most delicate date, but lacking in that indescribable *date* flavor which characterizes these Persian and Arabian sorts. The Khalas is a sticky date, but of most unusual flavor.[b]

In his report on the "Persian Gulf Dates" Mr. Fairchild says:

The skin is a golden brown and of most delicate texture, covering closely the rich golden flesh, which is of exquisite date flavor and with the consistency of a chocolate caramel.[c]

OTHER PROMISING DATES.

Among numerous other sorts secured by the writer from various regions in the Algerian Sahara and now growing in the Cooperative Date Garden at Tempe, Ariz., the following are especially noted for their superior quality, all being considered by some to equal or to be superior to the Deglet Noor in flavor.

(1) The Teddala, a very large, very early sort from M'Zab in western Algeria (see page 33).

(2) The Iteema, a midseason date, short and round, with soft flesh, very sweet, said to keep well; in Tunis it is very much esteemed and is considered suitable for export.

(3) The Bent Keballa, possibly a large form of the Iteema, considered one of the best varieties in M'Zab.

(4) The Timjooert, also from M'Zab, a medium-sized red date, so full of juice that the fruit drips honey from the tree when ripe; when properly cured keeps well and is of most excellent quality; flesh granular with almost no fibers about the seed; very sweet.

(5) The Hamraya, a very large, dark-red date, ripening very late; flesh free from fiber and of good flavor; in Tunis it is the largest date known and one of the two heaviest bearers,[d] the average yield being 220 pounds per tree.

(6) The Mozaty or Mazauty date, from the Pangh Ghur country[e] in Baluchistan, recently secured by Messrs. Lathrop and Fairchild, has been highly extolled. It is said by Fischer, in his monograph of the

[a] Mr. D. G. Fairchild reports that Khalas is a delicate packer and is nowadays never exported except in form of presents. (See Bul. 54, Bureau of Plant Industry, U. S. Department of Agriculture, 1903, p. 25.)

[b] Fairchild, D. G. In letter dated Bassorah, February 22, 1902.

[c] Fairchild, D. G. Persian Gulf Dates and Their Introduction into America. Bul. 54, Bureau of Plant Industry, U. S. Department of Agriculture, p. 25.

[d] The Areshtee is the other. (See page 26, footnote *a*.)

[e] Some thirteen days' caravan journey from the port of Gwadur, on the Gulf of Oman.

date palm, to be "the best date in the celebrated date region Pandschgar."[a] This variety is reported by Mr. Fairchild to be one of the finest in the world; it "is packed in date syrup in small jars and sold as a great delicacy in the Kurrachee market." Such preserved Mozaty dates were eaten by Mr. Fairchild in February, 1902, at Kurrachee. He says, "They impressed me as the richest flavored dates I had ever tasted."[b]

THE ORDINARY DATES OF COMMERCE.

The standard varieties of dates which are grown along the Shat-el-Arab River and which are exported from Bassorah to America and Europe in enormous quantities have recently been secured and introduced into this country by Messrs. Lathrop and Fairchild. The principal varieties grown for export in this region are the Halawi, Khadrawi, and the Sayer. Of these the Halawi is doubtless the best; it is a medium-sized, rather light-colored, sticky date, and forms the best grade of the ordinary dates imported into America. The tree grows well on an adobe soil and needs much water. From the region about Maskat Messrs. Lathrop and Fairchild secured the Fard date, of which about 1,000 tons a year are exported. It is largely shipped to America, but it is darker colored and inferior in flavor to the Halawi of Bassorah, according to Mr. Fairchild,[c] whose recent bulletin should be consulted for a detailed account of the varieties and methods of culture observed by him in a trip through the oriental date regions.

VARIETIES OF DATES THAT SHOULD BE SECURED FOR TRIAL IN THE UNITED STATES.

There are other very promising late sorts which should be secured as soon as possible, even at considerable expense, in order that they may be tested in the Salton Basin and in Arizona in comparison with the Deglet Noor.

Among these may be mentioned the Menakher (or Monakhir) of the Tunisian Sahara, a variety later than the Deglet Noor, with large brown fruits which attain the length of the little finger. This sort is rare and much sought after in the Tunisian Sahara, where it sells for slightly more than the Deglet Noor, which it surpasses in length by 50 per cent and to which it is by many considered superior in quality. The average yield of a Menakher palm is said to be 30 kilos or 66 pounds, only half the yield of the Deglet Noor. The offshoots are more costly than those of the Deglet Noor, selling at from 4 to 6 francs each, while those of the Deglet Noor cost only 2 to 3 francs, and the ordinary sorts from 1 to 3 francs.

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[a] Fischer, Th. Dattelpalme, p. 26.

[b] Fairchild, D. G. Persian Gulf Dates and Their Introduction into America. Bul. 54, Bureau of Plant Industry, U. S. Department of Agriculture, 1903, p. 27.

[c] Fairchild, D. G. Persian Gulf Dates and Their Introduction into America. Bul. 54, Bureau of Plant Industry, U. S. Department of Agriculture, 1903, p. 25.

Another sort of great promise is the Wahi, of which samples were secured by Mr. Fairchild in the market of Fayoum, in west-central Egypt. This variety is said to come from the oasis of Seewah, known to the ancients as Ammon, or Ammonium, some 300 miles to the westward, in the interior of the Sahara Desert. The date is brown, less transparent than the Deglet Noor, but rather longer and decidedly broader; the seed is blunter and much more irregular in outline. The flesh is yellowish, granular midway between the skin and the seed, and of a most delicious flavor. This date had been gathered and kept, with no precautions against drying out, for at least eight months when it was received at Washington, but it was still in very good condition, except for the attacks of weevils. It seems to be a better keeper and to have a higher flavor than the Deglet Noor. Nothing is known as to the palm which produces this date, but from the quality of the fruit it is presumably a late-maturing variety.

Dates of a superlatively good quality are reported from Morocco, and Mr. O. F. Cook[a] obtained some years ago at Tangiers, from a European official in the employ of the Sultan, dates which he considers superior to the Deglet Noor. These dates were about as long as and somewhat thicker than the Deglet Noor, but more wrinkled and of a darker color. They were covered with a bloom and were so dry that the flesh was firm and not at all sticky. At London a prominent produce dealer in Covent Garden market assured the writer that the Tafilet dates were better than the Deglet Noors, which are also much appreciated in England. Inasmuch as the drier grades of Deglet Noor dates are preferred in England, it may be that the Tafilet dates of the London markets are the same as the dry variety Mr. Cook secured at Tangiers. No good dates are produced west of the Atlas Mountains in Morocco, and any sort of superior quality must come from the Moroccan Sahara, very probably from Tafilet, the largest and most important Moroccan oasis, though Mdaghra and Tissini are also reported to produce excellent dates. Rohlfs,[b] the celebrated African explorer, says: "The dates of Tafilet are known as the best in the whole desert; the varieties Buskri, Bu Hafs, and Fukus are most sought and bring the highest price."

The importance of securing a date possibly superior to the Deglet Noor would warrant sending Arab or Berber merchants to these oases to investigate the quality of the dates and to secure offshoots of the better sorts. In the present unsettled state of trans-Atlasian Morocco it would be hazardous for Americans or Europeans to venture there.

The Mirhage date of Mandalay, some three days' journey from Bagdad, and the very similar but somewhat inferior Maktum of Bagdad,

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[a] Oral communication to the writer, 1900.

[b] Rohlfs, Gerhard. Tagebuch seiner Reise durch Morocco nach Tuat. In Petermann's Geographische Mittheilungen, 1865, Heft 5, p. 175.

are considered by Mr. Fairchild as being very promising sorts. The Maktum is "a soft, sticky date with a small stone, no fiber, and a beautiful golden-brown skin which adheres closely to the golden, brownish-yellow flesh."[a] It matures in August. Unfortunately the Mirhage could not be secured by Mr. Fairchild at the time of his visit to Bagdad in 1902, though he sent the Maktum to this country, where it is now growing.

The dates of Bafk and Terachabad, in Persia; of Medina[b] and Tur,[c] in western Arabia; of Kasem, in central Arabia; of Nedjed, in eastern Arabia; of Say and Sukkot,[d] in Nubia; of Dakhel, in western Egypt; of Traghen, in Fezzan; and of Tafilet, Mdaghra, and Tissini, in eastern Morocco, have been lauded by experienced travelers, and if possible these oases should be visited and offshoots secured of the best sorts, since it is now possible to bring even the latest varieties to full maturity by planting in the Salton Basin. Heretofore the uncertainty as to the possibility of growing the best late sorts has discouraged any attempt to obtain the varieties from the more remote regions; but now, when date culture is still in its infancy, is just the time when these sorts should be secured and tested, in order that no mistakes be made and so that only the best sorts be planted out. Once planted, a date palm can not be changed to another variety, as can all other ordinary fruit trees, for palms can not be grafted or budded. To change the variety it is necessary to dig up the old trees and plant young offshoots of the sort desired; in other words, to destroy the old orchard and plant a new one.

In view of the fact that offshoots are now very expensive, and that it costs more to plant an acre to date palms than to any other fruit tree, and in view of the fact that date palms can be propagated only at a slow rate by removing one or two offshoots annually and can not be increased indefinitely by budding or grafting, as with other trees, it becomes very important to secure a collection of the best sorts of date palms as soon as possible, in order that all the best varieties may be

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[a] Fairchild, D. G. Persian Gulf Dates and Their Introduction into America. Bul. 54, Bureau of Plant Industry, U. S. Department of Agriculture, 1903, p. 23.

[b] "The best kind [of Medina dates] is Al Shelebi; it is packed in skins or in flat, round boxes, covered with paper, somewhat in the manner of French prunes, and sent as presents to the remotest parts of the Moslem world. The fruit is about 2 inches long, with a small stone, and is seldom eaten by the citizens, on account of the price, which varies from 2 to 10 piasters [about 9 to 43 cents] the pound. The tree, moreover, is rare, and is said not to be so productive as the other species." (Burton, Narrative of a Pilgrimage to Mecca, vol. 1, pp. 400–401.)

[c] "The small, yellow dates of Tur * * * are delicious, melting like honey in the mouth, and leaving a surpassing *arrière goût*." (Burton, Narrative of a Pilgrimage to Mecca, vol. 1, p. 204.)

[d] "In Nubia the dates of Ibrim are celebrated, but still more so those of Sukkot and Say, the sweet aromatic Sultani, which attain a length of 3 inches." (Fischer, Die Dattelpalme, p. 25.)

compared and that there may be time to secure a supply of offshoots before the "rush" begins and whole regions are planted to dates.

Fortunately it will doubtless be possible to secure the Rhars for the cooler arid regions and the Deglet Noor for the hottest deserts in any desired numbers when once the demand for the offshoots exists.

INTRODUCTION OF SAHARAN VARIETIES OF DATE PALMS INTO THE UNITED STATES.

Seedling dates have long been growing in California and Arizona, and still longer in Mexico, but only recently have successful importations been made of offshoots of date palms, by which alone the varieties can be propagated. In 1889 the Division of Pomology of the Department of Agriculture imported some 59 offshoots from Egypt, 9 from Algeria, and 6 from Maskat, and, although many were lost, those sent to the Arizona Experiment Garden in Phoenix, in the Salt River Valley, grew well and fruited at an early age. (See Yearbook, 1900, Pl. LXII, fig. 1.) It was, however, found that most of the offshoots from Egypt had been falsely named; many bearing the names of valued sorts proved to be ordinary males of no value. Some few female palms bearing fruit of fair quality were included in the shipment, however, and the success of these proved the Arizona climate and soil to be suited to the culture of at least the Egyptian sorts. Prof. James W. Toumey first directed attention to the success of the date palm in central Arizona, as evidenced by the production of an abundance of fully matured dates, both by the seedlings planted by American settlers and by offshoots imported by the Department of Agriculture.[a] It was the success of these early importations which rendered it desirable and feasible to undertake the recent large importations of offshoots made in 1899–1900.

Shortly after the organization of the Section of Seed and Plant Introduction in the Department of Agriculture in July, 1898, attention was directed to the desirability of securing a large assortment of correctly named offshoots, particularly from the Algerian Sahara, whence are exported the best dates which reach Europe and America. The University of Arizona and the Arizona Agricultural Experiment Station meanwhile offered to provide a special date garden, and to set out, irrigate, and cultivate the palms, if the Department of Agriculture would furnish a collection of offshoots of the best sorts of dates grown in the Old World. This offer was accepted, and in the winter and early spring of 1899 the writer visited, under instructions from the Secretary of Agriculture, the oases in the Sahara Desert about Biskra, Algeria. A few offshoots were secured and forwarded as a trial

[a] Toumey, J. W. The Date Palm. Bul. No. 29, Arizona Experiment Station, Tucson, Ariz., June, 1898, pp. 50, figs. 13.

shipment, and a large number was contracted for, to be delivered the following spring.

In May and June, 1900, the writer again went to Algeria for the purpose of shipping to Arizona the date offshoots previously contracted for and to purchase such additional offshoots of good sorts as could be had. As a result of this second visit 440 offshoots, consisting of some 27 varieties, were obtained and shipped (see Pl. VI) to the Cooperative Date Garden at Tempe, Ariz., where 384 of the offshoots were planted (see fig. 6 and Pls. XXI and XXII). Of the remainder 21 were sent to Phoenix, Ariz., and 35 to the date gardens at the substations of the California Experiment Station at Pomona and Tulare and to private growers in California.

FIG. 6.—Cooperative Date Garden at Tempe, Ariz. The offshoots imported from the Algerian Sahara in 1900 have just been set out and a workman is planting one in the foreground. From negative by Prof. R. H. Forbes, August, 1900.

This shipment, which was the largest that ever left North Africa, came through in two months and arrived in good order. An innovation was made in packing the offshoots. It had been the custom to send them rooted in tubs, entailing the great expense of a year or two of care in a nursery to get the plants properly rooted, and then heavy freight charges on account of the bulk and perishable nature of the plants. The writer shipped the offshoots packed simply in boxes with damp moss about the bases,[a] in charcoal, or in straw, with no moisture whatever (see p. 21). A late report of Prof. R. H. Forbes, director of the Arizona Experiment Station, who gave his close

[a] For fuller details see the writer's report, "The date palm and its culture," in Yearbook, Department of Agriculture, 1900.

personal attention to the planting and subsequent care of these offshoots, shows that of the entire 384 plants set out in the Cooperative Date Garden at Tempe and at Phoenix, 294 were living, while 90 were dead.[a] These figures show that over 75 per cent of the offshoots have become established. (See Pls. XXI and XXII.) More than 80 per cent of those sent directly from the Sahara by the new system of packing lived, but the average was reduced by the plants that had been grown in tubs a year before shipment, of which only about 58 per cent lived. The offshoots simply packed in straw came through as well as those carefully wrapped about the base with moist moss or packed in charcoal. Inasmuch as only 70 to 75 per cent of the offshoots are expected to live in the Sahara when they are planted in the open without protection, as was done at Tempe,[b] the remarkable record was made of securing the growth of more offshoots in Arizona after a two months' voyage than would be expected to live in the Sahara, and that, too, even with the most inexpensive method of shipment that could be imagined—that of simply packing the suckers closely together in dry straw in ordinary wooden cases.

This experiment has demonstrated the possibility of importing date offshoots from the Sahara and placing them in the deserts of the Southwest in practically as good condition as when they were cut off the parent tree. The importance of this experiment is obvious, for it renders it certain that offshoots can be transported to great distances without loss, and makes it possible to undertake the culture of dates on a commercial scale by importing offshoots for planting. Doubtless means will be found to supply the demand for offshoots as soon as it arises by importation from the Sahara. In the meantime many of the best sorts of southern Algeria are on trial at Tempe, Ariz., and doubtless some will be found adapted to the climatic conditions there.

As was previously noted in the paragraph on varieties, it is greatly to be desired that the Deglet Noor and other late sorts be set out as soon as possible in the Salton Basin, in order that there may be a practical demonstration of the suitability of this region for the culture of the choicest sorts of dates.

THE DATE PALM AS A SHELTER FOR OTHER FRUIT TREES.

In many parts of the northern Sahara the date palm is almost as important as a shelter and partial shade for other fruit trees as it is for its own fruit. At the time of the Roman occupation of Africa these oases were largely planted to olive trees, some of which, indeed, still remain—giant stems perhaps 1,500 years old. It happens that the

[a] Forbes, R. H. Thirteenth Annual Report, Arizona Experiment Station, 1902, p. 242.

[b] Marcassin. L'agriculture dans le Sahara de Constantine. In Annales de l'Inst. Agronomique, 1895, p. 62 of reprint.

olive is about the only other fruit tree which is able to stand without injury the fierce heat, intense light, and the driving sand storms of the Sahara, and even the olive itself grows better and yields more fruit if planted under the protecting shelter of the date palm. Most other fruit trees, such as the apricot, peach, almond, pomegranate, fig, and jujube, can be grown successfully in the Sahara only in the shade of other trees, and do best where grown under the date palm. In the northernmost oases of the Sahara the dates are frequently of inferior quality, whereas the other fruit trees do better here than in the hotter and drier regions farther south. Many of these northern oases have veritable orchards growing under the half shade furnished by the crown of slender leaves of the date palms far above. This is well shown in Plate XII, which represents a fig orchard growing under date palms at Chetma, Algeria. It sometimes happens that vegetables are grown under the fruit trees, in which case it is possible to see three crops occupying the soil—first, the date palm, towering far above; then the fruit trees, and under them the more delicate and shade-loving garden vegetables. It is not at all impossible that in some parts of our own Southwest the date palm may prove very useful in the manner above described, serving as a shelter and partial shade to more delicate fruit trees which thrive perfectly in regions where the summers are far too cool to allow of the culture of the best sorts of dates.

IRRIGATION OF THE DATE PALM.

AMOUNT OF WATER NECESSARY FOR A DATE PALM.

The date palm requires a continuous supply of moisture about the roots and can not maintain itself in as dry a soil as can some desert plants. Much experience has been accumulated by the French planters in the Algerian Sahara as to the amount of water necessary to enable a date palm to grow and fruit well. M. Jus, the celebrated civil engineer, who has done so much to reclaim the northern Sahara by a study of its artesian water supply, considers[a] that each palm tree requires one-third of a liter (0.35 quart) per minute at the flowing well or main irrigating canal, and palms which receive from 0.4 to 0.5 of a liter (0.42 to 0.53 quart) per minute are more vigorous and yield more fruit even if crops are grown underneath. If each tree receives 0.35 quart per minute this would amount to 126 gallons per day, or about 17 cubic feet. At 1 pint per minute the daily consumption would be 180 gallons, or a little more than 24 cubic feet. These data are not for the amount of water actually furnished the trees, but for the amount which must be allowed for each tree at the head of the principal irrigating canals. Of course some of the water is lost by evaporation and seepage before it reaches the palms.

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[a] Jus, H. Les oasis de l'Oued Rir', Paris (Challamel), 1884.

M. Rolland, who has written a very complete account of the water supply of the Algerian Sahara,[a] and who is himself one of the members of a firm which has created extensive date plantations in the Oued Rirh country, in the Algerian Sahara, considers that one-half liter (0.53 quart) per minute should be allowed to each palm to secure the best results.

M. le commandant Rose, himself an experienced planter, has published a most detailed statement[b] regarding the practice of irrigation in the Oued Rirh country, where the water supply is furnished by artesian wells. He recommends 24 irrigations of 3 cubic meters (792.5 gallons) each, making 72 cubic meters, or 19,021 gallons during the year. During the hot season, from June to September, inclusive, weekly irrigations are practiced, 17 in all, consuming 51 cubic meters, or 13,473 gallons per tree, which is at the rate of about 113 gallons per day, or about 0.314 quart (0.3 liter) per minute, the lowest of the three estimates. During the autumn and winter 2 irrigations, and during spring 5 irrigations, are prescribed.

When the supply of water is invariable, as for example the flow from an artesian well, it is necessary to plant only the number of palms that can be properly irrigated by the available water supply during the hot season, when the amount needed is greatest. Where irrigation is practiced by means of water conducted from rivers or from storage reservoirs in canals, as is the case in most of the arid regions of the Southwest, it will be even more necessary to determine carefully how much water can be had in summer to avoid planting more dates than can be properly irrigated.

In the plantations made recently by French proprietors in the Algerian Sahara, the date palms are usually set out 8 meters, or 26 feet, apart, making 143 to the hectare, or 60 to the acre. Some of the planters consider this distance too small and plant about 10 meters (33 feet) apart, making about 40 to the acre, while others, among them the celebrated civil engineer Rolland, consider 200 to the hectare, or about 80 to the acre, as being the best number to plant.

Taking 60 to the acre, 26⅔ feet apart, as a good number to plant, the amount of water needed per acre can easily be calculated. Using Rose's estimate of 19,021 gallons per tree per annum, 3½ acre-feet of water would be required, of which 2¾ acre-feet would be used during the four summer months from June to September, inclusive. Using Jus's estimate, which puts the least amount necessary at one-third

[a] Rolland, Georges. Hydrologie du Sahara algérien (chemin de fer transsaharien), Paris, Imprimerie nationale, 1894, p. 9.

[b] "La culture du dattier dans le sud constantinois, par un homme du sud." Alger. 1898, Pierre Fontana & Cie, Paris, Augustin Challamel. 8°. 20 pp. The identity of the author of this pamphlet was disclosed by Rolland (Hydrologie du Sahara algérien, p. 167).

liter (0.35 quart) per minute, or 126 gallons per day, a trifle over 4 acre-feet would be required, of which nearly 3 acre-feet would be used in the four hottest months, from June to September, inclusive. On the basis of Rolland's estimate, which is also given by Jus as the optimum quantity, viz, one-half liter (0.53 quart) per minute, or 190 gallons per day, some 5½ acre-feet a year would be required, of which 4 acre-feet would be used during the four summer months, or at the rate of 16 acre-feet per annum.

The amount of water needed per acre depends of course directly on the number of date palms per acre, and in planting care should be taken not to set out more than can be irrigated with the water supply covering the land.

It must be remembered that the figures given above are for the western Sahara, a region noted for its extreme dryness, where the evaporation from a free surface of water often averages nearly one-half inch per day during the three summer months—June, July, and August. It is probable that a smaller amount of water would suffice in regions where the air is not so dry and consequently where the evaporation is less, as, for example, in the Salt River Valley and most other parts of southern Arizona,[a] while in hotter, drier regions, such as the Salton Basin, even more will be required. In the latter region it will be well to allow only about 12 palms to each acre-foot of water available, and this only if the water can be had whenever desired during the summer. This would permit planting some 50 date palms to the acre where 4 acre-feet of water are available whenever needed during the year.

It must be remembered in considering the needs of the date palm that the water supply must be practically continuous; that is to say, that the ground must in some way be kept damp throughout the entire year. It is probable, however, that the date palm does not require as much water as do ordinary fruit trees. It is, indeed, probable that owing to their having thick, leathery leaves, protected by a coating of wax, they evaporate a considerably less quantity than would an ordinary fruit tree having delicate leaves not adapted to withstand the hot, dry air of deserts. It is nevertheless necessary for the roots to have

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[a] At Tucson, Ariz., the average of three years' records taken at the University gives the annual evaporation from a free surface of water at 77.7 inches, and the average rate during the three hottest months, June, July, and August, at one-third inch per day. At Tempe, in the Salt River Valley, Arizona, a calculation by the United States Geological Survey from imperfect data gives 91 inches as the probable annual evaporation. At Biskra the careful records of M. Colombo show a mean annual evaporation during the ten years from 1884 to 1893 of 2.8374 meters, or 111.7 inches, averaging 12.47 mm., or 0.4915 inch (very nearly one-half inch) per day during June, July, and August. In the Oued Rirh country, where most of the observations relative to the amount of water necessary for irrigating date palms have been made, the rainfall is less than at Biskra and the temperature higher, so the evaporation is doubtless greater.

access to moist earth throughout the entire year, since, as has been stated above, the date palm is not at all a desert plant, in the sense of being able to exist on very dry soil, and would die in many of the situations in the Southwest where cacti and yuccas thrive.

Where the supply of irrigation water is limited, as at Biskra, where there is only 0.12 liter per minute available for each palm and where the soil is very heavy and consequently difficult to saturate, irrigation is commonly practiced by filling up with water a cavity—"dahir"—excavated at the base of the tree (Pl. XVII, fig. 2, and Yearbook, 1900, Pl. LV, fig. 3). Where water is more abundant and especially where crops are grown under the palms it is customary to flood the whole surface of the ground, the land being divided into small beds from 10 to 30 feet in diameter, which are surrounded by a slightly raised rim (Pl. XVII, fig. 1). When irrigated the whole bed is flooded, the water being retained by the surrounding ridge. A larger amount of water is required when applied in this manner than would be necessary if poured into a trench at the side of the palm, but the alkali is washed into the subsoil by surface flooding, whereas it is brought to the surface by the trench system, which should never be followed in dangerously alkaline soils. In the Salton Basin in particular, where the subsoil is often heavily charged with alkali, the land should always be watered by flooding or else by deep furrows, even where the surface soil does not contain harmful quantities of alkali.[a]

Where there is water at a short distance from the surface within reach of the roots, as is the case in the area about the Cooperative Date Garden at Tempe, Ariz. (see Pls. XXI and XXII), at Farfar, Algeria, in the western Zab, between Fougala and Biskra, Algeria (Pl. XIV, fig. 1, and Yearbook, 1900, Pl. LIX, fig. 7), and in the Souf country in the Sahara (fig. 8, p. 69) the amount of water required for irrigation is less when once the palms have become established. They can even exist without any irrigation whatever from the surface, although in this event they do not grow as well and bear very much less fruit, probably because of imperfect aeration of the soil about the roots and because of the continual rise of alkali from the subsoil, as will be explained in the chapter on drainage.

Well aerated running water is desirable for date palms and water-logging of the soil must be prevented. If these conditions are fulfilled this plant can live and thrive when irrigated with water so salty as to kill all ordinary plants, as will be shown later in treating of the alkali resistance of the date palm.

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[a] Snow, Hilgard, and Shaw (in Bul. 140, Cal. Exp. Sta., pp. 36–39) recommend for the Salton Basin first washing the alkali down by surface flooding and then preventing its subsequent rise by deep-furrow irrigation. However, the date palm is not sensitive to surface accumulation of alkali when once established, as will be shown farther on (see p. 117).

Irrigation by means of flooding is sometimes practiced in Egypt for the date palm, as has been done for all sorts of crops since remote antiquity. The water covers the land to a depth ranging from a few inches to several feet (see Pl. XI), and remains on the soil for about six weeks.[a] This method of irrigation is not likely to prove desirable anywhere in this country unless it be in the flood-plain of the Colorado River in California and Arizona (see p. 131). It may be desirable to use this method of flooding in order to wash the alkali out of the surface layer of the soil where the accumulation of alkali in the upper layers of the soil is so great as to prevent the best growth of the date palm. It is of interest in this connection to note that the Egyptian date palms are able to endure having their roots submerged for long periods without appreciable injury.

Mr. D. G. Fairchild has described a very interesting system of combined irrigation and drainage practiced in the date plantations along the Shat-el-Arab River at the head of the Persian Gulf, which are doubtless the most extensive in the world. The level valley land along the river is cut up into small rectangles, 10 to 15 by 20 to 30 feet on a side, by irrigation ditches, through which, twice a day, water flows when the river is backed up by the tide. As the tide recedes the water flows out of the ditches, preventing stagnation and causing a lowering of the water level in the soil. The soil is doubtless thoroughly aerated by this alternate rise and fall of the level of the ground water. By this interesting system of tidal irrigation, which, without any trouble beyond the first labor of digging the ditches provides for very perfect watering, drainage, and aeration of the soil, date palms thrive in this region where the soil is as pure an adobe as the clay of a brickyard.[b]

Such a system of combined irrigation and drainage can, of course, be applied only where a river is backed up by high tides. No such conditions occur, or at least not on any considerable scale, within the date regions of the United States, since the region along the Sacramento River in California where tidal irrigation can be practiced is so cooled in summer by the cold winds and fogs from the Pacific that none but the very earliest sorts of dates could mature. Along the Colorado River, near its mouth in Mexico, it is possible that tidal irrigation could be used in date culture, since the tides in the Gulf of California are very high and the climate and soil in this region are favorable to the culture of early and midseason dates.[c]

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[a] Kearney, Thos. H., and Means, Thos. H. Crops used in the reclamation of alkali lands in Egypt, Yearbook, Department of Agriculture, 1902, p. 504.

[b] Fairchild, D. G. Persian Gulf Dates and Their Introduction into America. Bul. No. 54, Bureau of Plant Industry, U. S. Department of Agriculture, 1903, p. 14.

[c] However, the head of tide water is only about fifteen miles above the mouth of the river (as may be seen on fig. 10, p. 102), and consequently there is not room for such immense date plantations as those described by Fairchild around Bassorah.

In many parts of California and possibly in some parts of Arizona there is enough rainfall to support the date palm without irrigation (see p. 124). The Wolfskill date palm at Winters, Cal., for example, is never irrigated, yet bears abundant crops of good dates every year.

In regions where the winters are very cold it is unwise to irrigate late in summer, except when necessary to keep the palms alive, since abundant watering forces a tender new growth, which is likely to be killed by the freezes of the succeeding winter. At Tulare, in the San Joaquin Valley, California, where there are from 6 to 34 severe frosts every winter and where the temperature sometimes falls as low as 17° F. or lower, the gardeners of the substation of the Agricultural Experiment Station consider it unwise to irrigate date palms after the month of June.

WARM IRRIGATION WATER ADVANTAGEOUS.

The growth of the date palm and the maturing of its fruit are hastened by supplying warm water to the roots. For example, in the oasis of Chetma, Algeria (see Pl. XII and Yearbook, 1900, Pl. LIX, fig. 8), largely supplied with water from warm springs having a temperature of 94.1° F. (34.5° C.), the Deglet Noor date ripens early in the season, especially on those trees growing near the springs and which, consequently, receive warm water even in winter and early spring, when the air is still cold. Biskra, near by and at nearly the same level, though less protected against cold winds, is also irrigated largely from springs, but the temperature of the water of these springs is only 70° to 81° F. (21.5° to 27.33° C.), and the water is cooled in winter and spring by admixture with the run-off from the Atlas Mountains to the north and by flowing a couple of miles in open canals before it reaches the nearest date palms. Here the Deglet Noor date does not mature so well as at Chetma and is not of the best quality. The artesian wells of the Oued Rirh country (see map, Pl. II, p. 76) furnish water of a temperature ranging from 76.3° to 79° F. (24.6° to 26.1° C.), and in the Souf country the ground water to which the palms send down their roots is much colder, having a temperature of only 57.2° to 68° F. (14° to 20° C.); but in these regions the summer heat is much greater than at Biskra and usually suffices to enable the Deglet Noor to mature perfectly.

In the Salt River Valley, Arizona, the irrigation water is conveyed in open canals mostly shaded by cottonwood trees. The temperature of the water naturally varies with the season. In June, when the temperature of the air ranged from 82° to 104° F., Professor McClatchie found the temperature to range from 73° to 94° F. in the canals and from 82° to 88° F. in the smaller irrigating ditches. It should be noted that in June the supply of irrigating water is less than for any other month of the year, and probably in February, March, and April, when the canals are full of the water from melting snows on the surrounding mountains, the temperature would be much lower.

The Salton Basin is supplied with water diverted from the Colorado River near Yuma and conducted some 40 to 60 miles in open ditches before it is put on the land. The annual overflow of the Colorado River occurs in early summer, usually in June or July, and is caused by the melting of the snows on the Rocky Mountains in Colorado, Utah, and Wyoming. This cold water fortunately reaches the Colorado Desert at a time when the heat is great, so that in flowing in the large open canals and in the shallow laterals and in soaking through the hot surface layers of the soil it will undoubtedly be warmed considerably before it reaches the roots of the date palms. On the whole the conditions are exceptionally good in the Salton Basin, for the most abundant supply of water occurs in early summer or midsummer, just when the plants have greatest need for it.

The annual overflow of cold waters from the melting snows is doubtless the principal cause of the failure of the date palms to mature their fruit properly on Mr. Hall Hanlon's place in the Colorado River flood plain in California, near Yuma, Ariz. (see Pl. XX, fig. 2). The temperature of the soil and of the air in this overflowed area and in adjoining areas at nearly the same level is doubtless much lower than at the town of Yuma, for instance.[a] Even at Yuma the summer heat is less than at Phoenix and very much less than in the Salton Basin. It is clear then that no conclusion unfavorable to the culture of dates in the Salton Basin can be drawn from the failure of these palms in the flood plain to mature their fruit. Early varieties, such as the Rhars and Teddala, will probably ripen even on these overflowed lands (see p. 132).

DRAINAGE FOR THE DATE PALM.

Although the date palm can withstand very much more alkali than any other crop plant, it does not endure having the soil about the roots water-soaked. Good drainage is as essential for it as for any other fruit tree if good crops are to be expected, and, unless the soil drains naturally, the superfluous water must be removed, usually by means of open ditches or with tile drains. Proper aeration of the soil about the roots is essential to enable the date palm to grow well and yield abundantly (see p. 80). Good drainage also permits the alkali to be washed out of the soil by means of heavy irrigation, and, doubtless, this also favors the growth of the palms. It is, however, worthy of being noted that the excessively alkaline water which flows off in the drainage ditches is used in some parts of the Sahara to irrigate date palms which occupy land lying at a lower level. Such palms, though

[a] According to Mr. Bernard G. Johnson, of Mecca, Cal., there is a drainage of cold air from the hills toward Mr. Hanlon's date plantation which renders it one of the coldest sites in the vicinity of Yuma.

less vigorous than those receiving good water, nevertheless produce moderate crops of fruit (see p. 98).

In most date plantations made by the French in the Sahara, drainage is provided by means of open ditches from 2 to 6 feet deep, running between alternate rows of palms, or at distances of about 50 feet apart (see Pl. XVII, fig. 1). Very unusual conditions of drainage are found at the oasis Fougala, Algeria (see Pl. XV, fig. 1), as will be explained in treating of the alkali soils collected at that place (pp. 78 and 84). The superfluous water there runs off through holes in an impervious hardpan, and the downward flow of water through the holes, induced by surface irrigation, has washed the alkali out of the surface soil, has aerated the subsoil, and has had marvelous effects in promoting the growth and increasing the yield of the date palms, which had managed to live for years before surface irrigation was begun with the supply of water absorbed by the roots from below the hardpan layer.

It will doubtless be found necessary to irrigate date palms about Tempe, Ariz., even where their roots penetrate to the subsoil constantly wetted by the water that seeps down from the irrigated fields located at higher levels. Unless this is done the palms are likely to become stunted and sterile, as they were at Fougala before surface irrigation by artesian water was commenced.

The presence of a hardpan layer, as at Fougala, may be advantageous in providing a means of drainage through holes made under each tree, while at the same time confining the drainage water below the hardpan, thereby preventing its rising to the surface by capillarity and carrying with it the alkali of the subsoil. When no hardpan exists, as at Tempe, a certain amount of drainage can nevertheless be accomplished, since the water applied at the surface drains into the great body of ground water, which has a practically constant level unless raised by excessive irrigation. In case the subsoil is too impervious to permit quick seepage from the surface to the ground water, outlets for drainage water can sometimes be provided advantageously by putting down wells.

In most parts of the Salt River Valley the natural drainage is good and no ditches or tile will be needed. In the Salton Basin drainage is impeded by the impervious nature of the clay, which occurs in many places as surface soil and nearly everywhere as subsoil. Drainage is especially desirable here, for the subsoil is often laden with alkali even where the surface soil is free from harmful quantities of salts. Natural drainage, nevertheless, will probably suffice for the date palm in many parts of this region, provided the level of the ground water is not raised too high by excessive and ill-timed irrigation. In some places, where natural drainage is insufficient, occasional open ditches will provide adequate drainage, especially where the soil is a sandy loam or a loam. The lands lying near the New River or Salton River beds, or near Mesquite or Salton Lake, can be drained into these lower levels, and in many other places wells may be put down to provide an outlet of drainage water into the great body of ground water which lies from 20 to 50 feet below the surface. Though required for the best growth and successful fruiting of the date palm, drainage is less necessary than for most other trees. Even if the ground water of the Salton Basin rose to within reach of the roots it would not kill the date palm, for, although this ground water is very brackish, containing from 0.4 to 0.6 per cent of dissolved salts, and would kill most ordinary plants, it is less alkaline than some of the artesian water used to irrigate flourishing date plantations in the Oued Rirh country in the Sahara (see pp. 86 and 121).

EFFECTS OF ATMOSPHERIC HUMIDITY AND RAIN ON THE DATE PALM.

An essential requirement of the date palm, in order that it may produce fruit of the best quality, is that the air be very dry during the season when the fruit is developing. Regions having abundant summer rains, and even those having a heavy precipitation in autumn, are unsuited to the profitable culture of this tree, but rains in winter may be beneficial. It has usually been held that the presence of humidity in the air is directly disadvantageous, but it is probable that the chief action of water vapor in the atmosphere is indirect and results from its peculiar action in screening out the heat from the sun's rays[a] and thereby preventing the temperature from going to the excessively high degree necessary to ripen the fruit properly. The same dry air which allows excessive heating during the day permits an equally great fall of temperature by radiation into a cloudless sky at night and brings about the enormous daily range of temperature characteristic of desert regions. The date palm, however, suffers no check from cool nights, unless the temperature falls below a point somewhere about 18° C. (64.4° F.), and is favored by excessively high temperatures, which are, indeed, necessary for the production of dates of the highest quality.

Table 1, on the following page, gives the mean relative humidity at four points where the date palm is grown, for the months of April to September, inclusive.

[a] Very, Frank W. Atmospheric Radiation. Bul. G, Weather Bureau, U. S. Dept. of Agriculture, 1900.

TABLE 1.—*Humidity of the air at four desert stations where dates are grown.*

Locality.	Altitude.	Mean relative humidity of six months, Apr. 1 to Sept. 30.	Mean relative humidity of driest month.	Remarks.
	Feet.	*Per cent.*	*Per cent.*	
Ghardaïa, Algeria	1,804	23	14 (July)	Dates are of excellent quality.[1]
Biskra, Algeria	449	30	25 (June)	Dates are largely grown, but are not of the best quality.[2]
Phoenix, Ariz.	1,068	33	21 (June)	Dates of the earlier sorts ripen well.[3]
Tucson, Ariz.	2,432	35	19.9 (June)	Dates ripen imperfectly here, probably because of deficient summer heat at this altitude; possibly also because of too great humidity.[4]

[1] Records of Dr. Amat for the years 1883, 1888, and 1889.
[2] Schirmer, Sahara, p. 64.
[3] Records of Weather Bureau Station, completed by A. J. McClatchie, Bul. 37, Ariz. Agr. Ex. Sta., p. 209, average of five years' record.
[4] Boggs and Barnes, Bul. 27, Ariz. Agr. Ex. Sta., p. 37, record for the years 1892-1894. The mean for October is 36.3 per cent.

The following averages show the amount of atmospheric humidity at Phoenix and Tucson, Ariz., for each month from the flowering to the ripening of the fruit of the date palm, and a partial record from Ghardaïa, Algeria:

TABLE 2.—*Mean relative humidity at desert stations during date season.*

Locality.	Length of record.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Average, April to November.
Phoenix	5 years	33.0	26.0	24.0	37.0	40.0	39.0	40.0	43.0	35.25
Tucson	3 years	28.1	25.5	19.9	42.8	51.8	39.6	36.3	40.2	35.52
Ghardaïa	1 year (1883)	28.1	37.5	32.3	11.9	14.4	22.1	......	......	....
Do	3 years	......	......	23.0	14.0	19.0	......	......	......	....

The occurrence of a well-defined rainy season in July and August in southern Arizona causes the humidity for those months to be much higher than it is in the Sahara, where all three summer months are very dry.

The following table showing the average rainfall for each month at Biskra and Ayata in the Sahara, at Phoenix and Yuma, Ariz., and at Salton, in the Salton Basin, California, brings out this difference in climate:

TABLE 3.—*Mean monthly rainfall, in inches, at Biskra, Ayata, Phoenix, Yuma, and Salton.*

Locality.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Biskra, Algeria[1]	0.52	0.64	1.38	0.94	0.83	0.33	0.25	0.26	0.57	0.64	0.93	2.17	9.46
Ayata, Algeria[2]	.08	.27	1.06	1.06	.16	0	0	0	.04	.12	1.21	.53	4.53
Phoenix, Ariz.[3]	.57	.89	.68	.30	.16	.07	.85	.97	.54	.62	.44	1.12	7.21
Yuma, Ariz.	.40	.54	.24	.07	.04	T.	.14	.37	.14	.30	.28	.53	3.05
Salton, Cal.[4]	.43	.62	.21	T.	.07	T.	.19	.14	.13	.12	.12	.55	2.56

[1] Records of M. Colombo, published by Marcassin in Annales de l'Inst. Nat. Agronom., 1895, 10 years.
[2] Records of M. Cornu, read from charts exhibited at Paris Exposition, 1900, 4 years.
[3] Records of the Weather Bureau, compiled by Thos. H. Means, Second Rep., Div. of Soils, U. S. Department of Agriculture, 1900, p. 292.
[4] Records of the Weather Bureau, compiled by Prof. Alexander G. McAdie, California Climate and Crop Service, April, 1901, 12 years.

During July and August more than three times as much rain falls at Phoenix as at Biskra, although the annual rainfull is nearly one-third greater at the latter station.

Unfortunately records are not available for the Salton Basin, but the very low rainfall in spring, summer, and autumn, and the excessively high temperatures which prevail there render it certain that the humidity is very slight—probably somewhat lower than at Ghardaïa. There is, however, as in Arizona, a well-defined rainy reason in July and August, which tends to raise the humidity for those months.

RAINY WEATHER DISASTROUS TO THE FLOWERS AND RIPENING FRUITS OF THE DATE PALM.

Besides its indirect harmful action in decreasing the amount of sunshine and heat and in increasing the amount of humidity in the air, cloudy or rainy weather is directly injurious to the date in preventing the fertilization of the flowers in spring, and also in bringing about the decay or dropping of the fruit when it is ripening in autumn. When the flowers are being pollinated a spell of wet, cloudy weather, by spoiling the pollen may hinder the setting of the fruit, though usually the harm can be remedied by repollinating with a fresh spray of male flowers when the weather becomes dry. In autumn the effects of rainy, humid weather are much more disastrous and may entail the loss of the entire crop by causing the dates to ferment and spoil just when they are ripening. No misfortune is more feared by the date growers in the Sahara than wet weather at this time.

Most varieties of date palms flower in April and May in Arizona, as in the Algerian Sahara, and the best sorts begin to ripen in October and November. The following table shows the amount of rain for the months of April and May, in spring, and October and November, in autumn, for a number of points in the Southwest, and also for Biskra and Ayata in the Sahara.

TABLE 4.—*Average, highest, and lowest rainfall, in inches, at flowering and ripening seasons of the date palm at stations suitable for date culture.*

Locality.	Altitude.	Rainfall during flowering season. April. Mean.	April. Maximum.	April. Minimum.	May. Mean.	May. Maximum.	May. Minimum.
	Feet.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Phoenix, Ariz. (Salt River Valley)[1]	1,068	0.31	1.25	0	0.16	1	0
Buckeye (Salt River Valley)[2]	900	Tr.	....	....	.09	....	....
Experiment Farm (Salt River Valley)[2]	1,110	0	....	....	0	....	....
Peoria (Salt River Valley)[2]	1,200	.09	....	....	.18	....	....
Mesa (Salt River Valley)[2]	1,214	Tr.	....	....	0	....	....
Average for five stations in Salt River Valley	....	.08	....	....	.086	....	....
Maricopa, Ariz. (Upper Gila Valley)[2]	1,173	.13	.75	0	.10	.64	0
Casa Grande (Upper Gila Valley)[1]	1,398	.11	.73	0	.07	.34	0
Florence (Upper Gila Valley)[1]	1,553	.37	1.55	0	.18	.97	0
Tucson, Ariz.[1]	2,430	.16	.62	0	.18	1.09	0
Yuma, Ariz.[1]	141	.07	.55	0	.04	.44	0
Mammoth Tank, Cal. (Salton Basin)[3]	257	.06	.80	0	.02	.30	0
Salton, Cal. (Salton Basin)[3]	−263	Tr.	.01	0	.07	.70	0
Biskra, Sahara[4]	419	.94	3.03	.08	.83	2.56	.04
Ayata, Sahara (Oued Rirh)[5]	100	1.06	2.24	0	.16	.47	0

Locality.	Rainfall during ripening season of late dates. October. Mean.	October. Max.	October. Min.	November. Mean.	November. Max.	November. Min.	Rainfall during year. Mean.	Year. Max.	Year. Min.	Length of record.
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*Years.*
Phoenix, Ariz. (Salt River Valley)[1]	0.50	2.80	0	0.44	1.66	0	7.08	12.83	3.77	15
Buckeye (Salt River Valley)[2]	.63	......	......	.42	......	......	6.60	......	......	....
Experiment Farm (Salt River Valley)[2]	.34	......	......	.48	......	......	7.01	......	......	....
Peoria (Salt River Valley)[2]	.92	......	......	.40	......	......	8.41	......	......	....
Mesa (Salt River Valley)[2]	.31	......	......	.46	......	......	5.52	......	......	....
Average for five stations in Salt River Valley	.54	......	......	.44	......	......	6.94	......	......	....
Maricopa, Ariz. (Upper Gila Valley)[1]	.28	1.51	0	.29	1.13	0	5.50	11.96	.38	18
Casa Grande (Upper Gila Valley)[1]	.32	1.31	0	.33	2.00	0	5.29	10.70	1.73	14
Florence (Upper Gila Valley)[1]	.63	1.80	0	.55	2.36	0	9.78	13.80	5.35	13
Tucson, Ariz.[1]	.53	2.24	0	.48	2.06	0	11.63	18.37	5.26	19
Yuma, Ariz.[1]	.30	1.70	0	.28	2.43	0	3.05	5.86	.74	19
Mammoth Tank, Cal. (Salton Basin)[3]	.12	.68	0	.14	.73	0	1.81	5.48	Tr.	23
Salton, Cal. (Salton Basin)[3]	.12	.93	0	.12	.71	0	2.56	11.19	Tr.	12
Biskra, Sahara[4]	.64	1.73	0	.93	1.97	.12	9.46	16.30	5.67	10
Ayata, Sahara (Oued Rirh)[5]	.12	.28	0	1.21	2.05	.02	4.89	9.32	2.52	[6]4 and 7

[1] Records compiled by Boggs and Barnes, Bul. 27, Arizona Experiment Station, Table XVI.
[2] Records compiled by Thos. H. Means, Field Operations Divison of Soils, U. S. Department of Agriculture, Second Report, 1900, p. 292.
[3] Records compiled by Alexander G. McAdie, Cal. Sec., Climate and Crop Service, Weather Bureau, February, 1901, p. 4.
[4] Records of Colombo, published by Marcassin, L'Agriculture dans le Sahara de Constantine, in Annales de l'Institut National Agronomique, 1895, p. 17 of reprint.
[5] Records of Cornu for years 1896–1899, read from charts exhibited at Paris Exposition, 1900.
[6] Annual rainfall for 1889 to 1891, from Rolland, Hydrologie du Sahara algérien, p. 415, is included n this table, making seven years in all.

These records show that the Salt River Valley, the upper Gila Valley, Yuma, and even Tucson, Ariz., have less rainfall at the critical periods for the date palm than occurs at Biskra, Algeria, where date culture is the principal industry. Yuma, in the Colorado River

Valley, in extreme southwestern Arizona, and especially Salton and Mammoth Tank, in the Salton Basin, in southeastern California, show decidedly less rainfall than occurs at Ayata, in the Oued Rirh country in the Sahara, where date culture is almost the sole industry and where the Deglet Noor variety is grown successfully. Even the maximum rainfall in exceptionally wet years in the Salton Basin does not equal[a] the average rainfall for these critical months at Biskra.

The number of rainy days, which is a matter of considerable importance in determining the suitability of climate to date culture, runs closely parallel to the amount of precipitation, as may be seen by comparing the following records for Biskra and Tucson with those given above for the rainfall:

TABLE 5.—*Number of rainy days at desert stations (Biskra, Algeria, and Tucson, Ariz.) during flowering and ripening seasons of the date palm.*

Locality.	Altitude (feet).	Length of record (years).	Flowering season. April. Mean.	Maximum.	Minimum.	May. Mean.	Maximum.	Minimum.	Ripening season. October. Mean.	Maximum.	Minimum.	November. Mean.	Maximum.	Minimum.
Biskra, Algieria..	449	10	3.4	7	1	3.5	6	1	2.6	5	0	3.6	7	1
Tucson, Ariz.....	2,432	5	.2	1	0	1.2	3	0	4.8	9	0	.2	6	0

The ideal climate for the date palm would be one that was rainless during the critical months. It is a matter of some interest to see how often this condition has been recorded for the Salton Basin stations.

Rainfall records are available for twelve years (1889–1900) for Salton in the lowest part of the Salton Basin (263 feet below the sea level), and they show that the critical months were frequently rainless; at Mammoth Tank, in the eastern border of the Salton Basin (altitude 257 feet above sea level), the record for twenty-three years, from 1878 to 1900, is still more favorable, as is shown by the following table:

TABLE 6.—*Number of years in which no rain (or trace only) fell at Salton and at Mammoth Tank, in the Salton Basin, California, during the months named.*

Month.	Salton (263 feet below sea level). Number of years rainless.	Total number of years recorded.	Mammoth Tank (257 feet above sea level). Number of years rainless.	Total number of years recorded.
April	11	12	14	23
May	10	12	20	23
April and May	9	12	13	23
October	8	12	12	23
November	8	12	13	23
October and November	7	12	7	23

[a] Except for one year of the twelve recorded at Salton, the rainfall in October, 1896, was 0.93 inch, exceeding the average at Biskra (0.64 inch), though not being more than half the maximum rainfall for the month (1.73 inches) at the latter station.

At Salton, out of the twelve years recorded, only one had more than one-tenth of an inch of rain during the two months of the flowering season (April and May) and only two had over 0.28 inch rainfall during the ripening season.

At Mammoth Tank, out of these twenty-three years, only one had more than three-tenths of an inch rainfall during the flowering season (April and May) and only three showed over three-tenths of an inch precipitation during October and November.

At Biskra, in the Algerian Sahara, the rainfall records are available for the ten years from 1884 to 1893. During this period only one month during the critical periods was rainless, viz, October, 1893. Only once during the flowering period (April and May) was there as low as 0.39 inch rainfall, and only once during the season when the fruit ripens (October and November) was there as low as 0.31 inch of rain.

At Ayata, some 100 miles south of Biskra, in the Oued Rirh country, where a specialty is made of the culture of choice Deglet Noor dates for the export trade, the rainfall for 1889 was 2.52 inches; for 1890 it was 9.32 inches; for 1891,[a] 4.16 inches; for 1896, 7.60 inches; for 1897, 4.84 inches; for 1898, 2.79 inches, and for 1899,[b] 2.91 inches, an average of 4.89 inches.

The distribution of the rainfall at Biskra and Ayata, by seasons, in comparison with the average at Yuma in the Colorado River Valley and Salton and Mammoth Tank in the Salton Basin, is given herewith:

TABLE 7.—*Table showing seasonal and annual rainfall at stations in desert regions.*

Locality.	Length of record.	Winter rainfall.	Spring rainfall.	Summer rainfall.	Autumn rainfall.	Annual rainfall.
	Years.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Biskra, Algeria (Sahara)	10	3.32	3.16	0.84	2.13	9.45
Ayata, Algeria (Sahara)	7	1.81	1.49	[a].09	1.50	4.89
Yuma, Ariz. (Colorado River Valley)	19	1.47	.35	.51	.72	3.05
Salton, Cal. (Salton Basin)	12	1.59	.28	.33	.37	2.56
Mammoth Tank, Cal. (Salton Basin)	23	.93	.27	.29	.32	1.81

[a] During the years 1896 to 1899 almost no rain fell in summer. April, May, September, and October are sometimes rainless.

It is noticeable that the summer rainfall is considerably higher at Yuma and at the Salton Basin stations than at Ayata, but that the spring and autumn precipitation is much less, rendering the climate decidedly more favorable for date culture.

It is clear from the above tables that there is less danger from rain to date flowers or to the ripening fruits in the Arizona deserts or in the Salton Basin in California than at Biskra in the Algerian Sahara, where date culture is an established and profitable industry. Indeed,

[a] Rolland. Hydrologie du Sahara, p. 416. For the years 1889 to 1891, inclusive.

[b] Records of Cornu exhibited at Paris Exposition, 1900. Amounts read from curves of charts for the years 1896–1899.

the conditions in the Salton Basin are most exceptionally favorable in this regard and are much better than at Ayata in the Sahara, where the Deglet Noor date is grown to perfection for export.

SUNSHINE NECESSARY FOR THE DATE PALM.

Even in the hottest desert regions the date palm does not grow well in the shade. In order that the leaves be heated to the very high temperatures which they require in order to function properly they must be exposed without interruption to the sun's rays during the hottest part of the day. Cloudy regions, where the sunshine is not continuous, and humid regions, where the heat is largely screened out of the rays by the water vapor in the air, are not adapted to the culture of the best sorts of dates. It is not improbable that there may be some specific action of light, especially of the more refrangible rays at the violet end of the spectrum, apart from the heating effects of the sun's rays, in favoring the production of a high flavor and aroma in the fruit.[a]

HEAT REQUIREMENTS OF THE DATE PALM.

No amount of heat and no degree of dryness of the air injure the date palm provided the roots have access to an adequate supply of moisture; on the contrary the best sorts of dates can be produced only in deserts having excessively hot weather from the time the flowers open in April until the fruit ripens in October or November. It is a well-known saying among the Arabs that the date palm must have its feet in running water and its head in the fire of the sky; this is a concise statement of the chief requisites for successful growth and fruiting of this extraordinary plant. As was shown above in treating of the effects of humidity on the date palm, very dry air is necessary to enable the temperatures to reach the excessively high point required by developing fruits. This dryness also permits an excessive cooling of the air and surface soil through loss of heat by radiation into the cloudless sky at night, and desert climates of a pronounced type are consequently characterized by great daily and seasonal fluctuations, with the result that the temperature may fall very low in winter even in deserts where the heat is excessive in summer. The difference in the mean daily temperatures between the hottest and the coldest month for a number of desert stations which lie in nearly the same latitude is shown in Table 8, on the next page.

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[a] It would be interesting to test this hypothesis by forcing a date palm to fruit in a dry greenhouse in some northern desert region in winter when the intensity of the sun's rays is much less than in summer. The experiment could not be tried in a humid region, because of the disturbing influence of the humidity of the air.

TABLE 8.—*Mean annual range of temperature in the Sahara Desert, Mesopotamia, and in the Southwestern States.*

Locality.	Latitude.	Altitude.	Temperature.
	° ′	*Feet.*	° *F.*
Biskra, Algeria	34 50	419	40.06
Phoenix, Ariz	33 25	1,068	40.50
Bagdad	33 25	131	45.64
Salton Cal	33 30	−263	43.90
Mammoth Tank, Cal	33 10	157	44.60
Ghardaïa, Algeria	32 30	1,804	45.90

These figures by no means indicate the extreme range of temperatures for these months, but merely the difference in the average level of temperature from which the daily fluctuations are counted.

The difference between the highest temperature in summer and the lowest in winter averages about 90° F. at Salton, in the bottom of the Colorado Desert, and 79.4° F. at Biskra, in the northern Sahara. An extreme fluctuation of 104° F. is recorded from Salton during the twelve years for which records are published, of 105° F. at Phoenix, in the Salt River Valley, Arizona, during thirteen years, 1882–1894, and of 108° F. at Mammoth Tank, in the Salton Basin, during the twenty-three years for which records are published; but in these cases the highest and lowest temperatures are not included in the same year. As might be expected, where such great fluctuations occur, the winter temperatures often fall low enough to injure tender plants, such as citrous fruit trees, for example. Such plants are easily forced into a tender new growth by a few days of hot weather such as often occur in winter,[a] only to be blighted by frosts a few days later.

RESISTANCE OF THE DATE PALM TO COLD IN WINTER.

Fortunately, the date palm is able to endure much cold, it being one of the most hardy of the evergreen fruit trees. When in a dormant condition it is probable that it is seldom injured by temperatures above 20° F., and is able to live in regions where the temperature occasionally falls as low as 12° F. Commonly, however, date palms are severely injured by temperatures as low as this, sometimes losing many of their leaves. The amount of injury they suffer is partly dependent upon their condition at the time when they are exposed to the cold. If entirely dormant they are much less injured than if some of the leaves have only recently unfolded or are still growing. It should further be noted that young date palms are much more likely to be injured by cold than are old ones. This, no doubt, is in part because the young plants have fewer leaves and in consequence a growing point more exposed to cold, but doubtless largely because the growing leaves, with their inclosed bud, are much nearer the ground on young trees, and would therefore be exposed to lower temperatures

[a] Temperatures of 90° F. or over are recorded for every month in the year at Mammoth Tank, in the Salton Basin.

than on the tops of old palms far above the surface. Old and vigorous trees might perhaps occasionally weather cold snaps where the temperature fell below 10° F., provided such were exceptional and occurred only at intervals of many years. In practice, then, four different limits below which palms would be injured by cold might be set: (1) Young palms in active growth would be liable to injury if the temperature fell several degrees below freezing; (2) young plants not in active growth and old palms if nearly dormant would be severely injured only by temperatures falling below 15° F.; (3) old and dormant trees would be severely injured only by temperatures below 12° F.; (4) most date palms would be killed and all would be seriously injured by the temperature falling below 10° F., and date culture would be impossible in regions where such temperatures occurred more than once in a decade. These considerations show that the date palm has about as much resistance to cold as the fig tree, for example, with this important difference—that a fig tree is able to recover and grow again the next year, even if it be frozen to the ground by severe cold in winter. With the date palm this is not possible, since, if the growing bud of an old tree be killed, it is impossible for the trunk to sprout out again.

In the Salt River Valley, Arizona, the temperature not infrequently falls to 25° or 22° F., and at rare intervals goes as low as 12° or 13° F., which temperatures of course injure the date palm but have not killed any of the many fine trees growing in the valley, though young offshoots recently transplanted have been frozen to death[a].

No temperatures low enough to injure seriously even young date palms (below 18° F.) are recorded from any of the stations in the Salton Basin,[b] and if the first winter after the plants are set out is passed safely no further danger from cold need be feared.

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[a] Even young palms seem more resistant to cold than has been supposed, for the severe cold of the winter of 1901-2, when a temperature of about 13° F., was reached, killed very few of the Saharan date palms in the cooperative garden at Tempe, which were planted in July, 1900. A few of the offshoots set out in 1901 passed through the cold weather without being killed, thanks probably to the protection afforded by wrapping them in several thicknesses of burlap sacking. It is now very clear that large offshoots withstand cold much better than small ones and besides bear the long voyage better.

[b] The lowest temperature recorded at Salton is 20° F., with 22° F. at Mammoth Tank, where only 9 out of the 23 years recorded show temperatures below 30° F. At Indio in the northern and at Imperial in the southern part of the basin temperatures of 18° F. are recorded. At Indio the temperatures are probably lowered by cold winds which blow down from the mountains to the north and west through a valley-like prolongation of the desert to the northwest. The young date palms which grow about Indio without any protection are proof that the winters are not too severe even for very young plants. However, winter cold is the greatest danger to which the date palm is exposed in the Salton Basin, and intending planters should be careful to avoid low, cold situations in setting out date palms, for Snow reports on January 2, 1902, at 8 o'clock a. m., a temperature of 13° F. and ice 2 inches thick. (Bul. 140, Cal. Exp. Sta., p. 45.) A. V. Stubenrauch states that this record is for Imperial, Cal.

THE DATE PALM FLOWERS LATE IN SPRING AND ESCAPES INJURY BY LATE FROSTS.

A very great advantage of the date palm is that it flowers late in spring, after all danger of frost is over,[a] whereas many other fruit trees, among them the peach, the apricot, and especially the almond, bloom very early and are exposed to much risk of having the flowers or young fruits killed by late frosts.

The records available from the Sahara are very poorly calculated to show how much cold the date palm can stand, for the whole northern and western Sahara is characterized by very warm winters. Temperatures of −5 to −7° C (21.4° to 23° F.) are recorded from date oases in the Sahara, but the date palm is able to endure lower temperatures than these without serious harm resulting. The northern limit and the limit in altitude in northwestern Africa at which dates can be grown are set more by the deficient summer heat failing to ripen the fruit than by the cold in winter.[b]

DRAINAGE OF COLD AIR AND INVERSION OF TEMPERATURE IN RELATION TO DATE CULTURE.

A peculiarity of climate which is of considerable importance in relation to date culture is the inversion of temperature which occurs in many places in Arizona and California, and more markedly in arid regions where the date palm succeeds best. For example, in many parts of Arizona the winters are mild enough to permit date palms to be grown at an altitude of nearly 5,000 feet, and even as high as 6,942 feet at Supai. It is noticeable, however, that points very much lower frequently show temperatures sufficiently cold to injure severely or to kill date palms. For instance, at San Carlos, at an altitude of 2,456

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[a] The pistache nut has the same advantage and can be grown with profit in place of the almond in many localities where the latter is likely to lose its fruit because of late frosts.

[b] It is probable that the date palm is hardier than has been supposed, and that by selecting hardy sorts and wrapping them well when young, date culture can be extended to many of the desert regions in the Southwest hitherto supposed to be too cold in winter for this plant. The experiments at the date garden at Tulare have shown that there is a great difference in the resistance of the various sorts to cold, the Seewah at an age of 9 years being, for instance, 12 feet high, with a spread of leaves of 15 feet, while the Sultaneh, equally old but which had been much hurt by the cold winters was only 4 feet high, with a spread of leaves of 7 feet. The experience of the winters of 1901-1902 at Tempe, Ariz., has shown that recently transplanted offshoots are hardier than has been supposed. It now becomes a matter of much importance to procure hardy sorts of date palms (probably best to be secured in the oases of Persia and Baluchistan) for planting in the deserts in the southwestern United States which have hot summers but cold winters. Fort McIntosh, altitude 460 feet, in southwestern Texas, and Fort Thomas, altitude 1,600 feet, in the valley of the Virgin River in southern Nevada, both have a summer climate hotter than that of Phoenix, in the Salt River Valley, Arizona, but at the same time colder winters. Late sorts of dates of good quality could be matured at these places provided they could pass the winters unharmed (see pp. 126 and 134).

feet, and at Tucson, at the University weather station, at an altitude of 2,230 feet, the temperature fell to 11° F. in 1891, while at Dragoon Summit, at about 4,611 feet altitude, some 60 miles to the east of Tucson and 80 miles southwest of San Carlos, the temperature is not recorded even as low as 15° F. in 1891.[a] In January, 1891, the temperature did not fall below 32° F. at Dragoon Summit, while at Wilcox, only 20 miles northeast, and nearly 500 feet lower, the temperature fell to 9° F. A still more striking example is shown by a comparison of the temperatures at Parker, on the Colorado River, at an altitude of about 500 feet, and at Supai, nearly 7,000 feet above sea level, some 120 miles to the northeast. In the winter of 1899 and 1900 the temperature did not fall below 26° F. at Supai, while the imperfect record at Parker shows a minimum of 23° F., that is to say, that although Supai is nearly 6,500 feet higher than Parker and is about 65 miles farther north, the minimum temperature was actually higher at Supai in winter. Numerous similar instances could be cited in California, and the "thermal belt" along the foothills of the Sierra Nevada Mountains, adjoining the interior valley region, offers some of the most striking examples that are known of inversion of temperature.

All of these anomalies are the result of a drainage of cold air to lower levels. During the night, if radiation is unhindered by clouds, as is usually the case in arid regions, the air next the ground is cooled rapidly and flows from the higher levels into the valleys below, much as water would. As the cold air flows into the plains it doubtless tends to flow under and to lift up the warm air; at any rate, all elevated points where there is a good drainage of air show relatively high temperatures during the night, while points located in the valley floor frequently show very low temperatures, constituting an exception to the general rule that the lower the altitude the higher is the temperature. It will frequently be possible to grow date palms along the foothills where it would be impossible for them to succeed in the plains a few hundred feet below.

However, high summer temperatures are essential to the proper fruiting of the date palm, as will be shown in the next paragraph, and the upper limit in altitude of its culture is more likely to be set by the insufficient heat of summer than by the severity of cold in winter. At points situated at high altitudes, whence there is a good drainage of air, the fluctuations of temperature are less than in the plains below, and consequently the winters are warmer and the summers are cooler. In order to grow date palms at high altitudes, it will usually be necessary to search for canyons or ravines with a southern exposure, where the air is heated by reflection from mountain cliffs as well as by direct insolation.

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[a] All the data as to temperature at the various points named are from the reports of the Weather Bureau and of the State weather services of California and Arizona.

HOT SUMMERS NECESSARY FOR THE DATE PALM.

Date palms require a definite sum of heat in order to mature their fruit properly, but the amount varies greatly for different sorts. In general the very early ripening kinds are watery and unfit for drying, being more like table grapes than like ordinary dates. They can be grown far to the north where the summers are not warm enough to ripen later varieties. The Wolfskill is such a date (see fig. 3, p. 31). The sorts ripening in midseason can often be dried, but lack the sweetness and exquisite flavor of the late sorts, such as the Deglet Noor (see p. 33). The late sorts, and especially the one just named, require enormous amounts of heat in order to ripen properly. The Deglet Noor date is produced in the oases of southern Algeria and southern Tunis, where fortunately there are well equipped meteorological stations whose records furnish a basis for a comparison of the climate there with that of American deserts, so far as records are available for the latter.

It has been calculated by De Candolle[a] that temperatures down to 18° C. or 64.4° F. have no effect on the flowering or fruiting of the date palm, and a study of the record sheets of a self-recording thermometer kept at Biskra in the midst of a date orchard confirmed the correctness of this assumption. In other words, this relatively high temperature is the zero point for this plant, so far as flowering and fruiting are concerned, though it is able to grow at somewhat lower temperatures. The curves shown in the accompanying diagram (fig. 7) represent in a manner plain to the eye the heat conditions of Biskra, Algeria, in the northern part of the Sahara Desert, in comparison with those of Salton, in the lowest part of the Salton Basin.[b]

The curves highest up in the diagram represent the mean maximum temperatures, the curves in the middle show the mean temperatures

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[a] Géographie botanique raisonnée, I, p. 371.

[b] The curves for Biskra for maximum and minimum temperatures are based on averages of twelve one-half years' observations by M. Colombo, summarized by Supan (Petermann's Mitth., Vol. 32, 1886, Lit. ber., p. 32); for the mean temperature, on ten years' observations by Colombo, published by Marcassan (Ann. de l'inst. nat. agronom., Paris, 1895). The curve for the maximum temperature for Salton is based on the record for two selected years, 1893 and 1899, each having nearly the same sum of heat for the fruiting season, from May to October, inclusive, as the average of the twelve years recorded. Prof. Alexander G. McAdie, director of the Pacific coast division of the Weather Bureau at San Francisco, kindly furnished the records, as yet unpublished, for these years. This curve is smoothed a little and is somewhat lower than the true mean maximum, as it is based on observations taken at 2 o'clock p. m., which do not always give the highest temperature which occurs during the day. The curve for the mean temperature at Salton is based on twelve years' observations published by Professor McAdie. (California Section, Climate and Crop Service, Weather Bureau, February, 1901, p. 4.) The curve for the minimum temperatures for Salton is not based on any observations, as the minimum temperatures are not available; the mean minimum temperatures are estimated to be as far below the mean temperatures as the mean maximum temperatures are above.

of the whole day, and the curves lowest in the scale show the mean minimum temperature. In every case the dotted lines represent the record for Biskra and the unbroken lines that for Salton. The months of the year are marked off horizontally and the degrees of heat are shown by the height of the curve from the base. The temperatures can be read off in Fahrenheit at the left and in Centigrade at the right. The heavy black horizontal line represents the zero point for the flowering and fruiting of the date, 18° C. (64.4° F.).

It is evident from the first glance at the curves that Salton is much hotter than Biskra and that the daily range of temperature is much greater, and as a consequence that the mininum is lower in winter, at the same time that the mean temperature is higher.

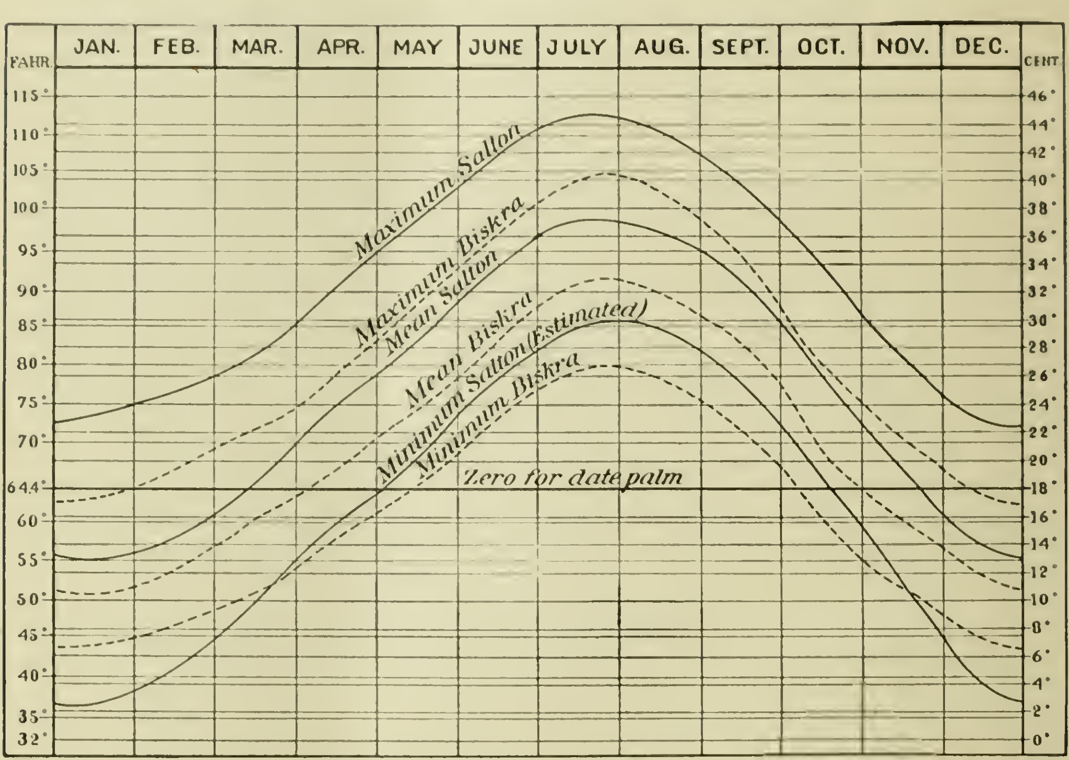

FIG. 7.—Curves representing the average maximum, mean, and minimum temperatures at Salton, Cal., and at Biskra, Algeria.

The zero point for the date palm, 18° C. (64.4° F.), is reached by the mean temperature about April 5 at Biskra, while it is passed fully three weeks earlier at Salton, or about March 12. The mean daily temperature rises more rapidly at Salton than at Biskra, which brings about the result that the period when the date palm flowers, which according to Fischer's calculations[a] is when the mean daily temperature is between 20° and 25° C. (68–77° F.), extends from about April 20 to May 20 at Biskra, whereas at Salton it extends from about March 23 to April 20; that is to say, if Fischer's calculations are correct, the date palm will flower about a month earlier at Salton than at Biskra,

[a] Fischer, Th. Die Dattelpalme, ihre geographische Verbreitung und culturhistorische Bedeutung. In Petermann's Mitth., Ergänzungsheft No. 64, Gotha, 1881, p. 51.

although the zero point for this plant is passed by the mean temperature only three weeks earlier.

The mean temperature at Biskra usually remains above 18° C. (64.4° F.) from about April 5 until about November 3, some 212 days, or nearly 7 months. At Salton the period having a mean temperature above 18° C. extends from about March 12 until about November 20, or some 253 days, nearly six weeks longer than at Biskra. As has been already stated, the flowering season will probably begin a month earlier at Salton than at Biskra because of the abrupt rise of temperature in spring, and as the mean temperature remains above 18° C. (64.4° F.) nearly a month and a half longer in autumn, the season is nearly two months and a-half longer, and, moreover, is decidedly hotter throughout. It is evident that if the Deglet Noor date can mature at Biskra it can certainly ripen perfectly at Salton.

AMOUNT OF HEAT REQUIRED TO MATURE THE DATE.

The comparison of the sums of the daily mean temperatures generally employed in determining the heat requirements of plants can be made only between regions having a somewhat similar climate, and some botanists have gone so far as to deny entirely that any trustworthy conclusions as to the development of a plant can be drawn from estimates of its heat requirements. To say that the sum of heat decides when a plant flowers or when its fruits ripen has been held to be equivalent to asserting that the other factors of equally vital importance to the plant, such as the amount and nature of its food supply, the supply of water, the amount of light, etc., have no appreciable influence on its development. This criticism doubtless has much force in the case of humid regions, where a variable and capricious rainfall greatly influences the growth of vegetation. In rainless deserts, however, where all cultivated plants are watered artificially and where the sunshine is almost uninterrupted by clouds, the sum of heat becomes a factor of predominant importance in the life history of plants, and consequently comparisons between similar desert regions in respect to their adaptability for any given cultures may very properly be made by determining the sum of heat for the critical periods of the plants in question.

The amount of heat necessary to ripen the fruits of the date palm has generally been calculated by adding together the daily mean temperatures during the months when the dates are developing, generally from about May 1 until October 31, six months in all. In this bulletin the sum above 18° C. is counted for greater convenience in making comparisons, though generally the sum is reckoned from 0° C. The table on the following page gives the summation of effective temperatures during the fruiting season of the date palm for a number of points in North Africa and in the Southwestern States.

TABLE 9.—*Sum of daily mean temperatures above 18° C. (64.4° F.) for fruiting period of date palm from May 1 to October 31, at the stations named.*

Locality.	Sum of daily mean temperatures above 18° C. (64.4° F.) from May 1 to October 31.		Remarks.
	Degrees centigrade.	Degrees Fahrenheit.	
Algiers, Algeria	652	1,174	No dates ripen here.
Orléansville, Algeria	788	1,418	Very early sorts mature.
Fresno, Cal	1,054	1,897	Average of many years' observations. Dates of sorts grown usually fail to ripen.
Tucson, Ariz	1,409	2,538	Average of 6 years' observations. Dates of the sorts now grown usually fail to ripen.
Cairo, Egypt	1,593	2,868	Dates ripen regularly.
Phoenix, Ariz. (Salt River Valley).	1,677	3,019	Average of many years' observations. Many sorts of dates ripen regularly.
Biskra, Algeria (Northern Sahara).	1,836	3,304	Average of 10 years' observations. Many sorts of dates ripen regularly; date culture the leading industry. Deglet Noor dates ripen but are not of the best quality.
Ayata, Algeria, 1890 (Oued Rirh region), Sahara.	1,816	3,269	Deglet Noor dates ripened very imperfectly.
Ayata, 1891	1,906	3,431	Deglet Noor dates ripened very slowly and imperfectly.
Ayata, 1889	2,091	3,764	Deglet Noor dates ripened well.
Tougourt, Algeria (Oued Rirh region).	2,049	3,689	Do.
Bagdad, Mesopotamia	2,356	4,242	Average of 5 years' observations. Many excellent varieties ripen.
Indio, Cal. (Salton Basin)	2,237	4,027	Average of several years' observations.
Indio, 1903	2,348	4,227	New thermometers.[1]
Mammoth Tank, Cal. (Salton Basin).	2,585	4,652	Average of 23 years' observations.
Salton, Cal., 1903 (Salton Basin).	2,074	3,734	The coolest summer recorded. Observations taken for the first time with standard Weather Bureau thermometers in the regulation shelters.[1]
Salton, mean	2,679	4,823	Average of 12 years' observations.
Salton, 1897	3,392	6,106	Hottest summer recorded at Salton.
Salton, 1902	2,749	4,948	
Imperial, Cal., 1902 (Salton Basin).	2,106	3,791	

[1] Until 1903 the temperature records in the Salton Basin were taken by voluntary observers from thermometers exposed without proper shelters. Mr. Bernard G. Johnson, who lives in the Salton Basin between Salton and Indio, Cal., writes as follows:

"Formerly there were used cheap thermometers, placed at Indio in the shade of cottonwood trees, at Salton under an overlapping roof, and at Volcano Springs under a roof that was but slightly overlapping. Now they have standard thermometers placed in regulation thermometer shelters, and hence the difference."

As might be expected, the older records taken at Volcano Springs proved to be much too high, at Salton still too high, though somewhat nearer normal, and at Indio normal or somewhat too low when compared with the records taken in 1903 with properly protected thermometers.

Station.	Month.	Mean temperature for 1903.	Departure from normal average.	Station.	Month.	Mean temperature for 1903.	Departure from normal average.
		°F.	°F.			°F.	°F.
Volcano Springs	April	69.4	−9.5	Indio	June	91.1	−2.8
Salton	...do	72.6	−3.9	Volcano Springs	July	90.9	−10.4
Indio	...do	72.6	+0.1	Salton	...do	87.8	−11.1
Volcano Springs	May	78.5	−8.3	Indio	...do	94.4	−0.1
Salton	...do	79.1	−4.0	Volcano Springs	August	95.2	−3.5
Indio	...do	81.0	+0.9	Salton	...do	94.2	−3.0
Volcano Springs	June	88.5	−7.9	Indio	...do	93.1	−0.1
Salton	...do	89.4	−4.4				

Mr. Johnson queries: "If this year, for example, May was 8.3 degrees cooler than the average at Volcano, why was it only 4 degrees cooler at Salton, 24 miles west of Volcano and at the level of the valley, while it was 0.9 degree warmer 24 miles farther west at Indio?"

Nevertheless, the sum of the daily mean temperature from May 1 for 1903 was still enough to mature the Deglet Noor date perfectly.

A further proof of the greater sum of heat in the Salton Basin, as compared with the Salt River Valley, is given by Mr. Johnson, who states that cantaloupes ripen at least fourteen days before the Salt River Valley melons at Mesa, Ariz., and that, too, before the really hot weather begins, which occurs about the first week in June. Mr. Johnson observes that if the same proportion continues, the growing season up to November 1 would give about six weeks advantage over Salt River Valley. Now the Deglet Noor date nearly matures at Tempe in the Salt River Valley and will surely ripen where it will receive such a considerable sum of heat more than in the Salt River Valley.

The records taken at Ayata,[a] Algeria, in the Oued Rirh country, are of particular interest. The Deglet Noor date is there grown largely for export and the meteorological observations are taken in an oasis largely planted to this variety. Even here in the interior of the Sahara Desert (see map, Pl. II, p. 76) the summers are frequently too cool to permit this choice date to ripen properly. From three years' observations it is considered that about 2,000° C. are required to ripen the Deglet Noor date satisfactorily. At Biskra the Deglet Noor is grown, but does not attain the superatively good quality which has made the dates of the Oued Rirh famous.[b] It will be noticed that Phoenix is somewhat cooler than Biskra, making it doubtful whether this date will ripen there in ordinary seasons. On the other hand, there can be no doubt about the Salton Basin stations being hot enough to bring Deglet Noor dates to maturity, even at Indio, in the northern edge of the basin, and at Imperial, while at Salton the sum of heat during the coolest summer recorded there was greater than the average sum for Tougourt, and almost the same as the maximum sum for an exceptionally hot summer at Ayata, when the Deglet Noor matured perfectly. *There can then be no doubt that the Deglet Noor date will ripen fully in the Salton Basin, even when the season is exceptionally cool.* The importance of this demonstration can scarcely be overestimated, since it renders it possible to establish in America the culture of this choice date, the most expensive of dried fruits, with certainty of success.

The date palm requires very high temperatures, very much higher than those recorded by thermometers exposed in the shade, and to measure accurately its heat requirements it will probably be necessary to devise a thermometer which can be exposed to the sun and which will indicate the temperature reached by the leaves. Accordingly a summation of the maximum temperature was made for the days from May 1 to October 31, which it is thought will give a better idea of the adaptability of a climate for date culture than does the sum of the daily mean temperatures. In making this summation 18° C. (64.4° F.) was taken as the zero point, as in the preceding table, and when the daily minimum fell below that point a deduction was made for the temperatures below the zero point, where they were considered as being a setback[c] and as preventing the observed maximum temperature from causing the growth or development it would otherwise have done.

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[a] Rolland, Georges. Hydrologie du Sahara algérien, p. 416.

[b] In the oasis of Chetma, near Biskra, the Deglet Noor date is said to ripen perfectly, thanks to the warm spring water with which the oasis is irrigated (see p. 49).

[c] For example, the mean maximum for October at Biskra is 27.4° C., or 9.4° above 18° C.; the mean minimum is 16.2° C., 1.8° below 18° C. Now 9.4° is 83.93 per cent of the total daily range of 11.2°, and so instead of counting $31 \times 9.4 = 291.4°$ as the sum for the month, only 83.93 per cent of this sum is counted, or 244.57° C.

The following table gives the results of such a summation of mean maximum temperatures from a number of points where date palms grow or can be grown:

TABLE 10.—*Sum of daily maximum temperatures above 18° C. (64.4° F.) for date season, May to October, inclusive, at the stations named.*

Locality.	Sum of daily maximum temperatures.		Remarks.
	Degrees centigrade.	Degrees Fahrenheit.	
Algiers, Algeria	1,482	2,667	No dates ripen. Records by Angot (Météor. Algér.).
Fresno, Cal	2,002	3,604	Very early dates can ripen. Weather Bureau records, 1897-1900.
Laghouat, Algeria (extreme northern Sahara).	2,337	4,213	Date culture practiced, but dates inferior. Records by Angot.
Orléansville, Algeria	2,593	4,668	Early sorts can be matured. Records by Angot.
Tucson, Ariz	2,652	4,773	Early sorts can be matured. Records of University of Arizona, 1892-1897.
Biskra, Algeria (northern Sahara).	3,049	5,489	All sorts of dates grown. Deglet Noor dates not of best quality. Records of Colombo for 12½ years.
Phoenix, Ariz. (Salt River Valley).	3,068	5,523	Many seedling dates mature; some sorts are too late to ripen fully. Records of Weather Bureau, 1897-1900.
Ayata, Algeria (Oued Rirh, Sahara).	3,295	5,932	Deglet Noor matures well if summers are hot; ripens imperfectly during cool years. Records of Cornu for four years, 1896-1899, read from charts exhibited at the Paris Exposition, 1900.
Tougourt, Algeria (Oued Rirh, Sahara).	3,666	6,599	Deglet Noor dates are grown for export. Records of Angot.
El Golea, Algeria (interior of Sahara).	3,990	7,182	Interior of Sahara, one of hottest stations known. Dates are extensively grown. Records from Toumey, Bul. 29, Arizona Agr. Exp. Sta.
Bagdad	3,898	7,017	Average of 5 years' records, published by Willcocks. (Fairchild, Bul. 54, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1903, p. 10.)
Salton, Cal. (Salton Basin)	4,059	7,306	Unpublished records for 1893 and 1899 furnished by courtesy of Prof. Alex. G. McAdie. These years have the temperatures for the summer season closely approximating to the average for 12 years recorded.
Salton, 1902	4,010	7,218	Record for 1902 supplied by courtesy of Prof. Alex. G. McAdie.
Imperial, Cal., 1902 (Salton Basin).	3,931	7,077	Do.

It is remarkable how nearly alike the sums of the daily maximum temperatures are for Salton and Imperial for 1902 when we consider how different the sums of the daily mean temperatures are, (See Table 9, p. 66). If the records for 1902 are correct at both points it would indicate a noteworthy difference in climate, the maximums being proportionally higher at Imperial than at Salton. These sums of temperatures show that the Deglet Noor date is certain to mature fully at Imperial, in the heart of the irrigated portion of the Salton Basin; this is indicated not only by the sum of the daily mean temperatures, but still more clearly by the sums of the daily mean maximum temperatures during the fruiting season.

It is worthy of note that by this system of calculating the sum of heat is higher at Phoenix than at Biskra, whereas the order was reversed when a summation of the mean daily temperature was made (see Table 9, p. 66). This result leads one to hope that the Deglet

Noor may after all ripen in the Salt River Valley. By this method of calculating, as well as by the summation of the mean temperatures, Salton heads the list, being the hottest desert station known.[a] There can be no question that the Deglet Noor and other choice late sorts will mature here and in the other parts of the Salton Basin.

The advantages of excessively hot summer climates for date culture are demonstrated in the Souf country in the Sahara, a region covered with large dunes, sometimes 500 feet high, of wind-blown sand (Pl. II, p. 76), lying about 50 miles east of the Oued Rirh and probably having about the same summer climate as Ayata and Tougourt. The best Deglet Noor dates are said to come from the Souf and are grown in peculiar sunken gardens excavated to a depth of from 25 to 30 or even 50 feet. These sunken gardens, called "Ghitan" or "Rhitan" (see fig. 8), are dug down to within a few feet of the level of the ground water

FIG. 8.—Sunken date gardens in the sand dunes in the Oued Souf region, near El Souf, Algeria.

and are large enough to contain from 6 to 100 palms, usually from 25 to 50. The sides are sloping, and composed of sand which reflects the sun's heat and light on the leaves from the sides and from below, thus intensifying the heat to such a degree that even the Arabs can not work in these gardens during the hottest weather.[b] In these torrid gardens the space is so valuable that the palms are not allowed to pro-

[a] See footnote, p. 66.

[b] No irrigation is necessary for the date palm in these gardens, as the roots reach the moist sand near the water level. The chief labor is the carrying out of the sand blown in by the wind. When the hot simoon winds of summer blow, the natives do not attempt to work during the day but commence after midnight when the temperature is lowest. So difficult is the struggle against the sand blown into the gardens by every high wind that their labor has been likened to that of ants rather than that of men.

duce offshoots, which are imported from the Oued Rirh country when needed to plant new gardens. A single palm may be worth from $80 to $100 and may produce as much as 330 pounds of dates, which bring the highest price of any in the Sahara. There can be little doubt that the superior quality of these dates is due to the accumulation of heat in the still air of the sunken gardens by reflection from the bare sand of the sloping sides.

In the Salton Basin the Deglet Noor date can doubtless attain the same perfection with infinitely less expense and trouble, since the higher summer temperature will give the same heat in level orchards that is reached in the sunken gardens of the Souf.

EFFECTS OF WIND ON THE DATE PALM.

In the large deserts there are frequently high winds which are usually very hot and dry and sometimes so violent as to carry great quantities of dust and sand. Delicate foliage is injured by such winds in two ways; first, by being lacerated by the violence of the wind and also bruised and abraded when sand is carried; second, by the drying action of the intensely hot, dry air, especially on leaves which have been torn or injured. Such winds often cause great discomfort and even grave danger to caravans in the desert. "The spectacle is frightful, the impression most painful, the danger real; sand obscures the air and singes the face, it fills the eyes, the mouth, the ears; it hurts the throat and dries up the water skins of the native caravans, which are thereby in danger of perishing."[a]

Such winds, called "simoons" or "siroccos" in the Sahara, often blow several days in succession, sometimes keeping up all night. During such winds the relative humidity sometimes falls as low as 2 per cent at a temperature of 33° C., corresponding to 0.75 mm. pressure of water vapor,[b] whereas the mean humidity of the driest month at Paris, for example, is 57 per cent, and at Biskra 25 per cent (see p. 53).

Observations made by the writer at Biskra during a sirocco at 3 o'clock p. m., May 13, 1900, showed even less humidity. The dry thermometer read 38.5° C. and the wet bulb sling thermometer 15.3° C., corresponding to a relative humidity of 2 per cent and an absolute pressure of water vapor of 1.02 mm.[c] Sometimes the air is so dry in the interior of the Sahara that the instruments such as have been used do not indicate the presence of any water vapor whatever.

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[a] Rolland, Georges. Géologie du Sahara algérien, p. 225.

[b] Massart, Jean. Un voyage botanique au Sahara. In Bul. Soc. Roy., Bot. de Belgique, vol. 37 (1898), I, p. 273, observations made near Ouargla at noon, May 23, 1898; the wet-bulb sling thermometer registered 14.2° C., which gives nearly 7 per cent relative humidity by Prof. C. F. Marvin's tables (Weather Bureau Publication No. 235, 1900).

[c] Calculated by Prof. C. F. Marvin, Weather Bureau, U. S. Dept. of Agriculture.

Such winds have no bad influence on the date palm, but on the contrary favor the proper maturing of the fruit in regions where the season is short and some oases in northern latitudes fail to produce a crop if the hot winds do not blow frequently.[a] The date trunk is so strong and elastic and so firmly attached by the cord-like roots that it is an extremely rare occurrence for a palm to be broken or blown over by the heaviest gales, although the crown of leaves at the top of the slender stem exposes the trunk to the greatest possible strain. The leaves are very tough and strong and are very seldom torn by the wind or bruised by sand. The only harm heavy windstorms do is to interfere with the setting of the fruit by blowing the pollen away. This injury can usually be remedied by repollination after the storm is over. In the Salt River Valley, at Tucson, and at many other points in southern Arizona, the average wind velocity is low and wind storms are infrequent, so the date palm has in these regions no particular advantage over other plants because of its ability to support wind and sand storms. In the Salton Basin, however, the case is different, as rather heavy winds are not uncommon, and dust and sand are often carried in considerable amounts. These winds are, however, certainly not so severe as in the Sahara and will in no way interfere with successful date culture.

It seems, however, that in the great date region about Bassorah, at the head of the Persian Gulf, the "shamel," or hot wind laden with dust, may do great damage. Mr. Fairchild states[b] that "if this (shamel) occurs before the dates have sufficiently matured it dries them up and covers them with dust, checking their development and soiling them so that they are refused by the European and American importers. Last year's crop (1901) was seriously injured in this way, and the export was reduced from nearly 2,000,000 cases to about 1,000,000."

It is conceivable that the enormous losses occasioned in the Bassorah region by hot, dust-laden winds, which are nowhere else reported to have so deleterious an action, may be due to the peculiar character of the climate at the head of the Persian Gulf. The proximity of the sea causes the humidity to be much greater here than in most date-growing regions, and this unusual humidity may perhaps render the developing dates peculiarly susceptible to injury by desert winds, possibly by rendering their surface sticky and thereby causing the dust carried by the wind to adhere to them.

The cold northwest winds which often blow for several days at a time during the winter and spring in the Algerian Sahara[c] and the

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[a] At the oasis of Khabis in Persia dates do not ripen well unless the hot, dry, desert wind blows at least forty days during the summer. Abbot, cited by Fischer, Die Dattelpalme, p. 55.

[b] Fairchild, D. G. Persian Gulf Dates and Their Introduction into America. Bul. 54, Bureau of Plant Industry, U. S. Department of Agriculture, p. 28, 1903.

[c] Rolland, Georges. Hydrologie du Sahara algérien, p. 416.

cold north and east winds in southern Tunis[a] are said to hinder the pollination of the date palm. When they occur in summer they retard the maturing of the fruit and may even cause it to drop. In Seistan, in the plain of southern Persia, at an altitude of 1,300 feet above the sea level, in the same latitude and altitude as flourishing date oases in the Sahara, date culture is entirely prevented and all other fruit cultures rendered impossible except in the shelter of high walls by the "Badi sado biat," or "120-day wind," a violent, bitterly cold northwest wind which blows from the spring equinox until about July 20.[b] This wind would destroy the flowers of the date palm if they were exposed to it, and as the date palm can not easily be protected by walls, its culture is not attempted in this region, though it is followed in oases lying at higher altitudes far to the north which by their position in the shelter of mountain ranges are protected from such winds. It is possible that in spring cold winds may occur in the Salton Basin, but they are probably less violent than in the Sahara, and are of course not to be compared to the "badi sado biat" of Seistan.

RESISTANCE OF THE DATE PALM TO ALKALI.

The date palm has long been known to withstand large quantities of alkali,[c] and some have even claimed that a certain amount of salt in the soil is beneficial to its growth.[d] As to how much alkali the date palm can resist and still grow and bear fruit in profitable quantities practically nothing definite is on record, notwithstanding the fact that hundreds of thousands of dollars have been invested by the French companies in plantations of date palms in the oases of the Algerian Sahara where alkali abounds. Apparently the date palm is so enormously resistant that it has not been necessary to pay much attention to the amount of alkali in the soil where it is grown. It has been planted on soil of practically all degrees of alkalinity and irrigated with all sorts

[a] Masselot, Les dattiers des oasis du Djerid. In Bul. Direct. de l'Agriculture et du Commerce, Régence de Tunis, vol. 6 (1901), No. 19, p. 121.

[b] Bellew, H. W. From the Indus to the Tigris, London, 1874, p. 239.

[c] The term alkali is applied rather loosely to the more readily soluble saline matters which accumulate in the soils or in the water of desert regions. In spite of the name such salts are mostly neutral in reaction, consisting chiefly of chlorids, sulphates, and nitrates of the bases sodium, potassium, and magnesium. Only the carbonates of sodium and potassium, constituting the much-dreaded "black alkali," are strongly alkaline in reaction, and because of their caustic nature much more deleterious to most plants than are the neutral salts or "white alkali," which latter are injurious chiefly indirectly by rendering the soil water too concentrated a solution and thereby unfitted to nourish the roots.

[d] Ibn-el-Fasel, an Andalusian Moor, whose book, written in the twelfth century, unfortunately has been lost, is said to have given the exact amounts of salt which should be mixed with the manure for date palms. (See Cusa, Salvatore, in Archivo storico siciliano, I, 1873, p. 356.)

of water, from good drinking water to veritable brine containing 1 per cent of saline matters. It is the custom to provide for drainage, usually by means of open ditches, in the oases having much alkali in the soil or in the water. If the drainage is good, abundant irrigation has the effect of washing the excess of alkali out of the soil. However, even in such situations there has been little study of the best means of preventing the accumulation of alkali or of washing it out of the soil, and many of the planters have no comprehension of its action on the date palm.

INVESTIGATION OF THE ALKALI-RESISTING POWER OF THE DATE PALM IN THE SAHARA.

In view of the entire absence of trustworthy data as to the alkali resistance of the date palm, the writer determined on the occasion of his last visit to the Sahara Desert in 1900 to make a study of the soils in the date plantations in order to determine the amount of alkali these soils contain and what effect it had on the growth and fruiting of the date palm when present in excessive quantities. Samples of soils were secured in five different regions in the Algerian Sahara (see map, Pl. II, p. 76), representing several different methods of culture and drainage and showing all degrees of alkalinity. Through the kindness of Prof. Milton Whitney, Chief of the Bureau (then Division) of Soils of the Department of Agriculture, who also furnished instruments for collecting and studying the soils on the spot, these samples were analyzed by Mr. Atherton Seidell in accordance with the methods usually followed in the Bureau of Soils, namely, by digesting 50 grams of soil in a liter of water for twenty-four hours and then analyzing the supernatant solution. The analyses made in this manner do not represent accurately the conditions existing in the soil water, since the amount of the slightly soluble salts, especially gypsum, reported is far in excess of what could dissolve in the soil moisture, which in the rather sandy loam of most of the Saharan oases would constitute about 8 to 15 per cent of the weight of the soil, whereas in the method followed in making the analyses about 150 to 200 times as much water was used. In this bulletin, therefore, the analyses of Mr. Seidell have been recalculated in order to represent more nearly the conditions existing in the soil. The amount of calcium sulphate that goes into solution in the soil moisture has been estimated at 0.05 per cent in all the analyses, except where large amounts of other sulphates were in solution, when it was estimated at 0.02 per cent. The amount that dissolves undoubtedly varies somewhat, depending on the quantity and nature of the other salts present in solution. However, the amount here estimated is not far from the quantity actually present, and its inclusion in the analyses renders them much more useful than to omit the gypsum altogether, or to include the very much larger amounts reported in the original analyses.[a]

The solubility of gypsum in the soil moisture is difficult to estimate, especially in the presence of large amounts of other salts in varying proportions. The researches of Doctor Cameron and Mr. Seidell,[b] of the Bureau of Soils, show that in pure water at 25° C. the solubility of calcium sulphate is about 0.21 per cent, or 2.1 grams of calcium sulphate per liter of water, which would equal 0.27 per cent of gypsum. In a 1 per cent solution of common salt 0.44 per cent of gypsum is dissolved, and in a 4.9 per cent salt solution 0.75 per cent of gypsum. In magnesium chloride an even greater solubility was observed and in a 10.5 per cent solution of this salt 11.13 per cent of gypsum dissolves. On the other hand, salts which yield either calcium or sulphuric acid ions on solution decrease the solubility of gypsum. In a 1.54 per cent solution of sodium sulphate only 0.16 per cent of gypsum is dissolved, though in a stronger solution more is taken up until, in a 22.2 per cent solution of sodium sulphate, 0.26 per cent of gypsum is dissolved. Calcium chlorid in solution depresses even more the solvent power of water for gypsum.

Estimating the water content of the Saharan soil, mostly sandy loam, at 10 per cent on the average, and the solubility of calcium sulphate at 0.5 per cent (equal to 0.6 per cent of gypsum) on the average in the salts such as occur in the Fougala and Oued Rirh region of the Sahara, the amount of calcium sulphate to be counted as alkali would be 0.05 per cent of the weight of the soil. When there were large amounts of sodium sulphate present, as at Chegga, the amounts of calcium sulphate would be much less, probably about 0.02 per cent (equal to 0.025 per cent of gypsum) of the weight of the soil.[c]

This method of expressing the amount of alkali is the one most easily applied where the analyses are made by extracting the alkali with an excess of water, but it is very doubtful whether it gives a cor-

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[a] In most alkaline soils the presence of gypsum is advantageous by preventing the formation of the very harmful carbonates of sodium and potassium (see pp. 101 and 119) by neutralizing the poisonous effect of the salts of magnesium (see p. 89). The physical action of alkali in rendering the soil water too concentrated to support the roots of plants is, however, exerted as much by gypsum as by any other salt in solution in equal amounts.

[b] Cameron, Dr. Frank, and Seidell, Atherton. Bul. No. 18, Bureau of Soils, U. S. Department of Agriculture, pp. 39, 40, and 46–57.

[c] Mr. Seidell's original analyses are given in every case as a footnote in order to facilitate any comparisons which students of alkali conditions may desire to make with analyses reported in other ways than has been done by the writer. As a result of this slight emendation the analyses are brought into such shape that the results may be compared, without danger of serious error, with the determinations of alkali made by the electrical method, on which data all the newest and best maps of the alkali lands of the Southwest which have been issued by the Bureau of Soils have been prepared.

rect idea of the alkali condition of the soil in relation to crop production, since the most important factor in reference to plant growth is the degree of concentration of the soil moisture. Inasmuch as the water capacity varies greatly in different types of soils it is easily possible that two soils having the same percentage of alkali by weight may differ very greatly in their ability to support crop plants sensitive to alkali. Thus in a coarse sandy soil having a low water content the concentration of the soil moisture may be three or four times as great as in a heavy clay soil having a correspondingly greater water capacity.

Fortunately it is now possible to determine quickly and accurately the degree of concentration of the soil moisture with the ingenious instrument devised by Professor Whitney and Mr. Briggs, by measuring the electrical conductivity of a column of soil saturated with water.[a] While this method shows approximately the degree of concentration of the soil water to which the roots of plants would be exposed, it gives no indication as to the composition of the alkali, which often varies greatly in soils only a few rods apart. Inasmuch as different sorts of alkali vary greatly in their poisonous action on the roots of plants, the needs of the biologist and agriculturist would be served best by the employment of both methods, the electrical giving the concentration of the soil water; the analytical, its chemical composition. At the same time a physical analysis of the soil showing the water capacity would be useful in forecasting the danger of an increase in alkali content through the evaporation of saline irrigation water or by a rise of alkali from the subsoil.

The soils secured from the Sahara, with the exception of the one above mentioned from Biskra, were all similar in nature, being composed of sandy loam or fine sand. In consequence the results of the analyses reported in this bulletin are fairly comparable one with another and are not likely to lead to an overestimate of the alkali-resisting power of the date palm, since the water capacity of these soils is low, and as a result of this the concentration of the soil water is high in proportion to the percentage of alkali present in the soil. The limits of alkali resistance worked out in this bulletin are then directly applicable to the soils best adapted to date culture, viz, sandy loams, and for all other heavier soils are below rather than above the true limit.[b]

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[a] This method depends upon the degree of ionic dissociation, rather than the total content of dissolved substance, and gives the best physical measure of the relative concentration and toxicity of solutions of similar composition.

[b] Very coarse sand would have a lower water capacity than the Saharan soils here studied, but alkali leaches out of coarse sand very easily, so that in such soil a dangerous accumulation of alkali is not common, though if present the limits here determined for the alkali resistance of the date palm would be too high because of the excessive concentration of the soil water in proportion to the percentage of alkali present.

The very unusual ability of the date palm to withstand alkali is of the utmost importance, since it permits it to be grown profitably in soils unfit for any other paying crop and where ordinary vegetation can not grow at all. The date palm is also of great value in aiding in the reclamation of alkaline lands; for once planted to dates and regularly irrigated the soil improves by a washing out of the alkali if the irrigation water is of good quality and if drainage facilities exist. The importance of the alkali-resisting power of this plant is so great that the results of the examination into the alkali conditions in the Algerian Sahara are given in detail, as they constitute the most trustworthy evidence so far in existence as to the amount of alkali the date palm can stand without injury.

ALKALI CONDITIONS IN RELATION TO DATE CULTURE AT BISKRA, ALGERIA.

The first important oasis planted to date palms seen in entering the Sahara by the railway is at El Kantara (see map, Pl. II), where a narrow gorge separates the Algerian high plateau from the Sahara, and in a few moments the train passes from one region to the other. At El Kantara, however, the date palm is chiefly valuable in furnishing a shelter and partial shade to other fruit trees, and it is at Biskra that the date palm is first seen under conditions permitting its best growth. This oasis contained some 95,000 palms in 1882, and now has a total of about 100,000 bearing date palms. The two near-by oases of Filiache and Chetma contain 35,000 more. Biskra is situated in a plain near the west bank of the Biskra River. The irrigation water is furnished by large springs, situated in the bed of the river, which yield about 13,000 liters, or 3,434 gallons, per minute. This water has been analyzed frequently, with fairly concordant results, the content of dissolved salts being given as follows by various chemists: Vatonne, 0.216 per cent; Buvry, 0.2236 per cent; Lahache, 0.226 per cent; Moissonnier, 0.2346 per cent.

The detailed analyses by Moissonnier and Buvry are as follows:

Table 11.—*Composition (in percentage, by weight) of spring water used for irrigating the oasis of Biskra, Algeria.*

Authority.	Calcium carbonate.	Magnesium carbonate.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Magnesium chlorid.	Sodium chlorid.	Silica.	Total.
Moissonnier[1]	0.0278	0.0070	0.0621	0.0357	....	0.0102	0.0894	0.0024	0.2346
Buvry[2]	.0156	....	.0448	....	0.0280	.0474	.0878	....	.2236

[1] Moissonnier, Recueil de mém. de médicine mil., 3 sér., vol. 31, pp. 260–267.
[2] Buvry, Zeitschrft. f. allgem. Erdkunde, N. F., vol. 4, p. 200. Vide Fischer, Die Dattelpalme, p. 41.

In winter, when there is a flow of water in the Biskra River, the water in the irrigating canals may contain as low as 0.075 per cent of dissolved salts, largely gypsum (0.0437 per cent), according to Moissonnier.[a]

The very good quality of the water in winter, together with the shortage of water in summer—there being only 0.1 liter per tree per minute when 0.3 is needed (see p. 45)—favors the practice of winter and spring irrigation commonly followed in this

[a] An analysis of the river water mixed with the spring water after a rainstorm in April, 1880, as reported by Rolland, showed only 0.04 per cent of salts, nearly half calcium carbonate (0.01852 per cent).

PORTION OF THE SAHARA DESERT IN SOUTHERN ALGERIA, SHOWING PRINCIPAL CENTERS OF DATE CULTURE.

oasis, either indirectly by growing crops needing abundant irrigation between the palms, or directly in soaking the ground about the trees. It is doubtless because of the very low alkali content of the irrigation water in winter and the only moderate content in summer that the alkali is not troublesome in this oasis, although surface flooding is never practiced, water being applied in excavations called "dahir," holding a barrel or more (Pl. XVII), which are made about the base of the tree (see p. 47). Biskra has clay soils of great depth[a] (as much as 40 feet) and this doubtless constitutes an additional reason for irrigating by means of dahir, since such soils are difficultly permeable for water and have a great water capacity, so that if irrigation were practiced by flooding the whole surface the water would largely be evaporated or absorbed by the surface layers of the soil, and only a small proportion would ever percolate to the roots of the date palm, especially in summer, when the supply of water is scanty.

Station No. 1, where soil samples were secured, was in a garden belonging to the Victoria Hotel, some 25 feet away from a century-old date palm (see Pl. XIII), and near a vigorous young Deglet Noor palm (see fig. 1, p. 16). Alfalfa and burr clover (*Medicago denticulata*) were growing where the sample was obtained. The subsoil was a stiff clay.

The percentage of the weight of the soil soluble in 20 times its weight of water was 0.42 for the surface foot and 0.40 for the subsoil. The following salts were found by Mr. Seidell:

TABLE 12.—*Amount and nature of salts soluble in excess of water in soil from date garden at Biskra (expressed in percentages of the total weight of the soil).*[1]

Depth.	Calcium bicarbonate.	Magnesium bicarbonate.	Calcium sulphate.	Sodium chlorid.	Potassium chlorid.	Total.
Surface foot	0.19	0.05	0.10	0.04	0.04	0.42
Subsoil (24 to 30 inches)	.15	.06	.11	.04	.04	.40

[1] This table is identical with Mr. Seidell's original analysis.

Disregarding the very slightly soluble calcium carbonate, the following would represent approximately the alkali content of the soil water:

TABLE 13.—*Per cent of alkali in soil of palm garden at Biskra, Algeria.*

Depth.	Calcium sulphate.	Sodium chlorid.	Potassium chlorid.	Magnesium bicarbonate.	Total.
Surface foot	0.5	0.04	0.04	0.05	0.18
Subsoil (12 to 14 inches)	.5	.04	.04	.06	.19

The amount of alkali present in this soil is insignificant and in no way affected the growth of alfalfa. This sample is also interesting as being a heavy clay soil of the sort which largely composes the oasis of Biskra, but which does not occur in the other oases studied. Such soils are not considered as favorable for date culture as loamy or sandy loam soils; nevertheless date palms grow very well at Biskra, although the late sorts do not ripen their fruits properly because the summer and autumn are not hot enough.

Of the area surveyed by Messrs. Holmes and Means, of the Bureau of Soils, in the Salton Basin, California, 23,120 acres, or 30 per cent, is a heavy clay comparable to this sample, and half this area contains less alkali than the Biskra garden, and a quarter more contains only slightly greater quantities (0.4 to 0.6 per cent), where

[a] Such soils are common in the Salton Basin in California. (See Pl. III, pp. 106 and 108.)

the date palm would be able to grow as well as in the Sahara oasis, since the irrigating water here is of better quality than at Biskra.[a]

ALKALI CONDITIONS IN RELATION TO DATE CULTURE AT FOUGALA, ALGERIA.

In proceeding west from Biskra one traverses the so-called Western Zab,[b] which is first seen beyond a low mountain range, the Djebel Mendjenaib, adjoining Biskra on the west. The Western Zab, or more accurately, the Zab Dahri (Map, Pl. II, p. 76, and Pl. XV), is a flat plain, 120 to 172 meters above sea level, which slopes gently to the south or southeast. To the north the plain is limited by the foothills of the Atlas Mountains, which rise rather abruptly. Throughout the Western Zab, at least along the route followed between Biskra and Fougala (see map, Pl. II), there are practically no surface indications of water, the vegetation being very scanty, consisting mostly of the "Zeita" bush (*Limoniastrum guyonianum*), which usually indicates the presence of much gypsum in the soil where it grows (see Yearbook 1900, Pl. LIX, fig. 5). In extremely alkaline spots where chlorids predominate the Zeita disappears, and is replaced by saltbushes (Atriplex), samphires (Salicornia), etc.

There occur throughout the Western Zab occasional large springs which are used to irrigate many oases situated at a somewhat lower level to the southward. Beginning at Farfar there is seen a most characteristic and most curious system of date culture. The young date offshoots are planted at the bottom of pits about six feet square, and from 4 to 8 feet deep (Pl. XV, fig 1). An inspection of a freshly made ditch, or "bir," as it is called by the Arabs, shows that the ditch is just deep enough to penetrate an impervious hardpan, composed of marl and gypsum. Below this stratum water is found and the palms are so planted that their roots can easily penetrate to the water level, and after once getting established they are able to grow without being irrigated from the surface. As the palms grow older the ditches are slowly filled up, the palms in the meantime sprouting forth roots all along the lower part of the trunk. In some cases very old trees are seen to be banked up instead of being planted in ditches (Pl. XIV, fig. 1). Curiously enough the trees planted in such pits are often irrigated, although their roots are in contact with water. As will be shown later on, this is doubtless done in order to aerate the subsoil and to wash out the alkali, which would otherwise be left at the surface by the evaporation of the moisture brought to the surface by capillary attraction. When irrigated, there is of course perfect drainage through the bottom of the "bir" to a practically fixed water level below.

At Fougala a French company purchased an entire oasis containing thousands of old bearing date palms, and has made in addition extensive new plantations. This property comprised in 1900 some 263 hectares and contained about 18,000 bearing date palms and 6,000 young trees not yet in bearing. On this property irrigation has been practiced on an extensive scale, although the older palms were grown by planting in pits as previously described, and were irrigated when young by the Arabic method, namely, by raising water from shallow wells by means of buckets attached to sweeps ("kitara")[c] (Pl. XIV, fig. 2). The wells on this property are from 9 to 12 feet deep and are from 6 to 8 feet square. They yield about 35 gallons per minute, for some three hours, by which time the water is usually exhausted. These sweeps are run at this rate by a single Arab, although on some wells there are double sweeps, and then two Arabs work side by side. The water from such wells is poured into a large receptacle called "jabia," from which it flows into irrigation ditches. In

[a] Biskra water contains from 0.075 to 0.235 per cent of alkali and is worst in summer. (See p. 76.) Colorado River water used to irrigate the Salton Basin contains from about 0.021 to 0.125 per cent of salts and is best in quality in midsummer, when the flood occurs.

[b] Marked Zibane in the map, Pl. II, p. 76.

[c] See also Yearbook 1900, Pl. LXI, fig. 6.

addition to these native wells the Companie de l'Oued Rirh has put down several artesian wells[a] which are some 80 meters deep and yield from 50 to 75 gallons of flowing water per minute, which is conducted directly into the irrigation ditches. This water is remarkably pure, containing very much less salts in solution than the artesian water of the Oued Rirh country or that of Biskra. A rough test of its electrical conductivity indicated the presence of about 0.085 per cent of dissolved salts.

The effect of irrigation with this water is marvelous. Old date palms which had made a slow and stunted growth and which had fruited but little, at once grew luxuriantly when irrigated and began to bear heavy crops of fruit. Inasmuch as these trees had their roots in constantly moist layers of earth, the effect of irrigation was in all probability due not so much to the increased supply of water as to other actions brought about by irrigation. In the first place, the structure of the soil and the manner in which the date palms are planted in pits which penetrate the hardpan, below which standing water occurs, hinder the aeration of the subsoil and at the same time favor the accumulation at the surface of the alkali dissolved by the capillary currents of water in ascending through the strongly alkaline soil. On the other hand, irrigation with the remarkably pure water furnished by the deep artesian wells would tend to have exactly the opposite effect, namely, the subsoil would be aerated by means of the water which had been flowing in surface ditches, and secondly, the watering of the date palms with an abundant supply of pure water, coupled with a perfect system of drainage by means of the holes through the impervious subsoil[b] over which the trees are planted, would bring about the washing out of the alkali from the soil, especially where the trees were irrigated frequently and with large amounts of water. The hardpan would tend to confine the alkali and prevent its rise between the trees after it was once washed out of the soil.

Although the date palm can grow, as will be shown further on, in soils containing as high as 3 per cent of alkali, even when irrigated with strongly brackish water containing over 0.6 per cent of salts in solution—it being in fact able to endure more alkali than any other plant cultivated in the Sahara Desert—there can nevertheless be no doubt that its growth is retarded and its fruitfulness lessened by the presence of large amounts of alkali in the soil or in the irrigation water. It was noticeable at Fougala that the trees which were grown in the most alkaline parts of the oasis, and especially where surface irrigation with pure water had not been practiced, were stunted and showed a pronounced yellowish color of the leaf and especially of the leafstalk. This was later seen in the oases in the Oued Rirh country, and it would seem to be an indication of an excess of alkali beyond the amount which the trees can endure without noticeable injury.

An effect of pure water similar to that observed at Fougala has been noticed at Koseir, in the Egypto-Arabian desert, on the shores of the Red Sea, where Klunzinger reports[c] that dwarfed date palms 30 to 40 feet high grow on the very alkaline soil and were nourished by very brackish water, but yield crops of small but very sweet dates only in good years after heavy rains. The action of these heavy rains probably would be much like that of the irrigation with the pure artesian water at Fougala.

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[a] The natural springs in the Western Zab, according to Rolland (Hydrologie du Sahara), are supplied from the same source that feeds the artesian wells, viz, the water carried in the cretaceous strata which are upturned in the Aures Mountains limiting the Sahara on the north and which underlie the whole northern belt of the Sahara. The water of these springs soaking into the soil feeds the superficial layer of water which directly underlies the hardpan at Fougala. Very probably this hardpan has been formed by the action of this standing water.

[b] Professor Hilgard has noted the drainage through holes in the hardpan in the San Joaquin Valley in California. Bul. No. 83, California Experiment Station.

[c] Klunzinger, C. B. Die Vegetation der egyptisch-arabischen Wüste bei Koseir, in Zeitschrift d. Gesellschaft f. Erdkunde, Berlin, vol. 13 (1878), pp. 432–462.

It is difficult to say how much of the beneficial effect observed in Fougala from surface irrigation is due to the better aeration of the subsoil thereby brought about. There can, however, be little doubt that the date palm is distinctly favored by a proper aeration of the soil in which it grows, since the palms at Fougala when irrigated from the shallow wells did better than those near by which have their roots in contact with the very same layer of water which fills these wells. Of course the identity of the water supply in the case in question does not exclude the probability of the alkali being washed out from the surface soil by abundant irrigation, even if the water used is rather brackish. Unfortunately no tests were made of the water in these surface wells, but it is undoubtedly much more alkaline than the water of the deep artesian wells. Other observations made at Ourlana in the Oued Rirh region went far to show that proper aeration of the subsoil is even more important than absence of alkali for the proper growth and fruiting of the date palm. For instance, the extremely brackish water which flows from the drainage ditches is nevertheless used in some instances to irrigate palms planted at lower levels and without apparent injury, although such palms do not show a rapid growth (see p. 98).

Station No. 1 at Fougala represents the undisturbed desert conditions (Pl. XV, fig. 1). It was situated where no culture, drainage, or irrigation had been practiced, or at least not in modern times.[a] The samples were taken a short distance to the northeast of the ruins of an old Roman fort. The natural vegetation consisted of a scanty growth of saltbushes, samphires, and other plants able to stand much alkali. A date palm, yellow and evidently not in a thriving condition, was growing near by.

The amount of alkali present in the surface crust and at various depths is shown in the following table:

TABLE 14.—*Per cent of alkali in undisturbed Saharan soil at Station No. 1, Fougala, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Magnesium chlorid.	Sodium bicarbonate.	Total.
Surface crust	0.07	0.41	1.41	9.19	0.53	....	0.12	11.76
Surface soil (1 to 12 inches)	.05	.34	.37	3.79	.29	....	.08	4.92
Subsoil (12 to 30 inches)	.05	.23	....	1.32	.12	0.02	.08	1.82
Subsoil (30 to 48 inches—estimated)	(.05)	(.17)	....	(.98)	(.10)	(.02)	(.08)	(1.40)
Soil (1 to 4 feet—estimated)	(0.38)			(1.98)			(.08)	(2.44)

[1] Mr. Seidell's original analyses of the samples from this station are as follows:

Composition.	Crust.		Soil, 0–12 inches.		Subsoil, 12–30 inches.	
	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ca	1.65	9.53	1.39	14.51	1.28	20.89
Mg	.08	.48	.07	.70	.05	.85
Na	4.12	23.81	1.64	17.02	.54	8.83
K	.28	1.60	.15	1.62	.06	1.01
SO_4	5.26	30.42	3.86	40.16	3.26	53.10
Cl	5.82	33.64	2.44	25.37	.88	14.34
HCO_3	.09	.52	.06	.62	.06	.98
Total	17.30	100.00	9.62	100.00	6.13	100.00
$CaSO_4$	5.61	32.38	4.74	49.28	4.36	70.98
$MgSO_4$	.41	2.41	.34	3.49	.23	3.75
KCl	.53	3.08	.29	3.07	.12	1.95
NaCl	9.19	53.06	3.79	39.47	1.32	21.60
Na_2SO_4	1.44	8.35	.37	3.84	....	....
NaHCO	.12	.72	.08	.85	.08	1.33
$MgCl_2$	....	....	....	....	.02	.39
Total	17.30	100.00	9.61	100.00	6.13	100.00

[a] Similar conditions near this station are shown in Yearbook, 1900, Pl. LXI, fig. 4, in the background.

It will be noted that the most readily soluble salts, sodium sulphate and the chlorides, are largely concentrated in the surface soil. This is shown graphically in the accompanying diagram (fig. 9), in which the curves are smoothed so as to show approximately the distribution at various depths of the more important salts composing the alkali at this station.

This distribution of alkali is the common one when there is an appreciable rainfall, as in the northern Sahara (about 9½ inches at Biskra), but is very unlike that of the nearly rainless Salton Basin, where the subsoil often contains more alkali than the surface layers.

This soil was excessively alkaline, the surface foot containing nearly one-twentieth of its weight of alkali, and the whole surface soil to a depth of 4 feet containing nearly 2.5 per cent of alkali. The alkali is characterized by the large proportion of chlorides (amounting to 81 per cent of the total salts), of which almost all is common salt, which alone makes up nearly 4 per cent of the weight of the surface foot, or some 160,000 pounds per acre in the surface foot!

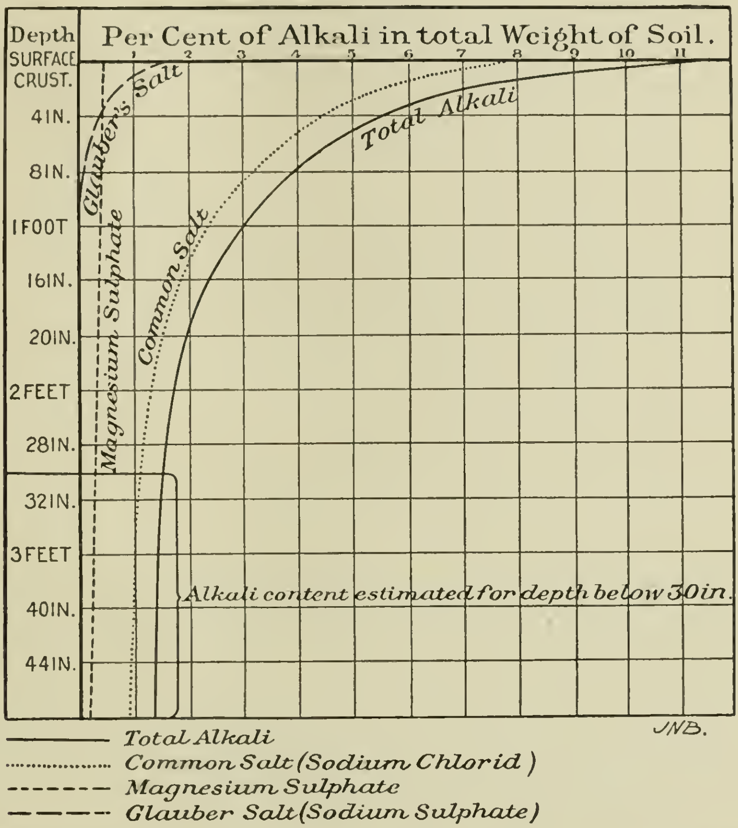

Fig. 9.—Curves showing distribution of alkali to a depth of 4 feet in uncultivated Saharan soil at Station No. 1, Fougala, Algeria.

This soil is very interesting as representing practically the extreme limit of endurance of the date palm for this type of alkali. Unfortunately samples were not obtained down to the hardpan, but if the decrease followed the same ratio as in the Station No. 2, the amount of alkali in the subsoil at 30 to 48 inches would be about 1.42 per cent, and the average for the soil to a depth of 4 feet, 2.55 per cent.

Station No. 2, where the soil was sampled at Fougala, was only a few hundred feet from Station No. 1, in a young date plantation, where irrigation had been practiced for three years. The samples were taken by cutting away a foot or so of the side of the pit, or "bir," in which a date palm had been planted three years before. Fresh earth was reached before the sample was taken. Hardpan was encountered at a depth of 4 feet. The appearance of the locality is shown in the background of Plate XV, figure 2.

The following amounts of alkali were found:

TABLE 15.—*Per cent of alkali in soil of young date plantation, station No. 2, Fougala, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Magnesium chlorid.	Sodium bicarbonate.	Total.
Surface, foot	0.05	0.25	0.01	1.38	0.18	....	0.08	1.98
Subsoil (12 to 30 inches)	.05	.15	....	.09	.09	0.05	.08	.51
Subsoil (30 to 48 inches)	.05	.07	....	.06	.07	.04	.09	.38
Hardpan (48 to 54 inches)	.05	.01	....	.01	.06	.04	.08	.31
Soil, 1 to 4 feet		.21			.54		.08	.83

[1] Mr. Seidell's original analyses of the samples from this station are as follows:

	Soil, 0 to 12 inches.		Subsoil, 12 to 30 inches.		Subsoil, 30 to 48 inches.		Compact gypsum subsoil, 48 to 54 inches.	
	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ca	1.30	20.46	1.23	26.50	1.18	27.19	1.08	27.70
Mg	.05	.79	.04	.94	.02	.55	.02	.46
Na	.58	9.14	.06	1.24	.05	1.10	.02	.51
K	.09	1.47	.05	.99	.03	.83	.03	.87
SO_4	3.35	52.70	3.07	66.03	2.90	66.56	2.63	67.28
Cl	.92	14.50	.14	3.01	.10	2.25	.06	1.64
HCO_3	.06	.94	.06	1.29	.06	1.52	.06	1.54
Total	6.35	100.00	4.65	100.00	4.34	100.00	3.90	100.00
$CaSO_4$	4.42	69.56	4.19	89.99	4.02	92.37	3.68	94.08
$MgSO_4$	.25	3.90	.15	3.18	.07	1.70	.04	1.02
KCL	.18	2.83	.09	1.89	.07	1.56	.06	1.64
NaCL	1.38	21.70	.09	2.02	.06	1.43	....	....
Na_2SO_4	.04	.72	....	....	....	....	....	....
$NaHCO_3$	.08	1.29	.08	1.76	.09	2.07	.08	2.09
$MgCl_2$	....	....	.05	1.16	.04	.87	.04	1.17
Total	6.35	100.00	4.65	100.00	4.35	100.00	3.90	100.00

The results of three years' irrigation with pure artesian water is very striking. The surface crust has disappeared entirely and the amount of alkali has greatly decreased at all depths.

Station No. 3 at Fougala was situated in the space between large date palms, which were in a most thriving condition as a result of eleven years' irrigation. Garden vegetables and cereals had been grown on the land for a number of years. The hardpan layer was reached at a depth of only 26 inches.

TABLE 16.—*Per cent of alkali in soil in old date plantation, station No. 3, Fougala, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium chlorid.	Potassium chlorid.	Magnesium chlorid.	Sodium bicarbonate.	Magnesium bicarbonate.	Total.
Surface foot	0.05	0.06	0.05	0.02	0.01	0.09	....	0.28
Subsoil, 12-26	.05	.12	....	.06	.05	.10	....	.38
Hardpan, 26-28	.05	.01	....	.03	.04	.03	0.05	.21
Soil 1-4 (estimated).	(.12)		(.08)			(.09)		(.29)

[1] Mr. Seidell's original analyses of the samples from this station are as follows:

	Soil, 0 to 12 inches.		Subsoil, 12 to 26 inches.		Compact gypsum subsoil, 20 to 28 inches.	
	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ca	0.31	24.05	1.10	27.03	1.12	28.03
Mg	.01	1.26	.03	.88	.03	.70
Na	.04	3.30	.03	.69	.01	.25
K	.01	.94	.03	.73	.01	.40
SO_4	.78	61.33	2.74	67.19	2.73	67.94
Cl	.05	3.93	.06	1.57	.04	1.04
HCO_3	.06	5.19	.08	1.91	.06	1.64
Total	1.26	100.00	4.07	100.00	4.00	100.00
$CaSO_4$	1.04	81.76	3.74	91.82	3.81	95.21
$MgSO_4$	.06	4.56	.12	2.98	.04	.95
KCl	.02	1.73	.06	1.37	.03	.75
NaCl	.05	3.77	....	....	....	....
$NaHCO_3$	.09	7.08	.10	2.60	.03	.90
$MgCl_2$	.01	1.10	.05	1.23	.04	.95
$MgHCO_3$	....	....	....	....	.05	1.24
Total	1.27	100.00	4.07	100.00	4.00	10.000

The results of long-continued irrigation with pure water and of good drainage through the holes in the hardpan are clearly shown in the very much lower percentages of alkali than at stations 1 and 2. The most remarkable feature of this soil is the almost complete absence of common salt, so abundant at the other two stations at Fougala, where indeed it constituted the bulk of the alkali. The analyses of the soils from these three stations represent three stages in the reclamation of very alkaline desert land and are very instructive. The conditions somewhat resemble those in the Salton Basin, California, where the irrigation water is also very pure and where likewise the alkali is largely composed of chlorides. In the latter region, however, there is no hardpan through which holes for drainage can be dug and which would serve to keep the alkali down when once it was washed out of the soil. Where good drainage can be provided the soils in the Salton Basin doubtless can be as completely freed from harmful excess of alkali as those of Fougala have been.

Station No. 4 at Fougala was situated in a very alkaline spot—too alkaline to grow any crops—near a date palm which was yellow and stunted, but which had nevertheless managed to live twenty years or more. Only the surface crust was secured; it showed the following percentages of alkali salts soluble in an excess (20 times the weight of the soil sample) of water. The surface crust from station No. 1 is also given, analyzed in the same way.

TABLE 17.—*Per cent of alkali soluble in excess of water in surface crusts from Fougala, Algeria.*

Station.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Total.
Surface crust, station No. 4[1]	3.81	0.84	5.52	4.32	0.40	0.15	15.04
Surface crust, station No. 1	5.61	.41	1.44	9.19	.53	.12	17.30

[1] Mr. Seidell's original analysis of this surface crust is as follows:

	Surface soil.			Surface soil.	
	Alkali in soil.	Composition of alkali.		Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Ca	1.12	7.44	$CaSO_4$	3.81	25.26
Mg	.17	1.13	$MgSO_4$	.84	5.60
Na	3.53	23.51	KCl	.40	2.69
K	.21	1.41	NaCl	4.32	28.77
SO	7.08	47.10	Na_2SO_4	5.52	36.71
Cl	2.81	18.71	$NaHCO_3$	.15	.97
HCO_3	.12	.70	Total	15.04	100.00
Total	15.04	100.00			

The crust from Station No. 4 shows less than half as much common salt (sodium chlorid), but four times as much Glauber's salt (sodium sulphate) as that from station No. 1.

ALKALI CONDITIONS IN RELATION TO DATE CULTURE AT CHEGGA, ALGERIA.

In traveling southward from Biskra one follows near the course of the Biskra River, and passes occasional areas covered with bushes and small trees, which doubtless get scanty supplies of water by seepage from the subterranean flow in the river. After crossing the Oued Djedi (see map, Pl. II, p. 76), which is the principal artery of surface drainage of the Algerian Sahara, but which is usually entirely dry, the Small Desert of Morran is entered, a region almost entirely devoid of vegetation. At about 30 miles south of Biskra the "bordj"[a] of Chegga (see map, Pl. II, p. 76) is reached. Chegga is about 22 meters (72 feet) above sea level, and is only about 8 miles from the Chott Melrirh, a salt lagoon nearly dry, which is here some 90 feet below sea level. Samples were secured of the water from a flowing artesian well which irrigates the little group of palms near the bordj, and which in spite of its bad quality is used for drinking and for cooking purposes.

About a mile to the eastward and at a somewhat lower level is a date plantation of some size, the property of a French company. Here samples were secured of the artesian water used to irrigate this plantation. Analyses are given herewith of the water of the two artesian wells at Chegga, made by Mr. Seidell, and also the analysis by Carnot[b] (of the École des Mines, Paris) of the water from the Bir Djefaïr well, some 6 miles north of Chegga.

[a] A bordj is a fortified shelter for travelers, such as is common in Algeria.

[b] Rolland, Hydrologie du Sahara, p. 294.

TABLE 18.—*Composition (in percentage by weight) of artesian water at Chegga and of the well at Bir Djefaïr, Algeria.*

Locality.	Calcium carbonate.	Magnesium carbonate.	Iron carbonate.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.
Chegga, bordj [1]	....	....	....	0.1790	0.0629	0.2067	0.0803
Chegga, date plantation [1]	....	....	....	.2062	.0966	.1215	.1955
Bir Djefaïr [2]	0.01536	0.00187	0.00102	.17784	.08632	.06214	.05364

Locality.	Potassium chlorid.	Sodium carbonate.	Sodium bicarbonate.	Silica.	Nitrates and soluble organic matter.	Organic and mineral matter in suspension.	Total.
Chegga, Bordj [1]	0.0133	0.0030	0.0033	....	....	....	0.5185
Chegga, date plantation [1]	.0127	.0030	.0046	....	....	....	.6401
Bir Djefaïr [2]	.00632	....	....	0.00180	0.00030	0.00280	.41291

[1] Mr. Seidell's original analyses of artesian water of Chegga are as follows:

	Well at date plantation.		Well at Bordj (drinking water).	
	Alkali per 100 cc.	Composition of alkali.	Alkali per 100 cc.	Composition of alkali.
	Gram.	*Per cent.*	*Gram.*	*Per cent.*
Ca	0.0607	9.48	0.0527	9.61
Mg	.0195	3.05	.0127	2.32
Na	.1190	18.59	.1008	18.37
K	.0067	1.05	.0070	1.28
SO_4	.3047	47.60	.3162	57.65
CO_3	.0017	.27	.0017	.31
HCO_3	.0033	.51	.0024	.44
Cl	.1245	19.45	.0550	10.02
Total	.6401	100.00	.5485	100.00
$CaSO_4$	.2062	32.22	.1790	32.63
$MgSO_4$	.0966	15.09	.0629	11.47
KCl	.0127	1.98	.0133	2.42
Na_2SO_4	.1215	18.98	.2067	37.69
NaCl	.1955	30.54	.0803	14.64
Na_2CO_3	.0030	.47	.0030	.55
$NaHCO_3$	.0046	.72	.0033	.60
Total	.6401	100.00	.5485	100.00

[2] Rolland, Hydrologie du Sahara.

The preponderance of sulphates is marked in the water of the well used to irrigate the date plantation. They constitute 66.28 per cent of the total soluble salts, whereas the chlorids make up only 32.529 per cent.[a]

The contrast with Fougala is most striking. There the artesian water was very pure, containing only about 0.085 per cent of dissolved salts, whereas at Chegga the water contained 0.6401 per cent, or nearly eight times as much alkali. This water

[a] The analyses made by Lahache (Archives de médicine milit., vol. 14 (1889), p. 50) have shown the existence of soluble nitrates in the artesian water of all regions of the Algerian Sahara. At Chegga 22.5 grams per cubic meter were found, or 0.00023 per cent, corresponding closely to the 0.00030 per cent of nitrates and dissolved organic matter reported by Carnot in the analysis of the water of the well at Bir Djefaïr. No nitrates were found by Mr. Seidell, though tests were made. Possibly the small amounts present had been consumed by micro-organisms before the water was analyzed. The nitrates present in the artesian water are considered by Marcassin (Annal. Inst. Nat. Agron., 1895) to be of considerable importance in supporting the date palm and other vegetation grown by irrigation in the Algerian Sahara.

would be counted too alkaline to use for irrigation[a] anywhere outside of the Sahara, though at Chegga it is the only water used to irrigate a flourishing date orchard planted on soil originally very alkaline, but which has been improved, even while being irrigated with such water, by means of drainage ditches into which the excess of alkali has been washed. Figure 1 on Plate XVI shows the appearance of these palms growing where alkali can be seen at the side of the irrigation ditches. Figure 2 on the same plate shows a reclaimed area where Saharan alfalfa was growing.

Station No. 1 at Chegga was in the date plantation in a very alkaline spot, close to an offshoot that had failed to grow, probably because of the excess of alkali in the soil. The subsoil was taken from the side of the drainage ditch, some 18 feet away, and may not represent the true state of the subsoil where the surface soil and crust were taken.

The crust shows the following amounts of alkali soluble in an excess of water (20 times weight of soil sample):

TABLE 19.—*Per cent of alkali soluble in excess of water in surface crust from Station No. 1, Chegga, Algeria.*[1]

Locality.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Sodium carbonate.	Total.
Chegga, Station 1, surface crust	3.76	1.68	55.44	2.87	0.15	0.16	0.06	64.12

The soil shows the following amounts of alkali:

TABLE 20.—*Per cent of alkali in soil of date plantation, Station 1, Chegga, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Total.
Surface foot	0.02	0.20	4.89	0.53	0.10	0.08	5.82
Subsoil at 3 feet	.02	.25	1.50	.80	.08	.06	2.71
Soil 1 to 4 feet (estimated)	(2.61)			(.82)		(.07)	(3.50)

[1] Mr. Seidell's original analyses of the samples from this station are as follows:

	Crust.		Soil, 0–12 inches.		Subsoil, 36 inches.	
	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ca	1.11	1.72	0.97	10.68	0.96	16.12
Mg	.34	.53	.04	.44	.05	.81
Na	19.18	29.90	1.81	19.94	.82	13.77
K	.08	.12	.06	.71	.04	.74
SO_4	41.46	64.68	5.79	63.63	3.51	59.03
Cl	1.81	2.82	.36	3.94	.52	8.82
HCO_3	.12	.18	.06	.66	.04	.68
CO_3	.03	.05				
Total	64.13	100.00	9.10	100.00	5.94	100.00
$CaSO_4$	3.76	5.85	3.30	36.30	3.25	54.75
$MgSO_4$	1.68	2.62	.20	2.18	.25	4.18
KCl	.15	.23	.10	1.12	.08	1.42
NaCl	2.87	4.47	.53	5.80	.80	13.47
Na_2SO_4	55.44	86.49	4.89	53.70	1.50	25.24
$NaHCO_3$	.16	.25	.08	.90	.06	.94
Na_2CO_3	.06	.09				
Total	64.13	100.00	9.09	100.00	5.94	100.00

[a] The Chegga water contains over 374 grains of alkali per gallon; whereas 40 grains is usually given as the limit for drinking water, and anything above this is considered doubtful for irrigating purposes, unless the salt in solution is gypsum. Even excluding gypsum, the Chegga water still contains 250 grains to the gallon, whereas the water of Lake Elsinore, which so disastrously affected the orange groves on which it was used near Riverside, Cal., contained only 84 to 116 grains per gallon. (See Report, California Agricultural Experiment Station, 1897–98, pp. 99–113 and 126–130.)

The amount of alkali is enormous, the largest found in a date plantation in the Sahara, and is probably more than young offshoots just rooting can stand, as is evidenced by the death of one planted not long before the sample was taken. Older palms can doubtless endure this amount of alkali, for several were growing near by in soil apparently identical with the sample analyzed. It should be noted that the bulk of the alkali (some 70 per cent of all the alkali present and 2.35 per cent of the total weight of the soil), is sodium sulphate (Glauber's salt), and only 23 per cent of the alkali, or 0.82 per cent of the total weight of the soil, is composed of chlorids, whereas at Fougala, Station 1, where the alkali was also almost strong enough to prevent the growth of the date palm, the total alkali content of the soil was much less, being some 2.46 per cent instead of 3.53 per cent, but consisted of 1.98 per cent of chlorids, more than twice as much as at Chegga. The chlorids are, however, without doubt more injurious than sodium sulphate, and both of these stations are to be considered as representing very nearly the limit of endurance of the date palm—Fougala for chlorids; Chegga for sulphates.

The surface accumulation of sodium sulphate, as suggested by Mr. Seidell, may well have some connection with the composition of the very alkaline waters used for irrigation in which the sulphates predominate and in which sodium sulphate is present to the extent of 121.5 parts per 100,000, constituting 18.98 per cent of the dissolved salts (see p. 95).

Station No. 2, at Chegga (Pl. XVI, fig. 2), is very unlike the first, as it represents reclaimed land where Saharan alfalfa[a] was growing. It is to be noted that deep drainage ditches ran through the orchard at 50 to 60 feet intervals and provided escape for the superabundant alkali, and that this sample was secured near one of these ditches as may be seen in Plate XVI, figure 2. The analysis is given herewith.

TABLE 21.—*Per cent of alkali in washed-out surface soil of date plantation, station No. 2, Chegga, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Total.
Surface foot	0.02	0.17	0.04	0.05	0.05	0.06	0.39

[1] Mr. Seidell's original analysis of the samples from this station is as follows:

	Alkali in soil.	Composition of alkali.		Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Ca	1.04	26.57	$CaSO_4$	3.54	90.29
Mg	.03	.87	$MgSO_4$	.17	4.29
Na	.05	1.28	KCl	.05	1.38
K	.03	.72	NaCl	.05	1.33
SO_4	2.65	67.81	Na_2SO_4	.04	1.02
Cl	.06	1.53	$NaHCO_3$	.06	1.69
HCO_3	.05	1.22			
Total	3.91	100.00	Total	3.91	100.00

This soil shows a very low per cent of alkali, considering that the date plantation is on a very alkaline area and that the water used for irrigating is very brackish. This is almost the same amount of alkali as was found in the valley of the Colorado River near Yuma, where alfalfa grew in soil containing 0.498 per cent of alkali in the 4 upper feet (Loughridge, Bull. 133, California Agricultural Experiment Station, p. 27). However, at Yuma the irrigation water was of good quality, containing less than 0.1 per cent of dissolved salts, whereas at Chegga the water was very bad, containing over 0.64 per cent of alkali.

[a] See footnote *a*, p. 23.

Station No. 3, at Chegga, represents a subsoil thrown up in digging a drainage ditch and was so charged with alkali as to have become nearly solid. The soil came from a depth of 4 to 6 feet, and contains the following amounts of alkali:

TABLE 22.—*Per cent of alkali in subsoil of date plantation, station No. 3, Chegga, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Total.
Subsoil 4 to 6 feet	0.02	0.33	0.22	1.16	0.06	0.07	1.86

[1] Mr. Seidell's original analysis of the sample from this station is as follows:

	Alkali in soil.	Composition of alkali.		Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Ca	1.11	19.77	$CaSO_4$	3.76	67.17
Mg	.06	1.18	$MgSO_4$	.33	5.82
Na	.55	9.71	KCl	.06	1.14
K	.03	.61	NaCl	1.16	20.66
SO_4	3.07	54.71	Na_2SO_4	.22	3.96
Cl	.73	13.06	$NaHCO_3$	.07	1.25
HCO_3	.05	.93			
Total	5.60	100.00	Total	5.60	100.00

Though less alkaline than the subsoil of sample No. 1, which contained 2.765 per cent, this still shows a very high salt content.

When date palms were first planted on this property, many of the offshoots were lost through excessive alkalinity. The digging of drainage ditches has rendered it possible to wash out much of the alkali, even with the very bad water used for irrigation, as is evidenced by the fact that alfalfa can now grow on some of the land.

ALKALI CONDITIONS IN RELATION TO DATE CULTURE AT M'RAÏER, ALGERIA.

Going southward from Chegga, the Little Desert of Moran is traversed until a somewhat abrupt descent is reached, which is marked by a series of low cliffs called Kef el Dohr. At the base of this declivity there extends an almost unbroken plain, which slopes gently to the eastward to the shores of the salt lagoon, Chott Melrirh, or rather a branch of it called Chott Merouan (see map, Pl. II, p. 76). This salt lagoon is often dry, but always contains mud covered with a white crust of salt two-fifths of an inch or more thick. In proceeding southward, the road skirts the edge of the lagoon, and during the heat of the day the most deceptive mirages are seen in looking across the Chott (Pl. XVIII, fig. 2).

This region is remarkably like the Salton Basin in many ways, and Chott Melrirh, like Salton Lake, is below sea level,[a] the lowest part or the western border of Chott Melrirh being some 100 feet (31 meters) below sea level. The plain to the west is flat and extremely arid. Occasional small sand dunes occur, which are like those in the Salton Basin.

The oasis of Ourir, seen in passing, is one of the largest created by the French settlers, containing some 40,000 date palms. It is 42 feet (13 meters) below the sea level.

A stop was made at M'raïer, an oasis of considerable size (some 60,000 date palms) owned by Arabs. It is from 10 to 12 feet below sea level. In the village of M'raïer is a very saline area, where the scanty vegetation is composed of stunted saltbushes, samphires, etc. The water level was only a few inches below the surface. A stunted date palm grew some 15 feet away from the spot where the soil sample was obtained, but

[a] The lowest part of Salton Lake is some 270 feet below sea level.

at the side of a drainage ditch. The surface crust obtained here shows the following composition, as analyzed by Mr. Seidell, by extracting with an excess of water 20 times the weight of the sample:

TABLE 23.—*Per cent of alkali soluble in excess of water, in surface crust from Mraïer, Algeria.* [1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Total.
Surface crust	4.66	12.31	8.92	29.18	0.98	0.27	56.32

[1] Mr. Seidell's original analysis of the sample from this station is as follows:

	Alkali in sample.	Composition of sample.		Alkali in sample.	Composition of sample.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Ca	1.37	2.43	$CaSO_4$	4.66	8.27
Mg	2.48	4.41	$MgSO_4$	12.31	21.86
Na	14.46	25.68	KCl	.98	1.74
K	.52	.92	NaCl	29.18	51.82
SO_4	19.14	33.98	$NaHCO_3$	.27	.48
Cl	18.15	32.23	Na_2SO_4	8.92	15.83
HCO_3	.20	.35			
Total	56.32	100.00	Total	56.32	100.00

This crust is remarkable among those collected in the Sahara for its low content of calcium sulphate (8.277 per cent of total alkali) and the high content of magnesium sulphate (21.86 per cent of total alkali). The extreme sterility of the sink where the sample was secured may be due in part to the excess of magnesium over lime, which has been shown by Loew [a] to be very injurious to most plants. This was the only sample obtained in the Sahara, where magnesium sulphate was in excess of gypsum. Common salt makes up one-half (52 per cent) of the crust.

ALKALI CONDITIONS IN RELATION TO DATE CULTURE AT OURLANA, ALGERIA.

Going southward from M'raïer one soon enters the Oued Rirh region proper. The Oued Rirh or Rirh River is a chain of chotts (salt lagoons or dry salt beds) occupying a partially filled up, dry valley, which runs from Tougourt almost due north to the Chott Melrirh, with a gradual fall to the north, amounting to some 270 feet in the 70 miles from Bledet Amar [b] to Chott Merouan (see map, Pl. II, p. 76). The Oued Rirh has a very shallow valley, bordered on the west by a nearly flat plain of sandy loam soil (largely planted to date palms), which rises gradually toward the barren hills, which are reached at a distance of from one-half to 10 miles from the valley. To the east of the chain of Chotts this country is sandy, and dunes occupy most of the surface. Small dunes sometimes occur on the west side of the valley.

This valley is some 200 feet above sea level at Tougourt and is slightly below sea level where it enters the Chott Merouan. It is abundantly supplied with flowing artesian wells and is one of the most celebrated date regions in the world. The famous Deglet Noor date, reported in Tunis to have originated in the oasis of Bledet Amar near Temacin at the southern end of the Oued Rirh, is largely grown here and constitutes almost the sole export. In all parts of the Oued Rirh date culture is the chief industry, and in many oases the date is the only plant grown, as the very

[a] Loew, O. Relation of Lime and Magnesia to Plant Growth, Bul. No. 1, Bureau of Plant Industry, U. S. Dept. of Agriculture, and also Kearney and Cameron, Report 71, U. S. Dept. of Agriculture.

[b] Marked Bled et Ahmar in the map, Plate II, page 76.

alkaline soil and the high salt content of the irrigation water preclude other profitable cultures.

The artesian water at Ourlana, as elsewhere in the Oued Rirh, is confined below a compact stratum of pudding stone which lies some 175 to 250 feet below the surface. Below this pudding stone is a layer of loose quartz sand, more or less mixed with pebbles, which contains an abundant supply of water under sufficient pressure to give a ready flow, frequently to the tops of the lower hillocks in the plain.

The French engineers Jus and Rolland, who have studied exhaustively the question of the origin of the water supply of the Oued Rirh, agree in believing that the original source is in the Atlas Mountains to the north, where the heavy rainfall and snowfall (some 5¼ feet annually) is absorbed by the upturned cretaceous strata and conducted in these strata to the south, where it first reappears in the great springs of the Zab region along the northern border of the Sahara. The water of these springs and of many others which are believed to exist, though the water never reaches the surface, soaks into the pervious strata of the Saharan formation and flows southward toward the Oued Rirh country,[a] becoming imprisoned beneath an impervious pudding-stone layer, except where natural openings exist and allow the water to reach the surface[b] or where artesian wells have been put down.

On the 1st of October, 1885, Oued Rirh contained 114 flowing wells put down by the French and tubed with iron, 492 flowing wells constructed by the natives, and 22 natural springs, which were used for irrigating. The total supply of water furnished by these wells and springs was 253,698 liters per minute, or 4 cubic meters (over 1,050 gallons) per second, having an average temperature of 25.1° C. The largest flowing well is No. 4, at Sidi Amran, which was put down in 1884. It flows 6,000 liters per minute.

The beneficial effect of French occupation has been very marked in the Oued Rirh, where in 1856 there were 33 oases, all in a state of decay. They were nourished by 58,000 liters of water per minute and contained only 136,000 date palms, for the most part old and yielding but little fruit. Thirty years later, thanks to the artesian wells put down by the French, the total yield of water had been raised to more than 253,000 liters per minute; all the old oases had been put in a flourishing condition and new ones had been created, so that in 1885 there were 43 oases containing 509,375 date palms in full bearing, and about 138,000 young palms from 1 to 7 years old. The native population had more than doubled during this time and the value of the oases had increased more than fivefold.

The oasis of Ourlana, of which a special study was made, is located nearly 100 miles south of Biskra, at an altitude of 113 feet above sea level, and is in the most fertile part of the Oued Rirh. Within a radius of 10 miles of Ourlana there are no fewer than 15 oases irrigated from 32 artesian wells (30 of which are modern tubed wells of French construction) and from 16 springs—"behour." These 15 oases contained in 1882 over 182,000 date palms, and nearly half of these oases have been much enlarged since then, so that they now, doubtless, contain over 200,000 date palms.

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[a] The water of these springs of the western Zab contains on the average 0.203 per cent of dissolved salts. Those springs which reach the surface indirectly after filtering a distance through the superficial strata yield water showing a larger per cent of alkali—about 0.268 per cent on the average—and by the time the water has soaked its way through the Saharan strata and flowed to the Oued Rirh country, the alkali content has risen to an average of 0.487 per cent.

[b] Forming the springs and small lagoons called "behour" and "chria" by the Arabs.

The well—Puits Desveaux—from which the plantation was irrigated, yields an abundant supply of very alkaline water. Mr. Seidell's analysis is as follows:

TABLE 24.—*Composition of artesian water (Puits Desveaux) used to irrigate date plantation at Ourlana, Algeria.*[1]

	Calcium sulphate.	Magnesium sulphate.	Magnesium chlorid.	Sodium chlorid.	Potassium chlorid.	Sodium carbonate.	Sodium bicarbonate.	Total.
Composition in grams per 100 cc. (percentage by weight)	0.2327	0.0645	0.0690	0.2478	0.0143	0.0030	0.0040	0.6353
Percentage of total salt content	36.70	10.13	10.85	38.98	2.25	.47	.64	100.00

[1] Mr. Seidell's original analysis of the artesian water of Ourlana is as follows:

	Alkali per 100 cc.	Composition of alkali.		Alkali per 100 cc.	Composition of alkali.
	Gram.	*Per cent.*		*Gram.*	*Per cent.*
Ca	0.0685	10.78	$CaSO_4$	0.2327	36.70
Mg	.0305	4.80	$MgSO_4$	.0645	10.13
Na	.1001	15.75	$MgCl_2$	.0690	10.85
K	.0075	1.18	KCl	.0143	2.25
SO_4	.2155	33.91	NaCl	.2478	38.98
CO_3	.0017	.27	Na_2CO_3	.0030	.47
HCO_3	.0030	.47	$NaHCO_3$	.0040	.64
Cl	.2085	32.83			
Total	.6353	100.00	Total	.6353	100.00

In contrast to the water of Chegga (see p. 85), having almost the same amount of dissolved salts, in which the sulphates predominated, the chlorides are here in excess, constituting 52 per cent of the total dissolved salts, while the sulphates make up 46.83 per cent. The average of 26 analyses of the water from flowing artesian wells in the Oued Rirh is given by Rolland[a] as follows:

TABLE 25.—*Average composition (in percentage by weight) of 26 samples of artesian water from the Oued Rirh, Algeria.*

Sulphates	0.25436
Chlorids	.21279
Carbonates	.01257
Nitrates and dissolved organic matter	.00411
Silicates and suspended matter	.00310
Total	.48693

It will be noticed that the sulphates preponderate over the chlorids in this table, though not so much as in the Chegga water.

Station No. 1 at Ourlana was near the bordj and not far from the well. Young and old date palms were growing near by in good condition. There was an open drainage ditch near by, but this did not prevent the formation of a surface crust of alkali. At 36 inches below the surface water was found, and below that level the sand was very wet, resembling quicksand.

[a] Rolland, Hydrologie du Sahara, p. 260.

The surface crust showed the following composition:

TABLE 26.—*Per cent of alkali soluble in excess of water in surface crust, from Station No. 1, Ourlana, Algeria.*[1]

Calcium sulphate	3.21
Magnesium sulphate	2.67
Magnesium chlorid	.71
Sodium chlorid	7.52
Potassium chlorid	.29
Sodium bicarbonate	.12
Total	14.52

The soil to a depth of 4 feet showed the following amounts of alkali:

TABLE 27.—*Per cent of alkali in soil of date orchard, Station No. 1, at Ourlana, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Sodium chlorid.	Potassium chlorid.	Magnesium bicarbonate.	Sodium bicarbonate.	Total.
Surface foot	0.05	0.16	0.23	0.03	0.03	0.03	0.53
Subsoil, 12 to 24 inches	.05	.11	.16	.01	.04	....	.37
Subsoil, 24 to 36 inches	.05	.09	.12	.03	.03	....	.32
Subsoil, 36 to 48 inches	.05	.10	.13	.02	.02	.03	.35
Soil, 1 to 4 feet	.165		.18		.045		.39

[1] Mr. Seidell's original analyses of the samples from this station are as follows:

	Crust.		Soil (0–12 inches).		Subsoil (12–24 inches).		Subsoil (24–36 inches).		Subsoil (36–48 inches).	
	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ca	0.95	6.51	0.75	24.80	0.30	22.43	0.21	22.16	0.26	21.77
Mg	.72	4.96	.04	1.18	.03	2.12	.02	2.20	.02	2.04
Na	2.99	20.62	.10	3.22	.06	4.54	.05	4.21	.06	5.10
K	.15	1.04	.01	.53	.01	.45	.01	1.28	.01	1.02
SO_4	4.40	30.30	1.95	63.83	.80	60.32	.65	59.71	.69	58.84
Cl	5.23	35.99	.15	5.06	.10	7.87	.08	7.69	.09	7.83
HCO_3	.08	.58	.04	1.38	.03	2.27	.03	2.75	.04	3.40
Total	14.52	100.00	3.04	100.00	1.32	100.00	1.09	100.00	1.17	100.00
$CaSO_4$	3.21	22.13	2.56	84.28	1.00	75.95	.82	75.27	.87	73.98
$MgSO_4$	2.67	18.39	.16	5.40	.11	8.32	.09	8.24	.10	8.33
KCl	.29	1.99	.03	.99	.01	.90	.03	2.38	.02	1.87
NaCl	7.52	51.78	.23	7.57	.16	12.11	.12	10.81	.13	11.40
$NaHCO_3$	.12	.80	.03	.99	....	....	....	....	.03	2.38
$MgCl_2$	.71	4.91	....	....	....	....	....	....	....	....
$MgHCO_3$	....	....	.03	.77	.04	2.72	.03	3.30	.02	2.04
Total	14.52	100.00	3.04	100.00	1.32	100.00	1.09	100.00	1.17	100.00

The fourth foot from the surface, where the subsoil was full of water, shows a larger amount of alkali than does the third foot. This amount of alkali was evidently without effect on the date palm.

Station No. 2 at Ourlana (Pl. XVII, fig. 1) was of much interest, because located between old and flourishing date palms which had been planted ten years or more. Notwithstanding the existence of a drainage ditch only a few feet away and of the fact that the irrigation water had been applied to the whole surface of the soil by flooding, the surface still showed a considerable crust of alkali. Water was encountered at a depth of 30 inches, which was below the level of the shallow drainage ditch.

The surface crust showed the following composition:

TABLE 28.—*Per cent of alkali soluble in excess of water in surface crust, Station No. 2, Ourlana, Algeria.*[1]

Calcium sulphate	4.88
Magnesium sulphate	2.57
Magnesium chlorid	.60
Sodium chlorid	10.15
Potassium chlorid	.11
Sodium bicarbonate	.12
Total	18.43

The following table shows the amount of alkali in the soil:

TABLE 29.—*Per cent of alkali in soil of date plantation, Station No. 2, Ourlana, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Magnesium chlorid.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Total.
Surface, foot	0.05	0.15	0.27	0.90	0.05	0.07	1.49
Subsoil, 30 to 34 inches	.05	.15	....	.17	.03	.08	.48
Soil, 1 to 4 feet (estimated).	(.20)			(.445)		(.077)	(.72)

[1] Mr. Seidell's original analyses of the samples from this station are as follows:

	Crust.		Soil (0–12 inches).		Subsoil (30–34 inches).	
	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ca	1.44	7.79	1.24	21.91	1.02	26.15
Mg	.67	3.65	.10	1.77	.03	.76
Na	4.03	21.88	.37	6.61	.09	2.30
K	.06	.31	.03	.50	.02	.46
SO_4	5.49	29.80	3.09	54.63	2.57	65.77
Cl	6.65	36.08	.77	13.64	.12	3.02
HCO_3	.09	.49	.05	.95	.06	1.54
Total	18.43	100.00	5.65	100.00	3.91	100.00
$CaSO_4$	4.88	26.47	4.21	74.41	3.48	88.89
$MgSO_4$	2.57	13.94	.15	2.65	.15	3.79
$MgCl_2$	.60	3.27	.27	4.84	....	....
KCl	.11	.60	.05	.92	.03	.82
NaCl	10.15	55.05	.90	15.87	.17	4.40
$NaHCO_3$	.12	.67	.07	1.31	08	2.10
Total	18.43	100.00	5.65	100.00	3.91	100.00

The date palms were growing luxuriantly and fruiting abundantly here, entirely unaffected by the alkali, though they must withstand nearly one-half per cent of chlorids. It is interesting to note that over 60 per cent of the land surveyed by the Bureau of Soils in the Salton Basin has less alkali than was contained in this soil.

Station No. 3 at Ourlana was situated about half a mile from the bordj, in a low and badly drained part of the orchard, where the palms did not look so vigorous and healthy as they did elsewhere. Below 26 inches' depth the sand was full of water and perfectly fluid, like quicksand.

The surface crust showed the following composition:

TABLE 30.—*Per cent of alkali soluble in excess of water in surface crust, Station No. 3, Ourlana, Algeria.*[1]

Calcium sulphate	3.23
Magnesium sulphate	.03
Magnesium chlorid	.49
Sodium chlorid	1.20
Potassium chlorid	.07
Sodium bicarbonate	.12
Total	5.14

The following table shows the amount of alkali in the soil:

TABLE 31.—*Per cent of alkali in soil, Station No. 3, Ourlana, Algeria.*[1]

Depth.	Calcium sulphate.	Magnesium sulphate.	Magnesium chlorid.	Sodium chlorid.	Potassium chlorid.	Sodium bicarbonate.	Total.
Surface, foot	0.05	....	0.08	0.04	0.02	0.08	0.27
Subsoil, 12 to 26 inches	.05	....	.09	.04	.04	.07	.29
Subsoil, 26 to 30 inches	.05	0.04	.07	.11	.01	.07	.38
Soil, 1 to 4 foot (estimated)	(.07)			(.19)		.07	.33

[1] Mr. Seidell's original analyses of the samples from this station are as follows:

	Crust.		Soil (0 to 12 inches).		Subsoil (12 to 36 inches).		Quicksand (26 to 30 inches).	
	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.	Alkali in soil.	Composition of alkali.
	Per cent.		*Per cent.*		*Per cent.*		*Per cent.*	
Ca	0.95	18.49	0.90	27.35	1.05	27.54	1.02	26.81
Mg	.13	2.57	.02	.67	.02	.57	.03	.68
Na	.50	9.81	.04	1.15	.04	.94	.06	1.68
K	.04	.70	.01	.36	.02	.63	.02	.63
SO_4	2.31	44.88	2.15	65.67	2.52	66.03	2.48	65.10
Cl	1.13	21.92	.10	2.98	.11	2.88	.14	3.68
KCO_3	.08	1.63	.06	1.82	.05	1.41	.05	1.42
Total	5.14	100.00	3.28	100.00	3.82	100.00	3.80	100.00
$CaSO_4$	3.23	62.84	3.05	93.01	3.58	93.56	3.47	91.05
$MgSO_4$	.03	.66	....	....	....	....	.04	1.05
$MgCl_2$	.49	9.61	.09	2.61	.09	2.25	.07	1.84
KCl	.07	1.32	.02	.67	.04	1.15	.04	1.16
NaCl	1.20	23.32	.04	1.21	.04	1.10	.11	2.95
$NaHCO_3$	.12	2.25	.08	2.50	.07	1.94	.07	1.95
Total	5.14	100.00	3.28	100.00	3.82	100.00	3.80	100.00

This soil is unique among those analyzed in showing a slight but evident increase in the alkali content, especially of the harmful chlorids, as the depth increases and a predominance of magnesium chlorid over the other chlorids in the upper layers of the soil.

Mr. Seidell called the writer's attention to the influence of the composition of the irrigating water on the nature of the alkali.

The rather unusual occurrence of chlorids of the alkaline earths in the water which contains magnesium chloride to the amount of 0.069 per cent is paralleled by the occurrence of the same salts in large amounts in all the surface crusts from Ourlana. There can be no doubt that the composition of the alkali as it now exists in the soil of the date orchards of Ourlana is profoundly influenced by the alkali left in the soil by the evaporation of the water used for irrigation. Three acre-feet of such water, the least amount needed per annum, would carry on to the land no less than 50,000 pounds of dissolved salts, and, subtracting the excess of gypsum, some 40,000 pounds of harmful alkali, or 0.1 per cent of the surface foot of soil and 0.025 per cent of the 4 upper feet of soil. Of course, some of the water drains off directly, and even leaches alkali out of the soil, but much remains in the soil, and on evaporating leaves the alkali behind.

After a number of years' irrigation with strongly alkaline water such as that of Ourlana a condition of approximate equilibrium is reached between the amount of alkali carried to the land and the amount leached out by the drainage water. The composition of the alkali in a soil in such a condition doubtless depends much more on the composition of the irrigation water than on the character of the alkali originally present in the soil before irrigation was practiced. The influence of the composition of the irrigation water on the nature of the alkali is naturally most clearly marked on lands that are well leached out by means of irrigation for a long period of time with an abundance of water, accompanied with thorough drainage.

A comparison of the composition of the alkali at two such stations, one at Chegga and one at Ourlana, is of interest, because the artesian waters used for irrigation at these two localities contain almost identical amounts of dissolved salts, though of very different composition. The following tabulation shows the proportions of the principal salts in the water and in the surface soil:

TABLE 32.—*Proportions of sulphates and chlorids present in alkali of irrigation water and in well-drained long-irrigated surface soils at Chegga and Ourlana, Algeria.*

Station.	Sulphates in alkali (parts per 100 of total alkali).	Chlorids in alkali (parts per 100 of total alkali).	Total amount of alkali (in percentage of weight of water or soil).
Chegga, artesian water (well by date plantation)	**66.28**	32.53	0.6401
Chegga, surface soil (Station No. 2)	**58.97**	25.64	.39
Ourlana, artesian water (Puits Desveaux)	46.83	**52.08**	.6353
Ourlana, surface soil (Station No. 1)	39.62	**49.06**	.53

It is clear from this table that sulphates preponderate at Chegga, both in the irrigation water and in the alkali of well-drained surface soil after irrigation for a term of years, while at Ourlana the preponderance of chlorids, though not so great as that of the sulphates at Chegga, is nevertheless plainly marked. In both surface soils the approximation in composition of the alkali of the surface soil to that in the irrigation water is evident, and is rendered still more clear by a study of the bases. Magnesium, for example, is decidedly more abundant in the artesian water at Ourlana than at Chegga, and in consequence the surface soils at Ourlana likewise show more magnesium than those of Chegga.

All three Ourlana stations show amounts of alkali large enough to be dangerous to ordinary crops, and, in fact, in this oasis no other cultures were observed such as were followed at the other oases studied, and all three stations show a pronounced surface crust in spite of long-continued irrigation, accompanied with drainage by open ditches. The sandy nature of these soils and their consequent low water content cause the concentration of the soil water to be much higher in proportion to the percentage of alkali present than in heavier soils having a greater water content, such as those of Biskra, for example (see p. 77). There is then every evidence that the date palm is unharmed by these quantities of alkali, even when irrigated by water of very bad quality, full of harmful chlorids.

In Table 33 are given the results of the analyses of the soils from the ten Saharan stations where samples were obtained. The alkali content of the soil is expressed in percentages of the total weight of the soil, as in the preceding pages. All estimated quantities are inclosed in parentheses.

TABLE 33.—*Percentage of alkali in Saharan soils where date culture is possible and in artesian water used to irrigate date plantations.*

Station and depth.	Sulphates.	Chlorids.	Bicarbonates.	Carbonates.	Total alkali.	Remarks.
BISKRA, STATION NO. 1.						
Surface foot	0.05	0.08	0.05	....	0.18	In an old and flourishing date plantation.
Subsoil (12-14 inches)	.05	.08	.06	....	.19	
FOUGALA, STATION NO. 1.						
Surface crust	1.92	9.72	.12	....	11.76	Undisturbed desert soil adjoining young date-palm plantation.
Surface soil (1-12 inches)	.76	4.08	.08	....	4.92	
Subsoil (12-30 inches)	.28	1.46	.10	....	1.82	
Subsoil (30-48 inches)	(.22)	(1.10)	(.08)	....	(1.40)	
Soil (1-4 feet)	(.38)	(1.98)	(.08)	....	(2.44)	
FOUGALA, STATION NO. 2.						
Surface foot	.34	1.56	.08	....	1.98	Young date plantation in good condition.
Subsoil (12-30 inches)	.20	.23	.08	....	.51	
Subsoil (30-48 inches)	.12	.17	.09	....	.38	
Hardpan (48-50 inches)	.09	.04	.08	....	.31	
Soil (1-4 feet)	.21	.54	.084	....	.83	
FOUGALA, STATION NO. 3.						
Surface foot	.09	.08	.09	....	.28	Old flourishing date plantation; soil washed out by continued irrigation.
Subsoil (12-26 inches)	.17	.11	.10	....	.38	
Hardpan (26-28 inches)	.09	.07	.08	....	.24	
Soil (1-4 feet)	(.12)	(.08)	(.09)	....	(.29)	
CHEGGA, STATION NO. 1.						
Surface foot	5.11	.63	.08	....	5.82	Date palms barely able to grow.
Subsoil at 3 feet	1.77	.88	.06	....	2.71	
Soil (1-4 feet)	(2.61)	(.82)	(.07)	....	(3.50)	
CHEGGA, STATION NO. 2.						
Surface foot	.23	.10	.06	....	.39	Washed-out surface soil. Saharan alfalfa grows here.
CHEGGA, STATION NO. 3.						
Subsoil (4-6 feet)	.57	1.22	.07	....	1.86	Formed a solid crust on exposure to air.
OURLANA, STATION NO. 1.						
Surface foot	.21	.26	.06	....	.53	Flourishing date plantation.
Subsoil (12-24 inches)	.16	.17	.04	....	.37	
Subsoil (24-36 inches)	.14	.15	.03	....	.32	
Subsoil (36-48 inches)	.15	.15	.05	....	.35	
Soil (1-4 feet)	.165	.18	.045	....	.392	
OURLANA, STATION NO. 2.						
Surface foot	.20	1.22	.07	....	1.49	Flourishing old date plantation.
Subsoil (30-34 inches)	.20	.20	.08	....	.48	
Soil (1-4 feet)	(.20)	(.445)	(.077)	....	(.72)	
OURLANA, STATION NO. 3.						
Surface foot	.05	.14	.08	....	.27	Dates less vigorous than at Ourlana stations Nos. 1 and 2.
Subsoil (12-26 inches)	.05	.17	.07	....	.29	
Subsoil (26-30 inches)	.09	.22	.07	....	.38	
Soil (1-4 feet)	(.07)	(.19)	(.07)	....	(.33)	
ARTESIAN WATER.						
CHEGGA.						
Well at date plantation	0.4243	0.2082	0.0046	0.0030	0.6401	
OURLANA.						
Puits Desveaux	.2972	.3311	.0040	.0030	.6353	

PREVIOUS AND SUBSEQUENT ANALYSES OF ALKALINE SOILS FROM THE SAHARA.

Two analyses of soil from the vicinity of Ourlana are reported by Rolland.[a] These analyses were not complete, for all the more soluble constituents are lumped as salt, which is here synonymous with alkali. The vegetable soil of a new garden (see analysis No. 23, in Table 34) at Tala em Mouïdi, very near Ourlana (Saharan formation), showed 6.8 per cent of alkali. Another soil (No. 24, Table 34) was from Mazer, about a mile northeast of Ourlana. Here the sample was of washed soil of a salt flat not yet under culture; it contained 3.4 per cent of alkali. The same work reports 7 per cent of alkali in the vegetable soil (No. 21, Table 34) of a garden at Tougourt, 20 miles south of Ourlana, and at Coudiat el Koda, very near Tougourt, no less than 29.5 per cent of the estimated weight of the soil (No. 19, Table 34) of an alkali flat was composed of alkali (see analysis No. 19). The same soil (No. 20, Table 34) washed for two years and put under culture contained only 0.5 per cent of alkali.

TABLE 34.—*Composition (in percentage by weight) of Saharan soils, collected by Rolland.*[1]

Number of analysis.	Nature of sample.	Silica or quartz sand.	Clay.	Peroxid of iron.	Carbonate of lime.	Carbonate of magnesia.	Calcium sulphate.	Salt.[2]	Water and organic matter.	Total.
14	Vegetable soil of a garden at El Golea (quaternary)	39.0	6.0	3.0	43.0	7.0	0.5	0.6	0.3	99.4
19	Soil of Sebkha (alkaline flat) at Coudiat el Koda, near Tougourt (quaternary)	50.0	5.0	1.0	5.0	2.0	5.0	29.5	2.0	99.5
20	Same soil as No. 19 washed for 2 years and put under culture	70.0	9.0	1.3	7.0	1.0	5.0	0.5	6.0	99.8
21	Vegetable soil of a garden at Tougourt (quaternary)	48.0	6.0	2.0	9.0	0.7	22.0	7.0	5.0	99.7
23	Vegetable soil of a new garden at Tala em Mouïdi (Saharan formation)	11.8	55.5	1.3	8.0	1.2	8.0	6.8	7.0	99.6
24	Washed soil of Sebkha (salt flat) not yet under culture at Mazer (modern)	30.0	26.0	0.3	20.0	......	15.0	3.4	5.0	99.7
16	Soluble portion (84.91 per cent) of Saline incrustation of Sebkha at El Golea (modern)	....	......	.56	....	....	2.95	95.16	1.59	100.26

[1] Rolland, Géologie du Sahara, analyses by École des Mines, Paris.
[2] All the readily soluble salts occurring in these samples are lumped as salt, which is here equivalent to alkali.

None of the soils analyzed for Rolland was selected with any reference to date culture, and it is only from the samples secured by the writer and analyzed by the Bureau of Soils, which have been described above, that any adequate idea can be formed of the ability of the date palms to resist alkali. This power to withstand alkali is one of the most striking among the life-history factors of this tree, since, in this respect, it exceeds all other cultivated plants except possibly the cocoanut palm, which latter is not killed by sea water containing 3.4 per cent of salts in solution.[b]

Mr. O. F. Cook informs the writer that on Cape Mesurado, in Liberia, a Phoenix, perhaps *P. reclinata*, grows on the sea beach nearer to the surf than any other upright vegetation, among the stunted shrubs killed back by the salt spray. The fruit of this palm, though of inferior quality, is eaten by the natives. Hybrids should be

[a] Rolland, Georges. Géologie du Sahara.

[b] Ehrenberg and Hemprieht report that on the island of Farsan, in the Red Sea, date palms grow directly out of the crevices in the coral rock, of which the whole island is composed, and although said to be irrigated from springs it may be found that the trees are subject to occasional inundation by sea water.

made between this and the common date palm, in the hope of securing alkali-resistant date palms able to mature fruit near the sea in California.

Through the courtesy of Mr. Thomas H. Means, of the Bureau of Soils, the author is enabled to present the results of the analyses of soils from date-palm plantations of the Oued Rirh country in southern Algeria secured during the trip he and Mr. Thomas H. Kearney made in 1902 for the Office of Seed and Plant Introduction and Distribution.[a] These soil samples, which were collected after the above pages were written, were obtained in the same region as those secured by the writer two years previously, and amply confirm the writer's conclusions as to the extreme resistance of the date palm to alkali. Mr. Means's tabulation is as follows:

TABLE 35.—*Resistance of date palms to alkali at four stations in the Oued Rirh country in the Sahara Desert in Algeria.*

Location.	Condition of palms.	Depth of sample.	Electrolytic determinations of total salts.	Chemical analysis. Total salts.	Gypsum.	Harmful.	Estimated total alkali in soil moisture (gypsum put at 0.06 per cent).[a]
		Inches.					
M'raier	Good	0–12	4.5				
Do	do	12–36	1.4				
Do	do	36–60	.5				
Ourlana	Good; 13 years old	0–12	[b]1.5	4.36	3.45	0.71	0.76
Do	do	12–36	[b].36	4.02	2.20	.82	.88
Do	Good; 20 years old	0–12		4.77	3.79	.98	1.03
Do	do	12–36		4.46	3.89	.57	.62
Do	do	36–54		4.63	3.53	1.10	1.15
Do	do	(1–4 ft.)					.86
Ourir	Fair	0–12		6.99	2.38	4.61	4.66
Do	do	12–26		4.82	3.90	.92	.97

[a] This column has been added to Mr. Means's table, and shows the amount of alkali, counting calcium sulphate at 0.05 per cent in accordance with the method outlined on p. 74. These sums may be compared with the analyses reported on the preceding pages and with the alkali content of soils determined by the electric method.

[b] In regard to the seeming discordance between the results of the determination of the amount of alkali by the electrical and chemical methods, Mr. Means writes as follows: "The apparent discrepancy between the total solids as determined by the bridge and by chemical analysis in the samples collected from 13-year-old palms at Ourlana is due to error in sampling, for the sample sent to the laboratory was collected from a different hole from the sample determined by the bridge."

The amount of harmful alkali is very high in these soils, higher in fact than in any of the soils collected by the writer except at Chegga, Station No. 1, and Fougala, Station No. 1. These newest analyses demonstrate anew the remarkable alkali resistance of this wonderful palm and show that it is perhaps more resistant than the writer's soil samples seemed to indicate, and make his estimates of its probable resistance conservative, to say the least.

DRAINAGE WATER FROM ALKALINE SOILS USED TO IRRIGATE DATE PALMS IN THE SAHARA.

It is a remarkable fact, showing the high resistance of the date palm to alkali, that drainage water is used to irrigate date palms even in the Oued Rirh region, where the artesian water is strongly brackish as it flows from the well, and where in addition it must seep through the very alkaline soil before reaching the drainage ditches. Such palms are said to be less vigorous and to yield less fruit. There are several date plantations in the oasis of Tozeur, in the Tunisian Sahara, which are irrigated exclusively by water from the drainage ditches of gardens

[a] See Yearbook of the Department of Agriculture, 1902, p. 573.

situated on higher land.[a] These plantations are so low that drainage is impossible, and naturally the growth is poorer and the yield lower than in better situations, but it is remarkable that even date palms should be able to grow at all in such situations.

ALKALI CONDITIONS IN RELATION TO DATE CULTURE IN THE SALT RIVER VALLEY, ARIZONA.

A recent soil survey of the Salt River Valley region made by Thos. H. Means[b] shows that there are considerable areas, perhaps 1 per cent of the land in the valley, where the amount of alkali in the soil is from 0.25 to 0.50 per cent, or enough to be dangerous for most crop plants, and much more, perhaps 5 per cent of the land, contains over 0.5 per cent where none but alkali-resistant crops can grow. Most of these alkali spots are caused by the rise of the ground water in the lowest levels, as a result of irrigation, until it comes so near the surface that moisture reaches the surface and alkali is carried up from the subsoil by the capillary currents of water. Such ground water has leached from higher levels and is often charged with considerable amounts of alkali.

The water used to irrigate the Salt River Valley is diverted from the Salt River and conducted to the fields in open ditches. The river is low during summer and the water often contains a considerable amount of harmful alkali in solution. Prof. R. H. Forbes, who made a study of the water of the Salt River from August 1, 1899, to August 4, 1900, finds that from June 1 to August 4, 1900, the average content of soluble salts was 139 parts per 100,000, of which only 8.2 parts per 100,000 consisted of the harmless gypsum, leaving 130.8 parts per 100,000, or 0.13 per cent of harmful alkali. Professor Forbes remarks that "it is to be remembered that this year (1900) was exceptionally dry, and the waters were consequently concentrated for a longer than usual time. Nevertheless, for a considerable portion of each year these waters are low and salty in character, and it remains true that their use (which is unavoidable) must be attended with remedial care."[c]

Professor Forbes considers it probable that with the prevailing agricultural practice of Arizona the use of irrigating water containing 100 parts of soluble salt per 100,000 is likely in a few years to cause harmful accumulations of alkali. In view of this danger the great value of the date palm is obvious, since it can support very much more alkali than is sufficient to kill other crop plants.

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[a] Masselot F. Les dattiers des oasis du Djerid. In Bul. de la Direction de l'Agric. et du Commerce, Régence de Tunis, Vol. 6, No. 19, April, 1901, p. 132.

[b] Means, Thos. H. Soil Survey in Salt River Valley, Arizona, Field Operations of the Division of Soils, U. S. Department of Agriculture, 1900, pp. 287–332.

[c] Forbes, R. H. Bul. 44, Arizona Agricultural Experiment Station, Tucson, 1902, p. 166.

As was noted on page 86, water as alkaline as this is without any direct effect on the date palm and could be injurious only by leading to the accumulation of alkali in badly drained soils after many years of heavy irrigation.

A sample of surface crust from an alkaline spot south of Tempe, Ariz. (sec. 3, T. 1 S., R. 4 E.), near where the Cooperative Date Garden (Pls. XXI, XXII, and fig. 6, p. 36) is located, shows the following relative amounts of alkali soluble in excess of water (50 grams of soil to 1,000 grams of water), which may be compared with the analyses of crusts from the Sahara and from the Salton Basin (p. 134):

TABLE 36.—*Percentage composition of alkali (soluble in excess of water) in surface crust from near Tempe, Ariz.*[a]

Calcium sulphate	1.56
Magnesium sulphate	3.04
Sodium sulphate	8.98
Sodium chlorid	59.72
Potassium chlorid	12.18
Sodium carbonate	4.14
Sodium bicarbonate	10.38
Total per cent of weight of soil	2.56

The surface soil (1 to 12 inches in depth) from the same station shows the following amounts of alkali stated in per cents of the weight of the soil:

TABLE 37.—*Per cent of alkali in surface soil from Tempe, Ariz.*[b]

Calcium sulphate	0.06
Magnesium sulphate	.06
Sodium sulphate	.22
Sodium chlorid	1.53
Potassium chlorid	.23
Sodium carbonate	.06
Sodium bicarbonate	.32
Total	2.48

It must be remembered that in the Cooperative Date Garden at Tempe the roots doubtless reach a subsoil containing much less than this amount of alkali. Most of the alkali spots in the Salt River Valley can be planted profitably to date palms if care be taken in irrigating (see chapter on drainage, p. 50). Near the date garden alfalfa was killed by the rise of alkali a few years ago, and even pear trees showed evident signs of distress, while a date palm growing alongside was entirely unaffected by the alkali.

[a] Analyses quoted from Thos. H. Means, Field Operations of the Bureau of Soils, Second Report, 1900, p. 320.

[b] Calculated from an analysis reported by Means, l. c., p. 320.

It should be noted that the alkali occurring in many parts of the Salt River Valley, represented by this sample, is of a different type from that found in the Algerian Sahara and in the Salton Basin, California. In the last-named regions the alkali is of the "white" kind and contains only very small percentages of carbonates or bicarbonates. In the Salt River Valley sample, on the contrary, the alkali is of the so-called "black" sort, and contains an appreciable amount of the highly poisonous sodium carbonate, which is much more injurious to most plants than is "white alkali." Black alkali is intensely alkaline in reaction,[a] and because of this reaction is highly corrosive to the roots of plants. It also has the property of dissolving the humus of the soil, which causes the formation of black crusts and of black spots in the fields where this type of alkali is abundant; whence the name.

From the thrifty growth of the date palms in the Cooperative Date Garden at Tempe, Ariz., in soils approximating the above sample in the amount and nature of their alkali content, it is probable that the date palm is able to resist small quantities of black alkali. Further researches are, however, needful to settle this point. (See p. 120.)

ALKALI CONDITIONS IN RELATION TO DATE CULTURE IN THE SALTON BASIN, CALIFORNIA.

GEOGRAPHY AND GEOLOGY OF THE SALTON BASIN.

The Salton Basin, or Colorado Desert, (see Pl. IV, p. 122, fig. 10, p. 102, and Pl. XVIII, fig. 1),[b] is a basin the center of which is far below sea level (some 263 feet below at Salton). It is surrounded by mountains on three sides, and is limited on the south by sedimentary deposits of the delta of the Colorado River which have piled up considerably above the sea level. The high San Jacinto Mountains on the west effectually protect the basin from the cold and humid winds from the Pacific Ocean, while the still higher San Bernardino Mountains form a barrier on the north that stops the cold winds that sweep across the Mohave Desert; on the east, San Bernardino and the lower Chocolate Mountains limit the basin.

That part of the Salton Basin which lies below sea level was covered until comparatively recent times by the Gulf of California, which then extended much farther north than now. The Colorado River, which then flowed into the gulf near where Yuma is now situated, brought down at flood times an enormous mass of sediment, which gradually

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[a] Alkali, in spite of its name, is often composed of neutral salts, such as sulphates and chlorids, and has in consequence no pronounced alkaline reaction. (See p. 72.)

[b] See also Pls. LXXXVII to XCV, Means and Holmes, Soil Survey around Imperial, Cal., in Field Operations of the Bureau of Soils, Third Report, 1901; also Pls. XXIII to XXVI, Coville and MacDougal, Desert Laboratory of the Carnegie Institution, Publication No. 6, Carnegie Institution of Washington, November, 1903.

FIG. 10.—Sketch map showing the Salton Basin and the easily irrigable lowlands in the Colorado River Valley in Nevada, Arizona, and California. The area inclosed by the dotted line is below sea level. Based chiefly on maps of Lieutenant Ives and of the International Boundary Commission.

built a bar across the narrow gulf and cut off the upper portion, now the Salton Basin, from the sea.[a]

Barrows says:[b]

All this took place in very recent times. The Coahuila Indians, who to-day inhabit the upper end of the valley, have a distinct and credible tradition of the drying up of this lake and of the occasional sudden return of its waters, and the Dieguenos, who lived at a time when the supply of water along the central portion of the valley was probably much greater than at present, raised on the naturally irrigated soil abundant crops of maize, melons, and beans. But slowly the valley was abandoned to aridity. Almost unvisited by rainfall, except about the edge of the mountains, the loss of the river left it cruelly dry. Low, and inclosed between heat-reflecting ranges that shut off the breezes of the ocean, it gained a temperature which is one of the highest on the globe. The windstorms that rage up the valley from the southeast have drifted great dunes of sand over certain portions, and much of the country never reached by the deposits of the lake is as black, stony, and repulsive as eruptive rock formations in the desert can be. Apparently about the middle of the first half of the century the overflow from the Colorado was largely checked and not resumed to any extent until the year 1849. The Indians, who had lived in plenty along the central valley, were driven by the drought forever from their homes.

During the high flood of the Colorado River in June and July the water breaks through its banks near Algodones, in Mexico, a few miles below Yuma, and flows westward through an old channel for some thirty miles; then, turning north into the United States, it flows through the Salton River to Salton Lake, filling up Mesquite Lake on the way. Most of the stream, however, goes on to Lake Jululu, or Volcano Lake, from which the New River flows northward to Salton Lake, and the Hardy River southward to the Gulf of California (see fig. 10). The Salton and New rivers flow only during the highest floods, but the Hardy River flows all the year, being fed by the Rio Padrones.

The Maquata Basin, a region similar to the Salton Basin, and, like it, lying below sea level, lies to the west of the Cocopah Mountains in Mexico. It is usually a waterless desert, but, at times of very high flood in the Hardy River, water flows around the mountain range, creating the Laguna Maquata[c] (see fig. 10) in the center of the basin. This is probably the only region in Mexico which, when irrigated, will be suitable for the culture of the best sorts of dates.

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[a] Some students of this region believe that an upheaval of the region covered by the delta aided in cutting off Salton Basin from the Gulf of California. The occurrence of mud volcanoes and of extinct craters, such as the Sierra Prieta, lends strength to the view that the piling up of such enormous masses of sediment has induced geologic changes. The old beach lines of the Salton Basin are, however, still approximately at sea level, which would go to show that there has been but slight change in the level of the region as a whole since it was cut off from the sea. (See Barrows, David P., The Colorado Desert, in National Geographic Magazine, Vol. XI, No. 9, September, 1900, p. 340.)

[b] L. c., p. 341.

[c] Barrows, l. c., p. 344.

The greater part of the Salton Basin is as level as a floor and almost as destitute of vegetation (see Pl. XVIII, fig. 1), which renders it an exceptionally favorable region to put under irrigation, since in most places no leveling is required and very low dikes serve to retain the water.

The geographical position of Salton Basin is indicated by figure 10, its general character is shown in Plate XVIII, figure 1, and a detailed soil map, showing types of soil and the amount of alkali present, is given in Plate III, page 106. The location of the area shown in Plate III is indicated by the ruled space in figure 10, page 102.

Many schemes have been broached for the irrigation of the Salton Basin since it was first surveyed in 1854. Since 1891 Mr. C. R. Rockwood, of Los Angeles, Cal., has been making surveys and persistently endeavoring to interest capital in irrigating this region. His efforts have resulted in the formation of a company which in 1901 carried the first water into the lower part of the Salton Basin.[a] Land and irrigation companies formed at the same time and, working in cooperation with the company mentioned, pushed energetically the sale and development of the land irrigated by the water, and now in 1903 some 100,000 acres are under irrigation and it is planned to extend the canals so as ultimately to irrigate most of the basin below the sea level, some 500,000 acres in all.

The main diversion works are at Hanlon's Heading, some 7½ miles below Yuma, whence the water is conducted about 8 miles to the channel of the Salton River, which is used to carry the water 60 miles to the northwest, where at the international boundary line it is turned into a 60-foot canal with a capacity of 5,000 second-feet, intended to irrigate all the lands lying between the Salton and New rivers. After entering the United States for a short distance this large canal is divided into two 30-foot canals running side by side, the object being to use one while the other is being cleaned. The courses of the lateral canals are shown in the map on Plate III. Other main canals are planned to conduct the water from the Salton channel to irrigate land in Mexico as well as lands in the Salton Basin in California lying east of Salton River and west of New River[b] (see figure 10, p. 102).

WATER SUPPLY OF THE SALTON BASIN.

The greater part of the Salton Basin can be watered from the Colorado River, and a large area in the basin, from Calexico, on the Mexican boundary, to Imperial, Brawley, and northward, is now irrigated

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[a] Means, Thos. H., and Holmes, J. Garnett. Soil Survey around Imperial, Cal. In Field Operations of the Bureau of Soils, U. S. Department of Agriculture, Third Report, 1901, p. 588.

[b] Means and Holmes, Soil Survey around Imperial, Cal., Field Operations of the Bureau of Soils, U. S. Department of Agriculture, Third Report, 1901, pp. 588, 589.

by means of water conducted from near Yuma, as above described. Fortunately, the Colorado River water is of remarkably good quality, although this stream flows for hundreds of miles through arid regions and many of its tributaries drain highly alkaline deserts. An extensive set of analyses was made by Prof. R. H. Forbes for the period from January 10, 1900, to January 24, 1901,[a] during which time the content in soluble salt of the river water at Yuma varied from 21 to 125 parts per 100,000, or from 0.021 to 0.125 per cent. During the low stages of the river in winter, early spring, and late in summer, the alkali content runs about 90 parts per 100,000. For two months (from May 25 to July 27, in 1900), during the flood caused by the melting of the snows of the Rocky Mountains, less than 27 parts of soluble salt in 100,000 were observed. On the other hand, during a smaller sudden rise in October, due to torrential downpours on the Arizona watershed, the alkali content rose markedly, averaging 105 parts per 100,000 from September 26 to November 19. This decided increase in the soluble salt content of the water was doubtless occasioned by the washing of salts out of the desert soil into the Arizona rivers and its subsequent drainage into the Colorado River. During the year 1900 the Colorado River water contained less than 100 parts of salts per 100,000 of water during 315 days and more than 100 parts per 100,000 during only 50 days.

During the growing and fruiting season of the date palm, from April 15 to September 15, inclusive, when four-fifths of the water needful for the whole year must be applied, the soluble salt content ranges from 0.021 to 0.068 per cent, or from 21 to 68 parts in 100,000 of water; while for two months during the flood, when water is most abundant for irrigation purposes and consequently most easily spared for washing alkali out of the soil, the alkali content is only about 27 parts per 100,000, or 0.027 per cent.

A considerable part of the soluble salts held in solution consists of harmless (if not beneficial) gypsum, which varies but slightly during the year, making up from 5.6 to 8.6 parts per 100,000, which would reduce the harmful alkali content during the summer months to about 14 to 60 parts per 100,000, and to 20 parts per 100,000 during the two months of flood in May, June, and July. Such small amounts of alkali in irrigation water are without harmful influence.

The relatively high purity of the Colorado River water is shown best by a comparison with that used to irrigate the flourishing date gardens of the Sahara. At Biskra the amount of soluble salt varies from 75 to 235 parts per 100,000, and is highest in summer, when the palms need most water. At Chegga, Algeria, the soluble salt

[a] Forbes, R. H. The River Irrigating Waters of Arizona—Their Character and Effects. Bul. No. 44, Arizona Agricultural Experiment Station, Tucson, 1902, p. 202.

content of the artesian water is no less than 640 parts per 100,000, and after subtracting gypsum there remain 434 parts per 100,000 of harmful alkali—0.434 per cent, or 250 grains to the gallon. At Ourlana, Algeria, very extensive and flourishing plantations are irrigated from a flowing artesian well (Puits Desveaux), where the water contains 635 parts per 100,000 of soluble salt and 403 parts per 100,000 of harmful alkali.

The Colorado River water is better than that used to irrigate the famous Salt River Valley of Arizona, and has the advantage of having the lowest alkali content in summer, whereas just the reverse is true of the Salt River water (see p. 99).

The water of the Colorado River carries, both in solution and in suspension as fine silt, fertilizing materials of considerable value, consisting principally of potash, nitrogen, and phosphoric acid. The soils of the Salton Basin are at present so rich that they do not need the fertilizers thus carried to the land by the irrigating water, but such fertilizing substances deposited by the water will serve to keep up the fertility in the future even under heavy cropping. Even now the phosphoric acid brought by the Colorado River water (see p. 114) is doubtless decidedly beneficial to the soils of the Salton Basin, which contain but very small amounts of this very necessary plant food.

SOIL CONDITIONS IN THE SALTON BASIN.

The soil conditions existing in the greater part of the Salton Basin are shown by Means and Holmes, of the Bureau of Soils,[a] who made surveys in 1901 covering some 108,100 acres lying between the New and the Salton rivers (fig. 10 and Pl. III), comprising the larger part of the basin as yet put under irrigation. This area is shown on Plate III. The same classes of soils and the same general condition of alkalinity prevail over the greater part of the Salton Basin.[b]

In the portion of the basin surveyed by Means and Holmes five types of soils were recognized. The areas occupied by these types are shown in Table 38.

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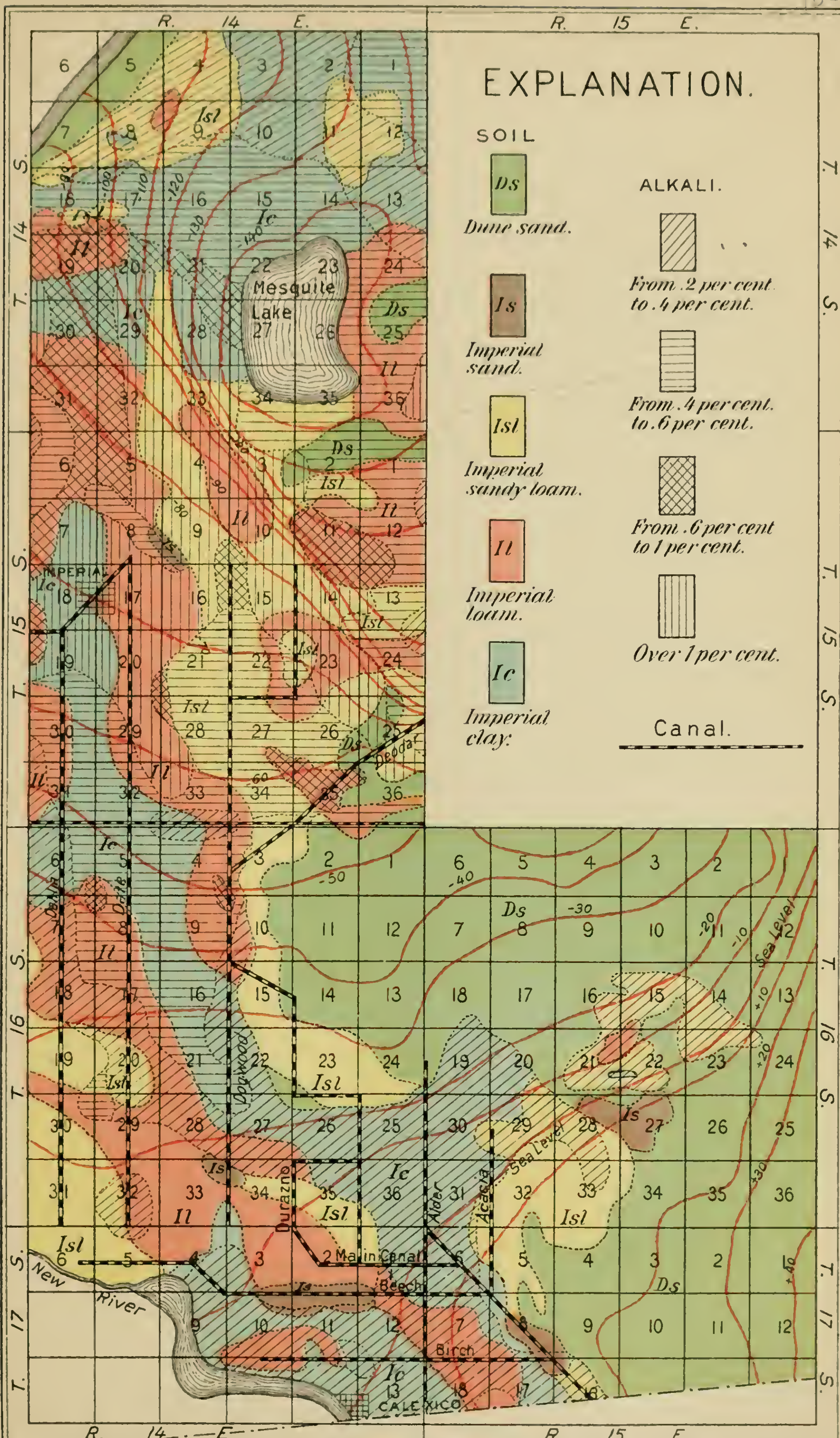
[a] Circular 9, Bureau of Soils, January, 1902, and Field Operations of the Bureau of Soils, U. S. Department of Agriculture, 1901, pp. 587–606, map 29.

[b] The University of California also investigated the soil conditions in the Salton Basin, and in February, 1902, published a valuable report on this region (Snow, Frank J., Hilgard, E. W., and Shaw, G. W., Lands of the Colorado Delta in the Salton Basin, Bul. 140, Cal. Agr. Exp. Sta., pp. 51, with supplement by Joseph Burtt Davy, The Native Vegetation and Crops of the Colorado Delta of the Salton Basin, April, 1902, pp. 8).



Soils surveyed by Bureau of Soils. GRAY LITH CO N Y Contour Interval 10 Feet.

MAP SHOWING DISTRIBUTION OF SOIL TYPES AND OF ALKALI IN THE IMPERIAL AREA, IN THE SALTON BASIN, CAL.

TABLE 38.—*Areas of different soils surveyed in the Salton Basin around Imperial, Cal.*

Soil type.	Area.	Per cent of area surveyed.
	Acres.	
Dunesand	29,840	27.7
Imperial sand	1,020	1.0
Imperial sandy loam	23,710	21.9
Imperial loam	30,110	28.0
Imperial clay	23,120	21.4
Total	108,100	100.0

The alkali content of the surveyed land is shown in Table 39.

TABLE 39.—*Alkali content of soils surveyed in Salton Basin around Imperial, Cal.*

Alkali content.	Area.	Per cent of area surveyed.
	Acres.	
Less than 0.2 per cent	42,220	39.1
From 0.2 to 0.4 per cent	25,320	23.4
From 0.4 to 0.6 per cent	23,040	21.3
From 0.6 to 1 per cent	5,220	4.8
From 1 to 3 per cent	5,670	5.3
3 per cent and over	6,630	6.1

Dunesand consists of reddish-brown sand, rather rotten, and often mixed with small particles of flocculated soil. It is blown by the wind into small dunes, usually crescent-shaped and 2 to 10 feet high. The dunes are underlain by the heavier soils of the basin. This soil is mostly free from alkali, but the land is not now occupied for agricultural purposes because of the heavy expense necessary to level it to render it fit for irrigation. This expense is variously estimated at from $20 to $30 an acre, and in view of the preference of the date palm for sandy soils, it may prove in future a profitable investment to level such land and plant it to the choice varieties of date palms. This dunesand area, as may be seen from the maps, is of considerable extent.

The small area of level Imperial sand is also free from harmful quantities of alkali and would be very useful for date culture. The amount of such land is small, however, and it will probably be used for truck crops sensitive to alkali.

The Imperial sandy loam soil is formed by the coarsest particles of the Colorado River deposit mixed with wind-blown sand. The sandy loam extends to a depth of 3 feet and is underlain by a loam or heavy loam. This soil will take water readily, and where level and free from alkali is adapted to cultivated crops or alfalfa. Some of the best and some of the worst lands of the valley are composed of this type.[a]

The Imperial sandy loam occupies over one-fifth of the surveyed area in the Salton Basin and is probably the soil on which the date palm will succeed best, as it is on such land that it grows best in the Sahara.

[a] Means and Holmes. Field Operations of the Bureau of Soils, U. S. Department of Agriculture, 1901, p. 594.

About three-quarters of the area occupied by this type of soil contains less than 0.6 per cent of alkali, which amount is absolutely without harmful effect on the date palm. It will probably grow nearly as well on an additional 10 per cent of the land even without drainage, and could struggle along on 10 per cent more of the area, while if drainage were provided doubtless the whole area of sandy loam could be planted to date palms.

The Imperial loam soil has a smooth surface as level as a floor and almost devoid of vegetation.

It has the peculiar slick, shiny appearance often seen in localities where water has recently stood. It is the direct sediment of the Colorado River, which was deposited in strata when the area was under water. These strata are from 0.01 inch to 2 or 3 inches thick, very much resembling shale; in fact, to all external appearances being exactly similar. When water is applied, however, the soil softens up and is a reddish, sticky loam, a little heavier than a silt loam. It is from 4 to 6 feet deep, underlain by a clay or clay loam, and contains considerable organic matter, including an abundance of nitrogen and potash. When free from alkali it is well adapted to the growing of wheat, barley, and alfalfa.[a]

The Imperial loam is much like the heavy soils in the oases at the northern edge of the Sahara, in Algeria, and is well adapted to the date palm if properly irrigated to prevent its becoming too dry and if kept in a proper state of tilth to prevent packing. This soil is very alkaline in the region surveyed in the Salton Basin, but about 60 per cent of the area covered by this soil has less than 0.6 per cent of alkali, and an additional 10 per cent will support the date palm nearly as well, making 70 per cent of the land where this plant will be unhampered by alkali. The date can grow, though less vigorously, on an additional 15 per cent of the area, though it may not fruit well unless drainage be provided and some of the alkali washed out.

The Imperial clay soil (Pl. XVIII, fig. 1) is found as a surface soil or as subsoil at greater or less depth throughout the surveyed area.

It is usually comparatively level, although in some places small hummocks have been blown up on its surface. It is this soil that surrounds both the towns of Calexico and Imperial, the only difference in the soils of the two districts being in the alkali content. The soil has been formed by the deposition of the finest sediment of the Colorado River, and is stratified in the same way as the loam. It is a heavy, sticky, plastic soil, very much resembling the clay subsoil found in the Mississippi River Delta. When dry and in its natural state, it exists in hard cakes and lumps, which may be cut with a knife and are susceptible of taking a high polish. When wet, the lumps are very plastic and sticky, making a soil which is very refractory and difficult to cultivate. Upon drying, the soil becomes very hard and cracked. Sorghum and millet were grown this year on several hundred acres of this land in the vicinity of Calexico, and produced good crops. The sorghum, however, was the best, the yield being 6 or 8 tons to the acre.

Cultivation of this clay soil will be very difficult. A similar soil is found in the Salt River Valley as a phase of the Glendale loess, and is locally known as "slick-

[a] Means and Holmes. Field Operations of the Bureau of Soils, U. S. Department of Agriculture, 1901, p. 595.

ens." The farmers of that neighborhood have considerable difficulty in managing this soil, and it is not as refractory as much of the Imperial clay. Either annual crops or crops which can be cultivated throughout the growing season are productive of best results on this soil, for the heavy and hard crusts need to be broken up and thoroughly pulverized occasionally. Alfalfa does not do well on such soil, for the crusts seem too hard and the soil too dense and impenetrable to permit the constant extension of the fine rootlets so essential to permanency in an alfalfa field. Deep plowing and thorough cultivation will in a few years greatly improve this soil.[a]

Practically none of the heavy clay soil is free from alkali, but some 45 per cent of this land in the surveyed area carries less than 0.4 per cent of alkali,[b] and about 25 per cent more of the area occupied by Imperial clay has from 0.4 to 0.6 per cent of alkali, where the date will succeed as well, making some 70 per cent of this soil available for the most remunerative date culture. The date palm can grow, but will fruit less on 7.5 per cent more of the clay land even without drainage, making in all about 77.5 per cent of this soil that is immediately available for date culture. The date can struggle along even without artificial drainage on, perhaps, 75 per cent more of the area.

The observations of Mr. D. G. Fairchild near Bassorah, on the Shat-el-Arab River, at the head of the Persian Gulf, show that these great date plantations, the most extensive in the world, are on "as pure an adobe as the clay of a brickyard,"[c] and indicate the probability that dates may be grown successfully on any heavy soils, provided the soils be adequately drained and aerated.

In the Bassorah date region the soil is automatically watered, drained, and aerated by a system of ditches which fill from the river at high tide and drain out again at low tide.

In the Salton Basin and elsewhere in the United States it is probable that drainage ditches or tile drains will be necessary to permit the proper utilization of the heaviest clay soils.

Messrs. Means and Holmes say: "Of the lands which are level enough to permit profitable irrigation 17 per cent have 0 to 0.2 per cent of alkali, and are at present safe for cultivation to all ordinary crops; 32 per cent have 0.2 to 0.4 per cent of alkali, which is risky for ordinary crops; the remaining 51 per cent are too alkaline to be taken up for any but alkali-resistant crops." That is to say, only 49 per cent of the irrigable land in the surveyed area of the Salton Basin is suitable for growing ordinary crops, whereas 76 per cent is available for date culture.

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[a] Means and Holmes. Field Operations of the Bureau of Soils, U. S. Department of Agriculture, 1901, pp. 595, 596.

[b] In soils of this nature, having a very fine texture and consequently a high water capacity, a given percentage of alkali is not so injurious as in a sandy soil of low water capacity, for the reason that the alkali forms a more dilute solution in the soils which hold more water. (See p. 75.)

[c] Fairchild, D. G. Persian Gulf Dates and Their Introduction into America. Bul. No. 54, Bureau of Plant Industry, U. S. Department of Agriculture, 1903.

To summarize, the date palm can grow on the following areas in the surveyed region without any especial provision being made for drainage:

TABLE 40.—*Area of lands in the surveyed portion of the Salton Basin suitable for date culture.*

Kind of soil.	Total irrigable area.	Area where date palms will be unaffected by alkali.	Area where date palms will grow and fruit without artificial drainage, but less vigorously.	Area where date palms will be able to struggle along but not to fruit well unless artificial drainage is provided.	Per cent of total irrigable area immediately available for date culture without artificial drainage.	Additional percentage of total irrigable area where date palms can grow but not fruit well without drainage.
	Acres.	*Acres.*	*Acres.*	*Acres.*		
Imperial sand	1,020	1,020	....	....	100	....
Imperial sandy loam	23,710	17,800	2,400	2,300	85	10
Imperial loam	30,410	18,300	3,000	4,500	70	15
Imperial clay	23,120	16,200	1,800	1,800	77.5	7.5
Total	78,260	52,320	7,200	9,800	76	12.5

In all some 59,520 acres, or 76 per cent of the 78,000 acres of surveyed land level enough to permit irrigation, is immediately available for profitable date culture without artificial drainage, while the date palm will grow on an additional 12.5 per cent of the land, though it probably will not fruit well unless the soil is drained.

With proper drainage almost all the surveyed area except about 3,000 acres of clay soil could be rendered suitable for date culture by washing out the alkali. Only 6 out of 156 borings made by Messrs. Means and Holmes showed a percentage of alkali so high as to be dangerous to the life of the date palm.

The immense importance of date culture for this region becomes at once apparent. It is the only profitable culture that can be followed on a quarter of the irrigable area too alkaline for other crops, while the climatic, soil, and water conditions are here so favorable for the date palm (see pp. 52 to 72) that it will pay to plant the choice sorts even on the best lands where many other crops would succeed.

It becomes of the greatest importance to introduce the Deglet Noor date into this region, where all the conditions combine to render its culture profitable, and where at the same time it is necessary in order to utilize a large part of the area already occupied and irrigated.[a]

[a] Very recently (March, 1904), since this bulletin was sent to the Printing Office, the Department of Agriculture has established, in cooperation with the California Experiment Station, an experimental date garden in the Salton Basin at Mecca, Cal. [Mecca was called Walters until January, 1904, and is so shown on all old maps and on fig. 10, p. 102.] At the same time a large number of offshoots of the best sorts of date palms (including many of the Deglet Noor variety) were ordered from the principal centers of date culture in the Algerian Sahara. In addition, several large Deglet Noor palms are being transplanted bodily, with large balls of earth about the roots, from Tempe, Ariz., in order to test as soon as possible the ability of this variety to fruit in the Salton Basin.

In the northern part of the Salton Basin around Indio and Walters, Cal., there are flowing artesian wells; in this and in many other respects the conditions of the Oued Rirh region in the Sahara are almost exactly reproduced. It is probable that date culture will prove even more profitable here than in the Oued Rirh country, since the summers are hotter in the Salton Basin, which will insure that the Deglet Noor variety will mature its fruit completely every year. The soils of this part of the Salton Basin have not yet been studied with reference to their alkali content, but it is known that there are large areas of land which could be irrigated by artesian wells where there is so much alkali that the growing of ordinary crops is prevented.[a] On such areas the culture of the date palm is likely to be the only paying industry that can be followed.

ALKALI CONDITIONS AT PALM CANYON, IN THE FOOTHILLS BORDERING THE SALTON BASIN.

The California fan palm (*Neowashingtonia filifera*) grows wild in the foothills surrounding the Salton Basin wherever the soil is sufficiently moist. In some respects the fan palm is much like the date palm, for it needs a constant supply of water at the roots, it delights in hot, dry weather, and can resist a large amount of alkali. An old fan palm produces in a good season from 50 to 200 pounds of fruit, according to Dr. Welwood Murray. The fruit is very small, of a pleasant flavor, and it is not unlike a miniature date. Natural groves of these palms as they occur in the foothills to the north of Indio are shown on Plate XIX, figures 3 and 4.[b]

Dr. Welwood Murray has kindly collected a series of soil samples in the groves at Palm Canyon, near Palm Springs, Cal. These samples were analyzed through the kindness of Prof. Milton Whitney, chief of the Bureau of Soils, and the results are given herewith, calculated in the same way as for the soil samples from the Sahara.

TABLE 41.—*Per cent of alkali in soils in which California fan palms were growing at Palm Canyon, California.*

Station.	Locality and depth.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Sodium chlorid.	Potassium chlorid.	Sodium carbonate.	Sodium bicarbonate.	Total alkali.
A1	Surface soil and crust, flowing water near by.	0.02	1.09	12.88	2.98	0.113	0.09	0.26	17.45
A2	Surface soil	.05	.078	....	.214	.156	....	.143	.66
B	Subsoil, about 2 feet deep	.04	.078	.227	.127	.014	....	.116	.60
C	Subsoil, about 4 feet deep	....	....	....	....	....	....	....	.25
D	Subsoil, sample taken from between roots of a full-grown fan palm.	.02	.266	4.52	.696	.088	Tr.	.212	5.80

[a] Recently J. Garnett Holmes, of the Bureau of Soils, United States Department of Agriculture, has surveyed this area, and his report will soon be published.

[b] See also Plates XXV and XXVI, in Coville and MacDougal, Desert Botanical Laboratory of the Carnegie Institution. Plate XXVI in particular gives an excellent idea of the appearance of the fan-palm oases as seen from a distance.

Sample D is the most interesting, as it shows the ability of the roots of the fan palm to grow in enormously alkaline soil.

A recalculation of sample D in comparison with the surface soil of Station No. 1 at Chegga, Algeria, the only sample obtained in the Sahara with so high an alkaline content, is given herewith.

TABLE 42.—*Per cent of alkali in soil at Palm Canyon, California, and at Chegga, Algeria.*

Locality and depth.	Sulphates.	Chlorids.	Bicarbonates.	Total.
Palm Canyon, Station D, subsoil at 6 feet depth, full of palm roots	4.806	0.784	0.212	5.80
Chegga, Station 1, surface soil	5.11	.63	.08	5.82

No subsoil in the Sahara or from the Salton Basin as yet reported is so alkaline as the subsoil from Palm Canyon. There are no roots very near the surface, where the amount of alkali is greatest, at Chegga (or at the other Saharan stations), whereas the layer in question in Palm Canyon is full of roots. Prof. R. H. Forbes[a] has called attention to the occurrence of roots of the date palm at 6 feet in depth in "very alkaline subsoil" in the Salt River Valley, Arizona, where they were forcing their way into the calichi hardpan. The date palm doubtless can stand as much alkali as the fan palm, and it is probable that it would grow where the fan palm is now found wild.

The summer heat will doubtless be less than in the lower parts of the Salton Basin, for these fan palms occur some 500 feet or more above sea level. The winters are, on the other hand, warmer at such altitudes, if there is a good drainage of cold air to lower levels (see p. 61).

CHEMICAL COMPOSITION OF THE ALKALI OF THE SALTON BASIN.

An analysis of a mixture of eight surface crusts was reported in 1901 by Means and Holmes, which analysis is given below alongside that of six surface crusts obtained in 1900 in the Algerian Sahara.

TABLE 43.—*Percentage composition of alkali in surface crusts from the Algerian Sahara and from the Salton Basin, California.*

Locality and station.	Calcium sulphate.	Magnesium sulphate.	Sodium sulphate.	Magnesium chlorid.	Potassium chlorid.	Sodium chlorid.	Sodium bicarbonate.	Sodium carbonate.	Sodium nitrate.	Total percent of weight of soil.
Fougala No. 1	32.38	2.41	8.35	....	3.08	53.06	0.72	....	....	17.33
Fougala No. 4	25.26	5.60	36.71	....	2.69	28.77	.97	....	....	15.03
Chegga No. 1	5.85	2.62	86.49	....	.23	4.47	.25	0.09	....	64.13
Ourlana No. 1	22.13	18.39	....	4.91	1.99	51.78	.80	....	....	14.52
Ourlana No. 2	26.47	13.94	....	3.27	.60	55.05	.67	....	....	18.43
Ourlana No. 3	62.84	.66	....	9.61	1.32	23.32	2.25	....	....	5.14
M'raier	8.27	21.86	15.83	....	1.71	51.82	.48	....	....	56.32
Sahara, average of 7 samples	26.17	9.35	[b]21.05	[b]2.54	1.52	38.32	.88	[b].013	....	....
Colorado Desert, average of 8 samples	9.91	9.02	.33	....	30.02	32.22	9.59	....	8.91	....

[a] Arizona Experiment Station, 11th Annual Report, p. 156.

[b] Wanting in some of the soils analyzed.

The following table shows the composition of the alkali in a few surface crusts and soils in the Salton Basin. The analyses are some of those given by Means and Holmes.[a]

TABLE 44.—*Theoretical percentage composition of alkali in soil about Imperial, Cal.*

Soils, laboratory No.	Location.	Depth.	Per cent soluble.	$CaSO_4$.	$MgSO_4$.	Na_2SO_4.	K_2SO_4.	$CaCl_2$.	$MgCl_2$.	NaCl.	KCl.	$NaNO_3$.	$NaHCO_3$.
		Inch.	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*
6308	NE. corner sec. 29, T. 16 S., R. 14 E..	0–½	17.42	9.16	2.62	27.72	2.41	......	......	37.77	......	11.62	5.70
6303	SW. corner sec. 13, T. 17 S., R. 14 E..	0–½	18.36	9.95	......	......	......	17.38	6.23	59.10	0.89	5.19	1.26
6314	NE. corner sec. 36, T. 14 S., R. 14 E..	0–3	15.05	3.97	......	......	......	34.02	6.56	48.76	.85	5.35	.49
6313	NE. corner sec. 29, T. 14 S., R. 14 E..	0–3	15.30	3.69	......	......	......	46.60	8.44	33.08	.86	7.02	.31
6285	NE. corner sec. 29, T. 16 S., R. 14 E..	0–36	.44	27.60	6.33	5.43	......	......	......	12.67	6.78	......	41.19
6286	Subsoil of 6285.....	36–72	.59	26.26	......	......	......	11.11	9.10	16.15	15.15	......	22.23
6279	NE. corner sec. 21, T. 17 S., R. 14 E..	0–36	.93	32.91	11.18	......	......	......	1.72	29.04	10.96	......	14.19
6298	NE. corner sec. 29, T. 14 S., R. 14 E..	0–36	6.81	14.62	......	......	......	25.89	5.75	42.55	2.34	7.89	.96
6299	Subsoil of 6298.....	36–72	3.36	29.36	......	......	......	5.29	2.34	56.36	3.67	......	2.98
6295	NE. corner sec. 25, T. 15 S., R. 14 E..	0.36	2.51	3.58	......	......	......	37.21	14.34	39.06	2.55	......	3.26
6296	Subsoil of 6295.....	36–72	1.82	4.28	......	......	......	15.17	3.40	66.39	5.38	......	5.38

The alkali of the Salton Basin is of the same type ("white alkali") as that of the Sahara Desert in southern Algeria, since in both regions a large excess of gypsum is present in almost all cases, which prevents the formation, under ordinarily good conditions of culture and drainage, of any dangerous amount of the very harmful alkaline carbonates. The Salton Basin samples differ considerably from those from the Sahara in showing rather large percentages of sodium nitrate in the surface crusts, which is entirely lacking in the surface crusts or soils from the Sahara. However, only very small quantities of nitrates occur below the surface crust in the soils of the Salton Basin, unless the soils are so alkaline as to preclude all agriculture. The Salton Basin soils often show considerable percentages of calcium chlorid, wanting in Sahara soils. Salton Basin soils contain much larger percentages of potassium chlorid and sodium bicarbonate and a larger proportion of chlorids and less sulphates than do the Sahara soils examined

The Salton Basin alkali is slightly more dangerous to crops than that of southern Algeria, because of the larger proportion of chlorids, and because of the presence, in many cases, of considerable amounts of sodium bicarbonate, which, if the land is watered excessively and badly drained, may be converted into the very harmful sodium carbonate.

[a] Means and Holmes. Soil Survey around Imperial, Cal. Field Operations of the Bureau of Soils, U. S. Department of Agriculture, Third Report, 1901, p. 601.

13529—No. 53—04——8

FERTILITY OF THE SOILS OF THE SALTON BASIN.

On the other hand, the Salton Basin alkali contains a considerable proportion of useful plant foods, especially sodium nitrate and potassium chlorid, which render the soils very fertile to any plant which, like the date palm, can withstand a considerable percentage of alkali in the soil. The Sahara soils are often mediocre or poor, and date culture suffers in southern Algeria for the want of nitrogenous fertilizers, which are very hard to supply at reasonable prices in such a remote and sparsely settled country. In the Salton Basin it may pay to wash the surface crust down into the soil in order to carry the nitrate of soda down within reach of the roots, in places where it is known that there is little alkali in the subsoil. For instance, if a crust such as No. 6308 of Table 44 (p. 113), containing 2.5 per cent of its weight of nitrate of soda, occurred over such a soil as No. 6285, collected near by, containing only 0.44 per cent of alkali to a depth of 3 feet, it is probable that the crust might be washed down to the level of the roots of the date palm without danger of their suffering from any excess of alkali. Such an operation must, however, always be carried out with caution, and is permissible only when it is known that the soil is relatively free from alkali, and that the amount contained in the crust would not suffice to raise it to the danger point for the date palm in any soil stratum in which the roots ramify.

Considerable amounts of potassium chlorid exist in most of the Salton Basin soils—probably enough to suffice for the needs of vegetation for a long time to come. Besides being naturally so rich, these lands will be improved by the deposition of silt[a] from the Colorado River water used in irrigating and from the addition of the small amounts of nitrates and potash contained in solution. (See p. 106.) In particular the small amount of phosphates the water contains is likely to prove very beneficial to the soils of the basin, naturally poor in this element. Analyses of the Colorado River water made daily for a period of seventeen months show that on the average it carries 13.8 pounds of phosphoric acid in an acre-foot of water or 55.2 pounds in the 4 acre-feet probably needed annually by a date plantation when the trees are full grown. What with the considerable supplies of nitrogen and potash contained in the alkali of these soils and the phosphoric acid brought by the river water, it is probable that the date palm will show a most luxuriant growth and bear heavy crops in the Salton Basin without any fertilizers being needed for many years, at least.

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[a] It must be kept in mind that much of the silt is deposited in the canal before it reaches the land, and in consequence the fertilizing value of the water is not so great as when it leaves the river. (See Means and Holmes, Field Operations of the Bureau of Soils, U. S. Department of Agriculture, Third Report, 1901, p. 598.)

SUBSIDIARY CULTURES TO FOLLOW IN CONNECTION WITH DATE PLANTATIONS ON ALKALINE SOILS.

Although no other profitable crop plant can stand as much alkali as the date palm, there are a number which can endure considerable amounts of alkali and which could be set out on the less alkaline parts of the tract to be planted or under the date palms after much of the excess of salts had been washed out of the soil by several years' irrigation, accompanied by drainage. The grape, the olive, the pomegranate, the jujube, and the fig are commonly grown in the partial shade of the date palm in the Saharan oases. (See Pl. V, fig. 1, and Pl. XII.) All of these plants can endure more alkali than can most fruit trees, though the almond and pear resist considerable amounts. Barley is one of the crops that can stand much alkali, and it is commonly grown in winter between the rows, especially of young date plantations. Sorghum is equally resistant. Asparagus is found to do very well in the salty soils of the Oued Rirh country, and it may prove a profitable minor culture. Cotton is alkali-resistant in Egypt and is grown in the oases in the interior of the Sahara.

Since a species of pistache, which could be used for stock on which to graft the pistache of commerce, occurs in the northern Sahara, where it is the only tree that grows wild, it is not impossible that this choice nut may be grown to advantage on alkaline soils. Carobs can stand the heat and dry air of the desert very well, yielding fruit valuable for horse and cattle food in place of grain, and are at the same time very ornamental evergreen shade trees, suitable for street planting. The Casuarina, the Tamarix, and some of the acacias and Eucalypti are trees well adapted to endure desert climates. Among forage plants the Australian saltbush deserves first mention, for it can endure very large amounts of alkali. Sorghum is another useful forage plant for such land. Saharan alfalfa will prove of great value for the less alkaline soils—those having 0.5 per cent of alkali or less. It is not unreasonable to hope to find a whole series of crops which can endure a considerable amount of alkali in the soil, and which will permit some diversification of agriculture even on the most alkaline tracts that are first put under culture by planting date palms.

LIMITS OF ALKALI RESISTANCE OF THE DATE PALM.

It is naturally of very great importance to determine as nearly as possible the limits of alkali endurance of the date palm, as it is the most profitable crop than can be grown in very alkaline lands, and on large areas in the hotter arid regions of the Southwest it is the only paying crop that can succeed. A careful study of the growth and fruitfulness of the date palm at various points in the Sahara desert shows that although this plant can grow in soils containing from 3 to

4 per cent of their weight of alkali, it does not produce fruit unless its roots reach a stratum of soil where the alkali content is below 1 per cent, and does not yield regular and abundant crops unless there are layers in the soil with less than 0.6 per cent of alkali. The surface soil may, however, be very much more salty, and may even be covered with a thick crust of alkali. It is probable that amounts of alkali below 0.5 per cent of the weight of the soil exert no appreciable injurious influence on the date palm. For example, in a flourishing date plantation at Ourlana, in the Algerian Sahara, at the spot shown in Plate XVII, figure 1 (Ourlana, station No. 2), the surface foot of soil contained no less than 1.52 per cent of alkali and was covered with a crust, while the subsoil at 2½ to 3 feet showed only 0.51 per cent of alkali. The water used to irrigate this soil contained 0.64 per cent of soluble salts, of which 0.40 per cent consisted of injurious alkali. Both in the soil and in the irrigation water the chlorids, very harmful to most plants, predominated; they constituted 80 per cent of the alkali in the surface soil, 40 per cent in the subsoil, and 52 per cent of the dissolved salts in the water. These amounts of alkali of so harmful a character, though sufficient to prevent the culture of any ordinary crop, seemed to be entirely without influence on the growth or yield of the date palm.

If the soil at all depths contains somewhat more than 0.6 per cent of alkali the growth is slower and the yield less than in better land, and where the alkali content is everywhere over 1 per cent date palms do not bear fruit regularly and their growth is very slow. On trees growing in the presence of very large amounts of alkali the leafstalks are usually of a pronounced yellowish color instead of the normal gray green;[a] on such soils in the Sahara the only other vegetation that can exist is a scanty growth of samphires and saltbushes. (See Pl. XV, figs. 1 and 2.)

It must be borne in mind that the percentages given above are for the stratum of soil containing the least amount of alkali and that the surface layers may contain very much more, since the date palm has

[a] A diseased condition of the date palms called at Fougala, Algeria, "meznoon" (z as in azure), meaning "crazy," occurs rather often among the trees growing on the worst alkali spots and may be caused in some way by the presence of excessive amounts of saline matters in the soil. The leaves of such palms do not unfold properly, but remain dwarfed and distorted, as is shown in Plate XV, figure 2. (This figure shows in the foreground the samphires and saltbushes characteristic of the most alkaline soils.) These meznoon palms are said to be cured in some cases by cutting off all the young leaves and hollowing out the bud, as is done in making "lagmi" or palm wine. When the new leaves push out some months later they are sometimes normal. The Arabs sometimes attempt to cure such trees by tying the youngest leaves into a compact bundle. A somewhat similar disease is described by Masselot (Bul. Direc. Agricult. et Comm., Tunis, vol. 6 (1901), No. 19, p. 134) as occurring in the Tunisian Sahara, where it is called "boussaafa." It attacks principally young palms and by preference the Deglet Noor variety.

the very important peculiarity of being able to withstand large amounts of alkali at the surface of the ground without the crown being injured thereby. Probably this is to be explained by the fact that, like other palms, the date tree has no bark and no delicate cambium layer just beneath; a date palm may be cut all about without dying when an ordinary fruit tree so girdled would perish.

In consequence of the ability of the date palm to endure great accumulations of alkali at the surface of the ground, the "rise of alkali" from the subsoil, so dreaded by growers of other crops, is often not at all dangerous to this plant and may even be advantageous in some conditions, provided thereby the alkali content of the subsoil in which the feeding roots extend is reduced. It is conceivable that in the Salton Basin, California, where, in consequence of the very slight rainfall, the alkali is often very uniformly distributed throughout the soil to great depths, it may prove desirable to draw the alkali to the surface rather than to try to wash it down beyond the reach of the roots at the risk of raising the level of the ground water and suffocating the roots. Once accumulated at the surface, the alkali could be largely removed, as suggested by Professor Hilgard, by scraping together the surface crust and carrying it off the field. The difficulty is that if by judicious irrigation the alkali should be brought to the surface from the subsoil at a depth of, say, 4 to 6 feet, there is always danger that a subsequent irrigation, especially if followed by an exceptionally heavy shower, would bring up alkali from still deeper layers of the subsoil and counteract the beneficial influence of the previous manipulation. The theoretical advantage of bringing about a rise of alkali is shown by the following comparison of a Saharan soil with one from the Salton Basin. In the Salton Basin, at boring 133, about 5 miles north of Imperial (Means and Holmes, Circular 9, Bureau of Soils), the alkali is, as usual in this region, rather evenly distributed throughout the soil. In the Sahara, at Fougala, Algeria (station No. 2), the alkali was largely accumulated at the surface, doubtless in part because of three years' irrigation, but also because the rainfall in this portion of the Sahara Desert is much greater than in the Salton Basin. The following table shows the distribution of the alkali at these two points:

TABLE 45.—*Distribution of alkali at different depths in the Sahara and in the Salton Basin.*

[Alkali expressed in percentage of weight of soil.]

Depth.	Sahara (Fougala, station No. 2).	Salton Basin (boring No. 133, 5 miles north of Imperial).
Surface soil, 1 to 12 inches	1.98	1.02
Subsoil, 12 to 24 inches	.51	.90
Subsoil, 24 to 36 inches (estimated for Fougala)	(.44)	.66
Subsoil, 36 to 48 inches	.38	.61
Average, 1 to 4 feet	.83	.80

Although the total alkali content of the soil to a depth of 4 feet is slightly greater at the Fougala station than at boring 133, the roots of the date palm would reach a layer of subsoil containing only 0.38 per cent of alkali at Fougala, whereas in the Salton Basin station the lowest amount of alkali is 0.61 per cent, or over one-half more than at Fougala. Were the alkali at boring 133 to concentrate at the surface in the same proportion as at Fougala, the lower subsoil would contain something like 0.37 per cent of alkali. However, the soil at 5 and 6 feet in depth at boring 133 contains 0.58 per cent, which alkali content probably continues downward for many feet, so that in order to bring about a diminution of the alkali content at any given depth it is essential that the soil lying deeper is not wetted. Whether such an operation can be carried out in practice is doubtful.

The view outlined above, that the accumulation of alkali at the surface may be beneficial to the date palm in some soils but that such accumulation may be dangerous to the plant if dislocated by unusually heavy rains, is confirmed by the following remarkable observation of Vogel, made at Moorzook in Fezzan, in the interior of the Sahara Desert:

> A heavy rain is considered a great disaster, as it destroys the houses that are built out of mud, and also kills the date palms by dissolving the great quantities of salt which are contained in the soil. For example, about twelve years ago [in 1843?] about 12,000 date palms were destroyed in the vicinity of Moorzook by a rain which lasted seven days.[a]

Moorzook is said to have no regular rainy season, though light showers occur in autumn. There is an abundant supply of underground water near the surface. Rohlfs says: "The palms do not require artificial irrigation [in Fezzan], since the roots seem to reach water everywhere."[b] Date palms are said not to be watered except during the first six months after they are set out. Under these conditions a great accumulation of alkali near the surface is to be expected, and the disastrous result of a heavy rain in washing the alkali down to the level of the roots is not surprising.

This indifference of the date palm to surface accumulations of alkali constitutes one of its greatest advantages over other crop plants for culture on alkaline soils.

RESISTANCE OF THE DATE PALM TO CHLORIDS.

The date palm seems to be resistant to all kinds of alkali, with the possible exception of the soluble carbonates, or black alkali. Common salt and the other chlorids, including the very poisonous magnesium chlorid so injurious to most cultivated plants, are resisted very well

[a] Vogel, Ed. In Petermann's Geogr. Mitth., 1855, p. 250.

[b] Reise durch Nord-Afrika von Tripoli nach Kuka. In Petermann's Geogr. Mitth., Ergänzungsheft No. 25.

by the date palm which was seen growing at Chegga, Algeria, in a soil containing about 0.8 per cent of chlorids, while amounts of chlorids as great as 0.2 per cent were apparently entirely without effect on the date palm at Ourlana, Algeria.

RESISTANCE OF THE DATE PALM TO SULPHATES.

Sulphates, such as Glauber's salt (sodium sulphate), are still less injurious than chlorids to the date palm, which, when well established, is able to withstand enormous amounts of these salts—probably from 2 to 5 per cent. Roots of the California fan palm, which is probably no more resistant to alkali than the date palm, were found at Palm Springs in the Salton Basin, California (see p. 112), ramifying abundantly in a layer of subsoil 6 feet below the surface, where there was 4.52 per cent of Glauber's salt and 0.26 per cent of magnesium sulphate present. Allowing 0.02 per cent as the amount of gypsum (calcium sulphate) that would go into solution in the soil moisture, the total sulphates would amount here to 4.80 per cent of the weight of the soil. Even greater amounts of sulphates were observed in the surface soil at Chegga, Algeria, where they amounted to 5.11 per cent of the weight of the soil, 4.89 per cent being Glauber's salt; the subsoil here contained 1.82 per cent of sulphates, which represents more nearly what the roots had to withstand, although in addition there was 0.88 per cent of chlorids. It is clear that, like other plants, the date palm can resist sulphates much better than chlorids.

RESISTANCE OF THE DATE PALM TO CARBONATES (BLACK ALKALI).

Whether the date palm can resist the dreaded "black alkali,"[a] the soluble carbonates, is not settled as yet, for none of the soils from the Sahara contained any appreciable amount of these very poisonous salts. At Tempe, Ariz., a soil obtained from the vicinity of the Cooperative Date Garden, where date palms grow luxuriantly, contained some 0.06 per cent of sodium carbonate in the surface foot. Well-drained soils containing an excess of gypsum, such as was observed in all the Saharan samples, can not contain any considerable amounts of soluble carbonates, for if any such salts existed they would immediately react with the gypsum present, and as a result inert calcium carbonate (limestone) and comparatively harmless sodium and potassium sulphates would be formed.

Professor Hilgard has demonstrated the possibility of reclaiming black alkali lands by the application of sufficient amounts of gypsum

[a] The name "black alkali" is applied because the soluble carbonates change the usually gray desert soils to black, as a result of their action in dissolving the humus. In contrast to black alkali, other soils are called "white alkali," from the color of the surface crusts that form in very alkaline spots.

to decompose the soluble carbonates present in the upper layers of the soil. It is not impossible that the obvious injury which results to the date palm from imperfect drainage may be caused by soluble carbonates, which can form under such conditions, even in the presence of gypsum.[a] It is a matter of much importance to determine the limits of resistance of the date palm to black alkali, as to which it is now impossible to speak with any certainty.[b] Even if the date palm proves to be sensitive to the soluble carbonates it will nevertheless still be possible to engage in date culture on black alkali lands by treating them with gypsum and providing for good drainage.

As yet no data are available for a study of the comparative alkali resistance of the different varieties of the date palm, but doubtless a careful investigation would show that there exists a considerable variation in this important character. Marked differences are known to exist among the diverse sorts of date palms in their ability to endure cold (see footnote, p. 61), and, as shown in the chapter on heat requirements, there are enormous differences in the amounts of heat required to ripen early and late varieties; it is reasonable to expect similar lack of uniformity in their ability to withstand alkali. The great importance of date culture, constituting as it does the only profitable industry that can be followed on very alkaline lands, would warrant a careful search in the date plantations in the most alkaline regions of the Old World deserts, in the hope of securing varieties still more resistant to alkali than those we now possess.

The high degree of alkali resistance of the date palm permits brackish water to be used in irrigating. Commercial date plantations of large extent exist at Ourlana and at Chegga in the Algerian Sahara,

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[a] Color is given to this supposition by the observation of Masselot (Bul. Direc. Agric. et Comm., Tunis, vol. 6 (1901), No. 19, p. 135) that a disease common among young palms, known as "Merd el Ghram," in the Tunisian Sahara, caused by excessive irrigation in badly drained soils, is accompanied by a blackening of the soil about the plant. The palms suffering from this disease cease to grow, sicken, and turn yellow; they may be cured by drainage and by replacing at the same time the blackened soil about the foot of the tree with fresh earth. These symptoms seem to indicate the formation of black alkali, and that it has a very injurious action on the date palm.

[b] It can not be assumed that because the date palm is enormously resistant to white alkali it must necessarily be able to support large amounts of black alkali, for the soluble carbonates have a decidedly alkaline reaction, whereas white alkali, in spite of its misleading name, may be nearly neutral in reaction. It is well known, especially from the interesting experiments of Prof. H. J. Wheeler, of the Rhode Island Experiment Station, that plants differ enormously in their requirements as to soil reaction. Lupines, for instance, are injured by soils having an alkaline reaction, whereas clover, soy beans, and most ordinary crop plants of humid regions are greatly harmed by soils having an acid reaction. It is possible that the date palm is injured by soils having a decidedly alkaline reaction, even if the amount of salts in solution in the soil water be small.

which are irrigated with artesian water containing 0.64 per cent of dissolved salts, and it is said that still more alkaline well water containing 1 per cent of salts is used to irrigate date palms in some of the other oases. Even the brine which seeps through the alkali soils and runs off in the drains is used to water palms growing at lower levels, and in some plantations no other water is available for irrigation (see p. 98). The alkaline water from Lake Elsinore, which proved so very disastrous to the orange orchards about Riverside, Cal., contained only from 84 to 116 grains per gallon, whereas the water used exclusively on the date plantations at Chegga, Algeria, contained 374 grains, and substracting gypsum, 250 grains per gallon of harmful alkali. Water, such as that supplied from Lake Elsinore at its worst, would be adapted perfectly to irrigate date palms. Even the intensely brackish ground water under the Salton Basin, which lies some 50 feet below the surface at Calexico and only about 30 feet below at Imperial, though it contains some 0.4 to 0.6 per cent of dissolved salts, and though it would prove fatal to most crop plants if brought up near the surface by injudicious irrigation, would not necessarily injure the date palm, Many plantations in the Sahara are irrigated with water more alkaline than this. The chief danger to the date palm to be apprehended from a rise of ground water is the suffocation of the roots because of imperfect aeration of the water-logged subsoil.

The immense superiority of the date palm over all ordinary crop plants for culture in alkaline lands becomes evident when it is remembered that all ordinary useful plants, such as wheat, corn, and alfalfa, peach, orange, and prune trees, etc., are killed by as much as 0.5 or 0.6 per cent of alkali in the soil,[a] which amount is entirely without influence on the date palm. The more resistant crop plants, such as barley, sorghum, sugar beets, grapevines, olive trees, and possibly pomegranate, jujube, and pistache trees, are able to withstand from 0.6 to 1 per cent of alkali; but these plants are easily injured by an accumulation of the alkali at the surface, which is perfectly harmless to the date palm. About the only crop plant which can withstand considerably over 1 per cent of alkali is the Australian saltbush (*Atriplex semibaccata*), and even this forage plant can not endure nearly as much alkali as the date palm—probably not half as much. As noted on page 115, asparagus is able to endure much alkali, though the limits of its resistance have not yet been determined. The date palm is, then, the most resistant to alkali of all plants now known capable of commercial culture in arid regions.

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[a]See Means and Holmes, Circular No. 9, Bureau of Soils, U. S. Department of Agriculture, 1902, and other publications of that Bureau.

REGIONS IN THE UNITED STATES WHERE DATE CULTURE CAN SUCCEED.

CALIFORNIA.

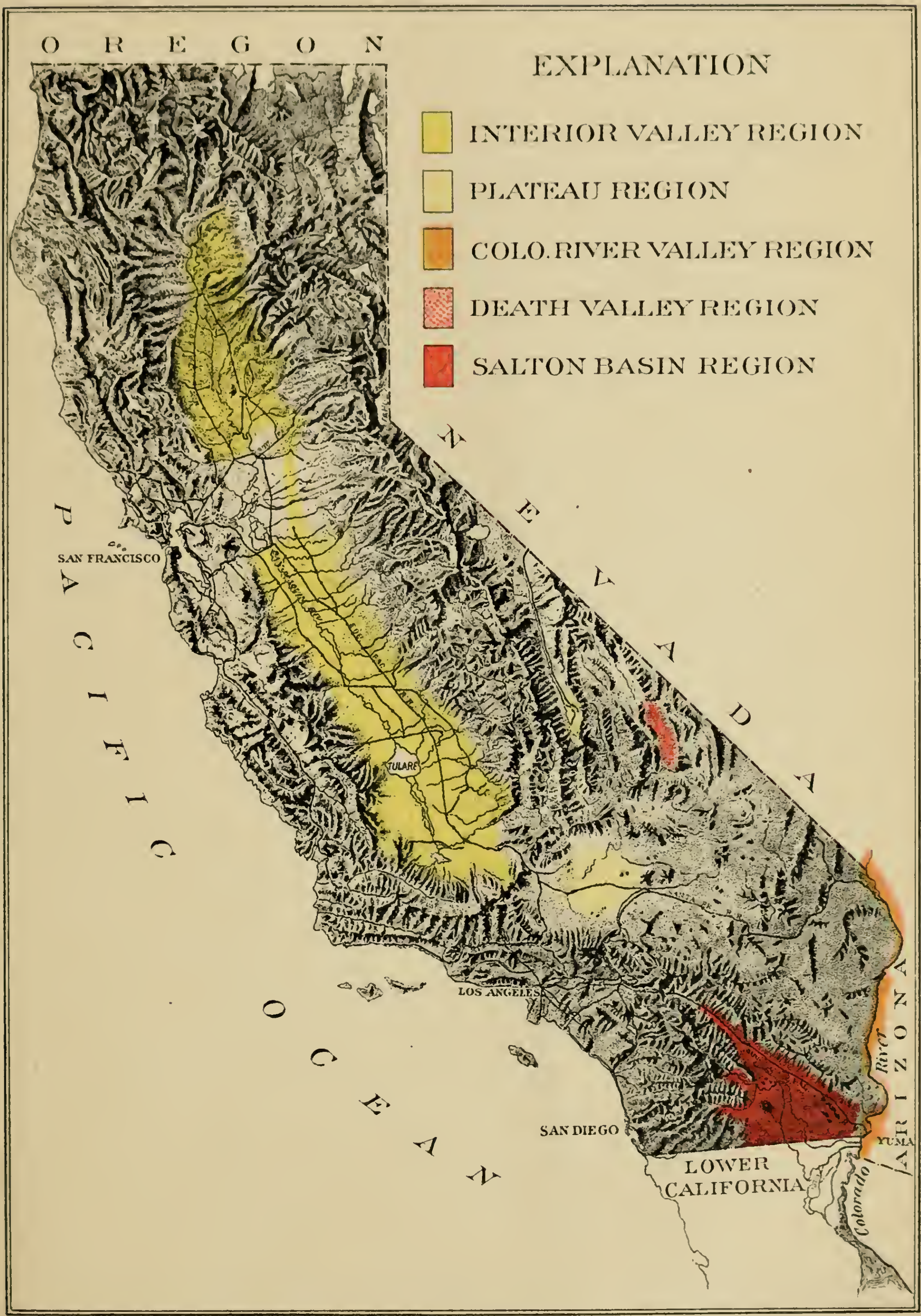
Salton Basin or Colorado Desert (see Pls. III, IV, XVIII, fig. 1 and fig. 10, p. 102).—It is clear, from what has preceded in this bulletin, that the Salton Basin or Colorado Desert is not only the most promising region in the United States, or in North America, for the culture of the best sort of dates, but that it is actually better adapted for this profitable culture than those parts of the Sahara Desert where the best export dates are produced. This favored region, though small in comparison with the vast arid areas of the Southwest, is nevertheless larger than any one Saharan oasis, probably equaling in extent all the oases in the western Sahara from Tripoli to Morocco, and is capable of producing all the dates consumed in America. Only the vast date plantations along the Valley of the Shat-el-Arab, formed by the junction of the Tigris and Euphrates rivers, near the head of the Persian Gulf, which furnish most of the great quantities of dates consumed in the United States, are comparable in extent with the irrigable portion of the Salton Basin.

The study of the life history of the date palm has shown that in the Salton Basin the long, hot summers, the very dry atmosphere, and the almost complete absence of rain during the flowering and ripening seasons of the date palm render the climate particularly adapted to the culture of the choice late-ripening sorts, such as the famous Deglet Noor. At the same time the presence of an abundant supply of water of excellent quality and the extreme fertility of the soil render the conditions unusually propitious for the establishment of this profitable fruit culture. The presence of considerable amounts of alkali in the soil has been shown to be no obstacle to the growth of this plant, which is harmed only by exceptionally large quantities of alkali. Indeed the presence of alkali, by rendering much of the land ill fitted or entirely unsuitable for other culture, constitutes one of the most cogent reasons for the speedy introduction of this resistant plant in order to enable all the lands now under irrigation to be put to profitable use.[a]

Death Valley (see map, Pl. IV).—The Death Valley, a depression in some places 320 feet below sea level, situated in east central California, near the boundary of Nevada, is in many ways very like the Salton Basin, and may be considered as a more northern extension of the same general conditions. Being some 4 degrees (300 miles) farther north than the Salton Basin, the winters are probably much colder, and possibly only hardy varieties of date palms will succeed, though it is probable that most sorts can be grown in certain protected situations if well covered in winter when young. The summer heat is

[a] Since the above was written, an experimental date garden has been established in the Salton Basin at Mecca. (See footnote, p. 110.)

122



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Relief Map of California, Showing the Principal Regions Where Dates Can Be Grown.

intense, nearly equaling that of the hottest parts of the Salton Basin; and even very late sorts, such as the Deglet Noor, could mature here perfectly. There is almost no rain, and in consequence no danger of the fruit being spoiled by wet weather during the ripening season in autumn. Unfortunately, there is almost no water available for irrigation in the Death Valley, and no large streams occur in the surrounding country which could be diverted into this desert. It is not known whether artesian water underlies this region, but if flowing wells could be dug it would be desirable to make a thorough test of the Deglet Noor and other first-class late sorts of dates. The date palm is particularly well adapted for culture in such regions remote from railways and from markets, as the crop can be transported to great distances without injury and, being a high-priced dried fruit, represents about the maximum of value, in proportion to the weight and bulk, among agricultural products.

Colorado River Valley (see map, Pl. IV, and fig. 10, p. 102).—This valley, lying partly in California and partly in Arizona, and especially the flood plain, which is irrigated and fertilized naturally by the annual overflow of the river offers considerable promise of being able to produce early drying dates at a cost low enough to enable them to be sold in competition with the so-called Persian dates, which are shipped to our markets in enormous quantities from the region about Bassorah, near the head of the Persian Gulf, and from Maskat, in Arabia. A detailed account of this promising region is given below (p. 129), in treating of the regions suitable for date culture in Arizona.

Plateau region (see map, Pl. IV).—This tableland, comprising the Mohave Desert, separating northern from southern California, would be fairly well adapted for date culture were it not for the fact that the winters are almost everywhere too cold. However, in canyons facing southward, where the cold air can drain off at night to lower levels, the hardier varieties may pass the winters uninjured. From the weather records kept at Keeler and Barstow it would seem probable that the date palm might succeed in the vicinity of these towns. If any attempt is made to grow dates in this part of California attention should be paid to the results of the experiments in date culture made by the California Experiment Station at Tulare, where it was found that irrigation in late summer is very disastrous to the date palm, because it forces a late growth, which is injured during the following winter. However, all through the plateau region the summer heat is insufficient to ripen any but early sorts, and it is very unlikely that date culture will prove a profitable industry in this part of California.

Interior Valley region (see map, Pl. IV).—The largest continuous area in California, and perhaps the largest in the world where dates can be grown, is the interior valley region, comprising the valleys of the Sacramento and San Joaquin rivers. The climate is here very different from that of the other regions mentioned above, especially in the much heavier rainfall, which in many places is sufficient to permit the date palm to grow without irrigation. As a result of this more humid climate there is more danger of damage to the flowers in spring, and especially more risk of losing the ripening fruit in autumn, in consequence of a spell of wet weather. The summer season is nearly or quite rainless; otherwise date culture would be impossible.

As a result of investigations on the life history of the date palm, it is evident that only the very early sorts can mature their fruit in this region, owing to the insufficient summer heat. These earliest varieties, though often a very palatable fruit, suitable for home consumption, are as a rule unfit for drying and for export. Experiments are now under way in cooperation with the California Experiment Station which will decide in a few years whether any of the early Saharan, Egyptian, and Arabian sorts suitable for drying can mature in this region.

All parts of the San Joaquin and Sacramento River valleys offer about equal advantages for date culture, except in the region where the two rivers unite. This section lies directly east and northeast of San Pablo and Suisun bays, and the cold winds which blow in from the Pacific over San Francisco Bay find their way eastward through this break in the coast range, and thus lower the summer temperature; it is unlikely that any dates can be ripened in this area, which extends from Stockton to Sacramento and across the valley to the foothills.

The winters are mild enough in most parts of the interior valley region to permit date palms to grow without injury, provided they are protected when young. In some of the colder localities only hardy sorts will succeed, and at Tulare it has been found by the California Experiment Station that several of the Egyptian sorts imported in 1889 by the Department of Agriculture are severely injured by freezes in winter, especially if by late irrigation the palms had been kept growing in late summer and autumn (see p. 49). In such cold localities no irrigation should be given after midsummer.

It is interesting to note that the Wolfskill date (fig. 3, p. 31, and Yearbook, 1900, Pl. LXII, fig. 2), which grows at Winters (latitude 38° 32′ north), about in the latitude of Washington, Lisbon, Athens, and Peking, is much farther north than any bearing date palm in the Old World, with the exception of one tree at Nice, France (latitude 43° 45′ north), which is probably not a true date palm but a hybrid between the date palm and the Canary Island palm. There are other date palms still farther north in the Sacramento valley which ripen edible dates, as for instance at Colusa and Willows, at both of which points date palms are growing which occasionally ripen a few fruits.[a]

[a] The Bee, Annual for 1902, p. 3: reported by Mr. J. M. Silvey, of Willows, and W. S. Green, of Colusa.

Indeed, the summer climate at Orland, Corning, Tehama, and Vina, in latitude 40°, seems to be as good as at Winters, and to be only slightly less suitable at Red Bluff or even at Redding, latitude 40° 30′, almost under Mount Shasta. Nowhere else in the world are there any such extensive regions north of latitude 35° where dates can be grown successfully.

Even if dates suitable for drying can not be produced here, it will certainly be possible for settlers all through this region to produce fresh dates for their own tables, and it is quite probable that these fresh dates can be shipped to the principal Pacific coast cities without spoiling.

Coast region of southern California.—Although the winters are never severe enough to injure the date palm and almost no rain falls during summer and early autumn, it is nevertheless very improbable that good dates can be grown in this part of California, for the simple reason that the winds which blow off the ocean are cold and humid and prevent the summer heat from being sufficient to ripen dates for 25 miles or more from the coast. It has been found that the date palm does occasionally ripen fruit at San Diego (see Pl. XX, fig. 1), but the plant is forced entirely out of its normal habits by the very low temperatures which prevail here in spring and summer, and instead of flowering in April, as it does in the Sahara, often does not open its flower clusters until August, in which event the half-grown dates hang on the trees in a green condition all through the winter and ripen only during the following summer. The date palm referred to above, which ripens its fruit at Nice, may be found adapted to the climate of this coast region, but unfortunately this tree has not yet produced any vigorous offshoots and only seedlings are available for testing in California. The best chance of securing dates capable of ripening in this region is by cross fertilizing early varieties with the pollen of the Canary Island palm (*Phoenix canariensis*), which, being adapted to the relatively cool and humid, though nearly rainless, summer climate of these islands, is able to mature its thin-pulped and flavorless fruit all along the California coast, even as far north as San Francisco. It is probable that the palm at Nice is such a hybrid, and that it will be easy for plant breeders, by selecting among numerous hybrids, to find a sort much better than this chance seedling.

NEVADA.

It is probable that the date palm may be fruited successfully in some of the protected valleys in southern Nevada; early sorts are, indeed, almost certain to succeed in the valley of the Colorado River wherever there is any land that can be planted. The actual flood plain, being both higher in altitude and farther north than in California and Arizona, may prove to be too cold in winter for any but hardy sorts, and, as noted below (p. 132), the annual inundation with cold water will prevent the ripening of any but the earliest sorts. At higher altitude in southern Nevada the summers are hotter, and even midseason or late sorts can be grown if they can withstand the winter cold. For example, at St. Thomas, in the valley of the Virgin River, at an altitude of 1,600 feet, the summers are hotter than at Phoenix, in the Salt River Valley, Arizona, but the winters are colder, the thermometer falling as low as 11° F. in January, 1899—a temperature which is likely to kill young palms and injure old ones. It is not impossible that there may be warm situations in the Pahrump Valley and in Ash Meadows, in southwestern Nevada, though in the absence of meteorological records it is impossible to speak with certainty, and it is probable that the winters are almost everywhere too cold in these valleys to permit dates to be grown. Hardy late sorts of dates would be very desirable for culture in southern Nevada, and it is probable that such could be found in the oases of Persia, where the winter cold is sometimes so severe as to injure or even kill old date palms, although the summer heat is intense. Inasmuch as such sorts would be of great value for culture not only here but also in southwestern Texas and in some parts of California, it would seem advisable to make a thorough search in the Persian oases as soon as possible and to secure the best varieties for trial in America.

ARIZONA.

As has been explained above (p. 61), in treating of the drainage of cold air and the inversion of temperature in relation to date culture, the earlier varieties will probably succeed in some parts of Arizona lying as high as 5,000 feet above sea level, and medium or late sorts in most parts below an altitude of 2,000 feet, except where there is a marked drainage of cold air from some higher level. This area lying below 2,000 feet in altitude would include the whole of southwestern Arizona, with an arm running up the Gila River, and also extending up the Salt and Verde rivers, and another extending along the Colorado river northward, passing up the tributary called Bill Williams River, and reaching as far north in the Grand Canyon as the Hualapai Indian Reservation. This portion of Arizona lying below the 2,000-foot contour line forms on the map the shape of a capital L with a very thick horizontal limb. It must not be supposed, however, that any large part of the 20,000 or more square miles included in the area above limited will ever be planted to date palms or to any other fruit trees, since most of this area is without adequate water to carry on agriculture. The irrigable areas along the Gila River and its tributaries, especially the Salt River Valley, the Upper Gila Valley from Florence westward to the Estrella Mountains, and finally the valley of the lower Gila, especially about Gila Bend, are the localities best adapted to the culture of the date palm. The whole of the valley of the Colorado, so far as it is irrigable, and especially the flood plain naturally irrigated by seepage from the river and by the annual overflow, is also adapted to the culture of the date palm, but probably only the earlier varieties will succeed. Of the regions just mentioned, only two are now furnished with a sufficient supply of water to render date culture possible on any large scale. These are the Salt River Valley from Mesa westward to Peoria, and the flood plain of the Colorado River. Wherever small amounts of water are available in the other valleys they could be utilized for irrigating date palms, which would undoubtedly succeed, and it is probable that in the future, with increased facilities for irrigation, the upper and lower valleys of the Gila will prove especially suited to this culture.

There is a region in south central Arizona, lying to the south of the Casa Grande ruins, where there are said to be thousands of acres covered with a heavy growth of mesquite trees (*Prosopus velutinus?*) and where water is found at a depth of from 20 to 30 feet below the surface. It is not impossible that if date palms were irrigated in this region when young, they might be able to grow without irrigation after the roots reached moisture. At any rate, both here and elsewhere, where a heavy growth of mesquite occurs and where there are indications of underground water near the surface, it would be desirable to make trial plantations of the date palm.

Salt River Valley.—This fertile region, which is one of the largest of the irrigated valleys in the Southwest, is situated in central Arizona (latitude 33° 25′). Its principal towns are Phoenix, Tempe, and Mesa. As has already been mentioned, the date palms planted by the earlier settlers have been strikingly successful (see Yearbook, 1900, Pl. LVII); in fact, it is no exaggeration to say that there are more bearing date palms producing fruit of good quality in the Salt River Valley than in all the rest of the United States. The Cooperative Date Garden at Tempe (see Pls. XXI and XXII) on June 15, 1902, had on hand (including a few palms at the experiment station farm at Phoenix) 556 trees, belonging to 81 varieties. Besides these 81 imported varieties, there are a number of seedling sorts of merit which have originated in the Salt River Valley, so that in all there are probably nearly 100 distinct varieties of date palms now on trial in this valley.[a] Prof. James W. Toumey, while connected with the University of Arizona, investigated the whole subject of the culture of the date palm in the United States and brought out very clearly in a bulletin[b] published in June, 1898, the fact that in these regions only had the plants imported

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[a] Forbes, R. H. Thirteenth Annual Report, Arizona Experiment Station, 1902, p. 244.

[b] Toumey, W. J. The Date Palm, University of Arizona, Arizona Agricultural Experiment Station, Bulletin No. 29, Tucson, Ariz., June, 1898.

by the Department of Agriculture in 1889 and 1890 grown rapidly and produced good fruit abundantly. This bulletin was the first important study of the date palm published in America, and it did much to attract attention to the possibility of establishing date culture as a profitable industry in the Southwest.

Although there are many regions in California, and some in Arizona, where the summer temperatures are higher than they are in the Salt River Valley, the only considerable area of land under irrigation where the climate is more favorable to the date palm is the Salton Basin in California. It may be stated that date culture is no longer an experiment in the Salt River Valley. It is, however, not yet certain that the Deglet Noor variety, which brings the highest price in the market, will come to full maturity here. It is to be hoped that it will, and the outlook is not without promise (see p. 68). If this variety does ripen properly, there can be but little question that it will be profitable to plant it on the best lands in the valley and to irrigate it abundantly. The question as to whether the Deglet Noor can mature its fruits in central Arizona will be settled within a very few years by the experiments now in progress at Tempe, in this valley (see Pl. XXII).

In case the Deglet Noor does not succeed in this valley, the effort should be made to produce a date intermediate in quality between the Deglet Noor and the ordinary dates sold in bulk in this country. Such a good second-class date would compete with the selected Bassorah and Maskat dates for household uses and take the place of Deglet Noor dates to some extent for use as a dessert fruit. Owing to the nearness to markets, the Salt River Valley dates could be sold while still fresh and need not be deformed by the close packing needful to preserve the oriental dates from drying out or from spoiling while en route to America.

The collection of varieties at the Cooperative Date Garden at Tempe is by far the most complete in the world, since it comprises the best known varieties from the Algerian Sahara, from Egypt, and from the regions about Bassorah and Maskat, where most of the dates imported into America are produced, as well as a large collection of varieties from the Pangh Ghur region in Baluchistan. Together with the seedlings that have originated in the valley and the sorts growing at the experiment station farm at Phoenix, there are something over 90 named varieties now on trial in the Salt River Valley. It is very probable that some of these will prove to be adapted for profitable culture in this valley, even if the Deglet Noor can not mature.

There are several seedling dates that have originated in the Salt River Valley in Arizona which promise to be valuable. One of the best of these is the Lount No. 6. It is small, being rather smaller than the Wolfskill date, but of very good texture, of clear amber color when dried, and of fairly good flavor. The Kales date and the Bennet date (fig. 4, p. 32) are seedlings of considerable merit, also growing near

Phoenix, Ariz. In addition, there are several other seedling varieties of considerable value which have already fruited in central Arizona, some of which may prove adapted to culture on a large scale.

Two of the varieties introduced from Egypt by the Department of Agriculture in 1890 have been fruiting for some time at Phoenix, Ariz. In 1900 one of the sorts, the Amreeyah, bore over 300 pounds (see Yearbook, 1900, Pl. LXII, fig. 1), while another, the Seewah, bore over 200 pounds. These dates were packed in half-pound boxes, and Prof. A. J. McClatchie writes that they sold readily for 20 cents a box wholesale and 25 cents retail, and there was a demand in the local market for ten times the quantity that could be furnished. The Seewah in particular is a very promising date for culture in the Salt River Valley, in Professor McClatchie's opinion, as it is fairly early and of excellent quality.

Although a good second-class date could doubtless be grown with profit on the best fruit land, it is probable that this culture will be undertaken first on lands too alkaline to be safe for other crops. Some of the low-lying alkali lands, especially near the date garden at Tempe, have water rising to within a few feet of the surface, which seeps down from the surrounding irrigated fields lying at higher levels. Date palms, when once established, will grow in such situations without any irrigation at all, though they will grow better and yield more fruit if occasionally irrigated from the surface with pure water from the canals.

Colorado River Valley (see fig. 10, p. 102).—The valley of the Colorado River, lying partly in Arizona and partly in California, comprises two adjoining though different situations where the culture of date palms is possible, viz, the flood-plain of the river and the mesa lands lying above the high-water mark not subject to inundation.

The immediate flood-plain is flat and only a few feet (10 to 15) above the low-water mark. It is in some places so narrow as to be only a strip along the bank, while below Yuma and again farther north in the Colorado River Indian Reservation, it is often several miles in width and is covered with a luxuriant growth of willows. The flood-plain is subject to annual inundation from the Colorado River, which overflows its banks every year, like the Nile in Egypt, when the summer heat melts the snows on the high mountains at the headwaters of the river in Colorado and Utah. The retiring flood waters leave a thick deposit of mud, which renders the soil exceedingly fertile.[a]

[a] In 1899 the writer saw a dense growth of 5 to 6 year old willow trees being cut for cord wood. The trees were 25 to 35 feet in height and from 6 to 10 inches in diameter near the ground. Any possible doubts as to the accuracy of the determination of the age of these trees, which was made by counting the annual rings of growth, were dispelled by the evidence of a woodman, who asserted that some five years before all trees of any considerable size had been cut from this tract of land.

The position of the larger bodies of easily irrigable land lying along the Colorado River is shown in fig. 10, p. 102. The cross-hatched areas in this figure along the river indicate low-lying lands, and are more extensive than the flood-plain proper, although in very high flood most of the areas marked on the map would be overflowed. All these lands are easily irrigable without expensive diversion works, which would be necessary were the water to be conducted to the mesas overlooking the Colorado. The land comprised in these areas amounts to some 800 square miles,[a] distributed as follows:

	Square miles.
Cottonwood Valley in Nevada and Arizona	14
Mohave Valley in Nevada, California, and Arizona	160
The small valleys near the junction of the Bill Williams River	56
The great Colorado Valley in California and Arizona	382
The valley in California and Arizona just above the junction of the Gila River at Yuma	80
The valley on the right bank of the river below Yuma in Arizona	108

There is a large area of similar land in Mexico along the Colorado River, as may be seen from the sketch map, fig. 10, p. 102.

Recent detailed surveys made by the Hydrographic Office of the Geological Survey[b] show that there are between 400,000 and 500,000 acres of irrigable land in the valley of the Colorado River between Fort Mohave and Yuma, and there are in addition large areas of land in Arizona below Yuma already irrigated, while still more can be put under water at slight expense. The flood-plain proper, naturally irrigated by the annual overflow of the river, does not comprise so extensive an area, but nevertheless embraces several hundred square miles of the very richest of these exuberantly fertile alluvial soils.

Of the 100 square miles (63,469 acres) surveyed in 1902 in the Colorado River Valley south of Yuma, Ariz., Holmes says: "About 75 per cent of the lands of the valley are overflowed and a layer of sediment added to the soil each year. The deposition has been much greater near the present stream bed than farther back, so that the lands immediately bordering the stream are higher and covered by only a few inches of water during the flood season, while those farther back may in places stand under 7 or 8 feet of water."[c]

The land near the river is usually nearly free from alkali, which occurs chiefly "just above the high-water line of present overflow, where evaporation from the surface has taken place without any surface flooding, showing plainly that the alkali is the result of the

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[a] An estimate of 700 square miles is made by Whipple, Pac. Ry. Rept., vol. 3, Pt. I, pp. 40–41, to include the lands from Fort Mohave to Yuma.

[b] Lippencott, J. B., and Davis, Arthur P. Colorado River Division in Arid Land Reclamation Service, First Annual Report, 1903, pp. 106–125.

[c] Holmes, J. Garnett. Soil Survey of the Yuma Area, Arizona. In Field Operations of the Bureau of Soils, Fourth Report, 1902, p. 781.

evaporation of the river water. Other alkali areas are found along the foot of the bluff, being caused by a small amount of seepage from the high lands above."[a]

In regard to the control of the overflow water, which is the problem of first importance in all ordinary agriculture, Holmes says: "Until this water is effectually in hand no farming worthy of the name can be done. To control the overflow it will be necessary to construct a dike or levee along the river, to connect with the mesa land below, of such height and strength as to keep out the river. As has been previously stated, the ground water of the valley rises and falls with the river, and some places are now overflowed 6 to 8 feet. The confining of the river would cause it to rise higher in the channel, so that the ground water over the present overflowed part of the valley would have several feet of head, thus bringing it near to or above the surface. This would necessitate the installation of a drainage system, with a pumping plant at the lower end of the valley to lift the water above the levee and back into the river. This leveeing and draining would be expensive, but since the subsoil is usually quite porous the drains need not be close together, and the natural fertility of the soil, together with the advantages of abundant water and almost tropical climate, would certainly make such reclamation a paying investment."[b]

If it is found, as now seems probable, that the date palm can be grown on the lands subject to overflow without artificial irrigation and without any such expensive system of levees and of drainage by pumping, then it will doubtless be possible to grow dates here as cheaply as in the Bassórah region, where likewise no hand labor is necessary to carry out irrigation when once the canals have been dug.[c]

The luxuriant growth and abundant fruiting of the seedling date palms (Pl. XX, fig. 2) grown by Mr. Hall Hanlon in the flood-plain some miles west of Yuma, on the California side, show that, in some places at least, the seepage from the river, which goes on throughout the year, and the thorough soaking which the land receives at the time of the annual overflow, render irrigation unnecessary. The deposit of mud left by the flood waters suffices to maintain the fertility of the soil and renders any manuring superfluous.

Although the meteorological records kept for several decades at Yuma, Ariz., on the banks of the Colorado River, show the summer climate to be nearly as hot as at Phoenix, in the Salt River Valley (though much cooler than in the Salton Basin), the dates planted by Mr. Hanlon usually fail to mature and must be ripened artificially. As was mentioned above, on page 50, this failure to mature the fruit

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[a] Holmes, J. Garnett, Soil Survery of the Yuma Area, Arizona, 1902, p. 786.

[b] Holmes, J. Garnett, l. c., p. 791.

[c] Fairchild, D. G. Bulletin 54, Bureau of Plant Industry, U. S. Department of Agriculture, p. 15.

is probably due in part at least to the lowering of the temperature of the soil about the roots[a] and of the air about the leaves by the overflow of cold water from the melting snows of the Rocky Mountains. This annual flood occurs in the midst of the hot season, usually early in June, and the waters remain on the land for several weeks.

Early sorts of dates, such as the Rhars and Teddala, undoubtedly will succeed in this favored region, which has many advantages for this culture. The land is irrigated and fertilized naturally, the dry air favors the ripening of fruit of a good quality, the very low rainfall in spring and autumn permits the date palm to flower and ripen its fruit unhindered by bad weather, and the winters are so mild that no injury by cold is to be apprehended after the young palms have once taken root.

The date palm has a great advantage over other fruit trees for culture in the flood plain, in that, when once established, it can resist the erosive force of the flood waters without being injured or losing its crop of fruit. There are thousands of acres of this land in California and Arizona now lying waste which could be utilized for this profitable culture if a variety of date palm could be found which produces early ripening fruit fit for drying, and which is adapted to the soil and climatic conditions of this region. Indeed, the chance to secure exuberantly fertile lands, requiring no irrigation, at low prices, gives this flood-plain great economic advantages over other regions for the production of an ordinary or second-class date, such as those that are now imported into this country in enormous quantities from the somewhat similar region about Bassorah, in the valley of the Shat-el-Arab at the head of the Persian Gulf, and from Maskat. No fewer than 9,000 tons of these dates were imported in 1901, so the market is practically unlimited, provided the cost of production can be kept down to a point permitting competition with the oriental dates. The date producer in the Colorado River Valley would have the great advantage over his Bassorah rivals of enormously greater proximity, both in distance and in time, to the great markets in the interior of the United States.

The prospect for successful culture in this region of the ordinary dried dates, one of the staples of the fruit trade, is so good as to warrant making a careful search in the Old World date countries for suitable sorts to grow here. Fortunately, the Department of Agriculture has already secured and has growing in the Cooperative Date Garden at Tempe, Ariz., many of the early-maturing sorts of dates from the Algerian Sahara, as well as from the valley of the Nile in Egypt and the valley of the Shat-el-Arab at Bassorah, the two latter regions having climatic and soil conditions somewhat resembling those

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[a] As shown on p. 49, warm irrigation water is very advantageous in date culture. Doubtless the date palm is as sensitive to the soil temperature as to the air temperature.

of the Colorado River Valley. In addition, the varieties from the island of Djerba, off the coast of Tunis, where only early sorts can mature, as well as the many early kinds reported from the Tunisian Sahara, should be secured for trial. Possibly other sorts of value could be found among the multitudes of seedling date palms growing in the valleys of the Indus and its tributaries in the Punjab, in India.

On the higher lands along the valley of the Colorado the conditions are very different from those described above, for, lying above the flood-plain, these lands are not subject to annual overflow and consequently there is no lowering of the summer temperature by the cold flood waters. The meteorological records kept at Yuma, Ariz., near the Mexican boundary, and at Needles, Cal., near the Nevada boundary, indicate that midseason and even late sorts, including possibly the Deglet Noor, may be expected to mature fully in this region.[a] So there is a good prospect for successful date culture wherever it is possible to irrigate the land.

NEW MEXICO.

All of New Mexico is over 2,500 feet above the sea level, and nine-tenths of its area is above 4,000 feet in altitude. In consequence the winters are almost everywhere too cold to permit the culture of any but hardy sorts of the date palm, and the summer heat is inadequate to ripen any but the earliest varieties. The winters are much too cold for the date palm in the principal irrigated regions, the valleys of the Rio Grande and the Pecos rivers, where this plant would be very useful for planting on alkali lands. From a study of the meteorological records, it would seem that La Paz, at 4,836 feet altitude, in south central New Mexico, near the Sacramento Mountains, has the most promising climate for date culture. The next best climatic region is found in the valleys of the Gila and Rio Mimbres, in the southwestern corner of the Territory. This latter region is of considerable extent, but unfortunately the winters are usually so cold that young palms would be injured if not protected. During the cold wave of 1899 the temperature fell below 7° F. at all the stations where records are kept, except at Gage, altitude 4,480 feet, where the record shows a minimum temperature of only 16° F.

Very early sorts of date palms capable of withstanding much cold are needed for trial in New Mexico. Such sorts are most likely to be found in the oases of Persia, especially in those which from their high altitude or northern position have a very cold winter climate. The northern Sahara, though it contains early varieties suitable for culture in the interior valley region in California and in the Colorado River

[a] Prof. R. H. Forbes is strongly of the opinion that the Deglet Noor date will ripen in the Colorado River Valley about Mellen and Fort Mohave, Ariz., where the climate is exceptionally hot. (Letter to the author, dated Tucson, March 1, 1904.)

flood plain, where the winters are comparatively mild, is unlikely to yield sorts suitable for New Mexico or for the plateau region of California, where hardiness is indispensable, for the reason that in the northern Sahara, even in oases lying at high altitudes, the winter climate is comparatively mild and equable.

TEXAS.

Only the extreme southwestern part of Texas, bordering the Rio Grande from the mouth of the Pecos River to near Brownsville, is adapted to the culture of the date palm. Throughout the eastern half of the State and in a strip along the Gulf coast, down to the Mexican boundary, the climate is too humid and the summers are too cool to ripen the fruit properly, while in all the northern part of the State, above San Antonio (latitude 30° north), the winters are too cold to permit the date palm to grow out of doors without protection. In the region lying south and west of San Antonio, between the humid Gulf coast and the Rio Grande, the summers are hot enough to mature even the medium or late varieties of dates. Fort McIntosh, in Webb County, at 460 feet altitude, has a summer temperature somewhat higher for the months from May to September, inclusive, than at Phoenix, Ariz. The rainfall averages in this region only about 10 inches, and the late summer is usually dry enough to permit dates to ripen; irrigation would usually be necessary. Ordinarily the winters are not severe enough to injure the date palm if protected when young, though this part of the State is occasionally exposed to "northers," during which the temperature sometimes falls very low. In February, 1899, for example, it fell to 7° F. or below all over the region where the date could be grown, and this temperature would doubtless injure or kill even old date palms. Such low temperatures are, however, very exceptional, and the date should be tested in this part of Texas wherever water can be obtained for irrigation.

Midseason and late varieties, resistant to winter cold, which are needed here and in southern Nevada, are most likely to be found in the depressions in the Persian plateau, where the summer heat is intense and, at the same time, the winters are rigorous. There is much less chance of finding hardy sorts in the Sahara, where the winters are mild, especially in low altitudes, where alone there is sufficient summer heat to ripen late varieties.

NO DANGER FROM MEXICAN COMPETITION IN DATE CULTURE.

The date palm was introduced into Mexico soon after the conquest, probably by means of seeds brought from Spain by the missionaries. Some of the palms in Sonora and Lower California are very old and have reached great height. A group of such old trees is shown in the frontispiece. They were growing at Hermosillo, only 150 miles south of the United States boundary, where the climate is not very unlike that of the hot valleys of Arizona. There are extensive date plantations in Lower California, especially in the central part of the peninsula, and considerable quantities of dates, packed in rawhide bags, are shipped from here to the cities of Mexico, and some even as far as Arizona and California. According to the statistics published by the Mexican Government, Lower California produced 137,300 kilograms (about 300,000 pounds) of dates in 1897, worth 10,845 Mexican dollars. In 1898 the production amounted only to 32,485 kilograms.

It might be supposed that northwestern Mexico would be better adapted for growing dates than the Southwestern States, since date culture in Sonora and Lower California has long ago passed the experimental stage and is a well-established industry. Furthermore, in these regions there is no danger of young palms being injured by winter cold, while from the latitude, some 5 degrees south of the Salton Basin, the summer heat might be expected to exceed that of the hottest deserts of California and Arizona. As a matter of fact, however, the absence of high mountain ranges and the proximity to the Pacific Ocean and to the Gulf of California permit the sea winds to sweep more or less freely over this whole region, thereby so reducing the temperature and increasing the humidity that late sorts of dates almost everywhere fail to mature on the tree and must be ripened artificially.[a]

Nowhere in Mexico is there any region comparable to the Salton Basin, in California, a depression below the sea level, surrounded on two sides by high mountain ranges which form an effective barrier to the cold, humid winds from the ocean.[b] Adding to these climatic advantages, the abundance and cheapness of the water supply, and the greater proximity to markets, it becomes evident that American growers of first-class dates have no need to fear Mexican competition. Even the growers of second-class and ordinary dates have little cause for alarm, for everywhere in Mexico date culture is carried on in the most primitive manner, seedlings being everywhere grown and the propagation of superior varieties by offshoots nearly or quite unknown. At present the inferior and badly packed seedling dates produced in Mexico are the poorest that reach our markets, and are of no importance whatever.

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[a] By exposure to the sun during the hot part of the day and storing indoors wrapped up in blankets at night. (Observations of Prof. R. H. Forbes in Lower California, communicated verbally to the writer, 1902. See p. 29.)

[b] Except possibly Maquata Basin, a region below sea level around the Laguna Maquata (see fig. 10, p. 102), in Lower California, just south of the boundary line, which may some day rival the Salton Basin as a date-producing region, as it can be irrigated from the Hardy River and is protected by mountain ranges on nearly all sides. It would be very desirable to explore more fully this interesting region, which, though adjoining our boundary, is one of the least known areas in North America.

In view of the great number of seedling dates that occur in Lower California and Sonora, it is probable that there are among them some valuable sorts which should be found and introduced into Arizona for trial. Unfortunately the older trees, whose value is best known, have long ago ceased to produce offshoots, so that such sorts can not be propagated.

PROFITS OF DATE CULTURE.

Wherever the Deglet Noor and other choice late varieties of dates can be grown date culture will be exceedingly profitable. In a region like the Salton Basin, California, where the winters are never cold enough to harm seriously old date palms, where the spring and autumn seasons are practically rainless, preventing injury to the flowers or to the ripening fruits, and, above all, where the summers are always hot enough to insure the perfect ripening of the fruit, the certainty of a crop is almost absolute, especially as the land is very fertile and the irrigation water of good quality.

The average yield of a Deglet Noor date palm is variously put at from 88 to 132 pounds. Counting only 75 pounds to a tree, the yield per acre would be 4,500 pounds if the trees were planted at the usual distance of 26⅔ feet. Such dates, even of the second grade, sell on our markets at from 35 to 50 cents a pound at retail when packed in fancy boxes, and would bring probably one-quarter as much in bulk at wholesale, or from 8 to 12 cents a pound, especially as they would ripen in the Salton Basin early enough for the Holiday markets. Allowing 10 per cent for loss in packing, there would still be 4,000 pounds of dates to the acre. Of this crop about 1,000 pounds would be of the first grade (see p. 35), worth, say, 10 cents a pound at wholesale; 1,300 pounds would be second grade, such as now reach our markets packed in three-quarter pound paper boxes, worth about 8½ cents a pound, and the remaining 1,700 pounds would be third-class dates, to be sold in bulk at, say, 2½ cents a pound, or in all some $250 worth from one acre. The care required by the date palm is much less than that necessary for any other fruit tree, and the fruit cures naturally on the tree and can be gathered quickly and easily by cutting off a whole bunch at a time. It is probable, therefore, that $100 per acre would cover all the fixed expenses of an orchard of Deglet Noor palms in full bearing, leaving a profit of some $150 per acre.

Offshoots bear fair crops of fruit from three to five years[a] after being planted, which is but little, if any, longer than many other fruit trees, such as the orange, fig, pear, etc., require to reach fruiting age. The date palm comes into full bearing from eight to twelve years after being planted, and lives to a much greater age than any other fruit

[a] A proof of the ability of a date offshoot to fruit abundantly at an early age is afforded by the Deglet Noor offshoot shown in Plate XXII, which was set out at Tempe, Ariz., in July, 1900, and which when photographed in August, 1903, just three years and one month later, bore three fair-sized bunches of fruit.

tree, bearing profitable crops even when a century or more old. No expensive pruning is required by this fruit tree, and it is remarkably free from diseases and injurious insect pests. The amount of labor required in a date plantation is very much less than for most other fruit culture, and this constitutes a great advantage in its culture, especially in desert regions, where labor is scarce and high priced. The fruit does not ripen suddenly and need immediate care, but may often be left on the tree for a week or two after it matures without being injured.

It would be difficult to imagine a fruit better adapted for growing in the Salton Basin than the choice late varieties of the date, and at the same time a culture better suited to the needs of the country.

Although not offering promise of being so unusually lucrative as the culture of the Deglet Noor dates, the production of good second-class dates, comparable with the best grades of so-called Persian dates, may nevertheless prove to be a paying industry, yielding profits equal to those given by other fruit cultures. The Salt River Valley in Arizona, which may be warm enough to permit the culture of even the Deglet Noor dates, can certainly produce the best grade of second-class dates, suitable for household use and serving as a substitute for Deglet Noor dates for dessert fruit or for use in confectionery. The American growers will have the great advantage over their rivals in the Persian Gulf region of much greater proximity to the centers of consumption, which will enable them to put their crop on the market earlier in the season and in fresher condition.[a]

Even the growing of ordinary dates, like those sold in bulk at the fruit stands, may prove a paying culture if carried on on an extensive scale where land and irrigation water are cheap. Being packed tightly together in boxes holding a hundred pounds or so, the labor of preparing them for market is much less than for the finer dates, which must be arranged carefully in small boxes to prevent the fruit from being crushed or deformed by mutual pressure. The flood-plain of the Colorado River in California and Arizona, where land that is naturally irrigated and fertilized by the annual overflow of the river can be had cheaply, offers promise of being suited for the profitable culture of such ordinary dates.

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[a] Another great advantage of American-grown dates will be their superior cleanliness. Fairchild says (Persian Gulf Dates, p. 29), in regard to the ordinary Persian dates of our fruit stands, "the stories which one hears in the region of the conditions in the packing sheds and the personal uncleanliness of the men, women, and children who put up the dates are enough to disgust a sensitive person and to prevent his ever eating packed dates again without having them washed. No old inhabitant thinks of eating a date without first thoroughly washing it in a glass of water, unless the cook has prepared it beforehand, and the sale of dates in America might fall off decidedly were it generally known how intimately the unwashed hands, bodies, and teeth of the notably filthy Arabs often come in contact with the dates which are sold by every confectioner."

EXTENT OF THE MARKET.

The enormous quantities of dates imported into this country every year are a measure of the extent of the market for the cheaper grades of this fruit. The average value of the imports of dates was $402,762 per annum for the ten years ended June 30, 1900, and the following table gives the quantities and values of imports during the last five years, almost entirely from Bassorah and Maskat:

TABLE 46.—*Quantities and values of dates imported into the United States.*[1]

Year ended June 30—	Quantity.	Value.
	Pounds.	*Dollars.*
1897	11,847,279	284,056
1898	13,561,434	371,992
1899	12,943,305	324,087
1900	19,902,512	410,349
1901	18,434,917	372,400

[1] Yearbook, Department of Agriculture, 1901.

The value per pound is very low for these common dates, amounting to 2.06 cents in 1900 and 2.02 cents in 1901. These values are those invoiced at the port of export, and the dates probably sell at wholesale for at least 50 per cent more at the receiving port.[a]

Even at these prices it is probable that date culture would be profitable if varieties that yield abundantly and regularly were planted on rich, naturally irrigated lands, and it is evident that the market is practically unlimited if the cost of production can be kept low enough to permit competition with the oriental dates.

There exists already a large market for a date of superior quality, suitable for household uses and for employment in confectionery, while the demand for the finest grades of Saharan Deglet Noor dates far exceeds the supply even when they are sold for more than selected Smyrna figs. American orders for a quarter of a million pounds have been refused by the Algerian producers because the supply barely suffices for the European demand. The consumption of these delicious dates is certain to increase as their merits become better known; they reach the same class of consumers as Smyrna figs, and like them can be served as a dessert fruit which can be eaten without soiling the fingers. At somewhat lower prices a practically unlimited market would exist for Deglet Noor dates, and the American grower would have the great advantage over his rivals in the Sahara of being able to gather the crop in abundant time for the Holiday trade.

[a] Thus Mr. E. W. Maslin shows that while the average invoiced value of figs imported into the United States is 5.7 cents a pound, the prices brought by these figs at auction sales in New York City range from 9 to 28 or 30 cents a pound. (See Eisen, G., The Fig, Bulletin 9, Division of Pomology, U. S. Dept. of Agriculture, p. 289.)

IMPORTANCE OF LIFE HISTORY INVESTIGATIONS IN DEMONSTRATING THE FEASIBILITY OF DATE CULTURE.

The importance of a detailed study of the climatic and soil requirements of the date palm is clearly shown in treating of the regions in the United States adapted to its culture, as well as in the discussion of the heat requirements and of the alkali resistance of this remarkable plant. No other crop plant can withstand so much alkali in the soil or in the irrigation water, and tens of thousands of acres of alkali lands in the irrigated areas in the Southwest can be reclaimed and put to profit only by growing dates. This renders it of the greatest importance to determine the extreme geographical limits of the regions where dates can be produced with profit in order that this invaluable plant may be utilized on alkali lands wherever possible.

Not only is it possible as a result of life history investigations to indicate with some degree of precision the regions where dates can be grown, but also to predict the types of varieties which alone can succeed in each region, and further, to indicate in which of the date-growing countries of the Old World such types can most likely be secured. For example, in order to secure hardy late-ripening sorts able to withstand the winter cold in Texas and southern Nevada, search should be made in the oases of central Persia, near the northern limit of date culture, where the winters are so severe that even old, bearing palms are sometimes killed, but where the summers are nevertheless very hot. North Africa on the contrary, is the least promising region to search for such sorts because of the mildness and equability of the winter climate, even in the oases situated on the slopes of the Atlas Mountains limiting the Sahara to the north. On the other hand, early maturing sorts, suitable for culture in the interior valley region of California and in the flood-plain of the Colorado River in Arizona and California, where the winters are relatively mild and the summer heat deficient, are most likely to be secured in just these oases on the slopes of the Atlas Mountains, though such varieties may be expected to occur in oases at high altitudes in the interior of the Sahara and in Arabia. Choice late sorts of date palms, suitable for culture in the hotter valleys of Arizona and in the Salton Basin, California, are most likely to be found in the oases at low altitudes in the interior of the deserts of Sahara, Arabia, and Persia.

It is also possible, from a study of the life-history factors of the date palm, to warn intending planters against attempting its culture in regions where it can not succeed. Thus it becomes possible to establish a new fruit industry in a rational manner without having to await the tardy results of costly and often badly conducted trials made without adequate foreknowledge of the requirements of the plant. Such trials often lead to elusive hopes on the one hand and to unjust condemnations on the other. To attempt to produce dates in Florida or in the coast region of California because the date palm grows well there, would be to commit a capital error, for no marketable dates can be produced in climates so humid as that of Florida or so cool as that of the California coast. To try to grow drying dates of the ordinary mid-season or late sorts in the interior valley region of California because the Wolfskill date palm at Winters produces every year a good crop of palatable dates would be an error almost as disastrous, because only very early sorts, for the most part unsuited for drying or for export, can be matured in this region.

It is confidently to be expected that in a few years this new branch of biologic and economic science which concerns itself with the determination of the exact requirements of crop plants as to climate and soil, and with the finding of the limits of their powers to resist unfavorable influences such as cold, excessive heat, drought, alkali, violent winds, etc., along with a study of the cultural requirements and market conditions of the new industry, will become so well known and its value so well recognized that it will become a comparatively easy matter to enlist the necessary capital and skill in a new culture when once detailed life history investigations have furnished a sound basis for judgment as to the chances of its proving a financial success in any given region. After such studies have been made, or during their progress, a few carefully planned demonstrations in suitable localities conducted by the Department of Agriculture, the State experiment stations, or in cooperation with skillful planters will take the place of haphazard testing by experimenters, and of the usually indecisive and often enormously expensive trials by private growers.

Millions of dollars have been thrown away in attempts to grow crop plants in regions where a properly carried out life history investigation would have shown that there was no hope of success. Unfounded inflation of values of agricultural lands, and the rush into new cultures in unsuitable regions by whole communities at a time as the result of a "boom," could largely be avoided were it possible to furnish the would-be planter with a black-and-white statement of the necessities of the crop plants under discussion, whereby he would be able to question intelligently whether the region were adapted to the proposed cultures.

At present it is no exaggeration to state that the life history requirements and the limits of the power to resist unfavorable environmental conditions are far better known for many microscopic lower plants, such as bacteria, fungi, and algae, even for species having no economic importance, than for the most important crop plants whose culture provides employment for tens of millions, and whose products constitute the daily food of hundreds of millions of human beings. Such a condition is discreditable alike to biological and to agricultural science and should not longer continue.

SUMMARY.

The date palm can endure any degree of heat and any amount of dryness in the air, and is even favored by hot winds and by a rainless summer. The best sorts can mature only in regions having a very long and very hot growing season.

It can endure more alkali in the soil than any other profitable crop plant and can thrive on soils containing from 0.5 to 1 per cent of alkali, even when irrigated with brackish water containing 0.43 per cent (430 parts per 100,000) or more of injurious alkali. It can withstand without injury accumulations of alkali at the surface of the soil that would kill all other crop plants, even those considered to be very resistant to alkali.

The choicest date that reaches America and Europe, the famous Deglet Noor of the Algerian and Tunisian Sahara, is very sweet, of exquisite flavor, and is adapted to serve as a dessert fruit; it sells for more than Smyrna figs, being the most expensive dried fruit on our markets. The demand for these dates during the holidays is nevertheless greater than the supply, and if they could be sold somewhat cheaper the consumption of this fruit would be enormous.

The Salton Basin or Colorado Desert, in southeastern California, recently put under irrigation, has a hotter and drier summer climate than the Algerian and Tunisian Sahara, where the best grades of Deglet Noor dates are grown, and is, indeed, better adapted to the culture of this fruit, since not only is the climate more favorable but the soils are richer and the irrigation water is of better quality.

The date palm will prove of equal value on the more alkaline areas of other arid regions in the Southwestern States where the winters are warm enough to permit it to grow. Most regions do not have sufficient summer heat to mature the Deglet Noor date, and other sorts which ripen earlier must be planted.

It is very probable that the culture of the best second-class dates, suitable for employment in confectionery and for household uses, will prove a profitable industry in the Salt River Valley, Arizona, and it is possible that the Deglet Noor variety may mature there.

Even the growing of ordinary sorts, such as the oriental dates, which are imported into this country in enormous quantities, may pay in some favored regions, such as the flood-plain of the Colorado River in Arizona and California, where exuberantly fertile lands can be had cheaply, and where the annual overflow and seepage from the river render artificial irrigation unnecessary.

Although date palms are likely to be grown first on soils too alkaline for other crops, the culture of the finer sorts promises to be a most profitable fruit industry that would warrant planting on the very best lands and the employment of the most modern horticultural methods.

DESCRIPTION OF PLATES.

PLATE I. Old date palms at Hermosillo, northern Mexico. Orange trees, peppers, and alfalfa are growing under the palms. December, 1899. Negative by the author.

PLATE II. Map of a portion of the Sahara Desert, in southern Algeria, showing the principal centers of date culture, Zibane, Oued Rirh, Oued Souf, etc. Reduced from 1 : 800,000 map of Service géographique de l'Armée, Paris. Scale 1 : 2,400,000. Localities where soil samples were secured are marked with a star. The fine lines indicate caravan routes. The railway does not yet extend beyond Biskra.

PLATE III. Map showing distribution of soil types and of alkali in the Imperial area in the Salton Basin, California. Prepared by the Bureau of Soils, U. S. Department of Agriculture, in 1903.

PLATE IV. Relief map of California, showing the principal regions where dates can be grown. Reduced from a drawing made after a photograph (furnished by Prof. Alexander G. McAdie) of a relief map of California exhibited at the World's Columbian Exposition, Chicago, 1893.

PLATE V. Fig. 1.—Date garden in Old Biskra, Algeria. Bunches of nearly ripe fruit are seen on the taller palms; fig trees are growing underneath in the partial shade. August, 1902. Negative by Thos. H. Kearney and Thos. H. Means. Fig. 2.—Date palms at Old Biskra, Algeria. To left, two old male date palms, showing more abundant leaves and thicker trunks than the female trees beyond. Negative by the author.

PLATE VI. Fig. 1.—Native gardeners (Rouara) at Ourlana, Algeria, putting date offshoots into sacks, preparatory to shipment by camel back; to the right is seen the corner of the date plantation. Soil samples (Ourlana, Station No. 1) were obtained a few rods from here, May, 1900. Negative by Charles Trabut. Fig. 2.—Caravan loaded with date palm offshoots for the Tempe garden, Arizona, starting from Ourlana northward toward Biskra, Algeria, May, 1900; negative by Charles Trabut. Fig. 3.—Final trimming of date offshoots at Algiers, preparatory to packing for shipment to America, June, 1900. Negative by the author.

PLATE VII. Fig. 1.—Flower cluster of male date palm just emerged from sheath; flowers opening and letting pollen escape. (One-fifth natural size.) Fig. 2.—Three female flower clusters. To left, just opening, ready to pollinate; in center, pollinated, male twig tied fast; to right, ten days after pollination. (One-fifth natural size.) Fig. 3.—Male and female flowers of the date palm, magnified: Above, young fruits turning green a week or so after pollination; in middle, female flowers ready to be pollinated; below, male flowers just shedding pollen. (Three times natural size.) Negatives by the author.

PLATE VIII. Fig. 1.—Forest of old date palms at Biskra, Algeria; an Arab has climbed the tallest tree (in the background), and is pollinating the flowers, May, 1900. Negative by the author. Fig. 2.—Arab pollinating a date palm, Ramley, Egypt, March 24, 1901; a rope passed around the trunk and attached to a broad belt at the waist aids in climbing. Negative by D. G. Fairchild. Fig. 3.—Arabs demonstrating the operation of pollinating the date palm; the cluster of female flowers is partly removed from the sheath and a sprig of male flowers is just being inserted with the right hand; the fiber with which the flowers will be tied in place is held in the mouth. Negative by the author. Fig. 4.—Arabs demonstrating the pollination of the date palm; the next stage after Fig. 1 above; the cluster of female flowers has been entirely removed from the sheath and is being tied together with a palm-leaf fiber to hold the sprig of male flowers in place. Negative by the author.

Plate IX. Deglet Noor dates from the Sahara Desert. (Natural size.) Photographed at Washington two months after being picked. Above, cut open date and two seeds. Negative by G. N. Collins and the author.

Plate X. Deglet Noor dates packed for the retail trade. The small paper box contains about two-thirds of a pound; the wooden boxes hold about four and one-half pounds. (One-third natural size.) Negative by G. N. Collins and the author.

Plate XI. Date palms growing in basin irrigated by flooding, at Bedrachin, near Cairo, Egypt. The water ranges from a few inches to several feet deep and remains standing about 6 weeks. September, 1902. Negative by Thos. H. Kearney and Thos. H. Means.

Plate XII. Fig trees growing under partial shade afforded by date palms in the oasis of Chetma, Algeria; May, 1900. Negative by the author.

Plate XIII. Date palms in garden at Biskra, Algeria. Soil samples (Biskra, Station No. 1) were secured in the foreground. An Arab is climbing the tall palm in order to pollinate the flowers; May, 1900. Negative by the author.

Plate XIV. Fig. 1.—Date palms growing without artificial irrigation near Fougala, Algeria; at the base of the palm trunks a bank or "goorma" is seen. Fig. 2.—Shallow well with sweep "kitara" used to irrigate date palms at Fougala, Algeria. Negatives by the author.

Plate XV. Fig. 1.—Very alkaline undisturbed Saharan soil at Fougala, Algeria; a scanty growth of salt bushes and samphires is seen in the foreground near where soil sample (Fougala, Station No. 1) was taken; to left, in middle ground, young palms are seen growing in pits. Fig. 2.—Date palm in condition called "meznoon" or crazy, showing youngest leaves dwarfed and distorted; oasis of Fougala, Algeria; May, 1900. Negatives by the author.

Plate XVI. Fig. 1.—Young date palms growing on very alkaline soil at Chegga, Algeria. A white crust of alkali is shown along the edge of the irrigation ditch. A soil sample (Chegga, Station No. 1) was secured near by. Fig. 2.—Young date palms at Chegga, Algeria. A soil sample (Chegga, Station No. 2) was obtained in the bed of oasis alfalfa seen on the left of the drainage ditch; May, 1900. Negatives by the author.

Plate XVII. Fig. 1.—Date plantation on alkaline soil at Ourlana, Algeria, in the Oued Rirh region of the Sahara Desert. A drainage ditch is shown and to right ridges to facilitate irrigation by surface flooding. A soil sample (Ourlana, Station No. 2) was secured between the first two trees on the right. Negative by the author. Fig. 2.—Crescent-shaped excavation, "dahir," at the base of a date palm, to hold irrigation water, Biskra, Algeria. Offshoots ready to remove are seen at the base of the trunk. Negative by the author.

Plate XVIII. Fig. 1.—View in the Salton Basin, near Imperial, Cal., looking southward, showing level, bare desert land, with almost no trace of vegetation; Signal Mountain, in Mexico, in the distance; January, 1901. Fig. 2.—Shore of a dry, salt lake, Chott Merouan, between Chegga and M'raïer, Algeria, with salt-loving vegetation; in the distance a mirage simulates a vast sheet of water, with remote islands covered with bushes. Negative by the author.

Plate XIX. Fig. 1.—A neglected Egyptian date palm growing without irrigation in the Salton Basin, near Indio, Cal., November, 1899. Fig. 2.—Old date palms showing reflexed, dead leaves growing at Hermosillo, northern Mexico; orange trees grow under the palms; arid hills form the background; December, 1899. Fig. 3.—Fan palm, showing persistent dead leaves clothing the trunk, near Indio, Cal. Fig. 4.—Group of fan palms growing wild in a dry ravine near Indio, Cal., November, 1899. Negatives by the author.

Plate XX. Fig. 1.—Old date palms growing at San Diego Mission, near San Diego, Cal. Negative by Park & Co., Los Angeles. Fig. 2.—Seedling date palm, showing bunches of nearly ripe fruit, growing without artificial irrigation in the flood-plain of the Colorado River, near Yuma, Ariz.; planted by Mr. Hall Hanlon (who stands beneath), November, 1899. Negative by the author.

Plate XXI. View in Cooperative Date Orchard at Tempe, Ariz., showing growth made in two years by offshoots imported from North Africa in 1900. Photographed December 31, 1902, by Prof. R. H. Forbes.

Plate XXII. Three-year-old Deglet Noor date palm in fruit, growing in the Cooperative Date Orchard at Tempe, Ariz., from an offshoot imported from the Sahara Desert in July, 1900. Photographed August 27, 1903, by W. W. Skinner.

FIG 1.—FRUITING DATE PALMS AT OLD BISKRA, ALGERIA, WITH FIG TREES GROWING UNDERNEATH, AUGUST, 1902.

FIG. 2.—DATE PALMS AT OLD BISKRA, ALGERIA. TWO LARGE MALE TREES AT LEFT.

FIG. 1.—NATIVE GARDENERS (ROUARA) AT OURLANA, ALGERIA, PREPARING DATE OFFSHOOTS FOR SHIPMENT BY CAMEL BACK.

FIG. 2.—CARAVAN LOADED WITH DATE PALM OFFSHOOTS FOR ARIZONA, STARTING FROM OURLANA NORTHWARD, MAY, 1900.

FIG 3.—FINAL TRIMMING OF DATE OFFSHOOTS AT ALGIERS PREPARATORY TO SHIPMENT TO AMERICA, JUNE, 1900.

FIG. 1.—FLOWER CLUSTER OF MALE DATE PALM JUST EMERGED FROM SHEATH AND LETTING POLLEN ESCAPE.

FIG. 2.—THREE FEMALE FLOWER CLUSTERS.

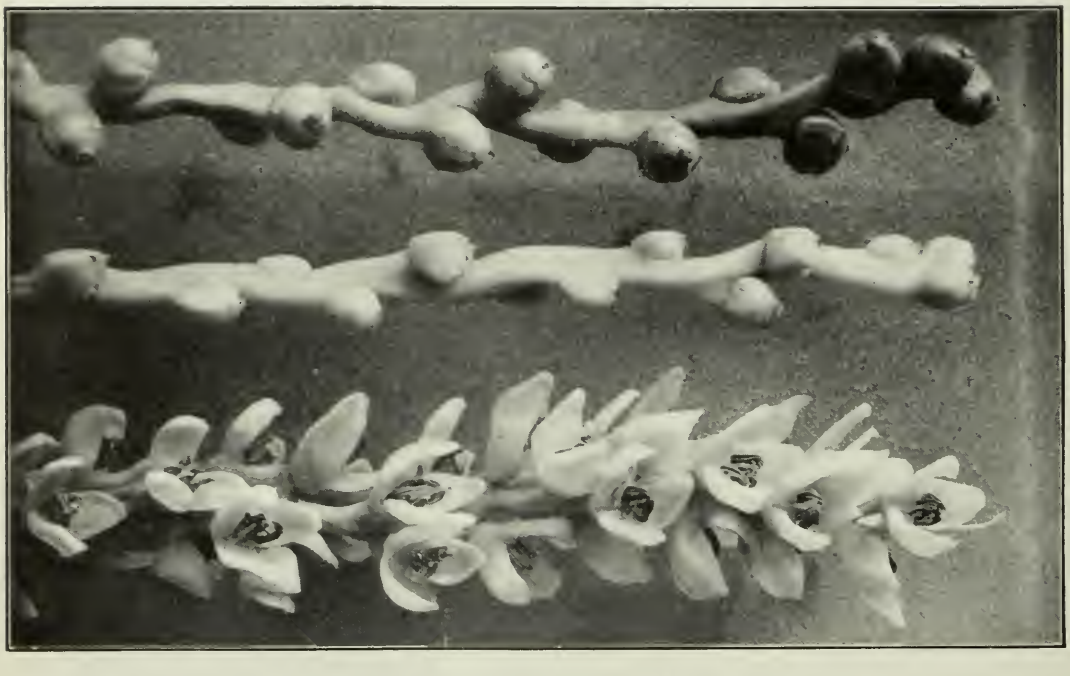


FIG. 3.—MALE AND FEMALE FLOWERS OF THE DATE PALM, MAGNIFIED.

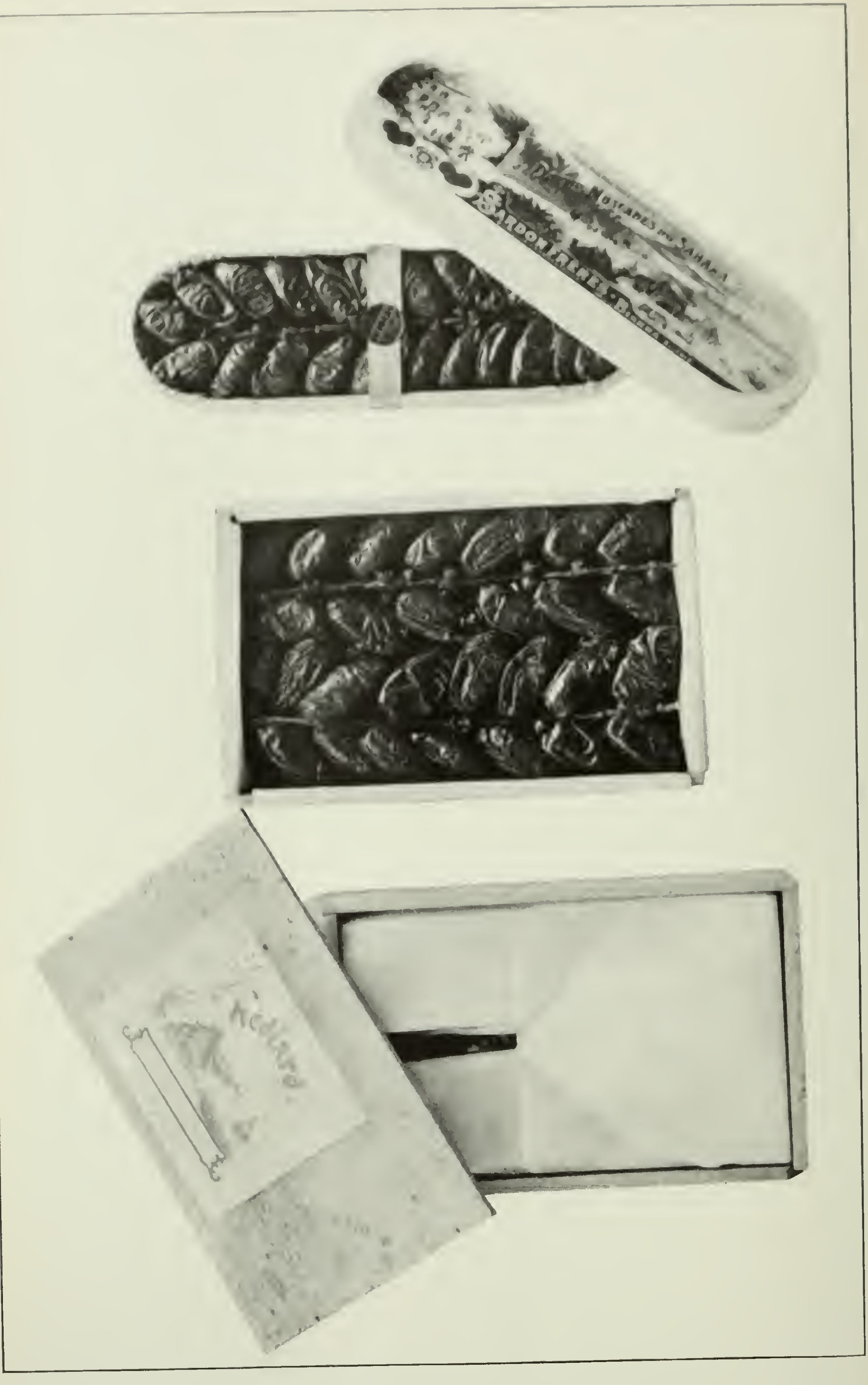
FIG. 1.—FOREST OF OLD DATE PALMS AT BISKRA, ALGERIA, SHOWING ARAB POLLINATING FLOWERS.

FIG. 2.—ARAB POLLINATING A DATE PALM RAMLEY, EGYPT, USING A ROPE AND BROAD BELT IN CLIMBING.

FIG. 3.—ARABS DEMONSTRATING THE POLLINATION OF THE DATE PALM. SPRIG OF MALE FLOWERS BEING INSERTED.

FIG. 4.—CLUSTER OF FEMALE FLOWERS BEING TIED TOGETHER TO HOLD THE SPRIG OF MALE FLOWERS IN PLACE.

DEGLET NOOR DATES FROM THE SAHARA DESERT (NATURAL SIZE).



DEGLET NOOR DATES PACKED FOR THE RETAIL TRADE.

DATE PALMS GROWING IN BASIN IRRIGATED BY FLOODING AT BEDRACHIN, NEAR CAIRO, EGYPT, SEPTEMBER, 1902.

FIG TREES GROWING UNDER PARTIAL SHADE AFFORDED BY DATE PALMS, OASIS OF CHETMA, ALGERIA.

ARAB CLIMBING TALL PALM IN A GARDEN AT BISKRA, ALGERIA, TO POLLINATE THE FLOWERS, MAY, 1900.

FIG. 1.—DATE PALMS GROWING WITHOUT IRRIGATION NEAR FOUGALA, ALGERIA.

FIG. 2.—SHALLOW WELL USED TO IRRIGATE DATE PALMS AT FOUGALA, ALGERIA.

FIG. 1.—VERY ALKALINE UNDISTURBED SAHARAN SOIL AT FOUGALA, ALGERIA. YOUNG PALMS GROWING IN PITS.

FIG. 2.—DATE PALM IN DISEASED CONDITION CALLED "MEZNOON," CAUSED BY EXCESS OF ALKALI. FOUGALA, ALGERIA.

FIG. 1.—YOUNG DATE PALMS GROWING ON VERY ALKALINE SOIL AT CHEGGA, ALGERIA.

FIG. 2.—YOUNG DATE PALMS AND SAHARAN ALFALFA AT CHEGGA, ALGERIA.

FIG. 1.—DATE PLANTATION ON ALKALINE SOIL AT OURLANA, ALGERIA.

FIG. 2.—CRESCENT-SHAPED EXCAVATION AT THE BASE OF A DATE PALM TO HOLD IRRIGATION WATER, BISKRA, ALGERIA.

FIG. 1.—VIEW IN THE SALTON BASIN, NEAR IMPERIAL, CAL., SHOWING LEVEL, BARE DESERT SOIL.

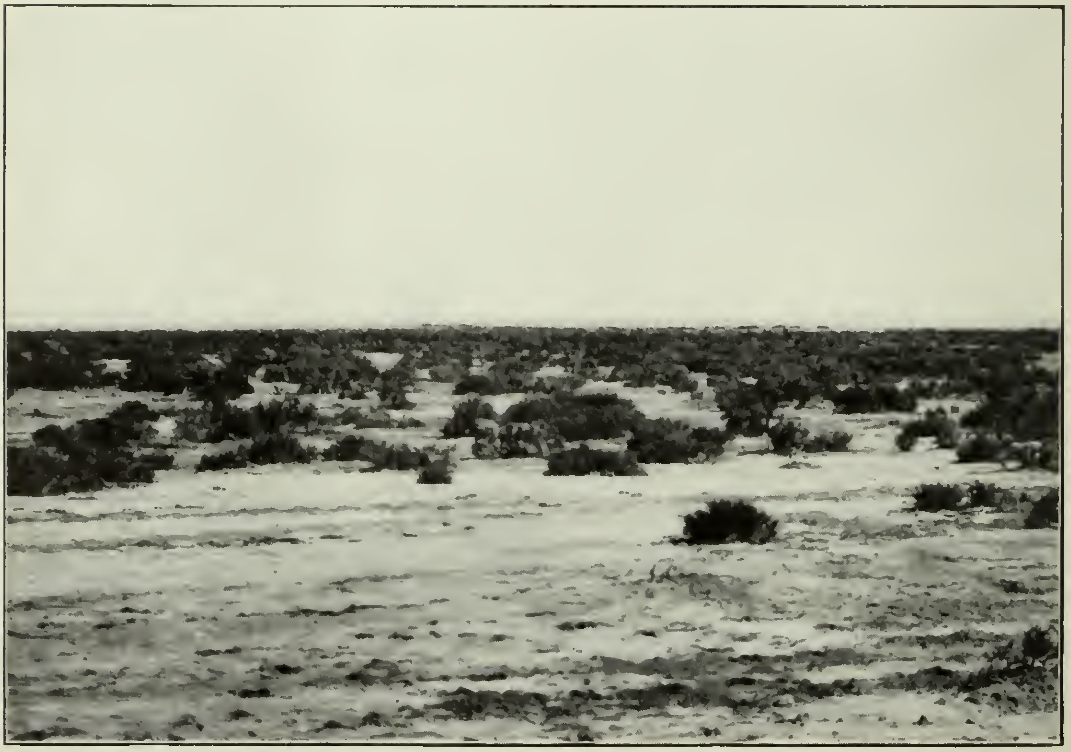


FIG. 2.—SHORE OF A DRY SALT LAKE, CHOTT MEROUAN, BETWEEN CHEGGA AND M'RAIER, ALGERIA.

FIG. 1.—A NEGLECTED EGYPTIAN DATE PALM GROWING WITHOUT IRRIGATION IN THE SALTON BASIN, NEAR INDIO, CAL.

FIG. 2.—OLD DATE PALMS AT HERMOSILLO, NORTHERN MEXICO, WITH ORANGE TREES GROWING UNDERNEATH.

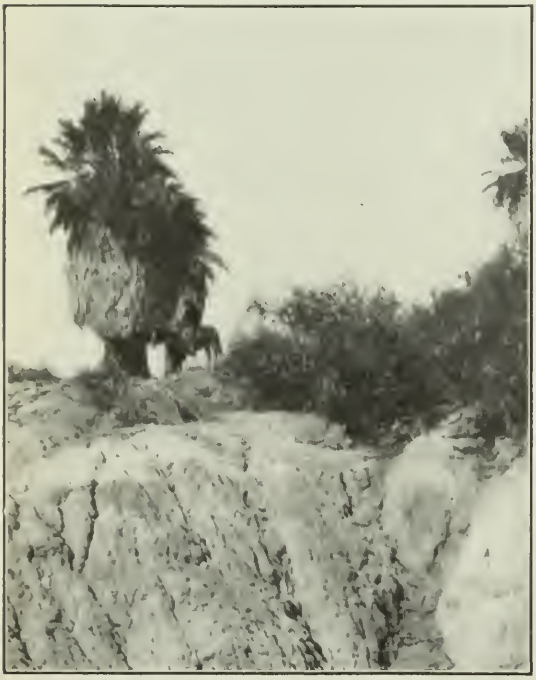
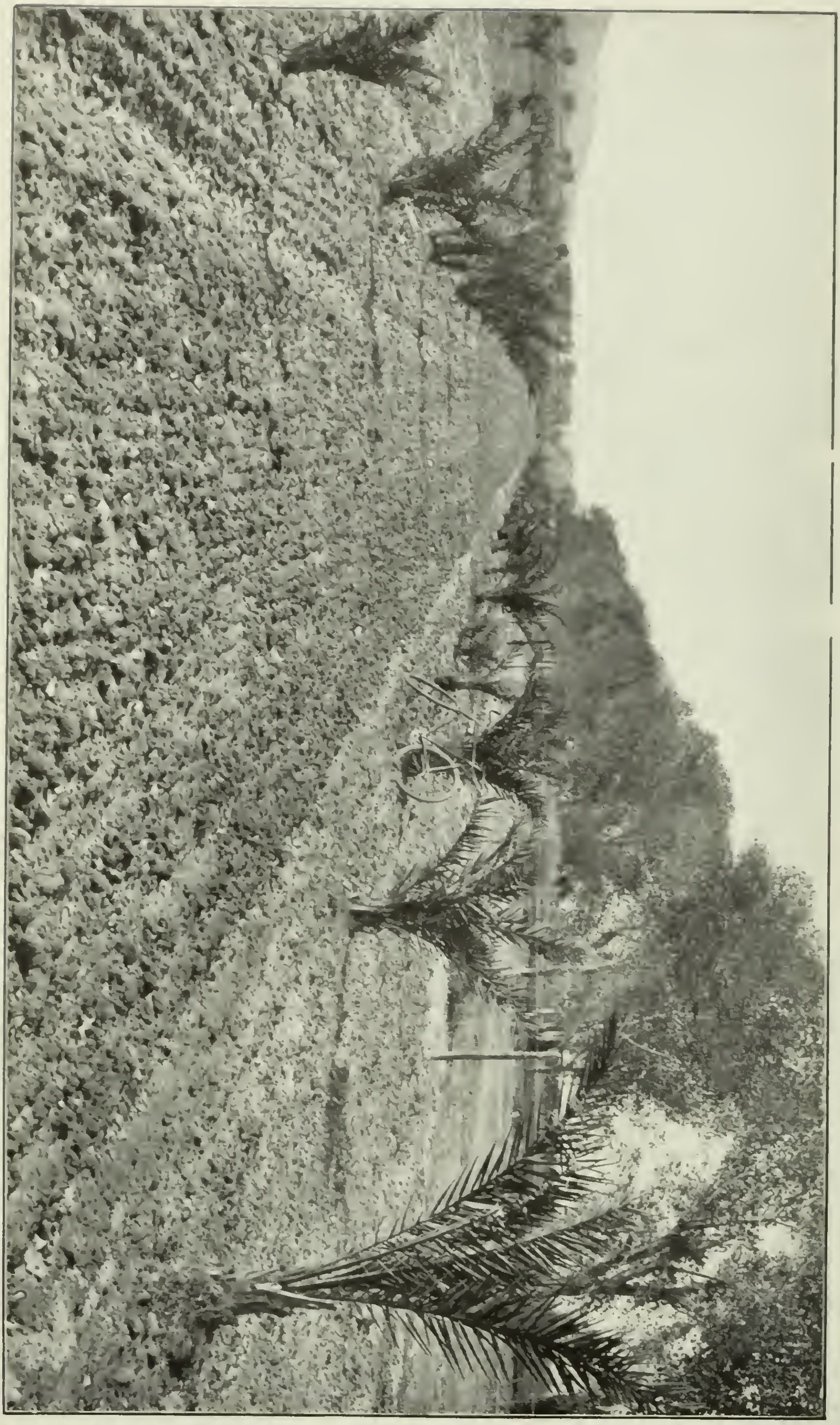


FIG. 3.—FAN PALM SHOWING DEAD LEAVES CLOTHING TRUNK, NEAR INDIO, CAL.

FIG. 4.—GROUP OF FAN PALMS GROWING WILD IN A DRY RAVINE, NEAR INDIO, CAL.

FIG. 1.—OLD DATE PALMS GROWING AT SAN DIEGO MISSION, NEAR SAN DIEGO, CAL.

FIG. 2.—SEEDLING DATE PALM WITH NEARLY RIPE FRUIT, GROWING WITHOUT IRRIGATION IN THE FLOOD PLAIN OF THE COLORADO RIVER IN CALIFORNIA.



VIEW IN COOPERATIVE DATE ORCHARD, TEMPE, ARIZ., SHOWING OFFSHOOTS IMPORTED FROM NORTH AFRICA IN 1900.

THREE-YEAR-OLD DEGLET NOOR DATE PALM IN FRUIT, GROWING IN THE COOPERATIVE DATE ORCHARD AT TEMPE, ARIZ., FROM AN OFFSHOOT IMPORTED FROM THE SAHARA DESERT IN JULY, 1900. PHOTOGRAPHED AUGUST, 1903.

145

INDEX.

O

A

FIG. 1.—CANAL THROUGH DATE PLANTATION AT BASSORAH.

FIG. 2.—NEW DATE PLANTATION, SHOWING IRRIGATION DITCHES.

FIG. 3.—AT THE BORDER OF IRRIGATION; PATCHES OF ALFALFA.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY--BULLETIN No. 54.

B. T. GALLOWAY, *Chief of Bureau.*

PERSIAN GULF DATES

AND THEIR INTRODUCTION INTO AMERICA.

BY

DAVID G. FAIRCHILD, Agricultural Explorer.

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

Issued December 19, 1903.

WASHINGTON:
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1903.

BUREAU OF PLANT INDUSTRY.

BEVERLY T. GALLOWAY, *Chief of Bureau.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

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3

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., October 17, 1903.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 54 of the series of this Bureau the accompanying paper entitled "Persian Gulf Dates and Their Introduction into America."

This paper was prepared by Mr. D. G. Fairchild, Agricultural Explorer, and has been submitted by the Botanist in Charge of Seed and Plant Introduction and Distribution with a view to publication.

The information contained in this bulletin and a collection of young date palms which were imported and are now growing in the Government date orchards in Arizona form another of the many generous gifts which Mr. Barbour Lathrop, of Chicago, has made to the American people.

The four half-tone plates are essential for the purposes of this bulletin.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

The importance of introducing the commercial culture of the date palm into Arizona and California led to the establishment of the cooperative date orchard at Tempe, Ariz., where already more varieties of this palm are gathered together than are to be found in any other one place in the world. To the original orchard additions have been made from time to time, one of the most important being the collection of Persian varieties presented to the Department of Agriculture by Mr. Barbour Lathrop and described in the present bulletin. Fortunately, many of the suckers sent from Persia are alive and will in time enable the Department to distribute the best of these varieties in suitable regions of our arid Southwest.

Mr. Fairchild's statements regarding the manner in which the Persian dates are packed furnishes an additional incentive for pushing the work of introduction, so that the home market may be supplied with clean, wholesome dates.

In securing much of the information which is contained in this bulletin and in the procuring of the young date palms Mr. Fairchild is indebted to the American vice-consul, Mr. A. Mackirdy, of Maskat, Mr. Rudolf Hürner, vice-consul, of Bagdad, Mr. O. Gaskin, British vice-consul, of Bahrein, and especially for unusual courtesies and aid to Mr. H. P. Chalk, of Bassorah.

A. J. PIETERS,
Botanist in Charge.

OFFICE OF BOTANIST IN CHARGE OF SEED
AND PLANT INTRODUCTION AND DISTRIBUTION,
Washington, D. C., September 17, 1903.

CONTENTS.

ILLUSTRATIONS.

PERSIAN GULF DATES AND THEIR INTRODUCTION INTO AMERICA.

INTRODUCTION.

The valley of the Euphrates is said to be the birthplace of the date palm. Whether this is true or not, it is certain that nowhere else in the world are more favorable conditions for the cultivation of the date to be found than along the shores of the Persian Gulf and in Lower Mesopotamia.

The Persian Gulf date region is doubtless the largest in the world and furnishes the greatest part of all the dates sold in the American markets. Two million cases, or over a hundred million pounds of dates, have been exported in a single year from the principal shipping port; and at a very moderate estimate—for no even approximate data are obtainable—there must be not less than fifteen to twenty million date palms in this great territory.

The date plantations of Biskra, in the Sahara, contain little over half a million palms, according to Swingle,[a] while the immense region comprising Upper and Lower Egypt together is estimated by Willcocks[b] to have only 7,400,000 date palms in cultivation. Moroccan and Spanish gardens are insignificant in comparison with these great regions, and no one connected date area can compare in size with the plantations which extend for 70 miles in an unbroken forest from below Mohammerah to above Kurna, on the Shat-el-Arab River. This strip of forest varies in width from less than a mile to over 3 miles, and more than 5,000,000 trees, it is estimated, are packed into it. There is certainly nothing comparable to it in the world, either as regards size or the ease with which it can be irrigated.

Date growing in Arizona is rapidly passing the experimental stage. The fact that this fruit could be grown there, however, was first called to the attention of the public by the success of a number of chance seedlings which bore good crops of fine fruit. The seeds from which

[a] Swingle, W. T. The Date Palm and its Culture. In Yearbook of Department of Agriculture for 1900, p. 461.

[b] Willcocks, W. Egyptian Irrigation, 1899, pp. 17–18.

these seedlings were raised came probably from Persian Gulf dates, since these are the most common ones in our markets. The excellence of the fruit from these seedlings and the fact that they ripened early made it seem probable that the Persian Gulf dates, as a class, might prove upon investigation to ripen earlier than those of North Africa, and therefore be better suited to the short, hot seasons in Arizona.

The stickiness of the dates from Mesopotamia, as sold in this country, is perhaps a disadvantage which they have in comparison with the African sorts, but it was thought that American date firms might not wish to import the best varieties and that there might be found under cultivation along the coast of the Persian Gulf superior early-ripening sorts of which nothing is now known in the United States.

The consideration of these possibilities decided Mr. Barbour Lathrop to send the writer up the Persian Gulf to Bagdad to look for the best and earliest varieties of dates and to secure such information regarding their culture as might be obtainable. The object of this short bulletin, therefore, is to make available to those interested in date culture the information, more or less fragmentary, which was secured during a brief stay in Bassorah and Bagdad and stops of a few hours at ports on the Persian Gulf.

GENERAL DESCRIPTION OF THE REGION.

The Persian Gulf, like the Red Sea, is a body of unusually salty water, surrounded by stretches of desert sand and barren hills and cliffs. Its waters are shallow and easily and often ruffled by storms, making landing on the shelving beaches sometimes difficult and dangerous. Its eastern shore is formed by the rocky coast of Persia, while the deserts of Arabia constitute its western coast. The Gulf of Oman is separated from the Persian Gulf by a narrow strait, south of which lies the Sultanate of Maskat, with its dependent province of Guadur on the opposite side of the gulf.

The Shat-el-Arab River is formed by the union of the Tigris and Euphrates at Kurna, where, according to the Arabs, the garden of Eden was located. It flows south for 70 miles and empties into the northern end of the Gulf of Persia, forming a shallow bar which must be crossed at flood tide by even shallow-draft vessels.

The Persian Gulf is politically controlled by Great Britain, whose officials settle petty intertribal disputes between the natives and push the interests of British trade by increasing the communication facilities of the waterways. Turkey nominally governs Arabia, but practically controls little territory south of the Shat-el-Arab River, while the Shah of Persia has jurisdiction over the whole eastern coast of the gulf, and the Sultan of Maskat, under the eye of Great Britain, manages the affairs of his Sultanate and of his dependency of Guadur.

Developments in this region have until recently been very slow, but those who read the signs of the times there foresee some interesting changes in the near future.

There are several ways in which the Persian Gulf region may be visited: By comfortable steamers of the British India Line from Bombay, which run weekly and form the easiest and quickest approach; by caravan from Damascus, in fourteen days, to Bagdad; by carriage from Trebizond to Mosul and down the Tigris (on a raft of inflated sheepskins) to Bagdad; via Teheran and Ispahan on mule back to Bushire or Bagdad; or by the Anglo-Arabian and Persian Steamship Company, of Leadenhall street, London, which keeps up a fairly good service to and from the gulf. This company runs steamers at least once a month, and frequently semimonthly, stopping at Port Said, Suez, and Aden.

The Turkish quarantine regulations at Bassorah require of all passengers on boats from India ten days' quarantine, while only five are demanded of this Anglo-Arabian Company coming direct from Europe. The easiest way, therefore, to reach the gulf will be to join one of this company's boats at Port Said, Suez, or Aden. Returning, one can take a boat of the British India Line to Bombay, if he desires to call at any of the ports on the coast, which are closed by quarantine to boats going up to Bassorah but open to all steamers returning from there.

CLIMATE.

The Persian Gulf and the Gulf of Oman are among the hottest regions in the world. Maskat, while not as warm as Jacobabad, is so hot that the thermometer registers 117° to 120° F. in the shade, and for nights and days the temperature has been known to remain somewhere about 110° F. The sea water in the harbor, as taken for the ship's engines, was registered on the log of the steamer as 96° F., and the eight Europeans who live in the place, in order to make sleep a possibility, resort to the use of special machines, like fanning mills, which force a draft of air through a perpetually wet screen. As high as 124° F. in the shade is recorded for the river Shat-el-Arab by the "Persian Gulf Pilot." The Europeans spend as much time as possible during the day in darkened, lower-story rooms, and the nights on the flat roofs of the houses. Nor is the heat by any means always a dry one, but it is often muggy and oppressively moist. The winters are as delightful, with their bright sunshine and cool breezes, as southern California. The rainfall is about 6 inches, according to Mr. Mackirdy, United States vice-consul, and occurs in the spring months. No rains fall during the principal date harvest in August and September, which are at the same time the hottest months. Owing to this long, excessive heat at Maskat the dates ripen earlier than they do farther north.

At Bahrein (the pearl islands), on the Arabian side of the Gulf, Rev. S. M. Zwemer, who has the self-registering thermometer of the Indian weather service, describes March, April, October, November, and December as "delightful," with indoor temperatures seldom above 85° F. or below 60° F. January and February are colder, even cold enough for a fire, and in these two months the rain of the season usually falls. The months from May to September form the hot season, and during this period heavy night dews are common and the thermometer often remains above 100° F. for many days and nights together. The minimum temperature in the village of Menamah, Bahrein, during the summer months of 1893 was 85° and the maximum 107° F. in the shade.

In Bassorah, near the mouth of the Shat-el-Arab, the climate is similar to that of Bahrein, with the exception that the winters are colder—so cold, in fact, that a grate fire is necessary for comfort. Such delicate plants as tropical guavas are injured by the low temperature.

Bagdad is still some distance from the northern limit of date culture, and yet frosts are of frequent occurrence. Temperatures of 17° and even 12° F. it is understood have been observed, though not by official weather observers. The summers are cooler than at most places on the gulf, and shortly after sunset the rapid radiation from the desert which surrounds the town lowers the temperature appreciably. Judging from the glare upon the light-brown soil in the winter season and from the precautions which it is necessary for travelers to take in crossing the deserts, the insolation to which the date palms are subjected in Mesopotamia must be something extraordinary. No figures regarding the force of the sun's rays, however, were obtainable.

From Mr. Willcocks's paper, cited later, the following tables are taken:

Meteorological observations at Bagdad.

Month.	1888				1894			
	Temperature.		Rainfall.		Temperature.		Rainfall.	
	Mean maximum.	Mean minimum.	Mean.	Total.	Mean maximum.	Mean minimum.	Mean.	Total.
	° F.	° F.	*Inches.*	*Inches.*	° F.	° F	*Inches.*	*Inches.*
January	62.5	41.1	49.9	0.1	55.5	37.1	46.3	1.5
February	68.1	47	54.9	2.4	61.5	44	52.8	7.9
March	74.2	51.7	60.5	.8	69.3	50.4	59.8	4.4
April	81	58.7	68.8	2.7	76.2	58.9	67.5	2.5
May	94.1	70.2	80.1	.7	91	69.9	80.5	....
June	102.2	76.9	88.3	....	100.3	76.9	88.6	....
July	109.3	80.2	92.6	....	105.3	78.5	91.9	....
August	106.3	78.6	90.9	....	106.7	79.3	93	....
September	103.4	72.8	85.7	....	100.3	70.5	85.4	....
October	100.2	69.1	79.1	....	90	61.2	75.6	.1
November	74.8	48.3	57.3	1.2	72.1	55.1	63.6	4.8
December	60.8	42.3	49.1	.5	61.5	44.8	53.2	1
Mean	87.9	61.4	71.4	8.4	82.5	60.5	71.5	22.2

Meteorological observations at Bagdad—Continued.

Month.	1899				1900			
	Temperature.		Rainfall.		Temperature.		Rainfall.	
	Mean maximum.	Mean minimum.	Mean.	Total.	Mean maximum.	Mean minimum.	Mean.	Total.
	° *F.*	° *F.*	*Inches.*	*Inches.*	° *F.*	° *F.*	*Inches.*	*Inches.*
January	58.7	38.8	48.8	0.3	60.4	39.5	49.9	0.4
February	67.2	43.2	55.2	.1	66.4	45.9	56.1	1.2
March	73.5	49	61.3	.5	72.7	53.7	63.3	1
April	87	61.3	74.2	.3	85.8	61.7	73.8	....
May	96.7	68.9	82.8	....	93.3	66.2	79.9	....
June	104.5	76.5	90.5	....	103.5	73.8	88.7	....
July	110.5	79.5	95	....	108.2	77	92.6	....
August	112.1	79.4	95.7	....	108.6	76.1	92.4	....
September	107.3	73.2	90.3	....	105.1	71.3	88.2	....
October	92.5	64.2	78.4	.1	93.2	65.4	79.3	....
November	72.3	47.9	60.1	1.1	71.8	49.2	60.5	1.7
December	58.3	39	48.9	1.2	64.5	44.8	54.7	1.4
Mean	86.7	60.1	73.4	3.6	86.1	60.4	73.4	5.7

Month.	1901				1902			
	Temperature.		Rainfall.		Temperature.		Rainfall.	
	Mean maximum.	Mean minimum.	Mean.	Total.	Mean maximum.	Mean minimum.	Mean.	Total.
	°*F.*	°*F.*	*Inches.*	*Inches.*	°*F.*	°*F.*	*Inches.*	*Inches.*
January	57	38.2	47.6	0.5	62	36.9	49.5	0.2
February	75.1	47.2	61.2	....	73.7	47.6	60.6	.4
March	82	54.7	68.4	.3	73.2	51.3	62.3	1.8
April	89.3	61.6	75.4	.2	84.3	60.2	72.3	1.9
May	95.1	67.2	81.2	.2	99.6	71.9	85.7	....
June	108.8	78.2	73.6	....	107.4	76.9	92.2	....
July	113.5	80.5	97	....	....	....	....	....
August	113.1	80.9	97	....	....	....	....	....
September	108	74.6	91.3	....	....	....	....	....
October	93.8	63.2	78.5	....	....	....	....	....
November	78.9	54.2	66.9	.1	....	....	....	....
December	68.3	43.1	55.7	.2	....	....	....	....
Mean	90.2	62	74.5	1.5	....	....	....	....

LOCATION OF THE DATE GARDENS.

Although the Arab knows more about dates than he does about any other plant, since it is his principal food, his knowledge is generally very local, and it is difficult to obtain accurate information regarding the extent of the date plantations along the gulf.

It is probable that small gardens are to be found almost anywhere on the coast where the water necessary for cultivation is obtainable, but there are several principal regions from which the dates are exported or have otherwise become well known. How large they are is, however, the subject of conjecture.

The Pangh Ghur region, lying thirteen days' caravan ride inland from the port of Guadur, on the Gulf of Oman, is in the Mekran territory of Baluchistan. According to Lieut. W. O. Grant, of the First Baluchistan Light Infantry, who recently took an expedition into the country and to whom the writer is indebted for much valuable information, the plantations in this region are of considerable size, including hundreds of thousands of trees; but the natives export into Kurrachee and other parts of India only small quantities of dates. Among them, however, is one of the finest in the world, called the "Mozaty," which is packed in date sirup in small earthen jars and is sold as a great delicacy on the Kurrachee market. Little is known about the other varieties of this region, except that they are reported to ripen very early, even as early as June. A guard is necessary in order to visit the region, as the inhabitants are quite uncivilized and are continually at war with each other.[a] Maskat itself has few palms in its immediate vicinity, but some 50 miles in the interior, at Semail, at least half a million trees are said to be under cultivation, while along the Batna coast is a region which, according to Vice-Consul Mackirdy, is 60 miles long and a half mile wide and is packed with date palms. These two areas are believed by Mr. Mackirdy, who is an old resident in Maskat, to nearly equal in size those of Bassorah and Mohammerah. They furnish 1,000 tons of dates for export to America and the total yearly export from Maskat is estimated roughly at 30,000 tons, which is second only to Bassorah in amount. Maskat has the largest date export from the gulf to Indian and other Asiatic ports. Owing to its southern latitude and excessive heat the dates of Maskat ripen earlier (some of them in June) than those farther north.

Back of Jask, which lies on the opposite coast of the Gulf of Oman, large gardens of dates are said to exist, but about the place itself scarcely a palm is to be seen, and the surroundings of the latter are almost a complete desert. Six days' camel ride into the interior, at a place called Bashkala, some especially fine varieties are grown and, according to Mr. G. W. Mongavin, of the Indo-European telegraph department, who was stationed for some years at Jask, the dates from this region are the finest he has ever tasted. How extensive the orchards are is unknown. Forty miles from Bunder Abbas, on the Persian coast, are the plantations of Minab, which are almost as large, it is said, as those of Bassorah and Mohammerah. These are the plantations which furnish the dates for consumption on the Persian Gulf, and, in the picking season, which is in June and July, the inhabitants of many small villages along the coast migrate to Minab, where dates are much cheaper than at home, to live for several months. The varieties, in part similar to those of Maskat and Bassorah, are inferior in flavor and keeping quality. Those tasted, late in the season it is true, had decidedly harsh skins, and were inferior in every way to any of the good Bassorah sorts.

The town of Lingah, in Persia, which owing to the quarantine restrictions was seen only from the steamer, is fringed with date

[a] The native servant, whom Lieutenant Grant was kind enough to dispatch to Pangh Ghur in search of palms for the expedition, was turned back at Kej, some seven days' caravan journey from the former place, but luckily secured at Kej palm shoots, which the chief of the place reports are of the Pangh Ghur variety "Mozaty."

palms, but it was not learned that any fruits were exported or that any considerable area was planted to dates. The people of Lingah are said to obtain most of their dates from Minab.

Bahrein Island, noted as the center of the pearl fisheries of the gulf, has itself a half-million date palms planted on it, but they are not much more than enough to supply local gulf demands, neither are they of superior quality. The region of Hassa, however, 60 miles inland, has extensive plantations and produces one of the most delicious dates of this part of the world, called the "Khalasa of Hassa." Zwemer, in his "Arabia, the Cradle of Islam," remarks that the Hassa date region is not comparably as large as that of Bassorah, but he does not tell how extensive it really is. Probably a million trees would be a fair estimate.

Bushire has few date palms about it, but the districts of Tangistan and Koweis, not far off, have plantations of considerable size, it was stated by an old resident of the place. Three or four hundred tons of dry dates are exported annually to India from this port.

Of the date gardens of Koweit nothing was learned, but they are probably inconsiderable in size.

Mohammerah and Bassorah, although 30 miles apart and on opposite sides of the Shat-el-Arab which separates Persia from Arabia, really belong to the same general district and are the centers for export of the largest single date-producing region in the world. Although no count has ever been made, there are probably over five or six million palms planted along the banks of the river, and as seen from the bridge of a steamer the waving crowns of these tall palms stretch away in every direction to the horizon. (Pl. II, fig. 1.) In reality, the strip of land occupied by them is from less than a mile to 3 or 4 miles wide and 70 miles long, with occasional rice fields or neglected areas.

At various places along the Tigris and Euphrates, which rivers run almost parallel to each other across the broad, slightly inclined plain of Mesopotamia, there are date plantations varying in size from a few trees to hundreds of acres. About Bagdad, 535 miles from Bassorah, and at Hillah, on the Euphrates, a day's journey by camel from Bagdad, there are extensive groves of dates—over a million trees in the two places—and numerous superlative sorts are produced here, such as the "Kustawi," "Maktum," "Taberzal," etc. Owing to the fact that there is little export to restrict the number of varieties which may be planted for profit, there are probably more different kinds to be found about Bagdad than anywhere else in the Persian Gulf region.

SOIL CONDITIONS.

The date loves a slightly alkaline soil and can thrive where enough salt is present to kill most ordinary plants. It finds in the countries around the Persian Gulf all degrees of saltiness. The writer was unable to obtain good samples of the soil from all of the noted date regions about the gulf but examined a sufficient number to satisfy himself of its variability. In Bassorah there is an adobe soil, resembling the silt of the Nile Valley, so sticky that it has only to be dried in the sun to make the best of adobe bricks. This pure adobe is not considered as suitable a soil as that which has a slight admixture of sand in it to make it lighter. Though undoubtedly a fine soil, this alluvium can not be compared with the rich river bottoms of the Missouri, Kansas, and Mississippi, and is able to produce no such crops of maize or wheat. The soil of Bagdad resembles that of Bassorah closely, being made up of the same alluvial deposits from the Tigris River. Not a stone the size of a man's fist can be found by searching for hours across the plains about Bagdad, and the broken antique pottery, tiles, and bricks attest the character of the fine-grained soil of which these millions of acres are composed. It is the very soil of which Babylon was built, and which when baked has so well preserved for later generations the cuneiform language of the Babylonians.

IRRIGATION OF THE PLANTATIONS.

Nowhere in the world does such an ideal water supply exist for the irrigation of date plantations as at Bassorah. A broad, muddy river, flowing at a rate varying from 0.4 mile to 6 miles an hour between banks which are so low that the Arabs sit upon them and wash their hands in the stream (Pl. IV, fig. 3), supplies an almost unlimited quantity of water. With each high tide the waters of the river are backed up for about 70 miles and rise on an average at Bassorah 6 feet above their former level, filling on both banks the hundreds of irrigating canals which run in every direction for many miles through the date forests. The height of the river at Bassorah changes little, summer or winter, though its level at Bagdad, 535 miles away, falls materially during the dry summer months. A strong southerly wind, if blowing up river for some time, will, together with the rising tide on the bar, raise the level of the water a foot or more over its natural high tidal mark.

Occasional large canals extend for more than 2½ miles into the desert at right angles to the river and give off numerous side canals. These mains are navigable by large steam launches and form the avenues by which dates are transported to the steamers that lie in the river during the shipping season. These large canals, planted for their whole length with palms, are in fact like rivers through a great forest of dates. The land is so level that apparently no engineering difficulty lies in the way of an immense extension of this canal system so as to take in thousands of square miles of this rich alluvial desert which stretches away to the horizon from the comparatively narrow strip of already utilized land fringing the river banks. The writer followed up one of the main canals and reached the end of the irrigation ditches to find, on the very border of the desert, luxuriant patches of alfalfa and fine looking 10-year-old date palms. (See Pl. I, fig. 3.) The Arabs are gradually, but very slowly, lengthening the canals and watering more desert every year. A great impetus was given to date culture in Mesopotamia by the opening of the Suez Canal in 1869. This brought the European and American markets within easy reach by water, and enabled the growers to get their dates to London and New York in time for the autumn market, avoiding the expense and delays of their transportation by camel across the desert. Large areas of palms which were planted at that time are now in the prime of their productiveness.

The method of planting is determined by the irrigating ditches, which are large (often 3 feet by 3 feet) and cut the ground up into small rectangular peninsulas, 10 to 15 by 20 to 30 feet in size. (Pl. I, fig. 2, and Pl. II, fig. 2.) On each peninsula 2, or sometimes 3, palms are set. (Pl. VII, fig. 1.) Often the peninsulas are much larger and hold from 4 to 5 and even as high as 10 palms. The size of these peninsulas depends somewhat upon the permeability of the soil and the height to which the irrigation water rises in the ditches. On an average 100 palms are planted to a "djerib," which unit of measure is a trifle less than an acre. In order to prevent the waters receding too quickly from the canals when the tide falls, dams of mud are built, and pipes, or the hollow trunks of palms, are run through them, which permit the water forced into the canals by the rising tide to flow away slowly. The length of time during which the canals are filled with water is more or less under the control of the proprietor, and as the supply is practically unlimited no tax of any kind is paid nor is any regulation necessary regarding its use. In short, the Bassorah date grower has only to see that his ditches are kept in order, which is an easy matter where the soil is as pure adobe as the clay of a brickyard and the backwater of the river will fill and empty them twice every twenty-four hours. The conditions of this form of irrigation, which might be called a tidal one, are quite ideal and so far as known are found on such a scale nowhere else in the world. Professor Hilgard, of the California Experiment Station, says that the waters of the Sacramento River are being utilized in a similar way, but on no such scale. With the proper extension of the canals on both sides of the river an area covering several million acres could, it is believed, be planted to dates and the Bassorah region might then supply the dates of the world.

Conditions in Bagdad are quite different. The banks of the Tigris are high, often 20 feet or more, and even at its highest level the water never flows into the irrigating canals, but must be lifted laboriously by means of contrivances of Babylonian antiquity, called "chirds."

These are composed of a set of pulleys, a bullock-skin bag holding 20 to 40 gallons, and a rope attached to a horse or bullock, which walks laboriously up and down a steep dirt incline, hoisting the water as it descends and lowering the bag into the river as it backs up the declivity. (Pl. IV, fig. 2.) None of our unpicturesque but practical Yankee windmills, with their ugly shapes, has yet invaded the banks of the Tigris, although during the spring season, when the water is most required, strong, steady breezes are almost constantly blowing. Once lifted intc small, shallow reservoirs, the water is led off by trenches and manipulated in the usual way, giving each palm a periodic watering by filling its particular trench.

What the irrigation conditions in this region were when Babylon was a great city and the whole country was as thickly populated as Egypt is to-day can be judged by a study of the remarkable ruins of the great canals and dams which are to be found in this now desolate country.

Sir William Willcocks, K. C. M. G., whose name is so well known from his remarkable work on the Assuan dam in Egypt, has recently made a study of the old canal system of Chaldea and has drawn a most vivid picture of the irrigation system of ancient Babylon.[a] He shows how favorably it compared with the system of ancient Egypt, and points out in the following words the cause of the destruction of its greatest canal, the Nahrawân, and the consequent widespread desolation which was produced:

What was the real cause of the ruin of all this agricultural wealth and these great cities, and the creation of the vast deserts which we see to-day? An examination of the map will make it evident. Those who have seen the headworks of the Ganges Canal at Hardwar in northern India, where the rubble weirs across the shingly bed of the Ganges lead the stream past Hardwar into the Ganges Canal above the steep bluffs of Kankhal, will readily understand what I am going to say. Let such imagine what would be the fate of the great Ganges Canal if the Ganges River were to desert the Hardwar channel, flow down the Budh Ganga, and then turning abruptly westward eat away the Kankhal bluffs until the canal was cut into by the river. It would mean ruin to the whole canal with its 500 kilometers of main channels and 3,500 kilometers of minor channels. Such a fate has overtaken the Nahrawân Canal.

The Tigris has a mean width of under 400 meters, according to information kindly supplied me by M. Moritz, librarian of the Khedivial Library at Cairo, while the lower heads of the Nahrawân Canal have a mean width of about 100 meters each, according to the plans of Commander Felix Jones. To insure the supply of this great canal we are, moreover, informed that the Tigris has constructed across its ancient bed, downstream of the intake of these feeder canals, massive rubble weirs. To me it seems conclusive that, in Chaldea's evil day, the main stream of the Tigris deserted its ancient bed, followed the scoured and degraded bed of the canal whose regulating head had been swept away, and cut out a new channel for itself at right angles to its old course. A careful examination of the plans and levels can lead to no other conclusion. Once the river had changed its course, the old bed gradually

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[a] Willcocks, Sir William. The Restoration of the Ancient Irrigation Works on the Tigris. Cairo, National Printing Department, 1903.

silted up, the river ate away the feeder canal at the site of the regulator whose ruins to-day are in the bed of the river, and again ate away the main Nahrawân itself between the seventieth and eightieth kilometers. The ruin was complete. Feeble hands did what they could to repair the disaster. The Beldai dam across the Dyála was strengthened and the head of the Nahrawân Canal was removed to its one hundred and fifty-second kilometer. The feeble supplies of the Dyála River could alone be depended on, the Tigris gave no aid from its ample waters, and a once flourishing and world-renowned region became a desert. The ruin on the west bank was equally great. The weirs which had held up the waters of the Tigris in order to feed the canals were turned and the mighty canals dwindled away into the feeble water courses of to-day. Commander Felix Jones well observes: "The summit of Opis, as we gaze around, affords a picture of wreck that could scarcely be conceived if it were not spread at the feet of the beholder. Close to us are the dismembered walls of the great city, and many other mounds of adjacent edifices spread like islands over the vast plain, which is as bare of vegetation as a snow tract and smooth and glass-like as a calm sea. This appearance of the country denotes that some sudden and overwhelming mass of water must have prostrated everything in its way, while the Tigris, as it anciently flowed, is seen to have left its channel and to have taken its present course through the most flourishing portion of the district, severing in its mad career the neck of the great Nahrawân artery, and spreading devastation over the whole district around. Towns, villages, and canals, men, animals, and cultivation must thus have been engulfed in a moment, but the immediate loss was doubtless small compared with the misery and gloom that followed. The whole region for a space of 400 kilometers, averaging about 30 kilometers in breadth, was dependent on the conduit for water, and contained a population so dense, if we may judge from the ruins and the great works traversing it in its whole extent, that no spot on the globe perhaps could excel it."

Of those who were spared to witness the sad effects of the disaster, thousands, perhaps millions, had to fly to the banks of the Tigris for the immediate preservation of life, as the region at once became a desert where before were animation and prosperity. The ruin of the Nahrawân is indeed the great blow the country has received. Its severity must have created universal stupor, and was doubtless followed by pestilence and famine of unmitigated rigor, owing to the marshes which accumulated annually in the absence of the dams on each spring rise of the river.

It is interesting to read what the trained imagination of Mr. Willcocks foresees will be the result of the restoration of these ancient irrigation works on the Tigris and his entirely preliminary estimate of the expense necessary to restore them. An outlay on canals and repairs of £8,000,000, he figures, will throw over a million and a quarter acres under cultivation, raise the value of the land which is now worthless to $150 per acre, and pay a profit in rentals of 25 per cent per annum on the investment of $40,000,000.

On page 17 of the volume cited Mr. Willcocks remarks:

To enable a true estimate to be made of the exact nature of the works and their cost, there lies much information to be collected by brigades of engineers working under a capable chief—such information as only experts can gather through months of patient observation and field work—exact gauge readings of the Tigris, Antheim, and Dyâla rivers; discharge diagrams; analyses of the waters of the rivers; field maps of the soils; contoured maps of the country on which to lay down the alignments of the canals, and the dimensions of the cross-drainage works; soundings of the rivers and borings of their beds; examination of the building materials available to enable designs to be made of regulators and escapes, weirs and locks, syphons and superpassages, and all the details which accompany a well-conceived project. Such works it will take a couple of years to collect; but I have not considered it unwise, with the aid of experience and prescience acquired in a lifetime of devotion to irrigation works, to make a rough preliminary estimate of what such works would cost and what would be their probable results, so as to encourage capital to pay for the collection of that detailed information whose outlines I have just described.

The area of first-class land, waiting only for water to yield at once a handsome return, I estimate as follows:

	Acres.
West of the old Tigris	280,000
Between the old and new Tigris	160,000
East of the Tigris, north of Bagdad	420,000
East of the Tigris, south of Bagdad	420,000
Total	1,280,000

The cost of the works, discounting all assets, I estimate roughly as follows:

Main canal, 200 kilometers by 500 square meters.........cubic meters	100,000,000
Earthwork, main canal	£2,000,000
Weirs on the Tigris	600,000
Masonry works, main canal, one-half the earthwork	1,000,000
Minor canals, 1,280,000 acres, at £3 per acre	3,840,000
Total	7,440,000
Add contingencies	560,000
Grand total	8,000,000
Cost per acre (£8,000,000 ÷ 1,280,000)	£7
Value of the land (1,280,000 acres, at £30)	38,400,000
Rent per annum (1,280,000 acres, at £3)	3,840,000

If of this sum nearly half is spent in maintenance of the canals, we have a net return of £2,000,000 per annum, or 25 per cent on £8,000,000 of capital. Let those who know Egypt say whether they consider such figures as too sanguine.

The date region of the island of Bahrein is watered by several most remarkable springs, the fresh water of which must reach the island by submarine water courses. The largest of these springs is 100 feet across and 27 feet deep, and flows a 2-mile-an-hour stream, with a cross section of 2 by 8 feet, or about 16,000 gallons per minute. This spring alone waters, the British vice-consul, Mr. Gaskin, states, about a half million date palms and if completely utilized could water almost as many more.

In Hassa, on the mainland, there are underground water courses, and the date palms which furnish the famous Khalasa date probably get their water from these underground sources. Zwemer describes vast areas in this region, now quite destitute of vegetation, where 3 or 4 feet below the surface an abundance of sweet water is obtainable.[a]

The river Lowadi flows through Minab, and the plantations of this date region are irrigated by it, according to the statement of a resident of Bunder Abbas, the nearest port.

[a] Zwemer, S. M. Arabia, the Cradle of Islam. New York, 1901, p. 112.

The method of irrigation used in the Pangh Ghur region, where the famous Mozaty date is grown, must be most peculiar, for, according to Lieutenant Grant, the system of canals is largely subterranean, and innumerable wells tap these underground water courses, which are tunneled through the soil at great expense. The levels are so carefully studied that land which is apparently, though not really, at a higher elevation than the supply well is furnished with water.

SECONDARY CULTURES BETWEEN THE PALMS.

One may look in vain for a cover crop in use in the date plantations. The use of leguminous plants to enrich the soil seems to be unknown, and although alfalfa (called "djet") is grown in diminutive patches to furnish food for the horses, the fellah, or Arab cultivator, is generally ignorant of its value for enriching the soil. Wheat and barley are often sown among the palms, but furnish an inferior product. (Pl. II, fig. 2, and Pl. IV, fig. 1.) The planting of grapevines has been most successful in Bassorah, and the palm stems form quite as admirable supports between which to train the vines as do the trunks of the mulberry trees in the groves of Italy and the Tyrol. The light shade furnished by the trunks and crowns of the palms appears to be none too much to protect the vines from the excessive glare and heat of the sun, and most excellent table sorts of grapes are produced. Other fruit trees, such as figs, jujubes, and pomegranates, are also frequently seen about the houses, and thrive very well. Altogether, however, there is a barrenness about these palm forests which reminds one of the Australian bush.

TREATMENT OF THE SOIL AND PLANTING OF YOUNG PALMS.

Though pure silt, like that of the Nile Valley, the soil on the Shat-el-Arab is manured to make it more productive and, whether rightly or wrongly, only cow manure is considered suitable, that from the horse stables being regarded as too heating. Such things as artificial fertilizers are quite too modern for Arabia, and the value of wood ashes and bone dust is scarcely appreciated.

Just before a plantation is set out with suckers the soil is dug over by hand to a depth of 18 inches, and this digging is repeated every four years. Weeding is done when necessary and the surface of the ground occasionally stirred, but aside from this primary treatment the soil is given very little attention.

In the matter of propagation the Arabs of Mesopotamia are more advanced than the Egyptians, for they have learned the practical advantage of employing small suckers. These are seldom over 6 feet long and generally with few roots. They are planted with the growing bud 2 or 3 inches above the surface of the soil, and for the first month are watered every four days, and later at longer intervals, as the season may demand.

There are thousands of seedlings called "degal," but these form a small proportion of the plantations and are recognized as bearing inferior dates. The market demand is for special uniform qualities, and these seedling dates are excluded because of their variability. A curious belief exists that date seeds, if immersed for a few seconds in water heated to nearly the boiling point before planting, will produce a much larger percentage of female trees than when planted in the ordinary way.

POLLINATION.

The dates were in flower in the middle of March at Mohammerah, and at Bahrein hundreds of female blossoms which had been already tied up with the sprig of male inflorescence inside were seen. Instead of tying about the female inflorescence a thin strip of palm leaf, as is done in Egypt and Algiers, the upper part was wrapped with a piece of the brown fibrous material which grows between the leaf and the trunk of the date palm. A single male tree yields sufficient pollen to fertilize the flowers of one hundred female trees, but there are especially productive male varieties whose pollen is more abundant, powerful, and has better keeping qualities than others. The names of three of these, as given by Mr. Raphael Sayegh, of Bassorah, to whom the writer is indebted for some valuable information, are: "Gunnami" (S. P. I. 8749[a]), "Wardi," and "Semaismi." Of these three, the first, "Gunnami," is considered the best, and is the only one which the old veteran date grower and buyer, Hadji Abdulla Negem, of Abu Kassib, would recommend for planting. At Maskat, or the date valley of Semail, in the interior, a special variety of male is planted, but so far as could be learned it has no name except that of "Fachl" (S. P. I. 8761[a]), which means "male." In the region back of Guadur, called Kej, the male variety in use is called "Gush" (S. P. I. 8763[a]). As young male plants of the best variety in each locality have been secured for introduction, it will be interesting to learn which sort will thrive best in America.

Whether or not the method of pollination which has been in practice for perhaps six thousand years is really the most economical one may be doubted, and some more effective way will possibly be discovered in the New World, which has already made so many improvements in methods of agriculture.

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[a] The numbers in parentheses are those given by the Office of Seed and Plant Introduction and Distribution, U. S. Department of Agriculture, to the specimens sent to America.

DIFFERENT VARIETIES OF THE REGION.

There are hundreds of varieties of dates in the Persian Gulf region, nearly every seedling being more or less different from its neighbor; but those which have been propagated by suckers and are more or less commonly known by the shippers number only about twenty or thirty. It would be foreign to the purpose of this paper to list all of these dates, although the time may come when it will be worth while to examine them all and to station an expert in the region during the fruiting season to search for superlative seedling sorts, or even with the hope of finding among the thousands of seedling trees a single one which bears a seedless fruit of fine quality. Seedless varieties which are not the result of imperfect fertilization are believed to exist. Mr. Sayegh showed the writer, in fact, on his own plantation, a single tree, unfortunately without suckers, which he says has regularly produced, even when properly pollinated, seedless dates of fair quality, though ripening late in the season.

The dates which are exported to the various European and American markets are not the most delicious varieties grown in Arabia and Persia, but simply good packing and shipping kinds. Different markets demand different varieties, and the principal market kinds for Europe and America are the "Halawi," "Khadrawi," and "Sayer" of Bassorah, the "Kursi" of Bagdad, and the "Fard" of Maskat. Indian and oriental markets call for quite different sorts from those known in America, generally of the dry and boiled class, and such kinds as the "Zehedi," "Brehm," "Chupchap," and "Mubsli" are exported to Bombay and Singapore, while for general home consumption the "Zehedi," of Bassorah and Bagdad, the "Gardiwahl" and "Murdasing," of Minab, and the "Batna" kinds grown along the coast of that name on the Gulf of Oman, are the commonest. Aside from these dates, which are good shippers, there are a large number of kinds which are highly prized for eating fresh from the tree—"rattab" as they are called in Arabic. The best of these are likely to prove of special interest to the date growers of America, where easy access to large cities will make the creation of a market for fresh table dates a possibility. Unfortunately, the notes secured on the comparative excellence of these different rattab varieties had to be taken second hand, as the visit of the writer to the Persian Gulf was made in March and the dates in this locality ripen from June to October. There are, further, no Europeans in the region whose interest in these fresh varieties has prompted them to make a study of their qualities. In the spelling of the different names, even, much variation exists, as it is often difficult to find the equivalent letter for an Arabic sound and all words are spelled phonetically. There is considerable variation in the Arabic pronunciation as well. The continental value of the vowels has been taken in spelling the names in the list given below and the numbers which correspond with detailed descriptions that have been made out for the records of the Office of Seed and Plant Introduction and Distribution and which accompany young plants or seeds of the various sorts that have been sent to the United States Department of Agriculture or to the trial gardens in Arizona have been put opposite the names. The dried dates of some varieties have been secured to assist in the meager descriptions.

BAGDAD VARIETIES.

Kustawi. (S. P. I. 8738[a]). A medium to large, oblong, soft, sticky date, ripening in August, with stone of small size and little or no fiber or "rag." Skin a light golden brown, very delicate in texture and adhering to the soft golden flesh, which is of exquisitely rich, sweet date flavor. Too delicate for packing in the usual way, though keeping well until April. Said to be fairly productive, but a delicate tree, suited to adobe soils with an admixture of sand, and will withstand a temperature of 17° F., or possibly lower.

Ascherasi. (S. P. I. 8739.) A medium-sized, ovate, semidry date, ripening in September, generally not sticky, but easily handled without soiling the fingers. Stone small in comparison with the flesh. Some fiber, but not an objectionable amount. Skin of stem end dry, straw colored, but at tip translucent and of amber hue; of medium thickness and closely attached to the rather hard but sugary, sweet flesh, which is of excellent flavor. As seen in March in Bagdad, these dates are not packed in mat bags or boxes, but are sold in dry shape. Grown in adobe soil, and reported to be a vigorous sort, hardy at 17° F., or even lower, and in special favor among both Christians and Mussulmans, the former of whom, however, prefer it to all other sorts to eat with English walnuts.

Bedraihe. (S. P. I. 8740.) A small, ovate to oblong, dry date, ripening late in September. Not at all sticky, with good-sized stone, and more or less fiber about it. Skin straw color, with occasional translucent amber-colored spots near the tip; of parchment texture and sticking closely to the dry flesh, which is full of sugar. Not packed, but allowed to dry on the tree, though when fresh of soft consistency like ordinary sorts. Eaten as commonly by Bagdadians as any sort of date; easy of cultivation and capable of withstanding a winter temperature of 17° F., and possibly lower. Grown in adobe soil by irrigation.

Maktum. (S. P. I. 8741.) According to the description given the writer, a superior sort of the "Kustawi," but resembling it closely,

[a] The numbers in parentheses refer to the records of the Office of Seed and Plant Introduction and Distribution, U. S. Department of Agriculture.

being a soft, sticky date, with small stone, no fiber, and a beautiful golden-brown skin which adheres closely to the golden, brownish-yellow flesh. The sort ripens probably about the same time as the "Kustawi," i. e., in August, and is doubtless a delicate variety to cultivate. This date is considered by the Arab sheik Abdul Kader Kedery, of Bagdad, one of the best two sorts in Arabia.

Burni. (S. P. I. 8742.) A small, short, oblong date, ripening in July or August in Maskat. When fresh, highly appreciated as a table date, but generally boiled to form the "Karak pokhta" before fully ripe. Formerly shipped to America from Maskat. It is thought that this variety is of Maskat origin, for it is little known in Bagdad. It will probably prove more susceptible to cold than other sorts from Bagdad. Grown in adobe soils.

Zehedi. (S. P. I. 8743.) A small, oblong, dry date, ripening in September to October. Stone of medium size and surrounded with considerable fiber. Skin straw colored and tough, sticking closely to the dry but sweet, mealy flesh of fair flavor. Sometimes packed in bags or cases and called "Kursi," but generally allowed to dry on the tree. This is said to be the hardiest, most resistant to drought and alkali, and one of the most productive palms in the region. Although considerably inferior to the "Bedraibe," it nevertheless develops so quickly and yields so heavily that it is very commonly planted. Often sold fresh attached to the clusters as "Zehedi gus." In the form called "Kursi" it is of a golden-yellow color, but much inferior in flavor to "Kustawi" or "Khadrawi." One of the commonest dates in Bagdad.

Barban. (S. P. I. 8744.) A date ripening at Bagdad, according to information given by a grower, in July, and of only mediocre quality. Very dark in color and not very sweet. Rarely cultivated in the region and not well thought of generally. Valuable principally for its early ripening habit and probable resistance to cold.

Sukeri. (S. P. I. 8745.) A very large date, 2 inches or more in length, and, when fresh, of excellent quality. Rarely cultivated and the writer could not learn much about it, except that it is not a good variety for shipment.

Taberzal. (S. P. I. 8794.) From dry specimens sent in, the writer was unable to obtain a good idea of this date, but should describe it as a small, oblong, soft variety, which ripens late in September. It has a small stone, no fiber (or at least extremely little), and a dark, amber-colored skin, which separates readily in dry specimens from the dark-brown flesh. The latter is of a caramel consistency, but has a most delicious flavor, and the variety can be eaten without soiling the hands, as the skin is quite dry. When fresh, said to resemble very closely the "Berhi," of Bassorah, though when dry there is scarcely any resemblance. A rare date in Bagdad, but very highly thought of there. This fruit was not seen on the market and only seeds were obtainable during the writer's short stay, but suckers may possibly be obtained through correspondence with the United States vice-consul, Mr. Rudolph Hürner, of Bagdad.

Mirhage. A variety reported to be grown in Mandalay, some three days' journey from Bagdad. Sheik Abdul Kader Kedery, of Bagdad, said it was the finest date he knew, resembling the "Maktum," but of even finer quality. It was not obtainable during the writer's stay, but may possibly be had by correspondence with the United States vice-consul in Bagdad.

BASSORAH VARIETIES.

Berhi. (S. P. I. 8746.) Considered by many as the best soft date in the region. Of medium size, not so sticky as the ordinary dates, with small stone, no fiber, skin of amber to golden brown, of thin but firm texture, tightly attached to the soft, luscious, rich-flavored, brown flesh. The most productive of all sorts in the Bassorah region, according to Hadji Abdulla Nigem. Up to the present time not exported, but sure to form one of the highest-priced export dates to America because of its dry skin and exceptional lusciousness. An easy variety to cultivate, but requiring an abundance of water. Grown in a stiff adobe soil.

Herezi. (S. P. I. 8747.) A date resembling the standard market sorts like "Halawi," but of a much more delicious flavor. Samples sent to New York were pronounced by date buyers the finest dates they had ever tasted. Color light, size medium, ripening in September in Bassorah. A little-known sort from Abu Kassib, the Bassorah date center.

Sayer (or *Ustaamran*). (S. P. I. 8748.) A soft date of medium size and dark color, with medium-sized stone and a small amount of fiber. One of the sorts at one time exported to New York; now superseded by others. Said to do best on a light, sandy soil and to require less water than the ordinary varieties.

Halawi. (S. P. I. 8750.) There are probably as many bearing trees of this one sort in Mesopotamia as of any other, as it is the great shipping date and the favorite on American and London markets. It is a medium-sized, soft date, of sticky consistency, and ripens in September. The stone is medium to small; there is little fiber present, and the light-brown skin of delicate texture sticks closely to the flesh, which is abundant and of a deep-brown color, golden toward the stone. It possesses a strong date flavor and is of unusual sweetness. It is one of the best packing dates, as it keeps well and can be sent all over the world. A fairly productive sort, but confined in its culture to an adobe soil with plenty of water. It is not grown outside of the Bassorah region, it is said.

Khadrawi. (S. P. I. 8751.) A longer-shaped, darker-colored, softer date than the "Halawi," but ranking second among the export varieties and maturing in September. It is not of so rich a flavor as the Halawi, which it resembles in other respects, but may prove more adaptable to the conditions in Arizona and California.

HASSA VARIETIES.

The few hours spent in Bahrein, in the pearl islands, which lie 55 miles or so from Hassa, made it expedient for the writer to confine his attention to securing a single superlative variety, for which an arrangement was made through the kindness of the British Consul, Mr. Gaskin. There are doubtless inferior dates in Hassa.

Khalasa (or *Khalasi*). (S. P. I. 8753.) A medium-sized, ovate, sticky date, with small stone and no fiber, ripening as early as August in the region of Hassa. The skin is a golden brown and of most delicate texture, covering closely the rich golden flesh, which is of exquisite date flavor and with the consistency of a chocolate caramel. Said to be a delicate packer, and never exported except in the form of presents. It has the renown all over the Persian Gulf region of being the most delicious date in the world. Of its productiveness or hardiness little is known, but it is probable that a sandy will suit it better than an adobe soil, as it comes from the sandy region of Hassa, which is fed by underground water courses. This variety probably requires surface irrigation also.

JASK VARIETIES.

It was possible to learn only the names of the best dates grown in the interior behind Jask from the gardener of the Persian telegraph station at that place. They are called "Kharoo," "Shakari," "Nimkadami," and "Zarek," and the "Shakari" is said to ripen some of its fruits in May (?). The former director of the telegraph station, Mr. G. W. Mongavin, stated that at Bashkhara, five to six days' camel ride into the interior, some very superior dates are grown, but he could not give their names.

BUNDER ABBAS VARIETIES.

Minab is the date region of which Bunder Abbas is the nearest port, and according to the "dabach," or ship's chandler, who has lived in the region, the best-known sorts are the "Halawi," "Gardiwahl," "Murdasing," and "Fard." The most superior of these is said to be the "Murdasing."

MASKAT VARIETIES.

Fard. (S. P. I. 8754.) One of the commonest dates in the American markets. More than 1,000 tons are said to be exported from Maskat every year, coming from the Semail Valley, 50 miles in the interior. A medium-sized date, longer and narrower than the "Halawi" or "Khadrawi," and belonging to the soft, sticky type. Stone medium large, with little fiber about it. The skin is of firm texture and dark brown in color, fitting closely to the deep amber-colored flesh, which is of a strong, rich, date flavor, but not of quite such fine texture as the "Halawi" or "Berhi." As a packing date it is the best in the region, although maturing late in the season for Maskat, i. e., in August. It is adapted to the hottest regions of America and probably to a sandier soil than that suited to the "Halawi."

Burni. (S. P. I. 8755.) See "Burni" of Bagdad (S. P. I. 8742) for the description of a date which the writer believes to be the same as this Maskat "Burni."

Nagal. (S. P. I. 8756.) A small, soft, sticky date, ripening before any other sort in Maskat—as early as June—and eaten exclusively as rattab or in fresh condition. It has a light-colored skin, and its flesh is inferior in flavor to "Fard," but it is keenly appreciated by Europeans as well as Arabs, because the first fresh date brought to the market. Of particular interest to American date growers, on account of its earliness, which may enable it to ripen good fruit farther north than the other sorts. Secured through the kindness of United States Vice-Consul Mackirdy at Maskat.

Mubsali. (S. P. I. 8757.) A long, narrow, unusually large variety, cultivated for boiling purposes. Stone large and with some little fiber about it. Prepared for market by boiling the still unripe fruits for an hour in water to which a large handful of salt per gallon has been added, and drying in the sun. After this preparation the flesh is hard and tastes like candy, but it is generally slightly astringent, particularly if improperly prepared. There is a large demand in India for this date, where it is used at wedding and other feasts, and big prices are paid for it, making it, it is said, the most profitable date grown about Maskat.

Khanezi. (S. P. I. 8758.) An almost globular date of the soft, sticky type, consumed locally in Maskat as rattab, ripening in July, and considered one of the best of the early dates. Not a packing sort, and keeping only a short time. From the valley of Semail, 50 miles in the interior.

Khassab. (S. P. I. 8759.) A soft, sticky date of red color, somewhat shorter than the "Fard" and ripening in August. Not shipped, but eaten fresh or soon after ripening. One of the heaviest yielders in the region, a single tree bearing, according to rough estimates, as much as 450 pounds. From the Semail Valley, and suited to culture in the hottest regions of the United States.

Hellali. (S. P. I. 8760.) A round date of the shape of an English walnut, but smaller, with light-yellow skin, borne in exceptionally large bunches. A rare sort even in Maskat, consumed locally as rattab and considered by the inhabitants as of excellent quality.

GUADUR VARIETIES.

It was impossible to secure much information regarding the region inland from Guadur. The port is that from which Pangh Ghur and Kej are reached by caravan; the former is thirteen days', the latter only six days' journey. Through the kindness of Lieuts. W. H. Maxwell and W. O. Grant, of the First Baluchistan Light Infantry, stationed at Kurrachee, a native Baluchistan servant was sent as far as Kej and secured from Rostom Khan, younger brother of the Nazim, or native ruler of the province, a collection of young plants of the best varieties grown there. These were brought down to Guadur, accompanied with labels bearing the name only, and comprising twenty-four varieties, among which was the famous "Mozaty." The fruit of this sort is sent to Kurrachee sometimes as a delicacy, and is packed in small earthen jars preserved in the sirup of inferior dates. As eaten in Kurrachee in February they impressed the writer as the richest-flavored dates he had ever tasted. The following list is made up from the labels found on the palms, though there may have been some confusion of the names previous to the time of delivery of the plants:

Mozaty (or Mozati). (S. P. I. 8762.)
Gush, a male variety. (S. P. I. 8763.)
Apdandon. (S. P. I. 8764.)
Soont Gora. (S. P. I. 8765.)
Hashna. (S. P. I. 8766.)
Gonzelli. (S. P. I. 8767.)
Jalghi (or Jalka). (S. P. I. 8768.)
Bagum Jurghi (or Junghi). (S. P. I. 8769.)
Shukkeri. (S. P. I. 8770.)
Koroch. (S. P. I. 8771.)
Hallani. (S. P. I. 8772.)
Shapego. (S. P. I. 8773.)
Dishtari. (S. P. I. 8774.)
Chupshook (or Trupshook). (S. P. I. 8775.)
Korroo. (S. P. I. 8776.)
Rogani. (S. P. I. 8777.)
Churpan. (S. P. I. 8778.)
Kharba. (S. P. I. 8779.)
Dundari. (S. P. I. 8780.)
Subzoo. (S. P. I. 8781.)
Gond Gorbug. (S. P. I. 8782.)
Washelont (or Washelunt). (S. P. I. 8783.)
Kalara (or Kularu). (S. P. I. 8784.)
Hurshut (or Hurshud). (S. P. I. 8785.)

DISEASES AND PESTS.

Altogether, the palms of the Persian Gulf region are most remarkably healthy. So far as could be learned they suffer from no serious disease, and none of the shippers or growers could name a single malady which had at any time done much damage to their estates. On a few palms at Bassorah several leaves were observed that were attacked by a small ash-colored scale insect (*Parlatoria planchardi* Tar. Tozz.), which is common in other parts of the world; but even this was doing little damage. In comparison with the palms of Egypt and Algeria they were most strikingly clean and healthy looking. The dry dates are often attacked in the storehouses by an insect (which the writer was unable to see) which leaves an excrement in the cavity near the stone, but the soft varieties in this region were remarkably free from insects of any kind.

One might imagine that there would be during the date season a host of birds and small animals which would feast on the ripening dates, but curiously enough the growers were not able to name a single troublesome pest of this character. Even the date bird is not believed to live on the dates; at any rate does no serious damage.

The principal enemy of the date in Mesopotamia is the "shamál," a wind blowing across the desert laden with hot sand. If this occurs before the dates have sufficiently matured it dries them up and covers them with dust, checking their development and soiling them so that they are refused by the European and American importers. Last season's crop (1900) at Bassorah was seriously injured in this way, and the writer was told that the export was reduced from nearly 2,000,000 to about 1,000,000 cases.

COST AND PROFITS OF DATE CULTURE.

Twenty years ago in Mesopotamia handsome profits were made by Europeans in the date packing and shipping business, but of recent years the native-born Jews have learned how to pack, and have seriously reduced the gains to be made in date exporting. The representative of one of the largest concerns at Bassorah informed the writer that last year some of the packers actually carried on business at a loss in order to keep their brands on the market, and that very small profits were made by any of the firms. This was owing to the poor crop and a glutted home market, with many cases left over from the preceding year.

With the date grower, matters are somewhat different. His expenses for the maintenance of the garden are small and the cost of marketing the product slight, so that he realizes, according to a conservative estimate given by the manager of one of the large firms in Bassorah, on an average about 5 to 6 per cent profit. In an especially good year his profits might reach 10 per cent, but would hardly surpass this figure. It is next to impossible to find out how well date culture pays in this region, for the Arabs do not keep careful books of their expenses. From a reliable source, however, it was ascertained that one large proprietor netted last year—which was, however, an exceptionally bad season—less than 2 per cent on the estimated value of the estate. So it is evident that the profits of date growing on the Shat-el-Arab are no more sure than those of any other agricultural business.

The mudir, or business manager, of the Sultan's large estates at Amara remarked that the Turkish Government levies a tax of 2 piasters (about 8 cents) per year on every palm in Bagdad, $1\frac{1}{4}$ piasters in Amara, and from 15 to 180 piasters per hundred palms in Bassorah, according to the location and bearing condition of the trees. This does not, however, in any sense represent the full amount of taxation to which a date planter is subjected, for there are many ways by which the rate of 10 to 15 per cent—which is commonly spoken of as prevailing—is made up. The methods of its collection and the hindrances to quick transactions form no inconsiderable part of the heavy yoke which is imposed upon the Arab landowner in his own land. The large landowner suffers less proportionately than the small one, for he can prevent the overappraisement to which the assessors subject the poor and ignorant peasant.

PACKING AND SHIPMENT OF DATES.

Dates are no doubt one of the stickiest, most difficult fruits in the world to keep clean, and the Persian Gulf varieties are perhaps particularly hard to pack in an attractive shape; but nevertheless the stories which one hears in the region of the conditions in the packing sheds and the personal uncleanliness of the men, women, and children who put up the dates are enough to disgust a sensitive person and to prevent his ever eating packed dates again without having them washed. No old inhabitant thinks of eating a date without first thoroughly washing it in a glass of water, unless the cook has prepared it beforehand, and the sale of dates in America might fall off decidedly were it generally known how intimately the unwashed hands, bodies, and teeth of the notably filthy Arabs often come in contact with the dates which are sold by every confectioner. Shippers claim they have tried better methods of packing but found that they did not pay, for the Persian Gulf date is expected to be obtainable for about 5 cents a pound. From the small pound boxes which were used last year it would seem that the packers have not yet learned the art of making them as attractive as the Algerian dates, which fetch as high as 40 cents for a box of less than a pound. It is probably true that the common varieties in this region are too full of sirup to pack well in the way that such a sort as the "Deglet Noor," of Algeria, is put up, but it is almost certain that varieties can be found which could be treated in a similar manner and could compete with this superlative sort of North Africa. The length of time which the fruit is allowed to hang on the tree has presumably something to do with the stickiness of the skin, for there are in Arabia dates of good quality with dry skins, which, when packed in the ordinary way, are indistinguishable from the ordinary sticky kinds. Under present conditions there is little prospect of any radical change being made in the old methods of packing.

Scarcely any of the packing firms own date plantations, but obtain their dates from the Arab landowners through trusted Arab buyers. Some of these buyers, who have been in the business for many years, are intrusted with £10,000 to £20,000 in cash at a time, with which they purchase the tons of dates that are necessary to supply the packing sheds. As in most businesses of this kind, there are risks to be taken, for the packer must buy in August and sell in November, during which time the price may have fluctuated considerably. It requires good judgment to decide how much to pay in August for November delivery. The New York shipments to be most profitable must be in before Thanksgiving Day, and when this comes unusually early in the month the packers have their hands full to get their shipments through in time. Last season two steamer loads went direct from Bassorah to New York, and though, owing to the bad crop and glutted market, this venture did not prove a great success, the experiment will probably be made again the coming year.

THE DATE AS A FOOD.

The doctors seem agreed that sweet things in excess are injurious to the digestion, and the dentists claim that sugar ferments between the teeth, forming lactic acid which attacks the dentine; but for all this, it is doubtful if there can be found a sounder, stronger race, with better digestion and finer, whiter teeth than the date-eating Arabs. The town Arabs and the Arabs of the seacoast eat quantities of dried fish and other sea animals, but the denizens of the Arabian desert live almost exclusively upon dates and bread, with occasional feasts of sheep, goat, or chicken. Travelers across those deserts report that 3 pounds of dates and a few thin loaves of hard wheat bread per day will keep an Arab in good health for years. The quantity of these packed dates that a healthy Arab can consume at a sitting is astonishing. Two pounds would not be much more than an ordinary meal. The remarkable physique of the Arabs and their resistance to the almost unbearable heat of their country might be attributed, in part at least, to the nature of their simple food. At any rate, a thorough investigation of the food value of the date and its adaptability to the formation of foods for our hot summer season should be made, and possibly this wonderful vegetable product, which is now used in America only as a second-class confection, might be utilized as a basis of a nutritious new food. Such investigations will never be made in that part of the world where the dates are grown, but must be undertaken by some country like America which is interested in increasing the number of its food products.

31

PLATES.

DESCRIPTION OF PLATES.

PLATE I. (Frontispiece.) Fig. 1.—The old canal of Bassorah, which leads from the Shat-el-Arab River up to the town of Bassorah through plantations of date palms. Fig. 2.—A new plantation of dates at Bassorah, showing how closely to one another the irrigation ditches are run. Barley is grown on these areas in which the young palms have just been set. Fig. 3.—The border of the area at Bassorah which is watered by tidal irrigation. Patches of alfalfa grow on the newly irrigated areas.

PLATE II. Fig. 1.—An old date garden at Bagdad, the property of Sheik Abdul Kader Kedery, one of the richest date planters in the region. Fig. 2.—Irrigation ditches of a new plantation at Bassorah, showing the frequency of the canals, the nature of the soil, and in the background the primitive habitations of the date peasants. Fig. 3.—Typical village and date palms on the old Bassorah canal; in the foreground, the oriental gondola or "bellem," which is the principal vehicle of Bassorah.

PLATE III. Fig. 1.—A bag of Maskat dates, showing old method of packing for export. Fig. 2.—Typical date plantation at Abu Kassib, the most famous date center of Bassorah, belonging to Hadji Abdulla Nigem, the most noted date merchant of the region. Fig. 3.—Bassorah date peasant with his spade, the principal hand tool used in the date plantations of this region.

PLATE IV. Fig. 1.—Panorama, from Mr. Marine's house, of a new date area on the Shat-el-Arab River above Bassorah. The patches are planted with barley. Fig. 2.—Irrigation machines at work near Bagdad. In the foreground the ordinary primitive machine called a chird; in the background a more modern invention, resembling a chain and bucket pump, operated by horsepower. Fig. 3.—Intake of irrigation canal on the Tigris above Bassorah, showing how low the banks are and that no lifting of the water is necessary on this part of the river in order to fill the irrigating ditches. A Turkish guardhouse is seen on the left.

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FIG. 1.—OLD DATE GARDEN AT BAGDAD.

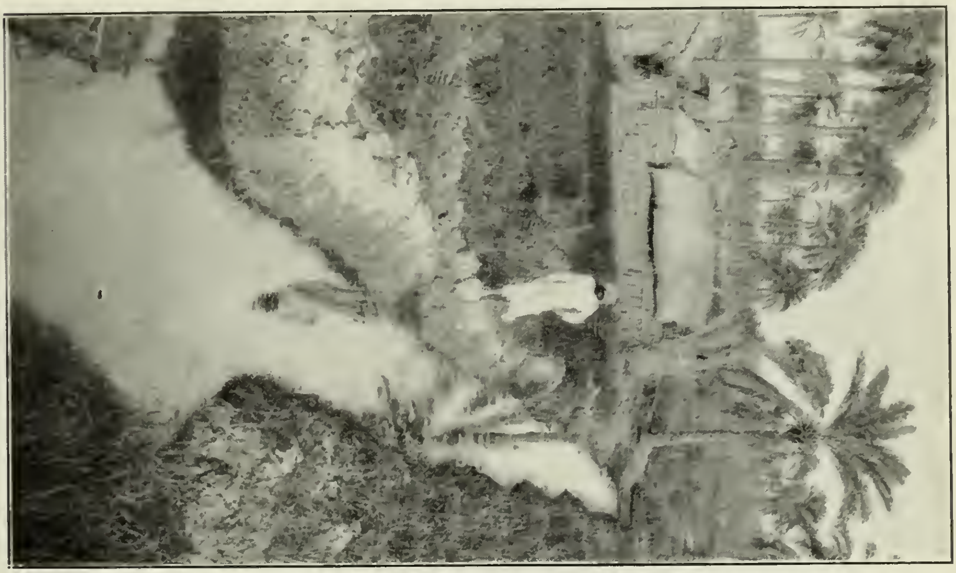

FIG. 2.—IRRIGATION DITCHES IN NEW PLANTATION, BASSORAH.

FIG. 3.—VILLAGE AND DATE PALMS ON THE OLD BASSORAH CANAL.

FIG. 1.—A BAG OF MASKAT DATES.

FIG. 2.—TYPICAL DATE PLANTATION AT BASSORAH.

FIG. 3.—BASSORAH PEASANT WITH HIS SPADE.

FIG. 1.—PANORAMA OF NEW DATE PLANTATION, NEAR BASSORAH.

FIG. 2.—IRRIGATION MACHINES ON THE TIGRIS, NEAR BAGDAD.

FIG. 3.—INTAKE OF IRRIGATION CANAL ABOVE BASSORAH.

HILL OF POTATOES PARTLY DISEASED BY THE DRY-ROT FUNGUS (FUSARIUM).

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN No. 55.

B. T. GALLOWAY, *Chief of Bureau.*

THE DRY ROT OF POTATOES DUE TO FUSARIUM OXYSPORUM.

BY

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AND

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VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

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3

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., December 7, 1903.

Sir: I have the honor to transmit herewith the manuscript of a technical paper on "The Dry Rot of Potatoes Due to Fusarium Oxysporum," by Erwin F. Smith, Pathologist, and Deane B. Swingle, Assistant in Pathology, Laboratory of Plant Pathology, Vegetable Pathological and Physiological Investigations, and recommend its publication as Bulletin No. 55 of the series of this Bureau.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

Studies on the widely prevalent dry rot of the potato have been carried on in the Laboratory of Plant Pathology in this Department for some years. It is now believed that the cause has been discovered, together with a method of storing diseased tubers which will reduce the winter loss to a minimum.

The results of the field experiments showed that the use of ordinary fertilizers, while favoring the growth of the potato, did not tend to make the plants resistant to the disease. It was observed, however, that some hills were more resistant to the disease than others, and it is believed that by the continued selection of resistant plants in badly diseased fields a hardy strain of potatoes can be obtained, and an effort will be made to do this. The bulletin also points out the fact that many fields are already permanently seeded down to the organism which causes this disease, and methods are suggested for avoiding the extension of the disease to uninfected fields.

A number of interesting points in the life history of the fungus have also been worked out. Whether this disease is identical with the "sleepy disease" of tomatoes, as the writers think probable, remains to be determined by cross inoculations.

ALBERT F. WOODS,
Pathologist and Physiologist.

OFFICE OF VEGETABLE PATHOLOGICAL AND
PHYSIOLOGICAL INVESTIGATIONS,
Washington, D. C., December 5, 1903.

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

B. P. I.—88. V. P. P. I.—114.

THE DRY ROT OF POTATOES DUE TO FUSARIUM OXYSPORUM.

INTRODUCTION.

Dry rot of the potato has long been known both in this country and abroad, but the real cause of the trouble was little understood until recent years, the first work of importance having been done in Germany.

Undoubtedly a number of diseases due to very different causes have been included under this name in different sections of this country, but there is no doubt that the disease here described has been for many years one of the chief causes of dry rot. Potato troubles characterized by browning of the flesh have been recorded by numerous workers, but the descriptions have been for the most part so incomplete that it is in nearly all cases quite impossible to say whether the diseases described were identical with this or not.

In Illinois, Clinton observed "bundle blackening" and "dry end-rot," but does not appear to have found these diseases serious or to have connected either of them with conditions originating in the field. Of the first, he says:

> This is a fungous trouble of stored potatoes. * * * The fungus gains entrance probably after the potatoes are gathered, through the dead stem, and proceeds from this through the bundles, causing them to turn black as a result of the attack. While not a very serious malady, it is objectionable, as it opens the way for other fungi and bacteria so that often tissue in the neighborhood of the affected bundles becomes diseased and a general rotting is started. It may also cause a slight waste and some trouble in cleaning potatoes for use. The fungus is quite similar to the one causing the following trouble [dry end-rot].

Of the latter, he says: "As in the preceding case, the trouble begins at the stem end, the fungus gaining entrance after the rupture of the tuber from the plant." This disease is correctly ascribed to *Fusarium solani*, and storage of the tubers in a dry, cool place is recommended.

Stewart, under the title "Another stem-blight of potatoes," has very briefly described a disease that is also probably the same, although in a second bulletin he makes the following statements:[a]

The potato stem-blight herein discussed is the one discribed by the writer in Bulletin No. 101 of this station, pages 83–84. The symptoms of the disease, as there given, are as follows: "First, there is a cessation of growth. The topmost leaves take on a yellowish, or, in some cases, a purple color, and roll inward from the edges upward, exposing the under surfaces. This condition is followed by wilting and complete drying up of the entire foliage, the process taking from one to three weeks. The tubers appear to be sound, but, when cut at the stem end, blackened fibers are seen penetrating the flesh to a considerable distance, materially injuring it for cooking purposes. No rot develops in the tubers. The stem just beneath the surface of the soil first shows discolored spots and later becomes dry and shriveled."

This disease has continued to be destructive in 1896 and 1897, but the cause of it is still unknown. Formerly a species of Oospora was suspected of having some connection with it, but it is now very doubtful if any organism is responsible for the trouble. The portion of the stem which is below ground is quite evidently the seat of the disease, but no fungus hyphæ can be found in the tissues of this part of the plant in the early stages of the disease; neither are bacteria abundant, and the few which are found in the tissues may easily have gained entrance after the death of the stem. Numerous petri dish cultures of tissue from the interior of diseased stems were made with varying results.

The best work has been done in Germany. Wehmer has given a very interesting account of inoculation experiments with a *Fusarium* called *F. solani*. He found that this *Fusarium* may enter through a fresh wound if either spores or pieces of potato affected with the same disease be placed on the raw surface; also that in some cases contact rot may take place through the unbroken skin if a mass of the actively growing mycelium be placed on it. He entirely misses, however, the very important fact that normally in the field the fungus enters the tuber through the underground stem. Indeed, all of his experiments appear to have been made on tubers in the laboratory. After the fungus has entered, Wehmer finds that it destroys the tubers without the aid of bacteria, and that keeping them in dry air does not seriously retard its action. Wehmer was the first to clearly demonstrate the infectious nature of this fungus. Sorauer observed this disease or a similar one in the field, and believed *Fusarium* to be the cause, but did not demonstrate it. De Bary and others considered the fungus as purely saprophytic.

Fusarium on decaying potato tubers has been a familiar sight to the senior writer ever since he began to be interested in plant pathology, but until recently always associated with other fungi or with bacteria. Dry rot of potatoes as a distinct disease caused by *Fusarium* first came to his notice in October, 1899, when two barrels of tubers were received by him from Hubbardston, Mich. They were a very fine lot and apparently sound when received, the disease not having progressed to a noticeable extent at that time. They were stored in

[a] Stewart in Bul. No. 138, N. Y. Agr. Exp. Station, Geneva, N. Y.

barrels in a warm, dry cellar, where there was plenty of light. Two months later (December 10) they were examined. A very few were entirely shriveled and dry, and specked on the surface with tufts of white fungus. Very many more were partly affected, the diseased portion in all cases except five or six being at the basal end. Only three of the entire lot showed soft bacterial rot. All the diseased tubers except these three showed a blackening in the vascular ring and other characters described later in this paper. The potatoes were of two varieties—Carman, and another that was not determined but which was neither Early Rose nor Burbank. They were grown from tubers obtained somewhere in the East. Both varieties were affected with the disease. Other potatoes of these two varieties grown in the same field, but stored in a cool, damp cellar in Michigan, were not seriously injured by the disease. Examined in midwinter it was with difficulty that any cases could be found. In almost every instance the black stain remained confined to a very small region around the stem, and did not materially lessen the value of the potatoes. Inquiries of the housewife also showed that disagreeable black places, so common in the badly affected tubers, had not been found in the cooked tubers.

Most of the potatoes in which this disease was studied were raised on the Potomac Flats, Washington, D. C., in the summer of 1902. Three varieties were planted—Burbank, Early Rose, and an unknown variety, designated for convenience, owing to certain characters, as "Brown." They were planted April 16, 1902, in rows both ways, in 24 large plots and 6 smaller ones, the larger plots having 5 rows of 20 hills each and the smaller ones 5 rows of 5 hills each. The hills were 3 feet apart each way and the distance between the plots was 4½ feet. The land used was a rich sandy loam (dredged river mud) that had been planted to watermelons the year before. It was nearly level, having only a very gradual slope to the southeast. There was a plantation road on two sides of the patch.

The following fertilizers were used: Freshly slaked lime, dissolved boneblack (16 to 18 per cent phosphoric acid), nitrate of soda, muriate of potash, and sulphate of potash. Exclusive of the "Browns," four large plots were devoted to each fertilizer, two receiving heavy doses and two moderate doses. Burbanks were planted on one of the heavily treated plots, and Early Rose on the other. The same varieties were planted on the lightly treated plots. Of those fertilized with lime, two plots received 25 grams and two 75 grams to the hill. Of the other fertilizers the amounts used were 8 grams and 16 grams to the hill for these two varieties. For the "Browns," which were in the smaller plots, only one amount of each fertilizer (the larger) was used. There were two check plots containing no fertilizer for the Burbanks, two for the Early Rose, and one for the "Browns." The fertilizer was dropped in the furrow and mixed well with earth, and on this the potato was dropped and covered with a hoe. In the case of the Burbanks and Early Rose only very clean, healthy-looking tubers were planted, and all but the smallest of these were cut longitudinally into two or four pieces, depending on the size. The "Browns" were affected with the "brown specking" described later, and were all cut in two.

Very marked differences were shown in the size, vigor, color, and habits of growth of the vines in the different plots, but that is a matter that need not be discussed here, the experiment being planned for quite a different purpose, viz, to check up Laurent's work on bacterial soft rot of the potato.

During the course of the season many of the shoots in all the larger plots were inoculated near the top by hypodermic injection with *Bacillus coli* and various other bacteria, but most of these inoculations (all of *B. coli*) had no more effect than would be caused by injecting the same quantity of water, and seldom was there any more serious result than a blackening of one side of the stem for a few centimeters below the wound. These inoculations can not be considered, therefore, as having had any influence on the progress of the *Fusarium* disease.

The disease began to show its effect on the foliage of a few hills about July 1, and by the middle of July it was quite noticeable on many of the plants. It did not seem to spread from centers of infection, but very frequently hills would be attacked that were entirely surrounded by healthy plants. There was little evidence that the disease spread from plant to plant through the soil. More and more plants continued to be attacked by the disease until the vines and tubers had completed their growth. From the fact that at the time the potatoes were harvested a very large per cent of them was affected, at least slightly, it would seem that the entire soil must have been infested with the fungus. There was very little soft bacterial rot and only a moderate amount of potato scab.

All of the "Browns" in the smaller plots were saved and about one and one-half bushels from each of the larger plots of Burbanks and Early Rose. They were put in canvas grain bags and stored in one pile in a rather warm, dry basement. There were 30 bags in all. The pile was made by laying one tier down on their sides and laying other tiers on top, and when complete was about twice as long as high. One end of each bag was against a board partition and the other exposed to the air. On top of the pile a few bags of cotton bolls were placed. This kept all the bags under about the same conditions of moisture. The bags being closely woven, the atmosphere between the tubers inside was very humid.

The potatoes were cut up and examined late in February and notes made on each individual tuber. The results of this examination will be given later in this paper.

EFFECT OF THE DISEASE ON THE PLANTS.

The disease ordinarily enters the plant through the roots and slowly spreads until the whole root system, a few centimeters of the lower part of the stem, the underground stems bearing the tubers, and the tubers themselves are invaded by the fungus.

The disease first becomes noticeable when the plants are about a foot high. The first indication to the casual observer that the plants are affected is a change in the appearance of the leaves. These assume a somewhat lighter green color than those of healthy plants, though they do not for a considerable time become decidedly yellow or brown. Along with this change in color the leaves lose to some extent their bright glistening appearance and look duller, and early begin to curl and roll up (Pls. I and II). Those that have not reached their full growth when the plant is attacked are somewhat dwarfed in size. The effect on the leaves does not, however, seem to be sufficient to stop or very seriously impair their work, and there is every evidence that in the first stages of the disease photosynthesis and respiration go on in a normal manner.

The stems above the ground do not show any evidence of being affected in the early stages of the disease. The color is normal, and there is no shrinkage; neither is there wilting of the shoots or leaves for several weeks after the disease begins. When the plants reach maturity the diseased vines that were attacked early are noticeably shorter than the sound ones. As the disease progresses the roots become so weakened that they can no longer hold the stems erect, and the latter, therefore, become prostrate in a manner that is very noticeable (Pl. III). This is especially the case if the earth has not been hilled up around the stems. Usually all the shoots in the same hill are affected, but such is not always the case, for not infrequently in the later stages some will be erect and to every appearance healthy while others have fallen down and have all the symptoms described above (Pl. I).

When the plants have reached this condition they can be pulled up with much greater ease than healthy ones, and an examination shows that all the smaller roots are so friable that they can be broken with almost no effort, and some can even be rubbed to pieces between the thumb and finger. The main root also is much more tender and brittle than that of healthy plants, and this condition extends nearly to the line marked by the surface of the ground.

Such diseased roots are usually covered with a white, pink, or even reddish growth of mycelium, which is distributed very unevenly and is much more conspicuous in some places than in others. Microscopical examination shows that this mycelium invades all parts of the root, though the bark is most affected. It is present in the water ducts, but it is not especially abundant there, as it is in the wilt disease of the watermelon, for example. The conidia are not formed in the early stages of the disease, and up to the time the potato stems have fallen over on the ground there are comparatively few. No perithecia and none of the mature sickle-shaped spores (macroconidia) characteristic of *Fusarium* were found on the roots of living vines. The mycelium does not extend up into the stems and leaves. Sections cut at the surface of the ground showed only very few hyphæ or none at all. There was, however, a marked browning of the tissues, particularly of the vascular ring. This browning usually extends only a few centimeters above the surface of the ground. The underground stems on which the tubers are borne are nearly always attacked, but they do not as a rule become so soft and brittle as roots of the same size. The mycelium passes through the whole extent of these underground stems into the base of the tubers. A detailed account of the effect of the fungus on the tubers will be given later.

As soon as the roots become so badly affected that they can no longer take up water and nourishment from the soil, a very marked change takes place in the leaves and stems. Up to this time, as has been previously stated, there is no wilting, but, now that the water supply is cut off, the foliage and the upper part of the shoots begin to droop and become flabby, and soon die and turn dark brown. Fortunately, the tubers have in most cases become ripe or nearly so (though usually prematurely), so that the crop from the diseased hills is not entirely destroyed.

In case the plants are not attacked until the stems and leaves have nearly reached maturity, the early symptoms of curling and dwarfing of the foliage do not appear. Even in such cases, however, if the roots are entirely destroyed before the tops have died down there are the later symptoms of wilting, but often the fungus grows into the tubers without causing any visible symptoms in the parts above ground.

As stated above, the fungus usually enters the tubers through the underground stems, though it occasionally gets in through wounds. As the tubers are so well protected from injuries by the surrounding earth the damage done by the disease entering in this way would necessarily be small.[a] Tubers examined much before the time of ripening were often found to contain the fungus at the basal end, showing that they may be affected while yet very immature, though there is little evidence that the growth of the tuber is thereby seriously checked. At the time the potatoes were harvested a very large proportion of those examined were found to be slightly affected, though the disease rarely extended into the potato more than three or four centimeters, and usually much less. At this time the disease was confined to the basal part of the vascular ring and appeared as a cinnamon-brown stain

[a] Except, perhaps, in continued wet weather. See footnote, p. 53.

extending inward irregularly, farther in some places than in others. There was very seldom any soft rot in those examined while they were being harvested, and the flesh inside and outside the vascular ring was white and perfectly normal as far as could be determined.

Tubers of all sizes are attacked. The fungus was often found in those not more than two centimeters in diameter, though probably a higher per cent of the large ones than of the small ones are diseased.

While the potatoes are in storage the fungus progresses inward farther and farther, at first following the vascular ring. This ring gradually changes from cinnamon-brown to nearly black in the parts affected. The discoloration becomes visible in the ring as fast as the hyphæ progress inward—at least the threads were never found in advance of the blackened part. The blackening does not, however, precede the advance of the fungus, as microscopical examination never failed to show threads in the most newly blackened parts, and numerous cultures made from the extreme ends of the discolored portions of the bundles very seldom failed to develop the fungus.

These cultures were made by carefully paring especially favorable pieces of diseased tubers with a hot scalpel, heating it nearly to redness before each stroke and cutting out pieces a few millimeters in diameter, containing a length of about two millimeters of the extreme end of the discolored part of the bundle. These pieces were cut from the main part of the specimen with the hot scalpel and allowed to drop directly into a tube of sterile culture media. Potato cylinders were used principally for media. Slant tubes of beef agar (+15 on Fuller's scale) also were sometimes used. One hundred and twenty-two cultures on potato and sixteen on agar were made, and in all but two cases on the potato and in every case on the agar the fungus appeared after a day or two as a white mycelium, sparse at first, growing directly out from the blackened bundles and spreading into the media. Forty-two cultures on potato and four on agar were also made from older parts of the discolored ring nearer the basal end, and of these all but one on the potato and all on the agar produced a growth of the fungus. Bacteria sometimes appeared in the cultures along with the fungus, and this was especially noticeable in those tubes in which the fungus did not come out, and was doubtless what kept the mycelium from developing further. These bacteria were probably, in many cases at least, intruders that got in while the cultures were being made. In other cases they probably developed from rods which entered the potato along with the fungus and did not find conditions favorable for growth until the fragments of potato were put into our culture tubes. In making a large number of cultures it is impossible to avoid occasional air-borne contaminations, but long experience has shown that in general we get in our cultures only what we put into them.

The fungus pushes its mycelium farther and farther into the vascular system until it has reached entirely to the eye end unless progress is interrupted by some change in the condition of the tubers.

The surface of the potato remains perfectly sound and normal during the early stages. Sometimes, indeed, the vascular ring is blackened throughout its entire extent before there is any external indication that the disease is present. Such potatoes might pass in the market, and as a matter of fact often do pass, as perfectly sound and healthy until cut open and examined. They are, however, quite unfit for use. Many such come into the Washington market every year.

If the diseased tubers be cut crosswise this ring may be seen to be blackened either continuously all the way around or in only a few isolated places (Pls. IV and V). Sometimes there is only a single dark band a few millimeters wide running through the tuber in the vascular system from end to end. A tangential section of the blackened ring shows that the color is much darker in some ducts than in others, giving it a veined or netted appearance. The thickness of the black ring is only very slight—seldom more than 1 or 2 millimeters.

As stated above, the flesh inside and outside the dark ring is at first white and apparently normal. After a time, however, a yellowish stain appears in places in that part of the flesh closest to the ring, either in the inner or the outer portion, and the fungus slowly spreads into these discolored portions. The discoloration seems, however, to keep a little distance in advance of the fungus, as no mycelium could be found with the microscope in the distal part of the yellow regions, nor did cultures made from such parts give any fungous growth. This process of discoloration, followed by the invasion of the mycelium, continues until, in many cases, the entire tuber is affected. If there is a cavity inside the tuber the fungus usually penetrates it and appears as a dense white growth (Pl. V) often bearing conidia. The hyphæ that push from the ring out toward the periphery break through the skin and first appear as a white growth on the surface. Whether or not these hyphæ ever bore directly through the cells of the skin is difficult to determine. It is certain, however, that they often break out through very tiny ruptures that seem to be the lenticels. More frequently the tubers are so shrunken by the time the fungus gets to the periphery that the skin folds and cracks, and the mycelium grows out through these openings in great abundance, appearing on the surface as dense white or gray-white tufts (Pl. VI). These soon bear small oval microconidia, and later the curved, septate macroconidia characteristic of the form-genus *Fusarium*. Occasionally, also, if the surface of the potatoes is kept moist, a compact, wart-like stroma, a few millimeters in diameter, is formed. Microscopical examination shows that this is made up almost entirely of a dense mass of chlamydospores. Perithecia were never found on any of the tubers. The formation of tufts on the surface seems to be favored by a moist atmosphere, as this phenomenon was much more common on the crop of 1902 stored in bags than on those received from Michigan and kept in open barrels. The appearance of the latter is shown in Plate VI, the shriveled tubers being very dry and hard, and many of them free from surface mycelium.

Along with the general discoloration of the flesh there is a very decided shrinkage of the tubers. This causes the skin to become wrinkled in the form of concentric rings about the stem end. If bacterial decay does not set in, the rot becomes drier and drier and the flesh turns darker and darker, the vascular ring, however, continuing to be the darkest, until the tuber is brown, dry, very light in weight, and often nearly as hard as wood, having a very characteristic musty odor entirely different from that of the bacterial decay.

The starch grains do not seem to be corroded by the action of the fungus, at least not promptly. In some tubers that were completely dry and shriveled the grains were notched over the entire surface, but in such cases there was probably a mixed infection of fungus and bacteria. Other fungi also may have been present as saprophytes. In tubers where the yellowing extended throughout only part of the flesh, starch grains were found in a tangled mass of the mycelium without any marks of corrosion. These grains were being acted upon by the fungus, however, for they stained purple with the iodine test, instead of blue, as do normal grains.

Though the fungus usually enters the tuber by way of the underground stem, in some cases it had clearly got in through wounds. Sometimes there would be two separate infections—one through the basal end, with a limited browning in the vascular ring, and the other through a wound in the side or the apical end. Often these two diseased regions would be separated by entirely sound white flesh. There were a few other cases where the tubers were infected through apparently unbroken skin by contact with diseased neighbors having tufts of white mycelium on their surfaces, but these cases were rare.

When the fungus has once gained entrance it spreads without any visible mechanical obstruction to its progress. Whether or not the cells produce any chemical substances that tend to check its progress has not been determined, but no corky layer is built between the diseased and the sound portions. The hyphæ sometimes go between the cells of the parenchyma for a short distance, but in most cases they penetrate the cell walls and ramify between the starch grains, apparently absorbing the protoplasmic contents and dissolving and assimilating parts of the grains themselves. Those hyphæ that follow the xylem ducts do not form a dense mass, filling the tuber, but push forward with little branching (Pl. VIII, fig. 34). A few small microconidia have been found in the ducts, but none of the septate, curved macroconidia.

The potatoes from Michigan stored in a very dry place were very little affected by other fungi or by bacteria. In the case of those raised in Washington and stored in bags, which kept them somewhat moist, several other fungi appeared, particularly *Stysanus stemonites* and *Acrostalagmus cinnabarinus*, in the cavities of those that were entirely dead and often worm eaten, and *Penicillium* and *Aspergillus* on the surface. None of these appeared to be true parasites, however, as they were always accompanied by either the *Fusarium* or a bacterial decay. More or less soft bacterial decay was present in all the bags, but this seemed for the most part only secondary, though the bacteria were often to be found in the blackened ring. In such cases they did not, when the flesh bounding the ring was white and sound, penetrate as far as the mycelium, as shown by microscopical examination and by the fact that poured agar plates from the most advanced part of the black-stained portion of the ring gave pure cultures of the fungus. When the bacteria were sufficiently vigorous in their attack they produced various kinds of soft rot, usually very vile smelling, that often consumed the entire tuber except the skin, which is very resistant to their action and also to that of the fungus. The bacteria, like the fungus, entered as a rule through the stem end, though there was occasionally a case of contact rot at the side, or the apical end, or in the vicinity of a wound. On the surface of the bags and on dead stems in the field two pyrenomycetous fungi were found, viz, *Melanospora ornata* and *Nectria brassicæ*, but neither could be connected with the disease. Mycelium cultivated from the ascospores of these two species grew badly on various media in which the *Fusarium* grew luxuriantly, and looked quite different.

In cases where there was a mixed infection of fungus and bacteria the black bundles could often be followed for long distances through the whitish macerated flesh, an indication that the infection by *Fusarium* had preceded the bacterial decay.

When examined in February most of the tubers, especially the Early Rose, bore sprouts several centimeters long, and these were often killed and blackened by contact rot, and sometimes even bore tufts of the fungus.

Another complication that was found in some of the tubers was a brown specking in the flesh. This specking is not confined to the vicinity of the vascular ring, though usually more prevalent there, but may be found in any part of the tuber, noticeably in the stem end, where it seems to originate. There may be specked regions entirely isolated and surrounded by white flesh, though such is not usually the case. Whether or not the *Fusarium* fungus is the primary cause of this trouble has not yet been determined. Microscopical examination, however, shows neither fungi nor bacteria. Cultures of the brown-speckled tissue made by cutting out pieces with a hot scalpel in the manner previously described did not, as a rule, develop any fungous mycelium. When this did appear it was almost invariably the *Fusarium* and was probably the result of a complication of the two troubles. Bacteria sometimes appeared in these cultures, but these were of such varied kinds and were so often absent that it seems probable that they accidentally got in when the cultures were being made. The brown specking may be due to a parasite—perhaps the *Fusarium*—but in any case the discolored regions themselves seem not to be infested.

EFFECT OF DIFFERENT FERTILIZERS ON RESISTANCE TO THE DISEASE.

For the purpose of determining whether or not the different fertilizers added to the soil in the several plots had any effect on the resistance of the potatoes to the attack of the fungus, the tubers that were stored in bags during the winter were examined about the last of February and a careful comparative series of notes was made. All the tubers were cut, and the extent and nature of the disease recorded for each individual separately; also the condition of the fungus and the extent to which other fungi and bacteria were present, as well as any other points of special interest in connection with the disease. From this enormous mass of notes tabulations were made, and these were condensed into the first four tables that appear in the text.

Several things must be taken into consideration in judging which of a number of individuals is the most resistant to the attack of any specific disease. In the case of this potato disease the most important of these are, first, resistance to the entrance of the fungus; second, ability to check the spread of the fungus after it has gained entrance; third, ability to keep the fungus from forming spores; and, fourth, ability to keep some part of the tuber alive until time for renewed growth the following season. Unfortunately, in the case of those examined there was in so many instances bacterial action during the latest stages of destruction that whether or not any particular tuber remained alive when examined did not depend simply on resistance to the fungus alone. Whether or not there was total destruction caused by the *Fusarium* could not then in many cases be determined, and therefore does not appear in the tables.

TABLE I.—*Percentage of tubers diseased by Fusarium, according to plot, variety, and fertilizer used.*

Plot.	Variety.	Fertilizer.		Percentage of stored tubers diseased in February.
		Kind.	Amount per hill.	
			Grams.	
2042	Burbank	Boneblack	8	98.6
2045	do	Sulphate of potash	16	98.0
2055	do	Muriate of potash	16	97.2
2054	Early Rose	do	16	95.4
2034	do	Lime	75	94.4
2060	Burbank	Check		94.1
2037	do	Lime	25	93.3
2047	do	Boneblack	16	93.2
2040	do	Sulphate of potash	8	92.9
2052	do	Nitrate of soda	8	92.7
2053	Brown	Sulphate of potash	16	92.3
2058	do	Nitrate of soda	16	91.8
2061	Early Rose	Check		91.5
2059	do	do		91.0
2046	do	Boneblack	16	90.1
2050	Burbank	Muriate of potash	8	90.0
2044	Early Rose	Sulphate of potash	16	89.3
2036	do	Lime	25	88.2
2041	do	Boneblack	8	87.9
2035	Burbank	Lime	75	87.9
2049	Early Rose	Muriate of potash	8	87.5
2051	do	Nitrate of soda	8	87.5
2048	Brown	Muriate of potash	16	87.1
2062	Burbank	Check		84.8
2056	Early Rose	Nitrate of soda	16	83.2
2039	do	Sulphate of potash	8	82.8
2043	Brown	Boneblack	16	82.1
2063	do	Check		78.1
2038	do	Lime	75	75.1
2057	Burbank	Nitrate of soda	16	74.7

Table I shows the percentage of tubers diseased in each plot, whether very seriously or only slightly. It will be seen that the plots are arranged in order of percentage affected, the worst being at the head of the list. Those that are most resistant to the entrance of the fungus would, then, other conditions being equal, be at the end.

TABLE II.—*Percentage of tubers wholly affected with Fusarium in February, 1903, by plot, variety, and fertilizer.*

Plot.	Variety.	Fertilizer.		Wholly affected.
		Kind.	Amount per hill.	
			Grams.	
2040	Burbank	Sulphate of potash	8	49.7
2042	do	Boneblack	8	30.8
2060	do	Check		30.2
2043	Brown	Boneblack	16	27.4
2055	Burbank	Muriate of potash	16	25.4
2049	Early Rose	do	8	24.2
2045	Burbank	Sulphate of potash	16	22.3
2053	Brown	do	16	22.1
2035	Burbank	Lime	75	19.7
2046	Early Rose	Boneblack	16	16.6
2054	do	Muriate of potash	16	15.4
2061	do	Check		15.3
2037	Burbank	Lime	25	15.1
2050	do	Muriate of potash	8	14.6
2051	Early Rose	Nitrate of soda	8	13.3
2048	Brown	Muriate of potash	16	13.0
2047	Burbank	Boneblack	16	12.8
2063	Brown	Check		10.9
2056	Early Rose	Nitrate of soda	16	10.5
2039	do	Sulphate of potash	8	10.4

TABLE II.—*Percentage of tubers wholly affected with Fusarium in February, 1903, by plot, variety, and fertilizer*—Continued.

Plot.	Variety.	Fertilizer.		Wholly affected.
		Kind.	Amount per hill.	
			Grams.	
2034	Early Rose	Lime	75	9.9
2038	Brown	do	75	9.8
2051	Early Rose	Nitrate of soda	8	9.8
2062	Burbank	Check		9.7
2059	Early Rose	do		9.1
2036	do	Lime	25	6.5
2044	do	Sulphate of potash	16	6.1
2057	Burbank	Nitrate of soda	16	5.6
2058	Brown	do	16	4.9
2041	Early Rose	Boneblack	8	2.1

Table II shows the percentage of tubers in which the browning of the vascular system has reached practically to the apical end. This does not mean necessarily that it is completely rotted, for in some cases there is sound white flesh inside and outside the ring, especially at the apical end; while in others, in which the blackening does not reach entirely through the potato, it is affected throughout by a semi-soft rot, partly bacterial. A large majority of the tubers recorded in this table are, however, completely dry-rotted by the fungus. Like Table I, the plots are arranged in order, the highest percentage being at the top.

TABLE III.—*Percentage of tubers showing tufts of mycelium, by plots, variety, and fertilizer.*

Plot.	Variety.	Fertilizer.		Percentage of tubers showing tufts of mycelium in February.
		Kind.	Amount per hill.	
			Grams.	
2045	Burbank	Sulphate of potash	16	67.6
2053	Brown	do	16	53.8
2048	do	Muriate of potash	16	48.1
2040	Burbank	Sulphate of potash	8	45.4
2042	do	Boneblack	8	44.0
2050	do	Muriate of potash	8	42.7
2055	do	do	16	42.7
2037	do	Lime	25	42.4
2038	Brown	do	75	40.5
2063	do	Check		38.4
2060	Burbank	do		36.7
2034	Early Rose	Lime	75	32.9
2039	do	Sulphate of potash	8	29.4
2054	do	Muriate of potash	16	29.0
2049	do	do	8	28.1
2035	Burbank	Lime	75	28.0
2047	do	Boneblack	16	26.3
2041	Early Rose	do	8	25.7
2059	do	Check		25.1
2046	do	Boneblack	16	25.1
2058	Brown	Nitrate of soda	16	22.9
2043	do	Boneblack	16	21.9
2052	Burbank	Nitrate of soda	8	18.7
2062	do	Check		18.4
2061	Early Rose	do		15.3
2056	do	Nitrate of soda	16	15.1
2036	do	Lime	25	13.7
2044	do	Sulphate of potash	16	11.2
2051	do	Nitrate of soda	8	8.3
2057	Burbank	do	16	7.8

In Table III is represented the percentage in each plot showing white fungous tufts, either in cavities or on the surface. This represents the extent to which the fungus has formed spores, for while there are sometimes microconidia borne on the hyphæ in the blackened ring, they are very few in number; whereas, on the other hand, the white tufts nearly always bear them, usually in great abundance. This table is likewise arranged in order of percentage.

TABLE IV.—*Giving number of tubers examined and extent of disease in per cents, by plot, variety, and fertilizer, in February, 1903.*[a]

Plot.	Variety.	Fertilizer.		Number examined.	Sound.	Doubtful.	Diseased with Fusarium.	Slight.	Less than half.	Half.	More than half.	Nearly all.	All.	Tufts of mycelium present.
		Kind.	Amount.											
			Grams.											
2041	Early Rose	Boneblack	8	140	11.4	0.7	87.9	40.7	18.6	6.4	11.4	7.9	2.1	25.7
2042	Burbank	do	8	143	.0	1.4	98.6	19.6	17.5	9.8	13.3	7.7	30.8	44.0
2046	Early Rose	do	16	151	9.9	.0	90.1	29.1	13.2	9.9	14.5	6.6	16.6	25.1
2047	Burbank	do	16	266	6.4	.4	93.2	39.1	12.0	6.8	10.9	11.3	12.8	26.3
2043	Brown	do	16	146	15.8	2.1	82.1	19.9	10.9	4.8	10.3	8.9	27.4	21.9
2036	Early Rose	Lime	25	153	11.8	.0	88.2	45.1	18.9	10.5	4.5	2.6	6.5	13.7
2037	Burbank	do	25	165	5.5	1.2	93.3	19.4	21.2	10.3	19.4	7.9	15.1	42.4
2034	Early Rose	do	75	213	4.7	.9	94.4	29.1	25.4	12.2	13.1	4.7	9.9	32.9
2035	Burbank	do	75	157	7.0	5.1	87.9	21.0	15.3	5.1	14.7	12.1	19.7	28.0
2038	Brown	do	75	173	8.7	16.2	75.1	19.1	31.8	5.8	5.8	3.5	9.8	40.5
2039	Early Rose	Sulphate of potash.	8	221	8.1	9.1	82.8	24.4	19.5	10.9	9.9	7.7	10.4	29.4
2040	Burbank	do	8	141	.0	7.1	92.9	12.8	6.4	7.8	8.5	7.8	49.7	45.4
2044	Early Rose	do	16	196	10.7	.0	89.3	33.7	20.4	12.8	11.7	4.6	6.1	11.2
2045	Burbank	do	16	148	.0	2.0	98.0	12.8	28.4	3.4	21.6	9.4	22.3	67.6
2053	Brown	do	16	104	.0	7.7	92.3	26.9	14.4	.0	19.2	9.6	22.1	53.8
2049	Early Rose	Muriate of potash.	8	128	7.0	5.5	87.5	18.7	12.5	14.8	10.9	6.3	24.2	28.1
2050	Burbank	do	8	199	1.0	9.0	90.0	11.1	23.1	8.5	23.6	90.0	14.6	42.7
2054	Early Rose	do	16	162	3.1	1.2	95.4	30.9	24.7	5.5	11.1	8.0	15.4	29.0
2055	Burbank	do	16	138	1.4	.7	97.2	31.9	7.2	10.1	9.4	13.8	25.4	42.7
2048	Brown	do	16	108	8.3	4.6	87.1	25.0	18.5	5.5	16.7	7.4	13.0	48.1
2051	Early Rose	Nitrate of soda.	8	144	12.5	.0	87.5	36.1	21.5	11.1	6.2	2.8	9.8	8.3
2052	Burbank	do	8	150	7.3	.0	92.7	36.0	18.7	8.7	8.7	7.3	13.3	18.7
2056	Early Rose	do	16	172	8.1	8.7	83.2	29.1	19.8	8.7	11.0	4.1	10.5	15.1
2057	Burbank	do	16	178	12.9	12.4	74.7	47.8	11.1	6.2	2.8	1.1	5.6	7.8
2058	Brown	do	16	61	.0	8.2	91.8	34.4	29.5	4.9	13.1	4.9	4.9	22.9
2059	Early Rose	Check	....	276	6.5	2.5	91.0	31.9	13.8	8.7	15.6	11.9	9.1	25.1
2060	Burbank	do	....	169	1.8	4.1	94.1	21.9	13.6	5.3	17.2	5.9	30.2	36.7
2061	Early Rose	do	....	189	6.9	1.6	91.5	33.3	18.5	11.6	5.8	6.9	15.3	15.3
2062	Burbank	do	....	185	7.6	7.6	84.8	37.3	16.2	5.4	7.0	9.2	9.7	18.4
2063	Brown	do	....	146	10.3	11.6	78.1	16.4	29.4	4.8	14.6	2.1	10.9	38.4

[a] See fig. 1, p. 23.

In Table IV we have recorded all the chief points of interest covered by the notes taken when the potatoes were examined. "Number examined" includes all that were stored during the winter and examined in February. In the larger plots there were so many that not all were saved at harvest time. "Sound" includes all that were certainly not affected with the *Fusarium* disease. "Doubtful" includes all those so affected, with other complications—e. g., bacterial rot and the brown specking mentioned above—in regard to which it was not determined with certainty whether or not the fungus was present. Under "Diseased with *Fusarium*" are all those known to be attacked by the fungus, i. e., those presenting typical symptoms free from perplexing complications. The next six columns to the right—i. e., the eighth to the thirteenth, inclusive—represent the distance from the stem end to which the fungus had penetrated (see fig. 1). Taking as a basis a potato 12 centimeters long, if the fungus has penetrated not more than 2½ centimeters the inroad is recorded as slight; from 2½ cm. to 5 cm., "less than half;" from 5 cm. to 7 cm., "half;" from 7 cm. to 9 cm., "more than half;" from 9 cm. to 11 cm., "nearly all;" from 11 cm. to 12 cm., "all;" these distances measured on the long axis of the tuber. The last column shows the number in which tufts of white mycelium are present, as in Table III, but in different order. In this table the arrangement is such that the effects of like amounts of the same fertilizer can readily be compared in the three varieties of potatoes studied to see if there is any difference in varieties in regard to resistance to the disease.

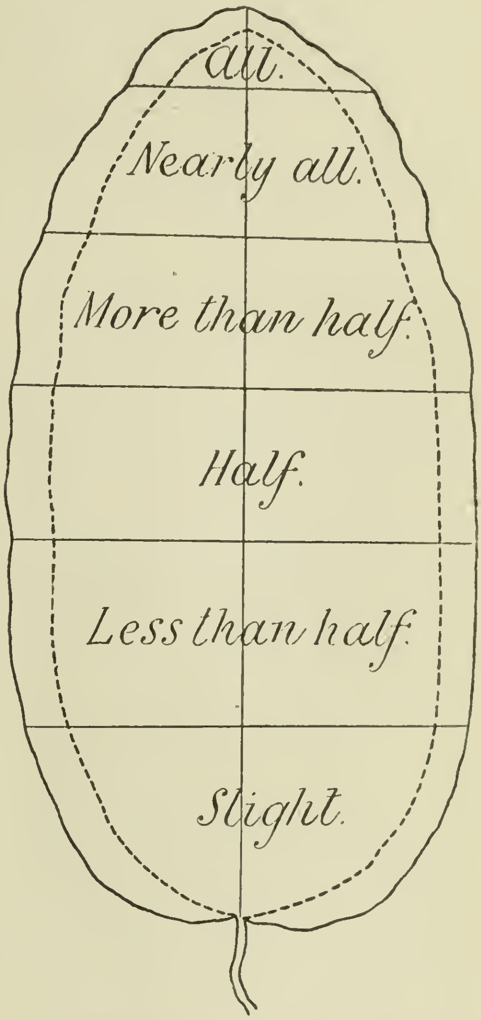

Fig. 1.—Diagram of a longitudinal section of a diseased tuber.

A careful study of these tables shows that no one fertilizer stands preeminently at the head of the list in any table for all three varieties. If any one fertilizer either furthered or retarded the action of the fungus, we should expect to find it relatively near the head or foot of the list for all varieties and for both amounts used, but such is not the case. That is, for example, in Table I the plot of Burbanks fertilized with 8 grams of boneblack has the highest percentage of diseased tubers, while the checks are much farther down and widely separated; but, in the case of the Early Rose, boneblack, 8 grams, comes below three of the checks. Furthermore, in the Burbank plots the lesser amount of boneblack comes before the greater in the list, while, with the Early Rose, the reverse is true. A similar comparison of any other two fertilizers used shows similar inconsistencies. One would expect the checks of each variety to be together in the table, but though such is the case with the Early Rose in this table those of the Burbanks are widely separated, more than half the list lying between them.

In Table II the comparison is no better. Here Burbank, potassium sulphate, 8 grams, stands first, with one check close below and the other almost at the end of the list, while, with the Early Rose, potassium sulphate, 8 grams, stands below the middle with one check eight numbers above and the other five below. It will be seen that in both varieties the two checks are widely separated.

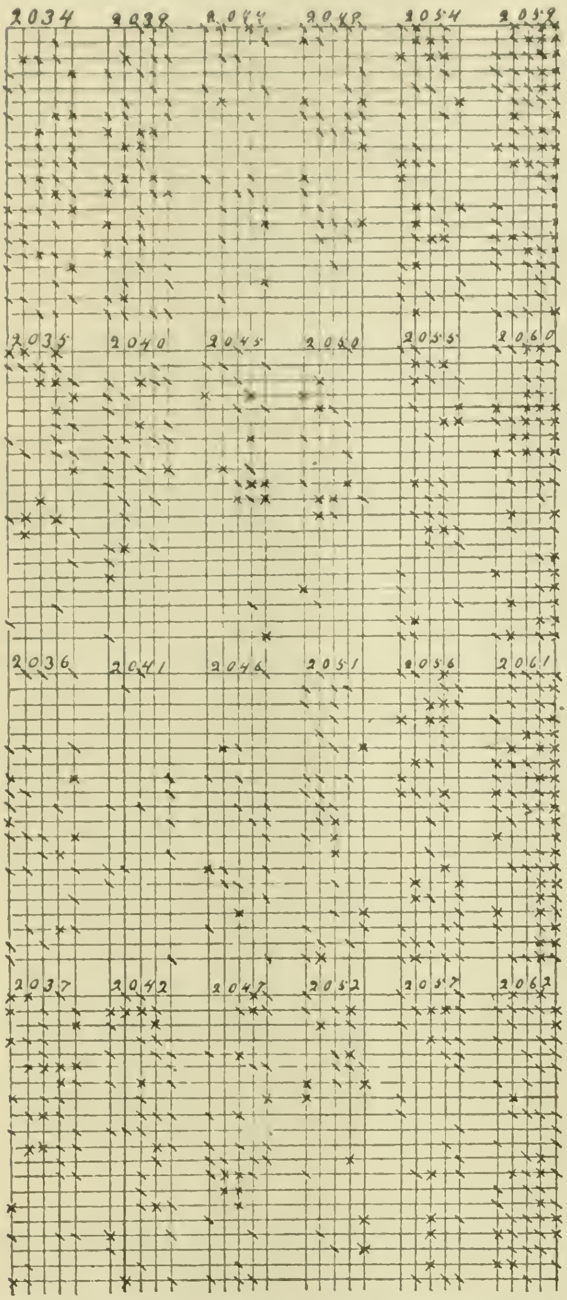

Fig. 2.—Diagram of experimental potato field, showing the cases of the *Fusarium* disease of potatoes found in the plots on July 27, 1902. A cross indicates that all the shoots in that hill were affected. An oblique line indicates that a part only of the shoots were affected. Small plots are omitted.

In Table III, Burbank, potassium sulphate, 16 grams, stands first, with one check a third of the way down the list and the other nearly at the end, and, with the Early Rose, potassium sulphate, 16 grams, is third from the end with one check three and the other nine numbers above.

Comparing the varieties in Table IV, we find equal complications. With boneblack, 16 grams, in the column showing the percentage diseased, Burbank has the highest per cent, Early Rose next, and "Brown" third, but with lime, 75 grams, Early Rose stands highest, Burbank second, and "Brown" third, while with potassium sulphate, 16 grams, Burbank is highest, "Brown" second, and Early Rose third. Comparing them in the last column, which represents the percentage showing white tufts of mycelium, we find that with boneblack, 16 grams, Burbank is highest, Early Rose second, and "Brown" third; with lime, 75 grams, "Brown" is highest, Early Rose next, and Burbank third; and with potassium sulphate, 16 grams, Burbank is highest, "Brown" second, and Early Rose third. Many other such comparisons can be made through the table, but no one variety can be found constantly with a higher or a lower percentage in any one column.

From a study of these tables one conclusion is very apparent, viz, that other factors than the fertilizers and varieties have taken a part in determining the relative extent and severity of the disease in the different plots. What these factors are has not as yet been determined. In the treatment of the ground while the potatoes were growing and during the previous year, and in the seed tubers planted, there was no appreciable difference. Neither would the location in the field of the different plots be expected to make any considerable difference (fig. 2). There was a plantation road on two sides, other potatoes from the same lot of Burbank seed on a third side, and bluegrass on the fourth, and none of these would be expected to have any effect on the prevalence of the disease in the experimental plots, especially as the roads were very wide, so that passers-by rarely came in contact with the plants. In the storage of the tubers during the winter there was the chief difference in treatment; but even here, as will be seen from the previous description of how the potatoes were kept, the only essential difference was in the pressure the various bags had to sustain and the fact that the upper tier was bounded above by a layer of cotton and the lower one lay in contact with a cement floor. These conditions can scarcely be considered sufficient to account for the differences found in the several plots.

During the early course of the disease the distribution in the field was very uneven. Exact data as to what plants were affected at any one time could not be obtained, as during the early stages of infection there was no change in the appearance of the tops, and a minute examination of the roots and tubers could not be made without destroying the future usefulness of the plots. A careful examination of the leaves and shoots was made, however, on July 27, and a record was taken of all those hills in which the disease had progressed far enough to show symptoms above ground. The distribution of these is shown in fig. 2. This represents a diagram of the field, showing the arrangement of the plots, fertilizers used, and the distribution of the plants showing the disease in the tops on July 27. The lines represent the potato rows, and their intersections represent the hills. The hills entirely diseased are marked with a cross; those partially diseased, with an oblique line.

TABLE V.—*Distribution of disease in the field, July 27, 1902, as determined by inspection of parts above ground.*

Plot.	Variety.	Fertilizer.		All diseased.	Part diseased.	Total.
		Kind.	Amount.			
			Grams.			
2059	Early Rose	Check		29	40	69
2061	do	do		27	34	61
2062	Burbank	do		14	39	53
2060	do	do		27	24	51
2034	Early Rose	Lime	75	11	38	49
2039	do	Sulphate of potash	8	13	31	44
2037	Burbank	Lime	25	16	24	40
2056	Early Rose	Nitrate of soda	16	15	25	40
2042	Burbank	Boneblack	8	9	29	38
2054	Early Rose	Muriate of potash	16	16	20	36
2047	Burbank	Boneblack	16	10	23	33
2055	do	Muriate of potash	16	10	23	33
2051	Early Rose	Nitrate of soda	8	6	26	32
2049	do	Muriate of potash	8	6	24	30
2035	Burbank	Lime	75	13	16	29
2036	Early Rose	do	25	6	23	29
2040	Burbank	Sulphate of potash	8	5	24	29
2057	do	Nitrate of soda	16	7	21	28
2045	do	Sulphate of potash	16	9	11	20
2044	Early Rose	do	16	5	16	21
2052	Burbank	Nitrate of soda	8	9	12	21
2046	Early Rose	Boneblack	16	3	16	19
2050	Burbank	Muriate of potash	8	8	9	17
2041	Early Rose	Boneblack	8	0	12	12

Table V gives the percentage in each plot that showed the effect of the disease in the tops on July 27. A study of this table reveals the fact that the distribution of the disease does not consistently follow either variety or fertilizer, neither are the plots in the same relative position in this table and in Table I. It also shows that at this date the checks were more seriously affected than any of the fertilized plots.

The distribution of the disease in the "Browns" does not appear in figure 2 or in Table V, as the leaves of these plants were so badly affected with "tip-burn" at the time the notes were taken that it could not always be told which were affected with the *Fusarium* disease.

From what precedes, it appears that though fertilizers and varieties may have some influence on the resistance of potatoes to the *Fusarium* disease, in the case of those particular fertilizers and varieties tested this effect was so slight that it was entirely hidden by the effect of other factors as yet little understood.

The experiments were repeated in 1903 on the same land, using the same fertilizers and same varieties, but with healthy seed potatoes obtained from a distance. The results were abundant scattered development of the disease on the foliage and tubers in summer and fall and slow increase of the disease in the stored tubers during late autumn and early winter. The tubers were stored in a cool, dry place, and when examined late in December a very large majority of them were found affected with the brown or black stain in the vessels at the stem end, but this rarely extended in more than 1 cm. and the tubers appeared sound externally. Bacterial decay was rare. In the sacks of tubers examined December 21 less than 10 per cent were free from the *Fusarium* disease. The slower progress of the disease in the stored tubers in 1903 was undoubtedly due to the fact that they were housed in a much cooler place. Cultures were made from the blackened vascular system in 24 of these potatoes. All yielded the fungus. Some also yielded bacterial colonies of various sorts. As in the cultures made from the crop of the preceding year the fungus did not, like the bacterial colonies, spring up at random anywhere on the surface of the potato block, but grew out of the deeper portions of the vascular system, first, as separated sparse hyphæ, then as luxuriant masses of sporiferous mycelium.

DESCRIPTION OF THE FUNGUS.

The form, color, and habits of growth of this fungus depend much on the medium in which it is grown. As it is found in the diseased plants, the mycelium is rather slender, with frequent septa, nearly colorless, and much branched in the parenchyma, but less so where it follows the xylem ducts (Pl. VIII, fig. 34). There are a few microconidia borne inside the host, but they are not numerous except where there is a cavity of some kind, and are, therefore, easily overlooked. Where the fungus breaks out in tufts on the surface of the tubers it is white or pinkish, and bears an abundance of microconidia, often many macroconidia, and sometimes chlamydospores. These tufts are from a few millimeters to several centimeters in diameter, and usually a little less than a centimeter tall. The individual hyphæ in these tufts are very much branched, with many septa.

In the many different kinds of culture media used this fungus showed a number of very striking variations. For this reason it is impossible to give a general description that will hold universally.

Sugar-beet agar (789[a]) was most used for poured plates, and boiled potato cylinders (792 and others) were the standard medium for tube cultures, as they afforded the same food as the host, differing only in being boiled.

The fungus used for all the comparisons on different media has descended directly from a single spore that developed in a plate poured from the interior of a tuber that was affected with the *Fusarium* disease only. The outside was pared off and the exposed surface sterilized with a hot spatula. A slice was then cut off with a hot scalpel and a little of the diseased part underneath was transferred with a sterile instrument to beef bouillon. This was used to inoculate tubes of beef agar from which six plates were poured. Only fungus

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[a] These numbers are given to the culture media when they are made up, and appear as a permanent record in the laboratory, with an exact description of the entire process by which they are made. These descriptions may be found near the end of this bulletin (pp. 55–59).

colonies appeared in these plates, and these seemed to be all alike. A little of one of these colonies was transferred to a tube of boiled potato, and this was used as a starting point for the inoculation of the different culture media. The fungus was obtained in pure cultures from many other tubers and compared with the one just described to make sure that it was the true parasite under investigation. Three kinds of spores are produced by this fungus—microconidia, macroconidia, and chlamydospores. These will be described in detail a little farther on.

MYCELIUM.

On poured plates of sugar-beet agar (789), the spores germinate in a few hours at moderate temperatures (20° to 27° C.) and in about twenty-four hours the colonies become visible to the naked eye. They grow in diameter rapidly, being at the end of nine days about 6 to 7 centimeters across, if the growth is not interfered with by the sides of the dish or by other colonies. The margin is as a rule approximately circular, though not exactly so. Such a colony 9 days old is shown in Plate VII. These colonies are made up of concentric zones. In the center is a rather dense tuft about 3 millimeters high. Outside this is a zone in which the aerial mycelium is very short; farther out is a second zone of mycelium, about as dense as that in the center and somewhat taller—5 to 10 millimeters high. The rest of the colony making up the outside zone is of short mycelium, and this shows several concentric rings, caused by different degrees of density in the mycelium and abundance of spores. As the colony grows older the zone of taller mycelium becomes wider, but this widening is much slower for a time than the growth of the outer zone. Eventually, however, the entire colony produces the taller mycelium. Microconidia are borne in all parts of the colony, except the extreme margin of about 1 millimeter. They are not confined to the part above the surface of the substratum, but are also formed in the agar itself. In the extreme edge of the colony the hyphæ are seen to be pushing out radially with very little branching, while a little farther back lateral branches are being pushed out (Pl. VIII, fig. 1). Still farther back the microconidia and macroconidia are being formed, and a little later the chlamydospores. While very young the mycelium is usually densely crowded with granular protoplasm, but later it becomes much vacuolated. The cells, at least many of them, are uninucleated.

MICROCONIDIA.

The mode of formation of the microconidia was best studied in plates of sugar-beet agar. For this purpose specially made petri dishes with extra thin bottoms were used. By inverting these on the stage of the microscope the growth of the fungus could be studied without injury or disturbance to the cultures.

The method by which the microconidia are produced is shown in Plate VIII, figures 2–12. The end of a long hypha, or more usually a lateral branch, is directly cut off from the remaining portion by a very wide constriction furrow (Pl. VIII, fig. 3). The time taken to do this is difficult to ascertain with exactness, as the furrow is at first so very wide that it can not be distinguished from the many slightly narrower places in the mycelium found at irregular intervals. It is certain, however, that it does not require more than half an hour as a rule, and often not more than half that time.

As soon as one of these microconidia is cut off the hypha begins to elongate, pushing past it, if it is embedded in the agar, so that it can not fall off, or shoving it out of the way. This continues until the point has advanced even with the farther end of the first microconidium, but even before this growth is complete a similar constriction furrow begins to cut off a second microconidium (Pl. VIII, fig. 6). This process continues until sometimes as many as six or eight microconidia are formed from one branch, and lie side by side in a little group. The time from the cutting off of one until the cutting off of the next has been observed to vary from 2 to 5 hours. The microconidia are oval or elliptical in shape, thin-walled, one-celled, uninucleate, and slightly curved. They vary in length from 5.4μ to 16μ, and in diameter from 2μ to 2.7μ, the most common size, when growing in this medium, being 9.8μ in length by 3.2μ in diameter.

The time required for germination varies somewhat in different media, and greatly for the different individuals in the same medium. To determine this a tube of each of several kinds of media was inoculated copiously from a culture 36 days old growing on boiled potato made +25 on Fuller's scale with tartaric acid, and which contained all three kinds of spores in abundance. From each of these tubes two Van Tieghem cells were made, and examined at frequent intervals for several hours. The temperature of the room was from 22° to 26° C. The results are shown below.

In sterile distilled water a few microconidia began to germinate in 6 hours, and in 8 hours many were pushing out germ tubes. In 10 hours nearly half were germinating, but none of the germ tubes were very much branched. In 24 hours the process had advanced but little farther than in 10 hours.

In sugar-beet agar (789) germination began in 5½ hours, and in 9 hours about one-half the microconidia were germinating, though none were very far advanced; but in 13 hours practically all had germinated, and the young mycelium of many was somewhat branched. In 24 hours the mycelium had formed many microconidia, and a very few macroconidia and chlamydospores. After 4 days there were numerous microconidia and a few macroconidia and chlamydospores.

In beef bouillon (858) germination began in about 6 hours, and in

9 hours more than half the spores were germinating, though none had advanced very far. In 12 hours practically all had begun to germinate. In 24 hours a few microconidia and macroconidia had been formed, and a very few immature chlamydospores. After 4 days all three kinds of spores were numerous.

In Raulin's fluid (822) germination began in 6 hours, and in 9 hours about one-half of the spores had begun to germinate, though none had advanced very far. In 13½ hours practically all had begun to germinate. In 24 hours a few microconidia had been formed, but no macroconidia or chlamydospores could be found. After 4 days there were numerous microconidia and a very few macroconidia and chlamydospores.

In Uschinsky's fluid (841) germination began in about 6 hours, and in 9½ hours at least half the spores had sent out germ tubes, but these were not very complex. In 14 hours all the spores had begun to germinate. In 24 hours a few microconidia had been formed, but no chlamydospores or macroconidia were found. After 4 days the macroconidia were numerous, and there were a few microconidia and chlamydospores.

As all three kinds of spores were germinated in the same Van Tieghem cells, it was impossible to distinguish the mycelium of one from that of another after the time they began bearing spores.

In all the media except the distilled water the growth of the mycelium had progressed so far in 24 hours that it would have been almost impossible to trace all the branches belonging to some of the individuals, though others were still quite simple. Very few were left ungerminated in any of the media except distilled water, where more than half failed to germinate.

The germination of the microconidia is very simple (Pl. VIII, figs. 13–15). They first swell a little and become thick in proportion to their length—sometimes almost spherical; then at one end a germ tube is pushed out, and a little later another usually forms at the opposite end. Later these branch and become septate. The spore itself is noticeable for some time as a thickened place in the young mycelium and might easily be mistaken for a young chlamydospore.

MACROCONIDIA.

It is by this kind of spore that the form-genus *Fusarium* is commonly distinguished. In the one under consideration they vary much in size and shape, depending on the culture media used, though they are by no means of equal size in the same medium. In a Van Tieghem cell of Uschinsky's fluid (841), 5 days old, they vary from 10μ to 36μ in length and from 3.5μ to 6μ in diameter, 28μ by 4.5μ being the most usual size. In this medium they are from one to five septate, usually three, slightly constricted at the septa, not sharp-pointed, varying from nearly straight to very much curved (Pl. VIII, figs. 23–25).

In boiled potato (871), made +25 on Fuller's scale with tartaric acid, they are somewhat smaller and more sharply pointed. Those found in the cavities of diseased potatoes are usually very blunt at the ends. All are thin-walled and contain 1 nucleus to each cell.

The formation of the macroconidia is somewhat similar to that of the microconidia. They are not, however, borne beneath the surface of the substratum, and consequently drop off immediately. The process is therefore much more difficult to study. They are cut off from the ends of short lateral branches by constriction furrows (Pl. VIII, figs. 16–19). When first formed the macroconidia are somewhat smaller and less pointed than when mature, and usually have no septa, these being formed after 2 or 3 hours. Just how many may be constricted from the same branch was not determined definitely, because being borne only in the air they immediately dropped off and were lost, but as many as five have been counted, and probably there are often more. The branches that bear the macroconidia differ from those bearing the microconidia in having a swollen portion in the middle and a constricted portion at the base (Pl. VIII, figs. 16–19).

As with the microconidia, the time of germination varies much with the different culture media.

In sterile distilled water germination began in 3 hours. In 4 hours about half of the macroconidia had begun to germinate and in 7 hours practically all were germinating. The germ tubes never became much branched, however.

In sugar-beet agar (789) germination began in 5 hours; half the macroconidia were germinating in 5½ hours, and all had begun in 8 hours.

In beef bouillon (858) a few were germinating in 4½ hours, half in 6 hours, and all in 8½ hours.

In Raulin's fluid (822) a few were germinating in 5½ hours, half in 6 hours, and all in 8 hours.

In Uschinsky's fluid (841) a few had begun to germinate in 4 hours, half in 4½ hours, and all in 7 hours.

In all these solutions practically every one of these spores germinated. In all but the distilled water the germ tubes grew and branched rapidly, so that at the end of 12 hours many of them were too complex to be traced. This was true of nearly all after 24 hours. The spores which formed in these cells in 24 hours and in 4 days have been mentioned under the germination of the microconidia which were in the same cells.

The germination of the macroconidia is somewhat complicated by the number of cells (Pl. VIII, figs. 20–22). The end cells usually germinate first, though this is by no means always the case, and the tube is sent out from the end of the cell, or, less frequently, from the side. Sometimes every cell in the spore germinates, but very often one or two near the middle of the spore fail to do so. As is the case with the microconidia there is a considerable swelling just before germination, and the spores are to be distinguished for a long time as swollen places in the mycelium.

The macroconidia produced in cultures vary in number according to the medium more than do the microconidia (Tables VII, IX, and X).

CHLAMYDOSPORES.

The chlamydospores are produced as swellings of the mycelium. These may be either intercalary or terminal, on long, comparatively straight hyphæ or short lateral branches (Pl. VIII, figs. 26–29). Sometimes there are several on the same hypha, close together like a string of beads.

The first indication of the formation of a chlamydospore is a slight enlargement at a certain point on a hypha, either at the tip or just behind a septum. This continues until a relatively large, nearly perfect sphere is formed, which is cut off by cross walls shortly before it reaches its definitive size (Pl. VIII, figs 26–29). The time required for a chlamydospore to mature is much longer than for a microconidium or a macroconidium.

The walls of these spores are relatively thick when mature, and seem to be made up of two layers, though this could not be brought out very sharply with Flemming's triple stain. They are smooth and light brown in color. The size in sugar-beet agar (789) varies from 5.5μ to 13μ, about 10μ being the usual size. All are one celled and each contains, at least at one stage, a single nucleus.

In boiled rice made so strongly acid that the growth was less than one millimeter high the chlamydospores were the only fruiting bodies found. Under such conditions they vary from their normal spherical shape and become very irregular, sometimes to such an extent as to be scarcely recognizable.

The chlamydospores are borne in abundance both in the substratum and above it, if the medium is favorable. They vary considerably in number according to the medium used, but, as will be seen from Tables VI–IX, at least a few were formed in every kind of medium in which the fungus was able to grow. They seem to be more resistant to unfavorable conditions than the other two kinds of spores but are hardly to be considered as resting spores, since in cultures a month old they germinate readily in a very short time; but here also this varies much with the medium used.

In the Van Tieghem cells described above, in distilled water the germination of the chlamydospores began in 4 hours, and at the end of 24 hours the germ tubes were only slightly branched. A little more than half entirely failed to germinate.

In sugar-beet agar (789) a few were beginning to germinate in 5 hours, half of them in 8 hours, and all in 10½ hours.

In beef bouillon (858) a few had begun to germinate in 4½ hours, half of them in 6 hours, and all in 8½ hours.

In Raulin's fluid (822) a few had begun to germinate in 6 hours, half of them in 8½ hours, and practically all in 12½ hours.

In Uschinsky's fluid (841) a few were beginning to germinate in 6 hours, about half in 9 hours, and practically all in 12 hours.

In all the media except the distilled water the germination of the chlamydospores was very complete, scarcely one failing to germinate. In nearly all cases 24 hours' growth had made the young mycelium much branched—often too much so to be followed.

As in the case of the microconidia, the germination is very simple (Pl. VIII, figs. 30–33). A germ tube is pushed out from one side, and this grows and branches into a complex mycelium. Cases have been observed in which there were two germ tubes, but these were rather unusual.

The chlamydospore is so much larger in diameter than the hypha that it remains very noticeable until hidden by the tangled mycelium.

Table VI shows more clearly a comparison of the germination of all three kinds of spores on the above media. All three were studied in the same Van Tieghem cells—two for each kind of medium. The inoculations were made at 10 a. m. from a 36-day culture. The temperature varied from 22° to 26° C. In a previous experiment, made at a temperature of about 30° C., the germination was somewhat more rapid.

TABLE VI.—*Germination of spores.*

Kind of medium.	Kind of spores.	A few spores germinating.	Half of spores germinating.	All of spores germinating.	Condition at the end of 24 hours.	Condition at the end of 4 days.
		Hours.	*Hours.*	*Hours.*		
Distilled water.	Microconidia	6	......	......	None of the germ tubes much branched. More than half of the microconidia and chlamydospores not germinated.	About the same as at the end of 24 hours.
	Macroconidia	3	4	7		
	Chlamydospores	4	......	......		
Sugar-beet agar.	Microconidia	5½	9	13	Many microconidia and a very few macroconidia and chlamydospores had been formed.	Very many microconidia and a few macroconidia and chlamydospores had been formed.
	Macroconidia	5	5½	8		
	Chlamydospores	5	8	10½		
Beef bouillon.	Microconidia	6	9	12	A few microconidia and macroconidia and a very few chlamydospores had been formed.	Many microconidia, macroconidia, and chlamydospores had been formed.
	Macroconidia	4½	6	8½		
	Chlamydospores	4½	6	8½		
Raulin's fluid.	Microconidia	6	9	13½	A few microconidia but no macroconidia or chlamydospores had been formed.	Very many microconidia and a very few macroconidia and chlamydospores had been formed.
	Macroconidia	5½	6	8		
	Chlamydospores	6	8½	12½		
Uschinsky's fluid.	Microconidia	6	9½	11	A few microconidia but no macroconidia or chlamydospores had been formed.	Very many macroconidia and a few microconidia and chlamydospores had been formed.
	Macroconidia	4	4½	7		
	Chlamydospores	6	9	12		

The above table shows that for the germination of microconidia beef bouillon is rather the best medium used and distilled water decidedly the poorest.

For macroconidia distilled water is a little the best for the early stages of germination, though Uschinsky's fluid is nearly as good, and beef bouillon is rather the poorest, though there is but little difference between it and Raulin's fluid. In all of the media this spore form germinated a little earlier than the microconidia.

For chlamydospores beef bouillon is the best and distilled water the poorest.

Though not under the head of germination, this table also shows that, relatively speaking, sugar-beet agar produces the most microconidia, Uschinsky's fluid the most macroconidia, and beef bouillon the most chlamydospores. This is extremely interesting, as it shows very strikingly how much the medium influences the kinds of fruiting bodies produced.

Table VI also shows at how very early a period the spores are formed. From the fact that all three kinds of spores were germinated in the same cells, it would be impossible to say with certainty from which kind of spore the mycelium bearing microconidia, macroconidia, or chlamydospores came. There is much evidence, however, that the mycelium from any one kind will, under the right conditions, produce all three.

SCLEROTIA.

There are produced in all cultures on boiled potato small masses of green sclerotia not more than 5 mm. in diameter and irregular in shape. These are borne at the surface of the potato, often partly covered with white mycelium, and were not found on any of the other media used, not even on raw potato. These masses are light green in color—about the same shade as *Penicillium glaucum*. They are rather hard, and in sections stained with Flemming's triple stain appear only as tightly interwoven masses of mycelium and seem to have little to do with the formation of fruiting bodies. Their true significance and why they appear in this medium only have not been determined.

GROWTH IN DIFFERENT MEDIA.

A considerable number of different kinds of culture media was used. This was partly to learn the extent to which the fungus would modify itself under changed conditions of nutrition, but largely in the hope of discovering a successful method of inducing the formation of perithecia. It is a well-founded belief that many of the imperfect fungi could be made to bear perithecia if the right conditions were given them, and it is more than probable that in some cases at least the procuring of the proper kind of food may be the solution of the problem. In the case under consideration, however, the attempt was entirely unsuccessful, not a single perithecium being found in any of the cultures. Whether this was because the right medium was not found or because in this case the necessary condition was some other than that of food supply, or whether the perithecial stage has been entirely lost from the life history of the fungus through many generations of asexual reproduction, can not be said with certainty at this time.

Many very interesting differences in the growth were, however, found in the various kinds of media used. At least four tubes of each kind of medium were inoculated, of which two were kept in a dark closet and two were suspended in a rack close to a north window, where they were exposed to strong daylight but not to direct sunshine. Careful notes were made on all these cultures at frequent intervals for several weeks. In all cases the growth was apparent to the naked eye in 24 to 36 hours. The growth in darkness was in no case materially different from that in light *except as to color*. (See p. 48.)

Pieces of sacks.—Many fragments of old sacks in which the potatoes had been stored were rolled into cylinders, thrust into test tubes, wet with distilled water or peptone water, sterilized, and inoculated. Growth was not very abundant and no perithecia developed.

Potato agar (*773*).—Growth about 4 mm. high, and rather sparse. In darkness, pure white; in light, very faint salmon—nearly white. Agar not changed in color; surface smooth.

Potato agar, peptonized (*774*).—Growth a very little more abundant than in 773; in light the salmon tint is very slightly more pronounced. Not different otherwise.

Beef agar (*786*).—Growth rather poor, not more than 2 or 3 mm. high and only moderately dense. Pure white both in darkness and in light. The agar is somewhat browned by the fungus, and the surface is wrinkled and uneven.

Sugar-beet agar (*789*).—Growth about 5 mm. high and very dense. Pure white in darkness, changing to creamy white with age; pale salmon in light. Agar not discolored but much wrinkled on the surface.

Beef gelatin (*793*).—Growth about 6 mm. high and very dense. White in darkness, changing to creamy; in light, rich salmon. Does not liquefy the gelatin.

Litmus lactose agar (*821*).—Growth about 2 to 3 mm. high, moderately dense. Grayish white in darkness; pale salmon in light. The fungus slowly turns the litmus blue, especially at the top of the slant, showing it to be an alkali producer in this medium. The change in color begins to be noticeable in about 10 days and goes on as long as the fungus remains active. It also reduces the litmus somewhat. Surface of medium much wrinkled.

Boiled potato (792).—Growth about 4 mm. high and very dense. In darkness, pure white, changing to creamy white: in light, rich salmon color. Contrast very striking. There are irregular masses of green sclerotia formed on the surface of the potato. The potato itself is gradually turned light brown. In old cultures it is much softened also.

Raw potato.—Growth about 4 mm. high and very dense. In darkness, pure white: in light, very pale salmon color. None of the green sclerotia are produced on the surface. The fungus acts on the starch grains without forming notches or marks of corrosion

Boiled rice (796).—Growth about 4 mm. high, moderately dense. In darkness the mycelium is mixed pink and lilac, shading into white—the latter color being mostly at the extreme top of the mycelium, but it is to be found in places all through the culture; in light, a deep rich salmon color, shading into salmon pink mixed with lilac.

Boiled beans (829).—Growth about 4 mm. high and rather dense. In darkness, pure white, changing to gray and finally to grayish brown: in light, the same.

Boiled corn (828).—Growth about 4 mm. high and very dense. In darkness, creamy white with a few streaks of purple and sometimes a little pink: in light, the same but with a little more purple.

Boiled wheat (827).—Growth about 4 mm. high and very dense. In darkness, creamy white streaked with lilac and pink: in light, the same.

Boiled tapioca (826).—Growth extremely short, scarcely rising above the surface of the medium, but very dense. The fungus spreads very slowly and does not entirely cover the surface of the slant for nearly two weeks. In darkness, mycelium at first pink, then lilac, with white in the upper part of the slant; the lilac finally turns to dark violet. In light, the same, except that in the upper part of the slant the mycelium is very pale salmon.

Boiled sweet potato (823).—Growth poor, about 3 or 4 mm. high but rather sparse. The mycelium shows a strong tendency to grow into little bundles or ropes. In darkness, pure white, changing to yellowish white; in light, rich salmon.

Boiled banana (824).—Growth about 4 mm. high, moderately dense, and, like that in 823, inclined to collect in little ropy bundles. In darkness, pure white, changing to creamy white: in light, rich salmon.

Boiled prunes (830).—Growth poor, about 3 mm. high, and rather sparse. Slightly ropy. In darkness, white at first, changing to a light cinnamon-brown; in the light, the same.

Silicate jelly (833).—Growth about 3 mm. high and rather dense. In darkness, at first pink, which becomes a rose color with a trace of lilac, but the new mycelium is white: in light, the same, except that the new mycelium is a rich salmon. In both light and darkness the jelly is turned to a pale yellowish color.

In all the agars, in the gelatin, and in the silicate jelly the mycelium seems unable to penetrate the substratum more than 2 or 3 mm. In the other media the fungus seemed to vary considerably. In the boiled potato the mycelium sometimes grew from the inoculated slant directly through the cylinder to the opposite side. In the corn, wheat, beans, and rice the mycelium filled the chinks between the grains, but did not show in the lower part of the tubes, where the medium formed a solid mass. When there was some liquid in the bottom of the tube, as in the potato, banana, and sugar-beet cylinders, for example, the fungus kept above the surface of this liquid.

Microconidia, macroconidia, and chlamydospores were found in cultures on all these media, but their relative abundance varied greatly. In most of the media all were present in considerable numbers, but in boiled tapioca and beans only occasional chlamydospores were found, and in boiled prunes only occasional macroconidia. Here also microconidia were fewest.

A comparison of the cultures in these various media is shown in Table VII.

TABLE VII.—*Comparison of growth of Fusarium in different media.*

Kind of medium.	No. of medium.	Height of growth.	Density of growth.	Kinds of spores.			Color in darkness.	Color in light.	Remarks.
		Mm.							
Potato agar	773	4	Sparse	Macroconidia	Microconidia.	Chlamydospores.	Pure white	Very faint salmon	Surface of agar smooth.
Potato agar	774	4	...do	...do	...do	...do	...do	Pale salmon	Do.
Beef agar	786	2-3	Moderately dense.	...do	...do	...do	...do	Pure white	Surface of agar wrinkled.
Sugar-beet agar	789	5	Very dense	...do	...do	...do	Creamy white	Pale salmon	Do.
Beef gelatine	793	6	...do	...do	...do	...do	...do	Rich salmon	Not liquefied.
Litmus lactose agar	821	2-3	Moderately dense.	Few macroconidia.	...do	Few chlamydospores.	Grayish white	Pale salmon	Alkali producer reduces litmus.
Boiled potato	792	4	Very dense	Macroconidia	...do	Chlamydospores.	Creamy white	Rich salmon	Forms green sclerotia.
Raw potato		4	...do	...do	...do	...do	Pure white	Pale salmon	No sclerotia.
Boiled rice	796	4	Moderately dense.	...do	...do	...do	Lilac, pink, and white	Lilac, salmon-pink, and rich salmon,	
Boiled beans	829	4	...do	Few macroconidia.	...do	Occasional chlamydospores.	Gray	Gray	
Boiled corn	828	4	Very dense	Macroconidia	...do	Chlamydospores.	Purple, pink, and white.	Purple, pink, and white	
Boiled wheat	827	4	...do	...do	...do	...do	...do	...do	
Boiled tapioca	826	1	...do	Few macroconidia.	...do	Occasional chlamydospores.	Deep violet and white	Deep violet and pale salmon.	Growth spreads very slowly.
Boiled sweet potato	823	3-4	Rather sparse.	Macroconidia	...do	Few chlamydospores.	Yellowish white	Rich salmon	Mycelium forms ropy strands.
Boiled banana	824	4	Moderately dense.	...do	...do	Chlamydospores.	Creamy white	...do	Do.
Boiled prunes	830	3	Rather sparse.	Occasional macroconidia.	Few microconidia.	Few chlamydospores.	Light cinnamon brown.	Light cinnamon brown.	
Silicate jelly	833	3	Moderately dense.	Macroconidia	...do	Chlamydospores.	Pink, rose, lilac, and white.	Pink, rose, lilac, and salmon.	Changes medium to pale yellow.

In tubes of liquid media the growth varied greatly.

In beef bouillon (898) the fungus formed after 5 days a rather dense white layer on the surface, with much mycelium down in the liquid. All three kinds of spores numerous.

In Raulin's fluid (822) the growth in 5 days was about the same as above, except that all above the surface was a rosy pink. Spores rather less numerous, especially macroconidia and chlamydospores.

In Uschinsky's fluid (841) the growth on the surface was a little less than in the preceding, and pure white. Macroconidia especially abundant, but microconidia and chlamydospores present also.

In a solution (891) containing 2 per cent of Witte's peptone, 1 per cent dextrose, 1 per cent maltose, and 1 per cent mannite, the growth on the surface of the liquid after 5 days was rather abundant and pure white. All three kinds of spores present.

In water with Witte's peptone 2 per cent, glycerin 1 per cent (892), the growth on the surface at the end of 5 days was rather poor and thin, pure white, and producing all three kinds of spores.

In all these liquid media the growth was densest on the surface, but there was a loose growth of mycelium running to the bottoms of the tubes. These same liquids were used also in fermentation tubes, to be described further on.

To determine whether or not any of the chemicals used as fertilizers in the field are markedly injurious or beneficial to the fungus it was grown on boiled potato, to which these substances had been added. Cylinders of potato weighing exactly 4 grams were put in tubes of such a size that when 1 cubic centimeter of liquid was added about one-fourth inch protruded above the surface. To three of these was added 1 c. c. each of 10 per cent KCl; to three, 1 c. c. each of 10 per cent K_2SO_4; to three, 1 c. c. each of 10 per cent $NaNO_3$, making the chemical added 2 per cent of the final product in each case. To each of three others was added 1 c. c. of a saturated solution of freshly prepared $Ca(OH)_2$, and to three others 1 c. c. each of distilled water. These tubes were all heated on three successive days at 100° for 10 minutes. They were then inoculated with the *Fusarium* and kept in a dark room.

On the second day after inoculation there was a little growth in all the tubes, but this was slightly more abundant in the checks, the others being about alike. On the third day the growth in the tubes containing KCl, K_2SO_4, and $Ca(OH)_2$ was almost as abundant as that in the check tubes, and in the tubes containing $NaNO_3$ it was slightly less. On the fourth day the growth was so abundant in all the tubes that practically no difference could be seen. It was pure white and covered the entire exposed surface of the potato.

From this experiment it is apparent that the fungus can accommodate itself perfectly to these chemicals in quantities vastly exceeding that which is ever stored up in a living potato tuber. It follows, then, as a natural conclusion that if these substances have any effect on the resistance of the plant to this disease it is by some modification in the host plant, and not because of the presence of the substances as such.

Boneblack was not used in this experiment because the principal ingredient that would affect the fungus is phosphoric acid, and that was tested along with other acids (Table IX) and found to be quite harmless to the fungus in not too large quantities; and the above conclusions would therefore apply to boneblack also.

GROWTH IN ALKALIS.

To determine the behavior of the fungus on alkaline media three alkalis were used—potassium carbonate, sodium carbonate, and sodium hydroxide. These were mixed in different proportions with rice and water. The results are shown in Table VIII.

Table VIII.—*Comparison of growth in media with varying kinds and amounts of alkali.*

Kind of medium.	Alkalinity of medium.[a]	No. of medium.	Height of growth.	Density of growth.	Kind of spores.			Color in darkness.	Color in light.
			Mm.		Microconidia	Macroconidia	Chlamydospores		
Rice with K_2CO_3	−5	884A	2–3	Dense	do	do	do	Dark lilac, pink, and white	Salmon and lilac.
Rice with K_2CO_3	−10	884B	2–3	do	do	do	do	Pale lilac and white	Do.
Rice with K_2CO_3	−15	884C	2–3	do	do	do	do	do	Rich salmon and lilac.
Rice with K_2CO_3	−20	884D	1–2	do	do	do	do	do	Salmon.
Rice with K_2CO_3	−30	884E	2	do	do	do	do	Creamy white	Do.
Rice with K_2CO_3	−40	884F	2–3	do	do	do	do	do	Do.
Rice with K_2CO_3	−50	884G	1–2	do	do	do	do	Yellowish white	Do.
Rice with Na_2CO_3	−5	885A	3–4	do	do	do	do	Lilac, pink, and white	Salmon and lilac.
Rice with Na_2CO_3	−10	885B	3–4	do	do	do	do	Pale lilac and white	Do.
Rice with Na_2CO_3	−15	885C	2–3	do	do	do	do	do	Do.
Rice with Na_2CO_3	−20	885D	2–3	do	do	do	do	White	Do.
Rice with Na_2CO_3	−30	885E	2–3	do	do	do	do	do	Rich salmon.
Rice with Na_2CO_3	−40	885F	1–2	do	do	do	do	Creamy white	Do.
Rice with Na_2CO_3	−50	885G	1–2	do	do	do	do	Yellowish white	Do.
Rice with NaOH	−5	886A	2–3	do	do	do	do	Lilac and white	Salmon and lilac.
Rice with NaOH	−10	886B	2–3	do	do	do	do	Pale lilac and white	Do.
Rice with NaOH	−15	886C	2	do	do	do	do	White	Rich salmon and lilac.
Rice with NaOH	−20	886D	1	do	do	do	do	Creamy white	Do.
Rice with NaOH	−30	886E	1	do	do	do	do	Yellowish white	Rich salmon.
Rice with NaOH	−40	886F	1	do	do	do	do	do	Do.
Rice check (no alkali)		887	4	do	do	do	do	Lilac, pink, and white	Lilac, salmon pink, and salmon.

[a] Reckoned on Fuller's scale. For those not familiar with this scale it may be stated that the acidity or alkalinity is measured on one liter with normal solutions. Zero on the scale means neutral to phenolphthalein, + means acid and − means alkaline. The figures after the sign denote the number of cubic centimeters of normal acid or alkali required, as the case may be, to render one liter of the fluid neutral.

The difference in growth in the different strengths of alkali was most noticeable at the end of 2 days. At that time there was an even gradation in the amount of mycelium, lessening as the strength of the alkalis increased until at the maximum strength the growth was scarcely perceptible. This was true of all three alkalis. At that time the growth was rather best in potassium carbonate, a little less in sodium carbonate of the same strength, and still less in sodium hydroxide. It will be noted, however, that at the time Table VIII was made—i. e., when the cultures had been growing for 17 days—the amount of growth in the different tubes had been equalized considerably.

One of the most noticeable effects of the increasing strength of alkali was the decrease in the amount of pigment formed, especially the pink. At the end of 2 days there was in all the weak alkalis (−5) a very conspicuous purplish color, in those somewhat stronger (−10) this was a little less noticeable, but those of higher alkalinity were pure white. Later the purplish color changed to lilac, and in the carbonates (−5) there was a little pink.

All three kinds of spores were formed in all the alkali tubes, but in the higher strength the macrospores were very scarce.

GROWTH IN ACIDS.

To determine their effect on the growth of the fungus, a considerable number of acids were used, both inorganic and organic. Of the inorganic acids, phosphoric, hydrochloric, and nitric were tried. The organic acids used were selected partly with an idea of testing those most commonly found in the vegetable and animal products with which the fungus might come in contact in nature, but more especially with regard to their classification. Of the acetic series, formic, acetic, and butyric were taken—all monobasic; of the oxalic series, only oxalic, the simplest dibasic organic acid; of the hydroxy acids, malic and tartaric (dibasic), and citric (tribasic). As a preliminary experiment (series 1 in Table IX), these acids were mixed with boiled potato in such proportion as to make the product approximately +25. The experiment was carried on farther (series 2 in Table IX) by mixing the acids with rice and water in very definite proportions, so that the products would be of exact acidities. The results are shown in Table IX.

TABLE IX.—*Comparison of growth in acid media.*

SERIES I.

Kind of medium.	Acidity of medium.	Number of medium.	Height of growth.	Density of growth.	Kinds of spores.			Color in darkness.	Color in light.
			Mm.						
Potato—check (no acid added)		865	4	Very dense	Microconidia	Macroconidia	Chlamydospores	White	Rich salmon.
Potato with butyric acid	+25	866A		No growth					
Potato with formic acid	+25	866B	3	Very dense	Microconidia	Macroconidia	Chlamydospores	Pink and white	Do.
Potato with malic acid	+25	866C	4	do	do	do	do	do	Do.
Potato with lactic acid	+25	866D	3–4	do	do	do	do	do	Do.
Potato with citric acid	+25	866E	4	do	do	do	do	do	Pale salmon.
Potato with tartaric acid	+25	866F	4	do	do	do	do	do	Rich salmon.
Potato with acetic acid	+25	866G	3	do	do	do	do	do	Do.
Potato with oxalic acid	+25	866H	3–4	do	do	do	do	do	Lilac and pale salmon.
Potato with phosphoric acid	+25	866I	4	do	do	do	do	do	Pale salmon.
Potato with hydrochloric acid	+25	866J	3–4	do	do	do	do	do	Rich salmon.
Potato with nitric acid	+25	866K	3–4	do	do	do	do	do	Faint salmon.
Potato with sulphuric acid	+25	866L	3–4	do	do	do	do	do	Pale salmon.

SERIES II.

Kind of medium.	Acidity of medium.	Number of medium.	Height of growth.	Density of growth.	Kinds of spores.			Color in darkness.	Color in light.
			Mm.						
Rice with butyric acid	+ 6¼	872*a*	4						
Rice with butyric acid	+ 12½	872*b*		No growth					
Rice with butyric acid	+ 25	872A		do					
Rice with butyric acid	+ 50	872B		do					
Rice with butyric acid	+100	872C		do					
Rice with butyric acid	+150	872D		do					
Rice with formic acid	+ 6¼	873*a*	3	Dense	Microconidia	Macroconidia	Chlamydospores	Lilac, pink, and white.	Lilac, pink, and rich salmon.
Rice with formic acid	+ 12½	873*b*	2–3	Rather dense.	do	do	do	do	Do.
Rice with formic acid	+ 25	873A		No growth					
Rice with formic acid	+ 50	873B		do					
Rice with formic acid	+100	873C		do					
Rice with formic acid	+150	873D		do					
Rice with malic acid	+ 25	874A	4	Very dense.	Microconidia	Macroconidia	Chlamydospores	Dark lilac, pink, and white.	Lilac and rich salmon.
Rice with malic acid	+ 50	874B	4	do	do	do	do	do	Do.
Rice with malic acid	+100	874C	3–4	do	do	do	do	Lilac, pink, and white.	Lilac and pale salmon.
Rice with malic acid	+150	874D	3	do	do	do	do	do	Do.
Rice with malic acid	+200	874E	2–3	Dense	do	do	do	do	Do.

TABLE IX.—*Comparison of growth in acid media*—Continued.

SERIES II—Continued.

Kind of medium.	Acidity of medium.	Number of medium.	Height of growth.	Density of growth.	Kinds of spores.			Color in darkness.	Color in light.
			Mm.						
Rice with malic acid	+300	874F	1–2	Dense	Microconidia	Few macroconidia.	Chlamydospores	Lilac, pink and white.	Lilac and pale salmon.
Rice with lactic acid	+ 25	875A	4	Very dense	do	Macroconidia	do	do	Lilac and rich salmon.
Rice with lactic acid	+ 50	875B	4	Dense	do	do	do	do	Do.
Rice with lactic acid	+100	875C	2	do	do	Occasional macroconidia.	Few chlamydospores.	do	Do.
Rice with lactic acid	+150	875D		No growth					
Rice with citric acid	+ 25	876A	3–4	Very dense	Microconidia	Macroconidia	Chlamydospores	Lilac, pink, and white.	Lilac and pale salmon.
Rice with citric acid	+ 50	876B	3–4	do	do	do	do	do	Do.
Rice with citric acid	+100	876C	2	Dense	do	do	do	do	Do.
Rice with citric acid	+150	876D	3–4	do	do	do	do	do	Pale salmon, salmon pink, and lilac.
Rice with citric acid	+200	876E	2–3	do	do	do	do	do	Do.
Rice with citric acid	+300	876F	2	do	do	do	do	do	Do.
Rice with tartaric acid	+ 25	877A	4	Very dense	do	do	do	Dark lilac, pink, and white.	Dark lilac and pale salmon.
Rice with tartaric acid	+ 50	877B	3–4	do	do	do	do	Lilac, pink, and white.	Lilac and salmon.
Rice with tartaric acid	+100	877C	3	do	do	do	do	do	Lilac and rich salmon.
Rice with tartaric acid	+150	877D	3	Dense	do	do	do	Pale lilac, light pink, and white.	Do.
Rice with tartaric acid	+200	877E	2	do	do	do	do	do	Do.
Rice with tartaric acid	+300	877F	1–2	do	do	Few macroconidia.	do	do	Salmon pink.
Rice with tartaric acid	+400	877G		No growth					
Rice with tartaric acid	+500	877H		do					
Rice with acetic acid	+ 6¼	878*a*	3	Dense	Microconidia	Macroconidia.	Chlamydospores	Lilac, pink, and white.	Lilac and salmon.
Rice with acetic acid	+ 12½	878*b*	2	do	do	do	do	do	Do.
Rice with acetic acid	+ 25	878A		No growth					
Rice with acetic acid	+ 50	878B		do					
Rice with acetic acid	+100	878C		do					
Rice with acetic acid	+150	878D		do					
Rice with oxalic acid	+ 25	879A	3	Very dense	Microconidia	Macroconidia.	Chlamydospores	Lilac, pink, and white.	Dark lilac and pale salmon.
Rice with oxalic acid	+ 50	879B	2–3	Dense	do	do	do	Pale lilac, light pink, and white.	Do.

Rice with oxalic acid	+100	879C	2	Dense	Microconidia	Few macroconidia.	Chlamydospores	Pale lilac, rose pink, and white.	Pale lilac and rich salmon.
Rice with oxalic acid	+150	879D		No growth					
Rice with phosphoric acid	+ 25	880A	4	Very dense	Microconidia	Macroconidia	Chlamydospores	Wine purple,[a] pink, and white,	Lilac, wine purple, and salmon.
Rice with phosphoric acid	+ 50	880B	2–3	do	do	do	do	do	Do.
Rice with phosphoric acid	+100	880C	1–2	Dense	do	do	do	Light wine purple, pink, and white.	Wine purple and rich salmon.
Rice with phosphoric acid	+150	880D	1	do			do	Rosy white	Melon color.[b]
Rice with hydrochloric acid	+ 25	881A	2–3	do	Microconidia	Macroconidia	do	Lilac, pink, and white.	Lilac and rich salmon.
Rice with hydrochloric acid	+ 50	881B	1	do			do	Pink	Rose pink.[a]
Rice with hydrochloric acid	+100	881C		No growth					
Rice with hydrochloric acid	+150	881D		do					
Rice with nitric acid	+ 25	882A	2	Dense	Microconidia	Macroconidia.	Chlamydospores	Pale lilac, pink, and white.	Pale salmon and lilac.
Rice with nitric acid	+ 50	882B	2	do	do	Few macroconidia.	do	do	Do.
Rice with nitric acid	+100	882C		No growth					
Rice with nitric acid	+150	882D		do					
Rice with sulphuric acid	+ 25	883A	4	Very dense	Microconidia	Macroconidia.	Chlamydospores	Lilac, pink, and white.	Do.
Rice with sulphuric acid	+ 50	883B	1	Dense			do	Rose pink (a)	Rose pink.
Rice with sulphuric acid	+100	883C		No growth					
Rice with sulphuric acid	+150	883D		do					
Rice check (no acid)		887	4	Very dense	Microconidia	Macroconidia.	Chlamydospores	Lilac, pink, and white.	Lilac, salmon pink, and rich salmon.

[a] Ridgeway's.

[b] Standard Dictionary, page opposite 1722.

From the above table it will be seen that for the different acids, both organic and inorganic, there is a very remarkable difference in the degree of acidity that this fungus can endure. Butyric, formic, and acetic acids, the representatives of the acetic series, seemed to be decidedly the most injurious; malic, tartaric, and citric, the representatives of the hydroxy acid group, are much the least so. This difference is really very great, as is shown by the fact that the fungus will grow in citric acid, for example, at least 25 times as strong as butyric.

The general effect of all the acids is to increase the production of the pigments, both lilac and pink—particularly the latter. This is somewhat noticeable in the rice tubes (series 2), but much more so in the potato tubes (series 1), where if no acid be added the growth (in darkness) is almost always pure white.

All three kinds of spores are borne in varying proportions in all the acid cultures in which only one acid is used, except phosphoric +150, hydrochloric +50, and sulphuric +50. In these no macroconidia or microconidia could be found, but there was a large number of chlamydospores. These were not of the normal form shown in Plate VIII, figure 29, but were of varying sizes and shapes—often much deformed. This is a further indication that the purpose of these spores is to carry the fungus through adverse conditions.

Table X shows the results of mixing the acids in the culture media in various ways.

TABLE X.—*Comparison of growth in mixed-acid media.*

Kind of medium.	Number of medium.	Kind of acid.	Acidity.	Kind of acid.	Acidity.	Total acidity.	Height of growth.	Density of growth.	Kinds of spores.			Color in darkness.
							Mm.					
Rice with hydrochloric and sulphuric acids.	895A	Hydrochloric.	+25	Sulphuric.	+ 25	+ 50	1	Dense			Chlamydospores.	Pink.
Rice with hydrochloric and sulphuric acids.	895B	do	+50	do	+ 50	+100		No growth				
Rice with hydrochloric and nitric acids.	895C	do	+25	Nitric	+ 25	+ 50	2	Dense	Microconidia.	Macroconidia.	Chlamydospores.	Lilac, pink, and white.
Rice with hydrochloric and nitric acids.	895D	do	+50	do	+ 50	+100		No growth				
Rice with sulphuric and nitric acids	895E	Sulphuric.	+25	do	+ 25	+ 50		do				
Rice with sulphuric and nitric acids	895F	do	+50	do	+ 50	+100		do				
Rice with sulphuric and lactic acids	895G	do	+25	Lactic	+ 50	+ 75	3	Dense	Microconidia.	Macroconidia.	Chlamydospores.	Lilac, pink, and white.
Rice with sulphuric and lactic acids	895H	do	+50	do	+ 50	+100		No growth				
Rice with sulphuric and lactic acids	895I	do	+25	do	+100	+125		do				
Rice with sulphuric and lactic acids	895J	do	+50	do	+100	+150		do				
Rice with tartaric and butyric acids.	895K	Tartaric	+25	Butyric.	+ 6¼	+ 31¼		do				
Rice with tartaric and butyric acids.	895L	do	+50	do	+ 6¼	+ 56¼		do				
Rice with tartaric and butyric acids.	895M	do	+25	do	+ 12½	+ 37½		do				
Rice with tartaric and hydrochloric acids.	895N	do	+25	Hydrochloric.	+ 50	+ 75	1	Dense			Chlamydospores.	Pink.
Rice with tartaric and hydrochloric acids.	895O	do	+50	do	+ 50	+100	1	do			do	Do.

This table would indicate that in the case of two acids for which the maximum strength that will allow growth is the same, mixing in equal proportions forms a product that is injurious in the same degree as either one alone. It also goes to show that when the maximum acidity at which growth can take place in any one acid is reached, the adding of another acid in a quanity representing half its own maximum for growth, or, in the case of butyric acid, the adding of tartaric in comparatively small quantities stops growth entirely. The adding of a comparatively small amount of the slightly injurious tartaric to the maximum of hydrochloric (+50) did not prove much more strongly inhibitory than hydrochloric of the same strength alone.

GROWTH IN THE ABSENCE OF FREE OXYGEN.

So far as could be determined the fungus is a strict aerobe. To test this, inoculations were made in fermentation tubes filled with the following media: Beef bouillon (858); Uschinsky's fluid (891); Raulin's fluid (822); water with peptone 2 per cent + dextrose 1 per cent + maltose 1 per cent + mannite 1 per cent (891), and water with peptone 1 per cent + glycerin 1 per cent (892). Two fermentation tubes of each medium were inoculated. This was done by transferring a little mycelium bearing many spores past the curve at the bottom of the tube, from which point it rose in every case to the extreme top of the closed end. At the end of a week there was a fairly good growth in the open ends of all the tubes, corresponding very well to that in the same fluids in test tubes. This growth did not in any case, however, extend into the closed ends more than 2 cm. past the stem, which showed definitely that this fungus can not take its oxygen from the compounds contained in any of these liquids.

REACTION TO SUNLIGHT.

In many kinds of culture media the mycelium is white, in part at least, when grown in a dark closet. On some of these same media the mycelium becomes a beautiful rich salmon color when grown in sunlight. In just which media this reaction takes place, and to what extent, is shown in Tables VII to IX. It will be seen that the depth of the color varies much in different media. The most unexpected difference was found between boiled and raw potato. In the former the color is nearly as deep as in any medium used, while in the latter it is very pale even after a week's exposure to north light. The time at which the color appears varies, of course, with the strength of the light. On boiled potato in north light close to a window it begins to be noticeable in a young culture on the second day of exposure if the weather is clear, and reaches its maximum on about the fifth day, after which it slowly fades as the mycelium dies from old age. In direct sunlight one day's exposure is enough to bring the color in a sufficient amount to be visible. In cultures exposed to the light for a few days and then placed again in darkness the new growth is white, showing that the action ceases practically as soon as the light is withdrawn.

The rays of light that cause the salmon color to appear are all at the violet end of the spectrum. To test this, eight tubes of boiled potato were inoculated with the *Fusarium*, and two of these were suspended in a saturated solution of potassium dichromate, two in a 1 per cent solution of copper sulphate made strongly alkaline with ammonia and filtered to remove the copper oxide, two in distilled water, and two were kept in the dark. The solutions were in 16-ounce wide-mouthed cylindrical bottles, the tubes inserted through perforated stoppers. The tops were wrapped well with black paper and the bottles set where they would get the direct sunshine in the afternoon. In the water the color began to appear in less than forty-eight hours and continued to get deeper for several days. The tubes suspended in copper sulphate and potassium dichromate solutions were first examined on the fifth day, and in the former there was a fairly deep salmon color, while in the latter the mycelium was pure white and continued so as long as the experiment was carried on, which was nearly six weeks.

This light reaction may perhaps be valuable as distinguishing this *Fusarium* from others, as some have been tried in which the color did not appear. It is not strictly confined to this species, however, for it was found to be very marked in a *Fusarium* obtained from the interior of a cowpea vine, and which is probably the *Neocosmospora* described by Smith.[a]

RANGE OF TEMPERATURE FOR GROWTH.

The fungus grows very well on boiled potato at temperatures from about 15° to a little above 30° C. Below 15° the growth is slower and slower as the temperature is reduced, until at 5° C. the increase in the cultures from day to day is hardly perceptible. At 37½° C. no growth takes place in cultures that have been started at room temperature, and at the end of a few weeks' incubation at this temperature the cultures were entirely killed. This may perhaps be one reason why the fungus did not pervade the stems above ground. In the roots the temperature is kept somewhat reduced by the earth, but in the stems growing in the sun it presumably often rises above 37½° C. in Washington summer weather.

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[a] Bulletin No. 17, Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture.

NAME OF THE FUNGUS.

Many specific names have been given to *Fusaria* growing on the potato, and while some of these names may stand for distinct forms, this is not at all certain. Most of these names undoubtedly are synonyms, and for the purpose of this paper all are regarded as such. The earliest available name, therefore, has been used for the parasite under consideration, viz. *Fusarium oxysporum* Schlechtendal, 1824. The following are some of the names that have been applied to *Fusarium* growing on the potato, the specific differences, as will be observed, being only such as are now known to occur in pure cultures of the same fungus when grown under varying conditions, viz. slight differences in compactness of mycelial growth, variations in size and shape of spores, number of septa, odor, and color. The appended descriptions, when not otherwise stated, are translations from Saccardo's Sylloge Fungorum.

1824. *Fusarium oxysporum* Schlechtendal.

Sporodochium convex, subverrucose, rosy, finally breaking forth, rugulose and confluent; conidia small, curved, and very acute at both ends. On half-rotten tubers of potato. Schlechtendal himself says: "F. stroma convexum erumpens varium roseum superficie inaequali rugulosa, sporidiis parvis curvatis utrinque acutissimis."

1842. *Fusarium* (*Fusisporium*) *solani* (Martius) Saccardo.

(Sporodochium) globose, irregular, tomentose, whitish; hyphae branching; conidia fusiform-falcate, 3–5 septate, 40–60 × 7–8μ, subhyaline.

Fusarium (*Fusisporium*) *solani-tuberosa* Martius. Berkeley says this is *Periola tomentosa* Fries.

Fusarium (*Fusisporium*) *solani-tuberosa* Desm. is transferred by Saccardo to *Pionnotes* as *P. solani-tuberosa*.

1846. *Fusarium didymum* Harting.

Same as *Fusarium solani*, according to De Bary.

1851. *Fusarium* (*Fusisporium*) *roseolum* (B. and Br.) Saccardo.

Sporodochium rosy red, delicate, floccose; hyphae short, conidia curved, elongate, somewhat obtuse, 3–6 septate, subtorulose. Berkeley says of this: "Of a delicate rose red, forming thin floccose patches; fertile threads short; spores curved, elongated, slightly obtuse, 3–6 septate, often slightly projecting at each dissepiment."

1869. *Fusarium violaceum* Fuckel.

Sporodochium widely spreading, with a pleasant odor, violet caerulean; conidia fusiform, 2–3 septate, curved, 24–30 × 5–6μ. According to Saccardo, Fuckel's species is the same as *Selenosporium caeruleum* Lib. in Herb. c. icone, and he substitutes the name *F. caeruleum* (Lib.) Saccardo.

1878. *Fusarium diplosporum* C. and E.

Rosy, pulvinate; some conidia fusiform, acute at both ends, arcuate, nucleate, finally becoming 3-septate, 40μ long; others elliptical, uniseptate, 18 × 8μ.

1886. *Fusarium commutatum* Saccardo.

Sporodochium widely spreading, white, mealy-floccose; sporophores continuous, branching; branches ascending, subalternate; conidia at first globose, then fusoid, 3-septate, slightly curved. This is the fungus described and figured by Bonorden in 1851 as *F. candidum* Ehrenb., but Saccardo says hardly *F. candidum* of Ehrenberg, and rejects the name apparently because of *F. candidum* Link.

1888 (?). *Fusarium pestis* Sorauer.

Sorauer may have described this fungus in some publication not seen by the writers, but there is no description of it in his Atlas other than what might apply to any of the foregoing. The brown spots on the stem are surrounded by a loose white narrow zone of hyphæ growing out of the stomata; later the black place is covered by a chalky white efflorescence (the fungous tufts).

1891. *Fusarium æruginosum* Delacroix.

Sporodochium large, hemispherical, varying from bluish to greenish ("e cyaneo æruginosis"), sporophores branching, sparingly septate, hyaline, with rather short branches; conidia falcate, 3–5 septate, not constricted, granular, hyaline or slightly greenish, 20–25 × 4–5μ.

1895. *Fusarium acuminatum* Ell. and Ev.

The authors describe this fungus as follows: "Sporodochia gregarious, minute, white at first, then flesh-colored; conidia falcate, attenuate-acuminate at each end, 3–5, exceptionally 6-septate, not constricted, arising from slightly elongated cells of the proligerous layer, in which respect it differs from the usual type of *Fusarium*. Quite distinct from *F. diplosporum* C. and E., which also occurs on the same host."

1896. *Fusarium affine* Fautr. and Lamb.

Sporodochia amorphous, dirty white, superficial or internal; conidia hyaline, cylindrical, attenuate, straight, at first simple then uniseptate, biguttulate, 10–15 × 4μ (inside of the stem). Authors describe external spores as 18–20 × 2μ.

If the potato disease here described is identical with the sleepy disease of tomatoes, as seems probable, then *Fusarium lycopersici* Sacc. may be added to the above.

Judged by the above descriptions, we have had a half dozen or more species of *Fusarium* in our culture tubes, some of them "new species," and yet all were the product of a single spore. This does not mean that there have been in our cultures any very wonderful transmutations of one thing into another, but only that organisms respond to their environment, and that "species descriptions" of the kind cited have not taken this fact into consideration, and consequently are worthless for scientific purposes. This is not a new idea, but it is a fact to which the attention of systematic mycologists might be directed profitably at frequent intervals.

GEOGRAPHICAL DISTRIBUTION OF THE DISEASE.

There is good reason for believing that this disease is very widely distributed over the United States. "Dry rot" has been known to be one of the most serious potato troubles for many years, and though it has not been so clearly described in most cases as to establish its identity with the disease under consideration, yet it is extremely probable that, in many cases at least, it is due to the same fungus.

It has been definitely identified from several different and widely separated States. As already stated, it was received in large quantities from Hubbardston, Mich., in 1899. In April, 1903, it was sent in from Alleghany Station, Va., where it had done very great damage to stored potatoes during the winter, so that the grower had been obliged to feed them to his hogs. About a half bushel of these potatoes was sent to the Department of Agriculture, and when cut open a large proportion showed the disease. Its identity was further established by microscopical examination and by making cultures of the fungus from the discolored part of the tubers. One diseased tuber was received from Manhattan, Kans., where there had been much loss in stored potatoes. This tuber was browned in the vascular ring throughout its entire extent. A few diseased vines and tubers were received in the summer of 1903 from Nebraska, where considerable injury was reported. Our own crop, raised on the Potomac Flats, established the presence of the disease in the District of Columbia. The disease reported by Stewart from several parts of New York State, and mentioned at the beginning of this paper, appears to be the same. It has also been sent to the Florida station of this Department from several of the Southern States. In the fall of 1903 it was observed in the vicinity of Madison, Wis.

It seems, then, safe to say that this disease extends north to Canada, east to the Atlantic, south to the Gulf of Mexico, and west to Colorado. How much wider its distribution is in this country can not be stated at the present time, but it is almost undoubtedly beyond the limits from which it has been so far reported.

If the disease in England, Germany, France, and Belgium be the same, it is certainly also widely prevalent in Europe.

REMEDIAL MEASURES.

As the fungus enters the plant below the surface of the ground and may gain access at any time during the season, it is very difficult to combat. Spraying with Bordeaux mixture and other fungicides has not been tried, but as these can be applied readily only to the tops there is little reason to expect beneficial results.

Adding chemicals to the soil as fertilizers might be expected to help ward off the disease, but so far as experiments of this kind have been carried out by the writers they have given practically negative results.

The selection of resistant plants of different varieties will be likely to prove of the most value. Our varieties all suffered severely with the disease, but some plants escaped, while others contracted the disease early in the growing season. In 1903, in our plots, above-ground symptoms were visible on a few plants as early as July 15, and many diseased plants were to be seen on July 22. A month later the disease was very conspicuous on the foliage in all parts of the field, but there were still many plants which showed no symptoms. Experiments with other varieties would be likely to establish the same partial immunity, and from the most resistant of these plants it is probable that hardy strains could be originated. According to Frank, the German disease also attacks some varieties more readily than others.

Planting on soil free from the disease, with sound tubers obtained from localities where the disease does not occur, is certainly to be recommended. The stem end of every tuber should be cut off and inspected before deciding to plant it. It is much easier to keep this fungus out of a soil than to overcome it when it is well established. It should be regarded in the same light as a very noxious weed, and every effort must be made to keep the potato fields free from it. A word to the wise is sufficient.

If tubers affected with this disease are used for seed, the resulting crop and successive crops will be attacked, as the fungus is thereby placed in the best possible position to infect the young roots, even if it does not grow into the new plants directly through the sprouts, which it is extremely likely to do.

It is of equal importance to avoid planting potatoes for several years on land where the disease has appeared, as the fungus keeps alive in the soil for some time—how long has not been determined.[a] Such infected land should be used for other crops, preferably cereals or grasses. Badly diseased tubers should not be fed to stock, as the heat of the animal body for so short a time is not sufficient to kill the spores, nor would the digestive fluids be likely to do so, and they would therefore be thrown out on the land ready to attack another crop. They should be burned or buried on waste land in a deep pit, with the addition of some barrels of caustic lime.

It has already been shown that when the potatoes are harvested the extent of the disease in those affected is usually comparatively slight—often quite unnoticeable to the casual observer.[b] It is while they are in storage that the greater amount of the destruction and consequent loss takes place. It becomes of very great importance, therefore, to know how to handle these slightly diseased potatoes so as to prevent the further progress of the fungus.

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[a] In the case of several diseases of this type it is known positively that land once infected remains infected for many years.

[b] If a potato disease that prevailed extensively in the fall of 1903 in several counties in Minnesota, which has been received more recently from Maryland and reported from Michigan, be the same, then this statement must be modified. This disease appears to follow wet weather, and is characterized by a hard, black stain running in from various parts of the surface of the tuber, often involving nearly the whole tuber, and seldom more than one centimeter deep. The infection in this disease is not by way of the vascular system, but seems to be from any part of the soil in contact with the tuber, and probably by way of the lenticels. The disease suggested *Phytophthora*, but the mycelium found in the tissues on microscopic examination did not belong to this fungus. Two sets of poured plates yielded *Fusarium* colonies, and the third set only some scattering bacteria. The losses in Minnesota amounted to thousands of dollars. Early digging would undoubtedly have prevented most of this loss.

First in importance is the question of temperature. Potatoes that show a slight trace of brown color in the flesh at the basal end should never be stored in warm rooms. They should be kept in a place as cool as it is possible to obtain without danger of freezing, i. e., at or below 40° F. This low temperature may be had in cool cellars, but is best obtained by our modern cold-storage processes, and here there is little danger of loss by continued growth of the fungus. For the average potato grower, however, cold storage is a process too expensive to be practicable. He must resort to storing in the ground or in cellars. Of these, pits in the ground or cellars under barns are likely to be cooler during the winter than cellars under houses, and on that account would be preferable for these slightly diseased potatoes, though there is, of course, a vast difference in the temperature of house cellars.

Where it is not practicable to store in a decidedly cool place, such potatoes should be sold in the fall. Except for the browned region at the base, the potatoes are not disqualified for eating, and this part, if not too extensive, can be removed in paring. This, however, involves a waste, and the quality of the unattacked parts of many of these tubers seems to be inferior. There is no danger in using these partially affected tubers. Cooking kills the fungus; but even if the tubers were eaten raw the fungus could do no harm to a human being, as it has been shown that it can not grow at blood temperature—37½° C.

Moisture is another factor to be considered, though to a much less extent than temperature. The fungus can grow readily and even rapidly in the tubers in a very dry air, but it has been shown that in a moist atmosphere there is a much greater production of mycelium on the surface, and consequently more spreading of the rot by contact. Furthermore, the tubers killed by the fungus, if kept dry, shrivel up and undergo no further change, but if there is moisture present they are invaded by various soft bacterial rots that may spread into the sound potatoes by contact, and thus increase the loss.

To recapitulate:

(1) Plant only sound tubers on uninfected land.

(2) Reject badly diseased tubers and store slightly diseased ones in a cool dry place, i. e., at 35° to 40° F.

(3) If rejection and storage can not be carried out as recommended above, sell soon after digging, or at least as early as December.

(4) When there is any suspicion, buyers should always keep the potatoes in cold storage.

(5) Stake the soundest, best-looking plants on diseased fields and save the tubers from such plants for further experiment in the hope of originating resistant strains.

CULTURE MEDIA USED.

That the reader may obtain a more accurate knowledge of the composition of each kind of medium used in the foregoing experiments and the details of the process by which it was made, to aid him in interpreting any peculiarities of the results the following descriptions are given. Unless otherwise stated in the text, the media were all used for tube cultures, and the tubes of the agar, the gelatin, the silicate jelly, and the boiled tapioca were all hardened at a long slant. When the nature of the medium was such that it could readily be measured, 10 cubic centimeters was the amount used for each tube. It is not to be understood that the following methods of procedure are recommended as always in all respects the best, but they are referred to only as those actually used.

Potato agar (773).—Very smooth, sound potatoes were thoroughly scrubbed, washed five times in distilled water, pared, washed again in distilled water, and sliced thin. To 200 grams of sliced potato were added 500 c. c. of distilled water, and the whole was heated in a steamer for 1½ hours at 75° to 85° C., then filtered hot, without pressure, through a clean towel. Water was then added to bring the amount up to 500 c. c. To half of this (250 c. c.) was added 7.5 grams of Lautenschläger's agar flour that had been heated with 250 c. c. of distilled water in an autoclave at 110° C. for 15 minutes. The potato infusion and the agar solution were then thoroughly mixed and heated in an autoclave at 110° C. for 10 minutes.

Peptonized potato agar (774).—Like 773 but with the addition of enough of Witte's peptonum siccum just before mixing with the agar solution to make the whole one-half per cent. The potato infusion used was half of the 500 c. c. prepared for 773.

Beef agar (786).—To one part finely chopped lean beef (918 grams) were added two parts (1,836 c. c.) distilled water. This was kept in a water bath between 50° and 60° C. for an hour, and then heated at 100° C. for an hour. It was then filtered hot in a meat press through a clean towel and cooled and filtered again through filter paper. Enough of Witte's peptonum siccum to make the final product 1 per cent was added and the whole heated to 100° C. for an hour and filtered through paper. Water was then added to bring the total amount back to 1,836 c. c. This bouillon was then titrated with phenolphthalein, and NaOH was added to make it +15 on Fuller's scale.[a] To 1,000 c. c. of this bouillon was added 10 grams of Lautenschläger's agar flour, and this was heated at 100° for half an hour and then cooled down below 60° C. The neutralized whites of two eggs were then added and thoroughly mixed to clarify the medium. It was then heated to 100° for one hour, filtered through paper, and autoclaved for fifteen minutes at 110° C.

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[a] See footnote on p. 41.

Sugar-beet agar (789).—A large sound sugar beet was thoroughly scrubbed, washed in distilled water, pared, and grated fine. To 1,000 grams of beet pulp was added 1,500 c. c. distilled water, and the whole was heated at 100° C. for half an hour, then filtered under pressure through a clean towel. Water was added to the liquid to bring the total amount up to 2 liters. This was titrated and found to be +3 on Fuller's scale. No alkali was added. Ten grams of agar flour were added, and it was then heated at 100° for three-quarters of an hour, filtered through filter paper, and heated again on three successive days for 10 minutes at 100° C.

Boiled sugar beet (790).—From the same beet used in making the above, cylinders about 1½ inches long were cut with a large cork borer. These were washed in distilled water and trimmed to a long slant at one end. They were then put in test tubes with a little distilled water and heated on three successive days for 10 minutes at 100° C.

Boiled potato (792).—Large sound potatoes were thoroughly scrubbed, washed in distilled water, pared, washed again, and cut into cylinders about 1½ inches long with a large cork borer. These cylinders were washed in distilled water, trimmed to a long slant at one end, washed again, and put in test tubes with a little distilled water. They were heated on three successive days in a steamer for 10 minutes at 100° C.

Beef gelatin (793).—To 500 c. c. beef bouillon (made precisely like that used for beef agar 786, including 1 per cent peptone) was added 50 grams of Nelson's No. 1 photographic gelatin. This was allowed to soak for 1½ hours, then heated in a steamer for 5 minutes at 100° C. It was titrated with phenolphthalein, and NaOH was added to make it +15 on Fuller's scale, then heated at 100° for 20 minutes and filtered. Heated in tubes on first day 10 minutes, and on second and third days 5 minutes each at 100° C.

Boiled rice (796).—Clean rice, 2½ grams, and distilled water, 10 c. c. per tube, were heated in the autoclave for 10 minutes at 115° C.

Litmus lactose agar (821).—To 500 c. c. of beef agar made like 786 was added 10 grams of lactose and just enough of Merck's purified litmus to make it a bluish color. Heated 10 minutes at 100°, pipetted into tubes, and heated on three successive days at 100° C. The tubes were laid so that the agar hardened at a long slant.

Raulin's fluid (822).—To 1,500 c. c. distilled water were added, in order: Cane sugar, granulated, 70 grams; tartaric acid, 4 grams; ammonium nitrate, 4 grams; ammonium phosphate, 0.60 gram; potassium carbonate, 0.60 gram; magnesium carbonate, 0.40 gram; ammonium sulphate, 0.25 gram; zinc sulphate, 0.07 gram; ferrous sulphate, 0.07 gram; and potassium silicate, 0.07. This mixture was heated on 3 successive days, for 15 minutes, at 100° C.

Boiled sweet potato (823).—Several small sweet potatoes were scrubbed, pared, washed in distilled water, cut into cylinders with a large cork borer, trimmed to a long slant at one end, and put in tubes with a little distilled water. Autoclaved for 10 minutes at 110° C.

Boiled banana (824).—Pieces of barely ripe yellow banana about ½ by 1½ inches were put in tubes with a little distilled water. Autoclaved for 10 minutes at 110° C.

Boiled rice (825).—Like 796.

Boiled tapioca (826).—Tubes were filled to the depth of 1 inch with pearl tapioca, and 10 c. c. of distilled water was added to each. After soaking for 4 hours they were autoclaved in a slanting position for 15 minutes at 115° C.

Boiled wheat (827).—Tubes were filled to the depth of ¾ inch with soft red wheat and 10 c. c. distilled water added. This was allowed to soak over night and then autoclaved three times for 15 minutes at 115° C.

Boiled corn (827).—Tubes were filled to the depth of ¾ inch with white dent corn, coarsely cracked, and 10 c. c. of distilled water added. After soaking for 3 hours they were autoclaved 3 times for 15 minutes at 117° C.

Boiled beans (829).—Tubes were filled to the depth of ¾ inch with coarsely cracked white navy beans and 10 c. c. distilled water added. After soaking 4 hours they were autoclaved for 15 minutes at 115° C.

Boiled prunes (830).—Several pieces of best quality prunes were put in tubes and 10 c. c. distilled water added. After soaking for 4 hours they were autoclaved for 10 minutes at 110° C.

Boiled sugar beet (831).—Made exactly like 790, except that the beets used were less than half grown.

Silicate jelly (833).—To 100 c. c. of hydrochloric acid, sp. gr. 1.10, was added drop by drop 100 c. c. sodium silicate, sp. gr. 1.107, the mixture being stirred constantly. This was dialyzed for 6 hours in running water. To 200 c. c. of this was added 50 c. c. of a solution like Raulin's, but more concentrated, the same weight of salts being used, but only 200 c. c. of water instead of 1,500 c. c. After thorough mixing, 10 c. c. quantities were pipetted into tubes and then were put in the autoclave in a somewhat inclined position and heated for 10 minutes at 110° C. The steam was not allowed to escape while the autoclave was cooling, and the jelly came out homogeneous and clear, and sufficiently hard.

Uschinsky's fluid (841).—To 500 c. c. of distilled water were added: Glycerin, 15 c. c.; ammonium lactate, 3 c. c.; sodium chloride, 1.5 grams; sodium asparaginate, 1.5 grams; dipotassium phosphate, 1 gram; calcium chloride, 0.05 gram; magnesium sulphate, 0.05 gram. This mixture was heated for 30 minutes at 100°, filtered, tubed, and autoclaved for 10 minutes at 110° C.

Beef bouillon (858).—This was made exactly like the bouillon for agar No. 786, except that 1,165 grams of beef and 2,330 c. c. of water were used, and the solution was heated only half an hour just after the peptone was added. It was finally autoclaved 10 minutes at 115° C. The acidity was +15 and the peptone 1 per cent.

Boiled potato (865).—Made exactly like 792.

In sterilizing the following media the autoclave was heated to the boiling point, the tubes put in cold, and the cover screwed down immediately. As soon as steam began to come out freely, which was before the tubes were heated through, the vent was closed and no steam was allowed to escape until the sterilization was finished and the autoclave cooled down below the boiling point. This was to prevent any escape of the acids. All the tubes containing acids were autoclaved for 10 minutes at a temperature varying between 105° and 107° C.

The acids used were all titrated with great care and accuracy, N/20 sodium hydroxide and phenolphthalein being used. They were in all cases retitrated after diluting to the proper strength.

866A to L.—These were made by preparing potato cylinders like those in 865, and adding to each tube before sterilizing a little water and 1 c. c. of acid +250. As the size of the potato cylinder and the amount of water were made so that together they would weigh as nearly as possible 9 grams, the approximate acidity of the product in each case was +25. The acids used are shown in Table IX, series 1.

872 to 883.—Made by heating together rice water and acids in such proportions that the products would be of the exact acidities given in Table IX, series 2. The acids used for making the tubes of acidities up to and including +150 were all +250, those for +200 and +300 were +500, and the tartaric for +400 and +500 was +1,000. The amount of rice used for each tube was such that the cultures should be neither too wet nor too dry, and varied with the different acids.

884 to 886.—In preparing these alkaline media the sodium hydroxide used was from the N/20 used in titrating acid solutions, while the carbonate used were made −100 on Fuller's scale. In titrating them phenolphthalein was used as an indicator, and residual titration was resorted to (see Sutton's Volumetric Analysis, Sixth Edition, p. 50). In this sulphuric acid N/20 and sodium hydroxide N/20 were used. These alkalis were mixed with rice and water in proportions to give exactly the alkalinities stated in Table VIII.

895A to O.—The acids used in preparing these media were all +250. They were mixed with rice and water in proportions to give the acidities shown in Table X. All were autoclaved for 10 minutes at 110° C.

Raw potato cylinders (896).—Several large sound Burbank potatoes were thoroughly washed, soaked 5 minutes in 1:1,000 corrosive sublimate water, washed again in distilled water, pared with a sterilized knife, and washed again in distilled water. From these potatoes cylinders were cut with a sterilized cork borer and allowed to drop directly into tubes containing a little autoclaved distilled water. They were allowed to incubate for 2 weeks at 37½° C., and for 2 weeks longer at room temperatures; and at the end of that time all that showed any signs of bacterial or fungous growth were discarded. They were at this time nearly black on the surface from oxidation.

SUMMARY.

(1) This bulletin deals with a potato disease common over a considerable portion of the United States and variously known as bundle blackening, stem rot, dry end-rot, and dry rot.

(2) The bundle blackening and dry end-rot of the tuber are two stages of the same disease. This begins in the field in the underground stems and roots.

(3) A fungus is always present in the darkened vascular bundles of the tubers in sparing amount, and cultures therefrom have shown this to be a *Fusarium*.

(4) The above-ground symptoms are slow change of color, dwarfing, more or less rolling or curling of the leaves, and, finally, a wilt of the foliage and the falling down of the stems.

(5) The first symptoms in the tuber are nearly always at the stem end in the form of browned or blackened vascular bundles. During this stage of the disease the tubers are sound externally. The dark stain in the vessels may finally extend to the eye end of the tuber, the parenchyma within and without remaining sound and white or becoming yellowish as the fungus invades it (finally shriveled, grayish brown, and hard), or else breaking down with mixed infections including various soft bacterial rots.

(6) The fungus grows readily in a great variety of culture media. It varies considerably in form, color, and sporification according to the environment. On cooked potato and in a number of other media it is white when grown in darkness but bright salmon when exposed to the light. On cooked beans the fungus is gray both in light and in darkness. Under varying conditions various colors were obtained, e. g., purple, violet, lilac, pink, rose, yellow, cream, salmon, cinnamon, gray, and green. Macroconidia were more abundant in some media than in others, and in certain acid media only distorted chlamydospores were produced.

(7) The fungus tolerates large amounts of some kinds of acids, e. g., malic, citric, and tartaric, and is inhibited by small amounts of others, e. g., formic, acetic, and butyric. It endures considerable amounts of alkalis, and these have a tendency to keep the mycelium white, or when in excess to make it yellowish.

(8) The fungus is aerobic. It does not grow at 37½° C. (blood heat) and grows with extreme slowness at 5° C. (41° F.). It grows well between 15° and 30° C.

(9) The fungus attacks the plant from the soil and winters over in the earth. In land frequently planted to potatoes it can probably maintain itself indefinitely.

(10) A copious use of fertilizers, such as lime, phosphates, nitrates, and potash salts, did not enable the plants to overcome the disease.

(11) The disease continues in stored potatoes, and if they are kept in warm rooms the loss during the winter is likely to be large. Tubers stored by the writers in warm rooms, whether moist or dry, became badly diseased. Those stored in a cool place kept much better.

(12) Diseased tubers, therefore, should be stored in cool, dry rooms and used early in the season. They should not be fed raw to stock.

(13) Infected land should be planted to other crops for a series of years. Tentatively, at least, it would be best to exclude also tomatoes, eggplants, and peppers from such land.

(14) The greatest care should be taken to avoid the infection of healthy land by the planting of diseased tubers. All tubers designed for seed should be cut at the stem end and carefully inspected before planting.

(15) Diseased tubers should not be thrown on the manure pile.

(16) If the new wet-weather disease of potato tubers mentioned in the footnote on page 53 be due to this same fungus, then some modifications should be made in the statements in paragraph 5. It is probable, also, that in some climates or conditions the fungus will be found growing out into the parts above ground.

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[*Melanospora ornata* was frequently found inside the stems killed by this disease.]

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[This is the one described by Ellis and Everhart as *F. acuminatum*. Some potato stems sent to the station were observed to be girdled by a pink fungus. The disease is said to have spread rapidly for a few days in midsummer and then disappeared so that additional material for study could not be obtained.]

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[The date given on the cover is Dec., 1897, but the date of the letter transmitting the Bulletin to the State Commissioner of Agriculture for publication is Feb. 7, 1898. "The stem-blight herein discussed is the one described by the writer in Bul. No. 101 of this station, pp. 83–84."]

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[Note on a disease of potato thought to be caused by *Fusarium*.]

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[Potato tubers are supposed to be *galls* due to the stimulating influence of *F. solani*.]

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[Reports a form of *Fusarium* associated with a bacterial disease of potatoes supposed to be due to *Bacillus solanacearum*.]

DESCRIPTION OF PLATES.

PLATES.

PLATE I. *Frontispiece.* Potato plant in which part of the shoots appears healthy, and part is affected with the *Fusarium* disease, showing difference in the habit of the affected part and particularly in the appearance of the leaves.

PLATE II. Potato plant in a somewhat advanced stage of the disease, the foliage wilted and drooping, but the shoot not yet fallen over on the ground.

PLATE III. Potato plant in a late stage of the disease, the shoots prostrate on the ground and the leaves drying up.

PLATE IV. Sections cut across diseased tubers at the stem end, showing an earlier stage of invasion of the vascular system by the fungus than that shown in Plate V. Natural size.

PLATE V. Figs. 1 and 2.—Sections cut across middle of diseased tubers, showing blackened condition of the vascular system. Fig. 3.—Tuber similar to Fig. 1, with the cortex carefully pared away so as to show the longitudinal extension of the brown stain in the vascular system. Fig. 4.—A later stage, showing extension of the disease to the whole interior of the tuber and tufts of white mycelium in the central cavities. Figs. 5 and 6.—More advanced stages of the decay, showing large central cavities filled by the fungus. More advanced condition than is shown in Plate IV. Natural size.

PLATE VI. Late stages of the disease in stored tubers exposed to warm, dry air. Tubers shriveled and hard. Some free from surface mycelium. Others with masses of the fungus on the surface and in closed cavities.

PLATE VII. A single colony of the fungus nine days old in a petri-dish culture on sugar-beet agar. Mycelium grown from a single spore.

PLATE VIII. Drawings made with the aid of the camera lucida, showing development of the fungus. Fig. 1.—End of submerged hypha from the margin of a colony (see Pl. VII) on sugar-beet agar in a petri-dish culture, showing habit of growth and branching. × 108. Fig. 2.—End of submerged hypha from a colony similar to that shown in fig. 1. This hypha has begun to form microconidia, which may be seen on the end and on short lateral branches. × 108. Figs. 3–12.—Tip of a hypha from mycelium similar to that in figs. 1 and 2, showing in detail the formation of microconidia. The hypha is submerged in the agar and the microconidia remain in approximately the position in which they were formed. The time required for their formation may be judged from the appended figures, the hypha being under observation for several hours. × 324. Figs. 13–15.—Stages in the germination of a microconidium in sugar-beet agar in a Van Tieghem cell. In fig. 15 one cross-septum has been formed and several vacuoles have become visible. The spore was put into the germinating chamber at 10 a. m. and began to germinate much sooner than is usual. × 480. Figs. 16–19.—Part of a hypha growing in Uschinsky's fluid in a Van Tieghem cell, showing in detail stages in the formation of macroconidia on a swollen lateral branch. × 216. Figs. 20–22.—Stages in the germination of a macroconidium in

Uschinsky's fluid in a Van Tieghem cell. The spore was put into the germinating fluid at 10 a. m. × 480. Figs. 23–25.—Mature macroconidia grown in Uschinsky's fluid. Fig. 23 nearly straight; fig. 25 much curved. × 216. Fig. 26.—Part of hypha grown in beef bouillon, showing intercalary chlamydospores in stages of formation. × 135. Fig. 27.—Young chlamydospore borne on a short lateral branch, growing in beef bouillon. × 135. Fig. 28.—Young chlamydospore borne terminally on a long hypha, grown in beef bouillon. × 135. Fig. 29.—Mature chlamydospore grown in beef bouillon. × 480. Figs. 31–33 —Stages in the germination of a chlamydospore in beef bouillon in a Van Tieghem cell. The spore was put into the germinating fluid at 10 a. m., and began to germinate earlier than any of the others in the same medium. × 480. Fig. 34.—Tangential section through the vascular system of a diseased tuber, showing the long slender hypha, following a reticulate vessel and branching with it. × 110.

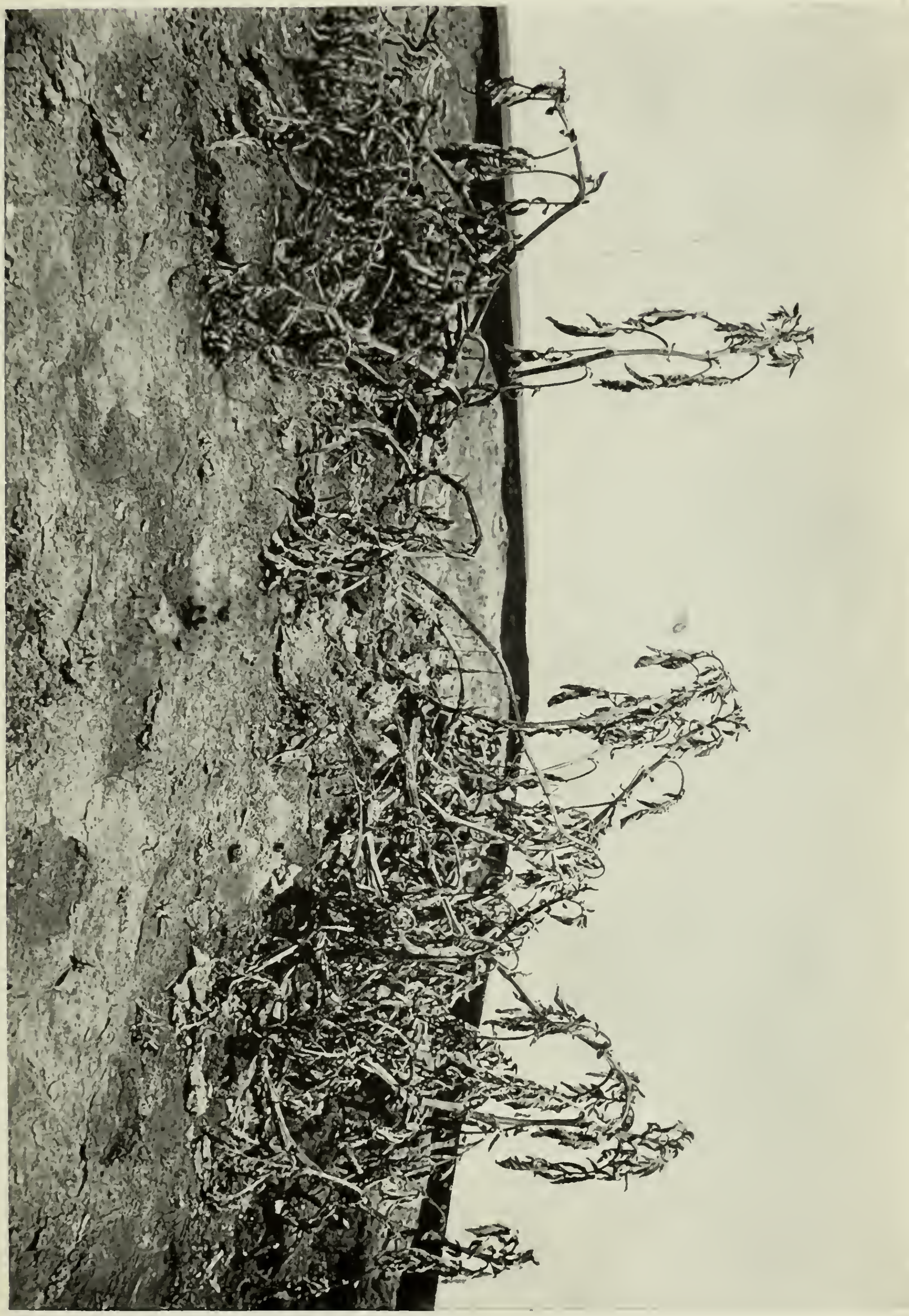
TEXT FIGURES.

Fig. 1.—Diagram of a longitudinal section of a potato. The dotted line marks the position of the vascular ring, and the lines across the main axis indicate the distances that the disease has progressed into this ring, designated in Table IV as "slight," "less than half," "half," "nearly all," and "all."

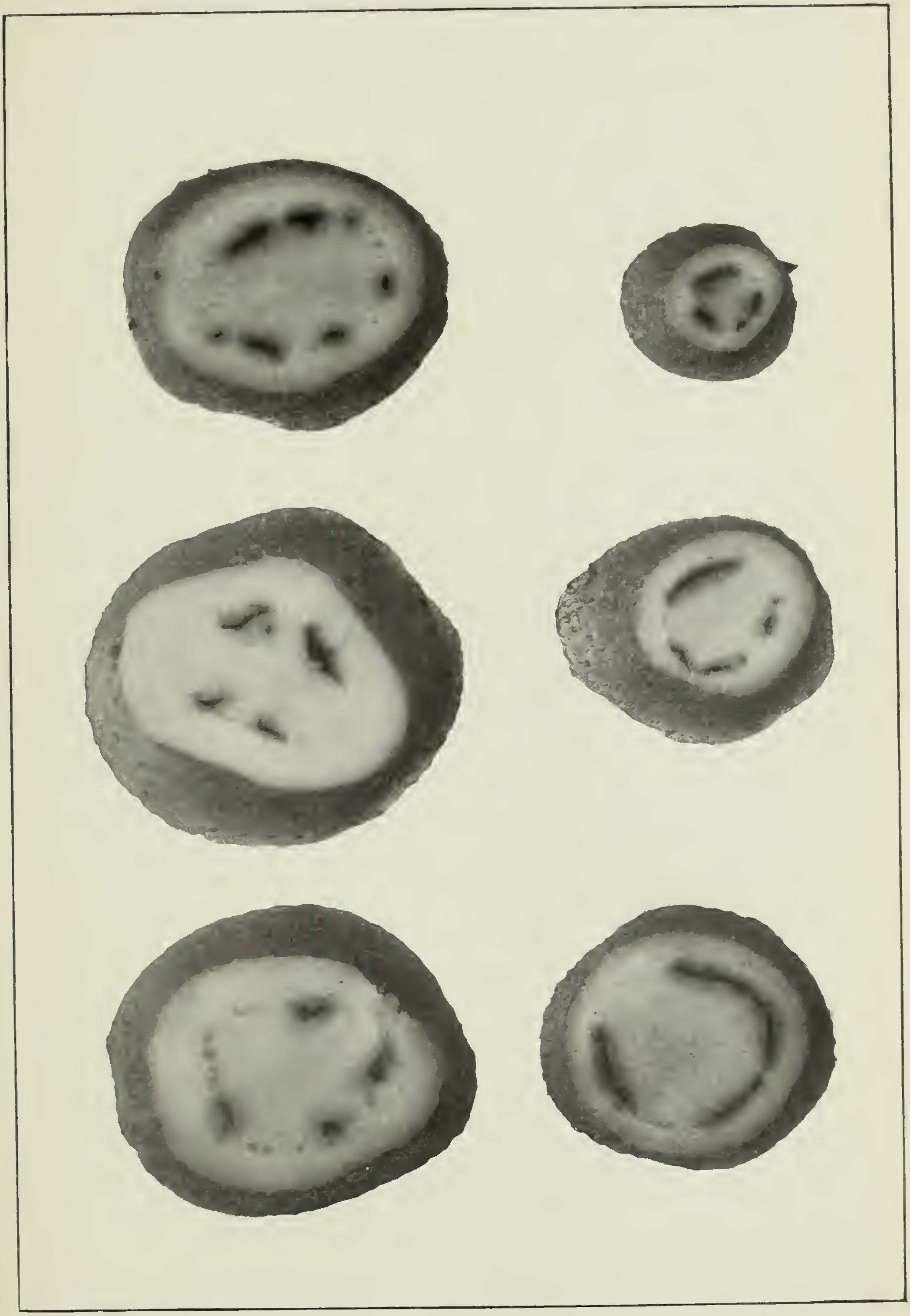
Fig. 2.—Diagram of potato field on Potomac Flats, Washington, D. C., in which (1902) the experiments were made with different fertilizers and different varieties with reference to resistance to the *Fusarium* disease. The lines represent the potato rows, and their intersections the hills. The numbers belong to the plots directly below them, and the fertilizers used and the varieties planted in them may be seen from Table I. The hills in which all the shoots showed the effect of the disease on July 27 are marked with a cross. Those in which only a part of the shoots was visibly affected are marked with an oblique line. The small plots planted to "Browns" are omitted for reasons already stated. There is a plantation road on the upper and right-hand sides of the field, bluegrass on the lower side, and Burbank potatoes of the same seed as that used in the experimental plots on the left-hand side. The ground slopes gently from the upper to the lower side of the field, as it appears on the page, and very slightly from left to right, but to the easual observer it would appear to be level.

O

POTATO SHOOT ATTACKED BY FUSARIUM AND BEGINNING TO WILT.

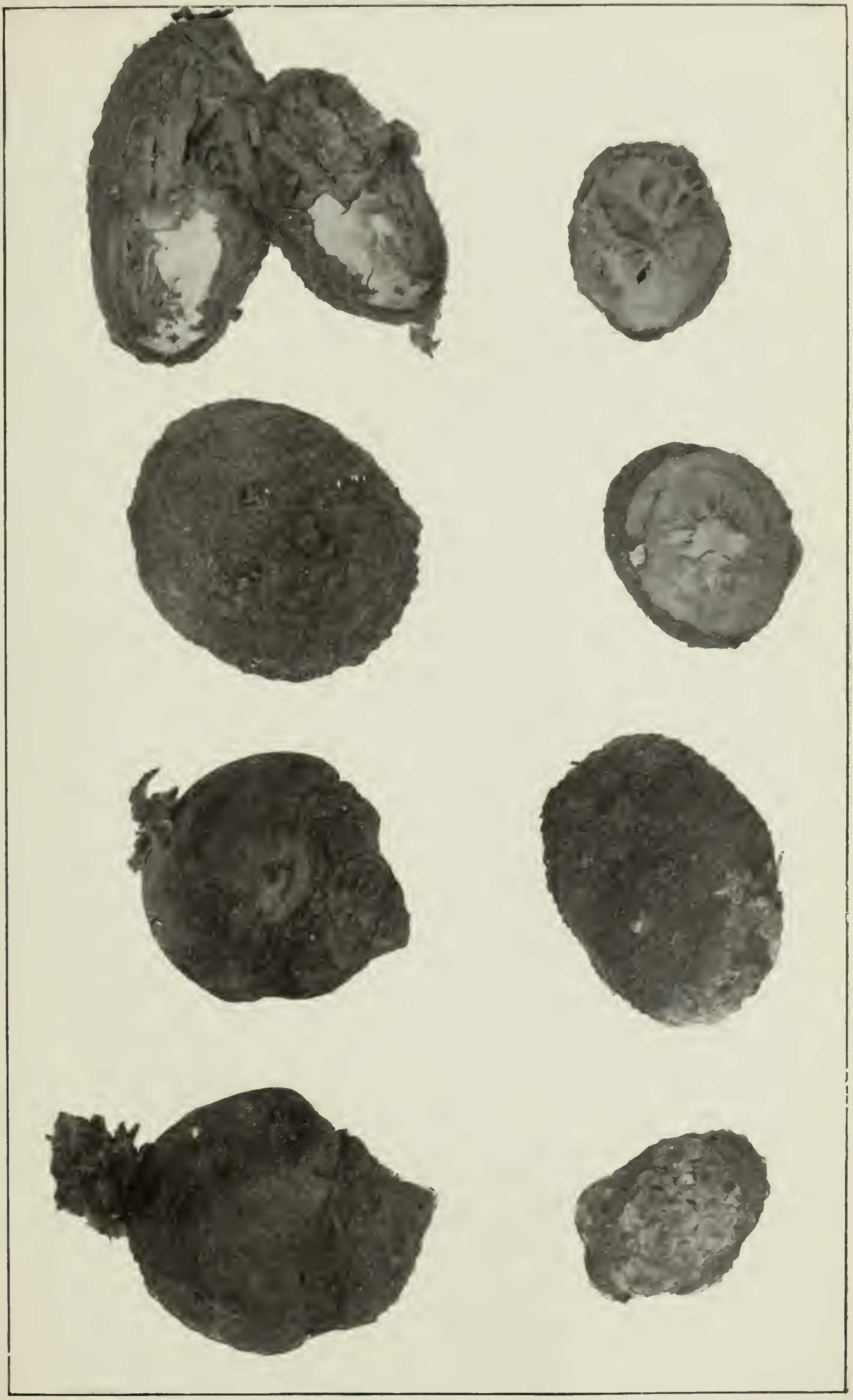


POTATO SHOOTS IN A LATER STAGE OF THE DISEASE.

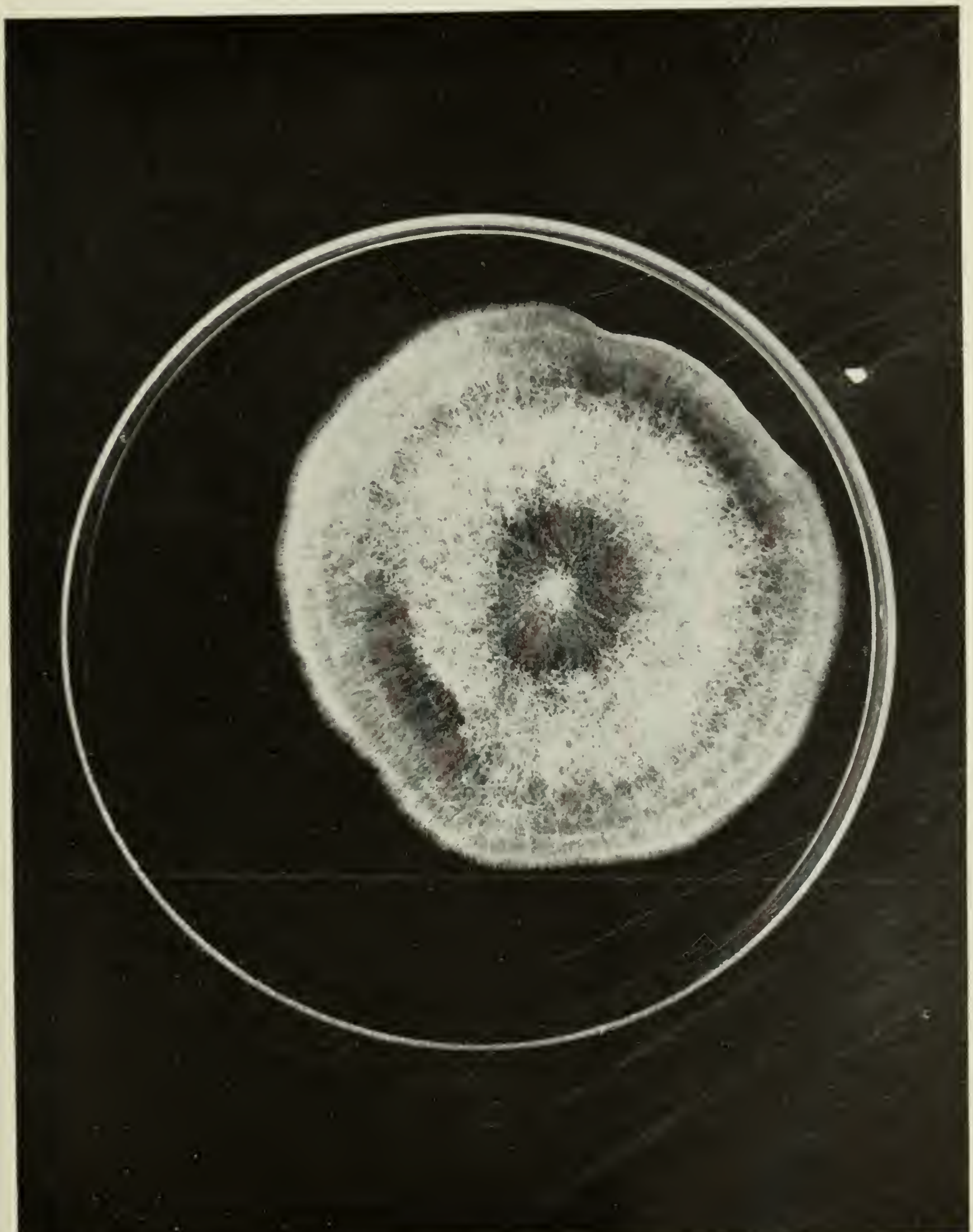


STEM END OF POTATO TUBERS, SHOWING BLACK STAIN IN VICINITY OF VASCULAR BUNDLES DUE TO PRESENCE OF THE FUSARIUM.

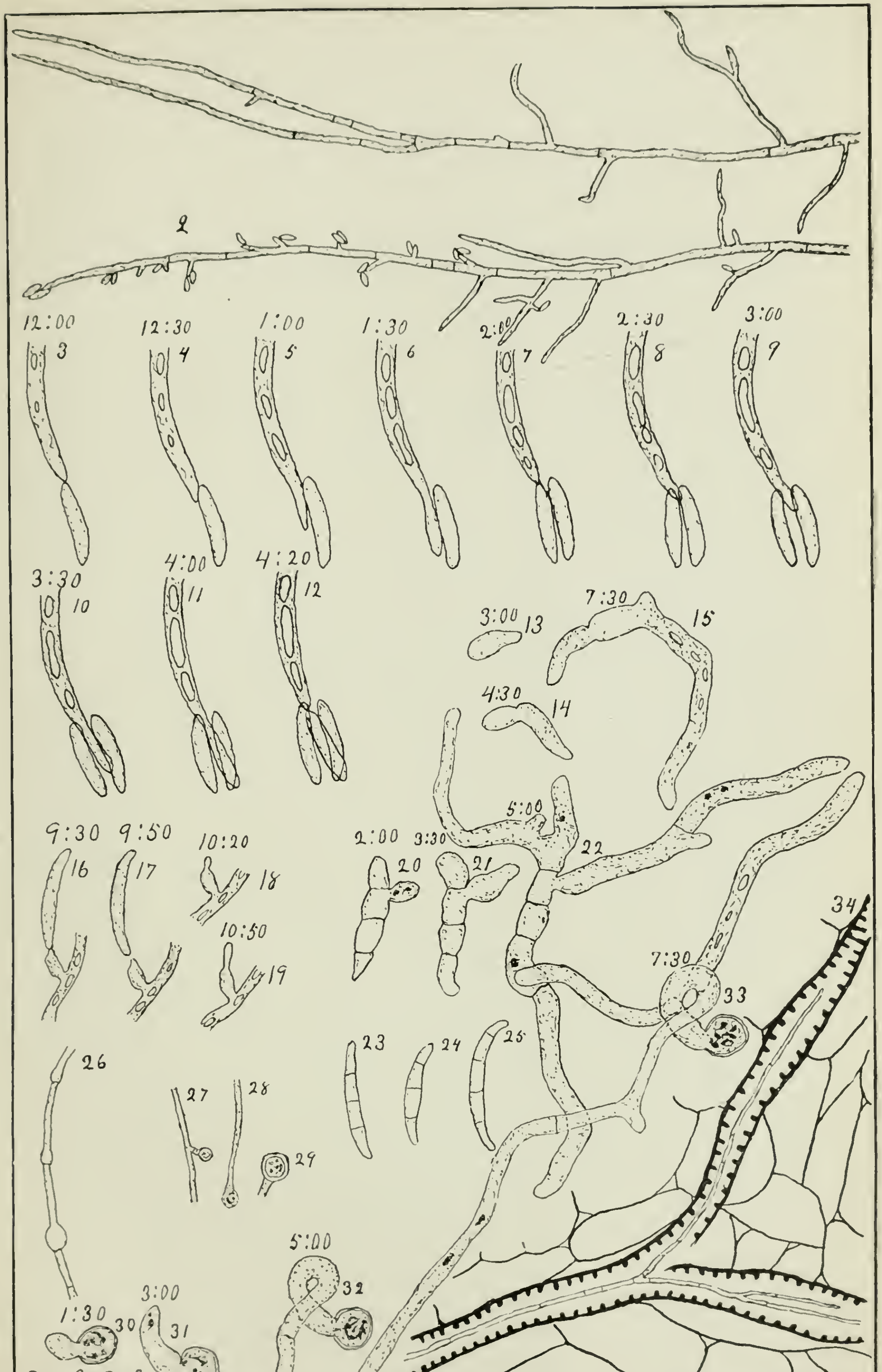
VARIOUS STAGES IN DESTRUCTION OF POTATO TUBERS BY FUSARIUM.



ACTION OF FUSARIUM ON POTATO TUBERS IN WARM, DRY AIR.



MYCELIUM OF THE POTATO FUSARIUM, GROWN FROM A SINGLE SPORE IN NUTRIENT AGAR.



Mycelium, Spores, and Germ Tubes of the Potato Fusarium.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 56.

B. T. GALLOWAY, *Chief of Bureau.*

NOMENCLATURE OF THE APPLE;

A CATALOGUE OF THE KNOWN VARIETIES REFERRED TO IN AMERICAN PUBLICATIONS FROM 1804 TO 1904.

COMPILED BY

W. H. RAGAN,

EXPERT IN POMOLOGICAL NOMENCLATURE.

POMOLOGICAL INVESTIGATIONS.

ISSUED JANUARY 25, 1905.

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3

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., January 6, 1904.

SIR: I have the honor to transmit herewith the manuscript of a catalogue of varieties of the apple, and respectfully recommend that it be published as Bulletin No. 56 of the series of this Bureau.

This catalogue was prepared by Mr. W. H. Ragan, Special Pomological Agent, under the direction of the Pomologist.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

PREFACE.

The pomologists and fruit growers of this country have long felt the want of a comprehensive publication on the nomenclature of cultivated fruits.

The standard American authors of pomological works have dealt mostly with select lists of varieties, naming and describing only those possessing qualities that commended them to the several writers, and which were, therefore, considered worthy of a place in their respective volumes. These authors have not invariably given preference to the same leading name for a variety. There are numerous instances where a variety appears under a particular name in the publication of one author, while it is referred to as a synonym or is entirely omitted by another writer.

For fully fifty years the American Pomological Society has diligently and intelligently labored for a correct and uniform nomenclature of fruits, but it has been hampered by lack of means and facilities for accomplishing more than a limited amount of this work. Under the auspices of the Division of Pomology of the Department of Agriculture, a dozen years ago the veteran pomologist Mr. T. T. Lyon, of South Haven, Mich., was appointed a special agent to carry forward this laudable work. At his death the work was undertaken by Mr. W. H. Ragan, of Greencastle, Ind., a man equally versed in fruits, and one who possessed natural qualifications, a long experience in pomology, and a national reputation in fruit nomenclature. He has carried this work well forward toward completion so far as it relates to the apple, and it gives me pleasure to offer to the fruit growers of the country the only approximately complete and elaborate catalogue of the nomenclature of apples thus far published.

It is the present intention to follow this with similar catalogues of other cultivated fruits.

G. B. Brackett,
Pomologist.

Office of the Pomologist,
Washington, D. C., January 4, 1904.

CONTENTS.

NOMENCLATURE OF THE APPLE;

A CATALOGUE OF THE KNOWN VARIETIES REFERRED TO IN AMERICAN PUBLICATIONS FROM 1804 TO 1904.

INTRODUCTION.

The following catalogue of named varieties of apples, with their various synonyms, though far from complete, embraces all or nearly all the names that appear in the published works of American writers on this fruit; in the serial numbers of the Magazine of Horticulture and of the Horticulturist, during their long periods of publication; in the transactions of the American Pomological Society, and other similar publications; in the reports of the State agricultural experiment stations; in the lists of Benjamin Buckman and of Charles Gibb; in the reports of the Pomologist of the United States Department of Agriculture; in many of the nursery catalogues and trade lists, and in other available publications.

The primary object of this bulletin is to bring together in one comprehensive volume all known names that have appeared in the American literature of the apple. Many of these names have been printed without descriptions of the fruit, and on further investigation some will doubtless prove to be synonyms of other varieties. It is believed that this publication will be especially useful in correcting and simplifying the nomenclature of the apple now well known to be in more or less confusion, and that it will become a standard guide in the naming of varieties in the future. To nurserymen who should desire correct names for their varieties, and especially to originators, who would avoid the serious mistake of duplicating names in bestowing them on their new products, this list must come as a valuable aid and helper.

In the nomenclature of this list the revised rules of the American Pomological Society have been followed. One of these rules, and perhaps the most important one, relates to the simplifying of our fruit nomenclature. All unseemly and superfluously long names are reduced to the simplest and most intelligible forms that will not bring them in conflict with other names. The orthography is frequently changed to make it conform to the latest and most approved authorities. This is notably true of certain personal names heretofore often misspelled even by the most careful writers, such as "Rawles" for "Ralls," the name of the introducer of the apple so well known throughout the South and West under many names and synonyms, of which "Rawles Janet" is perhaps the most common. This correction is made as the result of a careful search of the official records of Amherst County, Va., where exists indubitable proof that "Caleb Ralls" was not "Caleb Rawles." Other corrections, and by far the most numerous class, are made to conform to the rules of the United States Board on Geographic Names. These changes are applied to all names not heretofore in conformity with the decisions of that board, which are now followed in all the branches of the Government service. Other changes that will appear are made in compliance with a common-sense tendency now generally recognized and approved of making a single word of such names as "Winesap," "Redstreak," and others heretofore often written or printed as two words.

The catalogue is alphabetically arranged throughout, including both leading names and synonyms. Leading names are, however, invariably followed by citations of authors first using them and then by all their known synonyms. Their descriptions, if given or known, are presented in abbreviated forms in the tables. These descriptions appear in the following order: Origin, form, size, color, texture of flesh, color of flesh, flavor, quality, use, and season, after which will often be found some explanatory remarks. Synonyms are followed by citations of authors first publishing them, and then by their true names. In the citations of authors for names or for synonyms it has not always been possible to give the first publisher of the name owing to the inaccessibility of a complete set of pomological publications.

In not a few instances the same name has been applied to two or more varieties and these have been so confirmed by long usage that it has been thought impossible to avoid the conflict and therefore inadvisable to change them. In some of these cases an acceptable synonym has been substituted for the published leading name; for instance, the "American Golden Pippin," so called by Mr. Downing, is changed to "Golding," which the author mentioned gives as a synonym, and in this way one of the numerous "Golden Pippins" is disposed of. Others that can not be changed are written with their place of origin or the author first publishing in an abbreviated form following, to distinguish them, as "Golden Russet (Eng.)," "Golden Russet (Mass.)," "Golden Russet (N. Y.)," or "Eureka (Dap.)." In some instances, however, this rule can not be applied, since origins and the names of authors first publishing are unknown, and concerning such names there will still remain some degree of uncertainty.

In the long list of Russian varieties much confusion and uncertainty exist as to the several introductions, some of which errors will doubtless reappear in this publication. This problem is, however, being industriously and intelligently worked out in the Northwest, where these Russian apples are of most value and of the greatest promise.

An index to the literature of the subject is appended.

CODE OF NOMENCLATURE OF THE AMERICAN POMOLOGICAL SOCIETY.[a]

PRIORITY.

RULE 1. No two varieties of the same kind of fruit shall bear the same name. The name first published for a variety shall be the accepted and recognized name, except in cases where it has been applied in violation of this code.

A. The term "kind" as herein used shall be understood to apply to those general classes of fruits which are grouped together in common usage without regard to their exact botanical relationship, as apple, cherry, grape, peach, plum, raspberry, etc.

B. The paramount right of the originator, discoverer, or introducer of a new variety to name it, within the limitations of this code, is recognized and emphasized.

C. Where a variety name through long usage has become thoroughly established in American pomological literature for two or more varieties, it should not be displaced nor radically modified for either sort, except in cases where a well-known synonym can be advanced to the position of leading name. The several varieties bearing identical names should be distinguished by adding the name of the author who first described each sort, or by adding some other suitable distinguishing term which will insure their identity in catalogues or discussions.

D. Existing American names of varieties which conflict with earlier published foreign names of the same, or other varieties, but which have become thoroughly established through long usage, shall not be displaced.

FORM OF NAMES.

RULE 2. The name of a variety of fruit shall consist of a single word.

A. No variety should be named unless distinctly superior to existing varieties in some important characteristic, nor until it has been determined to perpetuate it by bud propagation.

B. In selecting names for varieties the following points should be emphasized: Distinctiveness, simplicity, ease of pronunciation and spelling, indication of origin or parentage.

C. The spelling and pronunciation of a varietal name derived from a personal or geographical name should be governed by the rules which control the spelling and pronunciation of the name from which it was derived.

D. A variety imported from a foreign country should retain its foreign name, subject only to such modification as is necessary to conform it to this code or to render it intelligible in English.

E. The name of a person should not be applied to a variety during his life without his express consent. The name of a deceased horticulturist should not be so applied

[a] Adopted at Boston, September 10, 1903.

except through formal action by some competent horticultural body, preferably that with which he was most closely connected.

F. The use of such general terms as seedling, hybrid, pippin, pearmain, beurre, rare-ripe, damson, etc., is not admissible.

G. The use of a possessive noun as a name is not admissible.

H. The use of a number, either singly or attached to a word, should be considered only as a temporary expedient while the variety is undergoing preliminary test.

I. In applying the various provisions of this rule to an existing varietal name which has through long usage become firmly embedded in American pomological literature, no change shall be made which will involve loss of identity.

Rule 3. In the full and formal citation of a variety name, the name of the author who first published it shall be given.

PUBLICATION.

Rule 4. Publication consists (1) in the distribution of a printed description of the variety named, giving the distinguishing characters of fruit, tree, etc., or (2) in the publication of a new name for a variety which is properly described elsewhere; such publications to be made in any book, bulletin, report, trade catalogue or periodical, providing the issue bears the date of its publication and is generally distributed among nurserymen, fruit-growers, and horticulturists; or (3) in certain cases the general recognition of a name for a propagated variety in a community for a number of years shall constitiute publication of that name.

A. In determining the name of a variety to which two or more names have been given in the same publication, that which stands first shall have precedence.

REVISION.

Rule 5. No properly published variety name shall be changed for any reason except conflict with this code, nor shall another variety be substituted for that originally described thereunder.

KEY TO THE ABBREVIATIONS USED IN CITATIONS OF AUTHORS AND PUBLICATIONS.

In order to avoid all undue complications in the initials used, the particular page where the name of a variety or its synonym is published by authors or others is not specified in this catalogue. The numbers of bulletins, the year in which reports or magazines were published, or names of the proprietors of the trade catalogues cited, only are given. Thus "D" indicates that the variety referred to is mentioned in Downing's Fruits and Fruit Trees of America, second revised edition, 1869; "IllH'90," in the Transactions of the Illinois State Horticultural Society for 1890; "A'91," in the Proceedings of the American Pomological Society for 1891; "IllB45," in the Illinois Agricultural Experiment Station Bulletin No. 45; "MagofH'38," in the Magazine of Horticulture for 1838; "P'94," in the Report of the Pomologist of the United States Department of Agriculture for 1894, etc.

The following abbreviations are used in the descriptions of varieties:

Origin: Eur., Europe; Fr., France; Am., America; N. Y., New York; etc.

Form: c, conical; o, ovate; ob, oblate; obl, oblong; r, round.

Size: l, large; l–vl, large to very large; m, medium; ml, medium to large; ms, medium to small; s, small; v, very.

Color: b, blushed; c, crimson; d, dark; g, green; l, light; p, pale; pu, purple; r, red; ru, russet; s, striped; w, white; y, yellow.

Flesh (*texture*): c, crisp; f, fine; fr, firm; j, juicy; m, medium; me, melting; t, tender; v, very.

Flesh (*color*): g, green or greenish; s, stained or wine-colored; v, very; w, white or whitish; y, yellow or yellowish.

Flavor: a, acid; b, brisk; m, mild; p, pleasant; r, rich; s, sweet; sa, subacid; v, very; vi, vinous.

Quality: b, best; g, good; g–vg, good to very good; p, poor; v, very; vg–b, very good to best.

Use: c, cider; d, dessert; f, family; k, kitchen; m, market.

Season: e, early; l, late; m, medium; ml, medium to late; v, very.

ALPHABETICAL LIST OF ABBREVIATIONS USED IN DESIGNATING THE PUBLICATIONS QUOTED.

A .... American Pomological Society Proceedings, 1852–1903.
AB.......... Branson, Abner, catalogue, Westbranch, Iowa.
ABW ...... Wenger, A. B., catalogue, Dayton, Va.
AB&Co..... Barnes, A., & Co., catalogue, Pleasant Run, Ohio.
ACT .... Tuttle, A. Clark, catalogue, Baraboo, Wis.
ADF&S .... Freeman, Mrs. A. D., & Sons, catalogue, Tadmore, Ohio.
AFM .... Mosby, A. F., catalogue, Richmond, Va.
AHCC&C .. Chadbourne, A. H. C., & Co., catalogue, Worcester, Mass.
AHG....... Griesa, A. H., catalogue, Lawrence, Kans.
AHortA .... American Horticultural Annual, 1868–1871.
AHS .... American Horticultural Society Transactions, 1883–1888.
AJC........ Collins, Arthur J., catalogue, Moorestown, N. J.
AJofH ..... American Journal of Horticulture, Volumes I–IX.
AKC....... Clingman, A. K., catalogue, Homer, La.
AlaB .... Alabama Experiment Station Bulletin.
AlaExR .... Alabama Experiment Station Report.
AlaNCo .... Alabama Nursery Co., catalogue, Huntsville, Ala.
AMB....... Amherst, Massachusetts, Experiment Station Bulletin.
AmF....... American Farmer, 1820–1881.
AmGar..... American Gardening, 1883–1902.
AndN ...... Andorra Nurseries, catalogue, Philadelphia, Pa.
AN&OCo... Albaugh Nursery & Orchard Co., Tadmore, Ohio.
AP.......... Pullen, A., catalogue, Milford, Del.
APC .... American Pomological Congress, 1 Vol., 1850.
ArizB ...... Arizona Experiment Station Bulletin.
ArizExR ... Arizona Experiment Station Report.
ArkB ...... Arkansas Experiment Station Bulletin.
ArkExR ... Arkansas Experiment Station Report.
ArkH ...... Arkansas Horticultural Society Report.

ASB&S..... Bassett, A. S., & Son, catalogue, Gainesville, Tex.
A&H....... Albertson & Hobbs, catalogue, Bridgeport, Ind.
B........... Barry, P., Barry's Fruit Garden, 1883.
BAC....... Craddock, B. A., catalogue, Curve, Tenn.
Bai........ Bailey, Dr. L. H., Annals of Horticulture.
BBCo...... Brown Brothers Co., catalogue, Rochester, N. Y.
BBL....... Buckman, Benj., List of Fruits in Trial Orchard, Farmingdale, Ill.
BBros...... Baker Brothers, catalogue, Fort Worth, Tex.
BOC....... Curtis, B. O., catalogue, Paris, Ill.
B(Ph)N.... Bloomington (Phoenix) Nursery, catalogue, Bloomington, Ill.
Bul6,8...... Bulletins 6 and 8, Division of Pomology, U. S. Department of Agriculture.
BWS....... Stone, B. W., catalogue, Thomasville, Ga.
C........... Coxe, William, A View of the Cultivation of Fruit Trees, 1817.
CAG....... Green, Charles A., catalogue, Rochester, N. Y.
CalB....... California Experiment Station Bulletin.
CanB...... Canada Experiment Station Bulletin, Central Experimental Farm, Ottawa.
CanExR... Canada Experiment Station Report, Central Experimental Farm, Ottawa.
CanH...... Canada Horticulturist, monthly, 1890–1904.
Cat........ Catalogue, some nursery catalogue; so indexed by Mr. Lyon.
CB......... Cornell, New York, Experiment Station Bulletin.
CBCo...... Chase Brothers Co., catalogue, Rochester, N. Y.
CBH....... Hornor, Charles B., catalogue, Mount Holly, N. J.
CGen...... Country Gentleman, 1859–1869.
CGP....... Patten, Chas. G., catalogue, Charles City, Iowa.
CH........ Hewitt, Clark, catalogue, Waupun, Wis.
ChNCo..... Cherokee Nursery Co., catalogue, Waycross, Ga.
CLW...... Watrous, Chas. L., catalogue, Des Moines, Iowa.
CN......... Cumberland Nurseries, catalogue, Nashville, Tenn.
CNC....... California Nursery Co., catalogue, Niles, Cal.
ColB....... Colorado Experiment Station Bulletin.
ColExR.... Colorado Experiment Station Report.
Cole....... Cole, S. W., The American Fruit Book, 1849.
ColH....... Colorado Horticultural Society Report.
CtB........ Connecticut (New Haven) Experiment Station Bulletin.
CtExR..... Connecticut (New Haven) Experiment Station Report.
CW........ Wright, Charles, catalogue, Seaford, Del.
D........... Downing, A. J. and C., Fruits and Fruit Trees of America, 1845, ed., 1869.
Dap........ Downing's Appendix I, 1872, II, 1876, and III, 1881, to Fruits and Fruit Trees of America.
DDH....... Herr, Daniel D., catalogue, Lancaster, Pa.
DelB....... Delaware Experiment Station Bulletin.
DelExR.... Delaware Experiment Station Report.
DMM...... Moore, D. M., catalogue, Ogden, Utah.
DOM....... Munson, D. O., catalogue, Falls Church, Va.
DomEnc... Domestic Encyclopedia, or Dictionary of Facts and Useful Knowledge, first American edition, 1804.
DrHS...... Schroeder, Dr. Herman, catalogue, Bloomington, Ill.
D&M....... Downing & Morris, catalogue, Clinton, Ind.
E........... Elliott, F. R., Elliott's Fruit Book, 1854.
ECNCo..... Elm City Nursery Co., catalogue, New Haven, Conn.

EFS .... Stephens, E. F., catalogue, Crete, Nebr.
EGM ...... Mendenhall, E. G., catalogue, Kinmundy, Ill.
EH .... Hoyt, Edward, catalogue, Scotch Grove, Iowa.
EMB....... Buechly, E. M., catalogue, Greenville, Ohio.
EON .... Eastern Oregon Nurseries, catalogue, Union, Oreg.
EPS .... Smith, E. P., catalogue, Gresham, Oreg.
EWK ...... Kirkpatrick, E. W., catalogue, McKinney, Tex.
EWR ...... Reid, E. W., catalogue, Bridgeport, Ohio.
E&B....... Ellwanger & Barry, catalogue, Rochester, N. Y., 1873–1893.
F .... Fitz, J. W., The Southern Apple and Peach Culturist, 1872.
FDNCo .... Franklin Davis Nursery Co., catalogue, Richmond, Va.
FEY .... Young, Fred. E., catalogue, Rochester, N. Y.
FF&S ...... Ford, Frank & Son, catalogue, Ravenna, Ohio.
FHC....... Chappel, F. H., catalogue, Oregon, Wis.
FlaB .... Florida Experiment Station Bulletin.
FlaExR .... Florida Experiment Station Report.
FlaH....... Florida Horticultural Society Report.
FSP........ Phoenix, F. S., catalogue, Bloomington, Ill.
FTR .... Ramsey, F. T., catalogue, Austin, Tex.
FWK ...... Kelsey, F. W., catalogue, Rochester, N. Y., 1877–1893.
F&L .... Fraser & Lippincott, catalogue, Huntsville, Ala.
G .... Goodrich, Chauncey, Northern Fruit Culturist, 1850.
GaB .... Georgia Experiment Station Bulletin.
GaExR .... Georgia Experiment Station Report.
GaH .... Georgia Horticultural Society Report.
GarCal ..... American Gardener's Calendar, Bernard McMahon, 1806.
GarM ...... Gardener's Monthly, 1859–1885.
GAS .... Sweet, George A., catalogue, Dansville, N. Y.
Gb......... Gibb, Charles, U. S. Department of Agriculture, List of Russian Varieties of Apples.
GB .... Greening Bros., catalogue, Monroe, Mich.
GBB....... Brackett, G. B., catalogue, Denmark, Iowa.
GenF ...... Genesee Farmer, 1832–1854.
GeoR ...... Ruedy, George, catalogue, Colfax, Wash.
GG&S...... Gould, Geo., & Son, catalogue, Villaridge, Ill.
GHM&S.... Miller, Geo. H., & Son, catalogue, Rome, Ga.
GHW ...... Whiting, Geo. H., catalogue, Yankton, S. Dak.
GJC .... Carpenter, G. J., catalogue, Fairbury, Nebr.
GJK&S .... Kellogg, Geo. J., & Sons, catalogue, Janesville, Wis.
GLA .... Anthony, G. L., catalogue, Vandalia, N. C.
GLT .... Taber, Geo. L., catalogue, Glen Saint Mary, Fla.
GNM ...... Moyer, G. N., catalogue, Laketon, Ind.
GO .... Onderdonk, Gilbert, catalogue, Nursery, Tex.
Govlist..... List of Russian Varieties Introduced by U. S. Department of Agriculture, 1870.
G&S .... Gardner & Sons, catalogue, Osage, Iowa.
H .... Hooper, E. J., Hooper's Western Fruit Book, 1857.
HB&T ..... Hoopes Bro. & Thomas, catalogue, Westchester, Pa.
HFH ...... Hillenmeyer, H. F., catalogue, Lexington, Ky.
HGO ...... Hale Georgia Orchard Co., catalogue, Fort Valley, Ga.
HG&Co .... Hoover & Gaines Co., catalogue, Dayton, Ohio.
HMHS..... History of the Massachusetts Horticultural Society, 1880.
HMSCo .... Simpson, H. M., Co., catalogue, Vincennes, Ind.
Hort .... Horticulturist, The, monthly, 1846–1875.

Hov .... Hovey, C. M., the Fruits of America, 1851.
HPN .... Hart Pioneer Nurseries, catalogue, Fort Scott, Kans.
HSR&S .... Rupp, Henry S., & Sons, catalogue, Shiremanstown, Pa.
HuC .... Huntsville Nursery Co., catalogue, Huntsville, Ala.
H&Co ...... Holland & Co., catalogue, Plymouth, Ind.
I .... Ives, J. M., New England Book of Fruits, 1847.
IaB .... Iowa Experiment Station Bulletin.
IaExR ..... Iowa Experiment Station Report.
IaH .... Iowa Horticultural Society Report, 1867-1903.
IdaB .... Idaho Experiment Station Bulletin.
IdaExR .... Idaho Experiment Station Report.
IH&S ...... Hicks, Isaac, & Son, catalogue, Westbury Station, N. Y.
IllB .... Illinois Experiment Station Bulletin.
IllExR ..... Illinois Experiment Station Report.
IllH .... Illinois Horticultural Society Report, 1867-1903.
IndB .... Indiana (Purdue) Agricultural Experiment Station Bulletin.
IndExR .... Indiana (Purdue) Agricultural Experiment Station Report.
IndF .... Indiana Farmer, 1840.
IndH ...... Indiana Horticultural Society Report, 1860-1902.
JAY .... Young, John A., catalogue, Greensboro, N. C.
JB .... Bidwell, John, catalogue, Chico, Cal.
JBW&B .... Wild, J. B., & Bros., catalogue, Sarcoxie, Mo.
JGH&S .... Harrison, J. G., & Sons, catalogue, Berlin, Md.
JGW .... Wertz, J. G., catalogue, Salem, Va.
JHB .... Black, Joseph H., & Son, catalogue, Hightstown, N. J.
JIN .... Newson, J. I., catalogue, Nashville, Tenn.
JLB .... Brown, J. L., catalogue, Kearney, Nebr.
JMO .... Ogle, J. M., catalogue, Puyallup, Wash.
JNCo ...... Jewell Nursery Co., catalogue, Lake City, Minn.
JRJ .... Johnson, J. R., catalogue, Coshocton, Ohio.
JSC&S ..... Collins, J. S., & Son, catalogue, Moorestown, N. J.
JSK .... Kerr, John S., catalogue, Sherman, Tex.
JTL .... Lovett, J. T., catalogue, Little Silvers, N. J.
JVC .... Cotta, J. V., catalogue, Nursery, Ill.
JVL .... Lindley, J. Van., catalogue, Pomona, N. C.
JW .... Waters, James, catalogue, Watsonville, Cal.
JWA .... Austin, J. W., catalogue, Pilot Point, Tex.
JWA&Co ... Adams, J. W., & Co., catalogue, Springfield, Mass.
JWK ...... Kerr, J. W., catalogue, Denton, Md.
JWM ...... Manning, Jacob W., catalogue, Reading, Mass., 1875-1892.
JWS .... Stevenson, J. W., catalogue, North Bend, Nebr.
JW&S ...... Wragg, J., & Son, catalogue, Waukee, Iowa.
J&R .... Jones & Rouse, catalogue, Rochester, N. Y.
K .... Kenrick, William, The New American Orchardist, first edition, 1841.
KanB ...... Kansas Experiment Station Bulletin.
KanExR ... Kansas Experiment Station Report.
KanFM .... Kansas Fruit Manual, 1886.
KanH ...... Kansas Horticultural Society Report.
KHN .... Kansas Home Nursery, catalogue, Lawrence, Kans.
KN .... Klehm's Nurseries, catalogue, Arlington Heights, Ill.
KyB .... Kentucky Experiment Station Bulletin.
KyExR .... Kentucky Experiment Station Report.
KyH .... Kentucky Horticultural Society Report.

K&S .... Kelly, J. O., & Sons, catalogue, Jeff, Ala.
L .... Lyon, T. T.; name modified by Mr. Lyon as Chairman of Committee.
LaB........ Louisiana Experiment Station Bulletin.
LaExR..... Louisiana Experiment Station Report.
LB.......... Burbank, Luther, catalogue, Santa Rosa, Cal.
LC.......... Coates, Leonard, catalogue, Napa, Cal.
(LC) .... Lyon's catalogue of trial varieties at South Haven, Mich.
Lin .... Linnæan Botanic Garden, catalogue of 1844–45.
LR.......... Roesch, Lewis, catalogue, Fredonia, N. Y.
LTS........ Sanders, L. T., catalogue, Plain Dealing, La.
LWC&Co... Carr, L. W., & Co., catalogue, Erie, Pa.
M.......... Manning, Robert, Book of Fruits, first edition, 1838.
MagofH .... Magazine of Horticulture, Boston, C. M. Hovey & Co., 1835–1860.
MassB...... Massachusetts (Hatch) Experiment Station Bulletin.
MassExR... Massachusetts (Hatch) Experiment Station Report.
MassH ..... Massachusetts Horticultural Society Report, 1865–1903.
MB&Co .... Barnes, M., & Co., catalogue, Groesbeck, Ohio.
MDB....... Beatie, M. D., catalogue, Atlanta, Ga.
MdB....... Maryland Experiment Station Bulletin.
MdExR .... Maryland Experiment Station Report.
MdH....... Maryland Horticultural Society Report.
MeB .... Maine Experiment Station Bulletin.
MeeM...... Meehan's Monthly, 1894–1897.
MeExR .... Maine Experiment Station Report.
MeH .... Maine Pomological Society Report.
MHSC ..... Montreal Horticultural Society, Canada, 1876–1888.
MichB ..... Michigan Experiment Station Bulletin.
MichExR .. Michigan Experiment Station Report.
MichH ..... Michigan Horticultural Society Report.
MinnB ..... Minnesota Experiment Station Bulletin.
MinnExR .. Minnesota Experiment Station Report.
MinnH..... Minnesota Horticultural Society Report.
MinnHort .. Minnesota Horticulturist, monthly, 1894–1901.
MissB ...... Mississippi Experiment Station Bulletin.
MissExR... Mississippi Experiment Station Report.
MJG .... Graham, M. J., catalogue, Adel, Iowa.
MJH....... Henry, M. J., catalogue, Vancouver, B. C.
MLACo .... Missing Link Apple Co., catalogue, Clayton, Ill.
MoB .... Missouri Experiment Station Bulletin.
MoExR .... Missouri Experiment Station Report.
MoH....... Missouri Horticultural Society Report, 1863–1902.
MontB ..... Montana Experiment Station Bulletin.
MontExR .. Montana Experiment Station Report.
M&S .... Myer, D. S., & Son, catalogue, Ridgeville, Del.
N .... Northwestern Pomology, Gurney, 1894.
NAPC...... North American Pomological Convention Report, 1849.
NCB .... North Carolina Experiment Station Bulletin.
NCExR .... North Carolina Experiment Station Report.
NCH....... North Carolina Horticultural Society Report.
NDB .... North Dakota Experiment Station Bulletin.
NDExR .... North Dakota Experiment Station Report.
NebB ...... Nebraska Experiment Station Bulletin.
NebExR ... Nebraska Experiment Station Report.

NebH ...... Nebraska Horticultural Society Report.
NEF .... New England Farmer, 1822–1871.
NevB ...... Nevada Experiment Station Bulletin.
NevExR ... Nevada Experiment Station Report.
NHB....... New Hampshire Experiment Station Bulletin.
NHExR.... New Hampshire Experiment Station Report.
NJB .... New Jersey Experiment Station Bulletin.
NJExR .... New Jersey Experiment Station Report.
NJH .... New Jersey Horticultural Society Report.
NMB....... New Mexico Experiment Station Bulletin.
NMExR.... New Mexico Experiment Station Report.
NSB .... Nova Scotia Experiment Station Bulletin.
NSExR .... Nova Scotia Experiment Station Report.
NSH .... Nova Scotia Horticultural Society Report.
NWC ...... Craft, N. W., catalogue, Shore, N. C.
NWFG..... Northwestern Fruit Growers' Association Report, 1852 and 1855.
NYAg...... New York Agricultural Society Report.
NYB....... New York Geneva Experiment Station Bulletin.
NYExR.... New York Geneva Experiment Station Report.
OhioB...... Ohio Experiment Station Bulletin.
OhioExR... Ohio Experiment Station Report.
OhioH ..... Ohio Horticultural Society Report.
OKG....... Gerrish, O. K., catalogue, Lakeville, Mass.
OklB....... Oklahoma Experiment Station Bulletin.
OklExR.... Oklahoma Experiment Station Report.
OL......... Locke, Otto, catalogue, New Braunfels, Tex.
OntB....... Ontario, Canada, Experiment Station Bulletin.
OntExR.... Ontario, Canada, Experiment Station Report.
OntH ...... Ontario Fruit Growers' Association Report.
OreB....... Oregon Experiment Station Bulletin.
OreExR.... Oregon Experiment Station Report.
P .... Pomologist, U. S. Department of Agriculture, Report, 1886–95.
PaB........ Pennsylvania Experiment Station Bulletin.
PaCR ...... Pennsylvania Agricultural College Report.
PaExR..... Pennsylvania Experiment Station Report.
PaH .... Pennsylvania Horticultural Society Report.
PE......... Emmerson, P., catalogue, Wyoming, Del.
PEN .... Port Elgin Nursery, catalogue, Port Elgin, Ontario.
PenH ...... Peninsula Horticultural Society Report.
PFar....... Prairie Farmer, 1843–1897.
PHF....... Foster, P. H., catalogue, Babylon, N. Y.
PJB .... Berckmans, P. J., catalogue, Augusta, Ga.
PN......... Phoenix Nursery, catalogue, Delavan, Wis.
Pr .... Prince, Wm. R., Pomological Manual, 1831.
R .... Ragan, W. H.; name modified by Mr. Ragan as Chairman of Committee.
RgltoIa .... Russian varieties sent by Dr. Regel to Iowa Agricultural College.
RGN....... Nicholson, R. G., catalogue, Chestertown, Md.
RIB .... Rhode Island Experiment Station Bulletin.
RIExR..... Rhode Island Experiment Station Report.
RIH .... Rhode Island Horticultural Society Report.
R&P....... Rakestraw & Pyle, catalogue, Willowdale, Pa.
RNY....... Rural New Yorker, 1854–1872.
S .... Strong, W. C., Fruit Culture, 1885.

SBro	Stark Brothers, catalogue, Louisiana, Mo.
SCB........	South Carolina Experiment Station Bulletin.
SCExR.....	South Carolina Experiment Station Report.
SCH	South Carolina Horticultural Society Report.
SCtB.......	Storrs, Connecticut, Experiment Station Bulletin.
SDB	South Dakota Experiment Station Bulletin.
SDExR	South Dakota Experiment Station Report.
SHNCo	Spring Hill Nursery Co., catalogue, Prospect, Va.
SHR	Rump, S. H., catalogue, Marshallville, Ga.
Shrotola ...	Russian apples sent by Dr. Schroeder to Iowa Agricultural College.
SHS........	Hoyt (Stephen) Sons, catalogue, New Canaan, Conn.
SK.........	Kinsey, Samuel, catalogue, Kinsey, Ohio.
SLN........	Silver Leaf Nurseries, catalogue, Boons Path, Va.
SL&Co	Lewelling, Seth, & Co., catalogue, Milwaukee, Oreg.
SMB	Bayles, S. M., catalogue, St. Louis, Mo.
SNCo	Sherman Nursery Co., catalogue, Charles City, Iowa.
SP&L	Smith, Powell & Lamb, catalogue, Syracuse, N. Y.
S&H	Storrs & Harrison, catalogue, Painesville, Ohio.
S&W	Stone & Wellington, catalogue, Toronto, Ontario.
T	Thomas, J. J., The American Fruit Culturist, 1846.
TCF	Ferrell, Thad C., catalogue, Humboldt, Tenn.
Td	Todd, S. E., The Apple Culturist, 1871.
TennB	Tennessee Experiment Station Bulletin.
TennExR...	Tennessee Experiment Station Report.
TexB.......	Texas Experiment Station Bulletin.
TexExR....	Texas Experiment Station Report.
TexH	Texas Horticultural Society Report.
Th.........	Thacher, James, The American Orchardist, 1821.
TJG&S.....	Garden, Thos. J., & Son, catalogue, Springhill, Va.
TSH	Hubbard, T. S. & Co., catalogue, Fredonia, N. Y.
TVM.......	Munson, T. V. & Son, catalogue, Denison, Tex.
TWW&S ...	Wood, T. W., & Son, catalogue, Richmond, Va.
UCExR	University of California Experiment Station Report.
UtahB	Utah Experiment Station Bulletin.
UtahExR ..	Utah Experiment Station Report.
VaB	Virginia Experiment Station Bulletin.
VaExR	Virginia Experiment Station Report.
VaH	Virginia Horticultural Society Report.
Van D......	Van Deman, H. E., name suggested by Prof. Van Deman.
VRS	Russian varieties introduced from various sources.
VtB........	Vermont Experiment Station Bulletin.
VtExR.....	Vermont Experiment Station Report.
W	Warder, Dr. John A., American Pomology—Apple, 1867.
WashB.....	Washington Experiment Station Bulletin.
WashExR..	Washington Experiment Station Report.
WAW&C...	Watson, W. A., & Co., catalogue, Normal, Ill.
WBKJ	Johnson, W. B. K., catalogue, Allentown, Pa.
WBro	Wirt Brothers, catalogue, Alpha, Ill.
WCR	Reed, W. C., catalogue, Vincennes, Ind.
Wg	Waring, Wm. G., The Fruit Grower's Hand-Book, 1851.
WGW......	White, Wm. G., catalogue, Ovid, Mich.
WHMCo ...	Moon, W. H., Co., catalogue, Morrisville, Pa.
WHR	Western Horticultural Review, monthly (Vols. 1 to 4) 1850–1853.
WHyS	Smith, Wm. Hy., catalogue, Franklin, Tenn.

WisB	Wisconsin Experiment Station Bulletin.
WisExR ...	Wisconsin Experiment Station Report.
WisH	Wisconsin Horticultural Society Report.
WisHort....	Wisconsin Horticulturist, monthly, 1897–1902.
WJN.......	West Jersey Nursery Co., catalogue, Bridgeton, N. J.
WMB	Benninger, W. M., catalogue, Walnutport, Pa.
WmCh	Chappelow, William, catalogue, Duarte, Cal.
WmP	Parry, William, catalogue, Parry, N. J.
WMP&S....	Peters, W. M., & Son, catalogue, Snowhill, Md.
WmW......	Watson, William, catalogue, Brenham, Tex.
Wn	Wickson, E. J., The California Fruits, 1889.
WRH	Harris, W. R., catalogue, Tecumseh, Nebr.
WSL&Co...	Little, W. S., & Co., catalogue, Rochester, N. Y.
WTH&Co ..	Hood, W. T., & Co., catalogue, Richmond, Va.
WVaB	West Virginia Experiment Station Bulletin.
WVaExR ..	West Virginia Experiment Station Report.
WyB.......	Wyoming Experiment Station Bulletin.
WyExR....	Wyoming Experiment Station Report.
W&Co	Webster & Co., catalogue, Centralia, Ill.
W&TSCo...	Smith, W. & T., Co., catalogue, Geneva, N. Y.
Y&Co......	Youngers & Co., catalogue, Geneva, Nebr.

CATALOGUE OF THE KNOWN VARIETIES OF APPLES REFERRED TO IN AMERICAN PUBLICATIONS FROM 1804 TO 1904.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Aaron. R. Syn. Aaron Holt	Tex							vg		l	In Texas nursery catalogues.
Aaron Holt. OL. Syn. of Aaron											
Abbott. D		obc	m	gyrs	etj	w	sa	vg	d	l	
Abbott Lawn. Syn. Abbott's Lawn	N. J.										
Abbott's Lawn. Syn. of Abbott Lawn											
Abbott Seedling. MagofH'44		rc	m	y			sa			l	Possibly identical with Abbott.
Abbott's Five-Sided Spice. D. Syn. of Abbott Spice											
Abbott Spice. VanD. Syn. Abbott's Five-Sided Spice		robc	m	pyrs	j	w	sa	g		m	
Abbott Sweet. T. Syn. Abbott's Sweet	N. H	c	ml	rs	t	w	pvs	g		l	
Abbott's Sweet. D. Syn. of Abbott Sweet											
Abbs. CH	Wis		m	rs				g		l	
Abe Lincoln. D. Syn. of Red Astrachan											
Aberdeen. IllB45		r	l	y			sa			e	Not Nickajack, of which Aberdeen is a synonym.
Aberdeen. D. Syn. of Nickajack											
Abernathy. P'94	Ind	rc	ml	gyrs	ftj	y	sa	vg	d	m	
Abraham. L. Syn. Father Abraham	{Va.? Ky.?}	rob	s	rs			sa	g		vl	Confusion as to identity.
Abraham. IllB45				y			sa	vg		me	Not the Father Abraham of Coxe.
Abram. Hort'56. Syns. Father Abraham, Father Abram, Red Abram	Va.?	r	ms	yrs	t	w	sa	g		l	
Accidental. D. Syn. of Nickajack											
Accokeek. PaCR'92		robl	m	yrs		yw	s			l	
Accomac. R. Syn. Accomack Pippin	Va										Not described.
Accomack Pippin. Cat. Syn. of Accomac											
Accubaefolia. A'73. [May be identical with Acuba-Leaved Reinette of Thomas.]											Do.
Acid Repka. Gb. Syns. Gov. list No. 466, Reipka kislaya, Repka kislaja, Riepka Kislaya, Sour Turnip.	Rus										Do.
Acker. A'85											Do.
Acker Dutchess. R. Syn. Acker's Dutchess. [Duchess is doubtless correct.]											Not described.
Acker's Dutchess. MinnExR'90. Syn. of Acker Dutchess											
Ackerman. OntExR'82											Do.
Ackers Duchess. SDB76			ml	yrs		y	sa	g		me	Probably identical with Acker Dutchess.
Acklam. R. Syns. Acklam's Russet, Aclemy Russet	Eng	rob	ms	ru			s	g		l	
Acklam's Russet. D. Syn. of Acklam											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Adam's Russet. GenF'35. Syn. of Sykehouse											
Acleny Russet. D. Syn. of Acklam											
Acme. Wn	Cal	c	vl	rs						m	Described by Wickson, p. 244.
Acorn. L. Syn. Acorn Greening											Not described.
Acorn Greening. Bui. Syn. of Acorn											
Aeuba-Leaved Reinette. T. Syn. Reinette a feuille d'Acuba		ob	ml	y			sa	g			Aucuba doubtless correct.
Adalaine. SDB76	Minn		m	yrs	f	w	sa	g		l	
Adam and Eve. AmGar'90	Ont		m	yrs	tj	yw				l	Fruit often double.
Adam Pearmain. L. Syn. Adam's Pearmain	For	c	ml	yru			sa			ml	From Lindley.
Adams. WHR3. Syn. Noll's No. 1	Pa	robl	l	rs			sa	vg	dm	vl	
Adamson. InH'03											
Adams Pearmain. GenF'33. Syns. Matchless, Norfolk Pippin		reobl	ml	pyrs	cfrj	y	sa	vg	d	l	
Adam's Pearmain. E. Syn. of Adam Pearmain											
Adam's White. Dap. Syn. of Settle											
Addie. OntExR'82											Not described.
Adirondack. P'93	N. Y	rc	m	yrs		gw	sa	g		ml	
Advance. SDB76. Syn. Lyman's No. 60	Minn	rob	l	drs				g		m	
Æsopus Spitzenberg. D. Syn. of Esopus											
Æsopus Spitzenburg. NEF'26. Syn. of Esopus											
African. R. Syn. African Prince											Do.
African Prince. MagofH'39. Syn. of African											
Agate. L. Syn. Agate d'Enckhuysen	Hol	rc	m	yg	fj	w	s	g		l	
Agate d'Enckhuysen. D. Syn. of Agate											
Agathe. D. Syn. Pomme Double Agathe	Hol	oblc	ml	rb	tj	yw	sa			l	
Agnes. D. Syn. Agnes's	Pa	obl	ms	yrs	t		sa	g		m	
Agnes's. D. Syn. of Agnes											
Agrippa. BBL											Do.
Agrise. MagofH'37											Do.
Aiken. JRJ. Syn. of Akin. [Akin is correct.]											
Aiken Red. GG&S			m	r			sa	vg		l	Doubtless same as Akin.
Aikin. JVC. Syn. of Akin											
Aikin Striped. R. Syn. Aikin's Striped Winter											Probably identical with Akin.
Aikin's Striped Winter. MichB31. Syn. of Aikin Striped											
Ailes. D	Pa	obl	l	yrs	cj	y	sa	g	k	vl	
Aisles. IllB45		obl	m	rs			sa	vg		vl	Probably same as Ailes.
Aken (Seedling). Cat											Probably Akin.
Akeria. MB&Co	Rus										Not described.
Akero. MHSC'86	Swed		ml	yr				vg-b			May be Akeria.
Akeson. L. Syn. Akeson's Winter Sweet	South						s			l	
Akeson's Winter Sweet. MagofH'53. Syn. of Akeson											

Akin. HH'91. Syns. Aiken, Aikin, Akin Red, Akin Seedling	Ill	c	ml	yr	c		sa	vg	dm	vl	
Akin Red. HMSCo. Syn. of Akin											
Akin Seedling. HH'90. Syn. of Akin											
Alabama. L. Syn. Alabama Queen	Ill										Do.
Alabama Pearmain. D. Syn. of Mangum											
Alabama Pearmain (of Peters). W. Syn. of Patton											
Alabama Pippin. BBL											Do.
Alabama Queen. BBL. Syn. of Alabama											
Alabama Winter. W	Ala		l							l	Do.
Alabaster. Gb. Syns. Alabaster Weisser, Alabaster White, Weisser Alabaster.	Rus										Do.
Alabaster Weisser. Gb. Syn. of Alabaster											
Alabaster White. Gb. Syn. of Alabaster											
Alaghana. BBL. [Allegheny is correct.]											Do.
Alamance. R. Syn. Alamance Beauty	N. C		l	yrs				vg		me	
Alamance Beauty. JVL. Syn. of Alamance											
Alameda. L. Syn. Beauty of Alameda	Cal	c	m				sa				
Alant. D. Syn. Pomme d'Aunee	Ger	c	m	gy	tj	y				l	
Alaska. A'99											May be Alaska (crab) of Iowa.
Albany. WHR2											Not described.
Albemarle. W	Va	r	l				sa	vg		l	Same as Yellow Newtown.
Albemarle. W. Syn. of Yellow Newtown											
Albemarle Pippin. MagofH'53. Syn. of Yellow Newtown											
Albert of Prussia. R. Syn. Prince Albert of Prussia		robl	ml	gyr	cj	gw	sa	g		me	
Albion. E&B'77											
Album. JVL											Not described.
Albury. R. Syn. Albury Park Nonsuch											Do.
Albury Park Nonsuch. BBL. Syn. of Albury											
Alden. HH'00	Wis	c	ml	yr				g		l	
Alerson. VanD. Syn. Alerson's Early	Ohio	obl	m	yg	tj	w	sa		k	e	
Alerson's Early. AJofHX. Syn. of Alerson											
Alexander. NEF'32. Syns. Aporta, Beauty of the West, Emperor Alexander, English King, Russian Emperor, Victoria (incorrectly).	Rus	re	vl	gyrs	ctj	yw	a	g	km	m	
Alexander. W		re	l	rs			sa	g		m	Perhaps same as preceding.
Alexander Early. R. Syn. Alexander's Early											Possibly same as Oldenburg.
Alexander's Early. Hort'73. Syn. of Alexander Early											
Alexander's Ice Cream. JVL. Syn. of Ice Cream (Alex.)											
Alexis Baldwin. CanExR'93. Syn. of Dery											
Alfriston. NEF'32. Syns. Baltimore (incorrectly), Lord Gwydr's Newtown Pippin, Oldaker's New, Shepherd's Pippin, V. R. S. to Ia. N. 29.	Eng	re	l	gy	ct	yw		g	k	l	
Algers. A'81											Not described
A. Lincoln. BBL											Do.
Alison. R. Syn. Alison's Early. [Probably same as Alerson.]											Do.
Alison's Early. Hort'70. Syn. of Alison											
All. R. Syn. All's Russet											Do.
All's Russet. Hort'17. Syn. of All											
Allanbank. BBL											Do.
Alleghany. D. Syn. of Nickajack											
Alleghany Seedling. NWC. Syn. of Allegheny Seedling											
Alleghany Spot. HB45. Syn. of Allegheny Spot											
Allegheny Seedling. R. Syn. Alleghany Seedling			vl	y	cj		sa			l	
Allegheny Spot. HB45. Syn. Alleghany Spot			m					g		m	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Allemand. D. Syn. Pepin d'Or Allemand	Ger	c	s	py	ft	y	s			l	From the Verger.
Allenby. R. Syn. Allenby's Seedling	Ont			wb	tfj	w	sa	g	d	ml	
Allenby's Seedling. CanH'02. Syn. of Allenby											
Allen Choice. L. Syn. Allen's Choice	Pa	ob	m	yrs	cj	w	a	g		l	
Allen's Choice. NWFG'55. Syn. of Allen Choice											
Allen Everlasting. BBL											Not described.
Allen Favorite. BBL											Do.
Allen Harvest. R. Syn. Allen's Harvest											Do.
Allen's Harvest. A'75. Syn. of Allen Harvest											
Allen Pippin. L. Syn. Allen's Pippin	{Ga.? / N. C.?}	ob	m	gy	t	w	sa			ml	
Allen's Pippin. D. Syn. of Allen Pippin											
Allen Russet. Hort'72	Wis.?			ru							Supposed origin, Pewaukee, Wis.
Allen Sweet. L. Syn. Allen's Sweeting	Mass	r	m				s	g		l	
Allen's Sweeting. W. Syn. of Allen Sweet											
All-Hallow. D	Ire	r	m		tj		psa			m	
Allington. SDB76	Minn	rc	m	yb	mj	yw	sa	vg		l	
Allis. BBL											Not described.
Allison. P'95. Syn. Jones's Seedling	Tenn	rob	l	yrs	fcj	y	sa	vg		l	
All-Summer. D	Pa	ob	s	yb	t	w	sa	vg		me	
All-Summer Sweet. L. Syn. All-Summer Sweeting		ob					s			me	
All-Summer Sweeting. W. Syn. of All-Summer Sweet											
Allum. D. Syns. Hallum, Rockingham Red	N. C	ob	m	r	ctj	w	a	g		vl	
Alma. R. Syn. Alma Sweet											Do.
Alma Sweet. IndH'89. Syn. of Alma											
Almance. BBL	Ill										Do.
Almota. P'94. Syn. May's Seedling	Wash	c	vl	ygrs	tj	gw	sa	vg	d	m	
Aloe. Gb. Syns. Gov. list No. 968, Saburouskoe	Rus										Do.
Alpian. Dap. Syn. of Cannon											
Alpine. P'95. Syn. Alpine Crab	Tenn	ob	sm	yrs	j	y	bsa	g-vg		l	
Alpine Crab. P'95. Syn. of Alpine											
Alsace. MagofH'53. Syns. Dumpling, Pfuffer, Speckled Oley	Pa	c	m	wyb	j	w	sa	g		l	Probably first published in Mag. of H.'53, 173.
Alsernon. R. Syn. Alsernon's Early	Ohio	ob	m	gy	tj	w	a	g	k	ve	
Alsernon's Early. A'71. Syn. of Alsernon											
Alstott. BBL	Ill										Not described.
Althorp Pippin. D. Syn. of Marmalade											
Aluska. SDB76	Minn	c	m	yrs	j	w	sa		k	m	
Amalanche. R. Syn. Amalanche Beauty											Do.
Amalanche Beauty. S&W. Syn. of Amalanche											

Amalia. RNY'69	N. J										Do.
Amasia. NYExR'96	Italy?	re	m	gyrs	cj	w	sa	vg	d	l	
Amber. MHSC'86. Syns. Gov. list No. 969, Shro. to Ia. No. 109, Yantarnoe, Zantar, Zantarnoe.	Rus										Do.
Ambrose. ColExR'88											Do.
Amelia. D	Eur	re	m	yrs	ftj	w	sa	g		l	
America. CBCo. Syn. Rebel	Va	r	ml	r			sa	vg		l	
American. MagofH'36											Do.
American. W. Syn. of Jersey Sweet											
American Beauty. NEF'70		r	l	rs	j		sa	vg		vl	Perhaps distinct from Sterling.
American Beauty. D. Syn. of Sterling											
American Beauty (incorrectly). D. Syn. of Baltimore											
American Beauty (incorrectly). Dap. Syn. of Sheriff											
American Best. DelExR'95											Not described.
American Black (Mass.?). W	Mass.?	ob	m	rs			sa	g		l	Identity uncertain.
American Black. Lin. Syn. Black American		ob	m	drs			sa	g		l	This and the preceding may be same as Black.
American Blush. CAG		ob	ml	yrb	ctj			vg		l	
American Calville. L. Syn. American White Winter Calville	Va		l	gy						l	
American Coddling. SDB76	Minn.?	re	l	gb	jf		sa	g	k	m	
American Fall. K. Syn. of Fall Pippin											
American Gloria Mundi. Th. Syn. of Gloria Mundi											
American Golden. Cat. Syn. of Golding											
American Golden Pippin. GenF'33. Syn. of Golding											
American Golden Russet. D. Syn. of Bullock											
American Golden Russet. G. Syn. of Golden Russet (N. Y.)											
American Golden Russet of *NE.* Dap. Syn. of Hunt Russet											
American Golden Russet of some (incorrectly). A'75. Syn. of Hunt Russet											
American June. OklB2											Not described.
American Limbertwig. GLA. Syn. of Limbertwig											
American Mammoth. GenF'33. Syn. of Gloria Mundi											
American Marygold. W. Syn. of Marygold											
American Newtown Pippin. GenF'33. Syn. of Green Newtown											
American Nonpareil. GarCal	Mass	oblo	m				sa			c	
American Nonpareil. DomEne. Syn. of Doctor											
American Nonpareil. Dap. Syn. of Domine											
American Nonsuch. MagofH'39											Do.
American Peach. D. Syn. of Pigeonette											
American Pearmain. E. Syn. of Summer Pearmain											
American Pearmain (erroneously). GenF'33. Syn. of Summer Pearmain (Eng.).											
American Pippin. DomEne. Syn. of Grindstone											
American Plate. D		rob	s	gb	cjt					l	From Ronalds.
American Red Juneating. M. Syn. of Early Strawberry											
American Summer Pearmain. Lin. Syn. of Summer Pearmain (Am.)											
American Summer. R. Syn. American Summer Pippin											Not described.
American Summer Pippin. IllB45. Syn. of American Summer											
American White Calville. L. Syn. American White Winter Calville	Am.? Ohio?									l	Probably White Pippin. See Mag. of H.'47, 195.
American White Winter Calville. Cole. Syn. of American White Calville											
American White Winter Calville. F. Syn. of American Calville											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
American White Winter Calville. E. Syn. of White Calville											
American White Winter Calville. MagofH'47. Syn. of White Pippin											
Ammidon's Fall Sweet. MagofH'44. Syn. of Sweet Ammidon											
Ammidon's Late. MagofH'44. Syn. of Late Ammidon											
Ammory. R. Syn. Ammory Pippin											Not described.
Ammory Pippin. GenF'32. Syn. of Ammory											
Amos. L. Syns. Amos Jackson, Jackson	Ill.?	ob	m	yb			sa	g		vl	
Amos Jackson. IllB45. Syn. of Amos											
Amos Summer. TJG&S											Catalogued by T. J. Garden & Son, Springhill, Va.
Amsterdam. L. Syns. Amsterdam Sweet, Hightop Sweet (incorrectly)	N. Y	rob	m	gyrs	tj	w	rs	g		ml	
Amsterdam Sweet. Dap. Syn. of Amsterdam											
Ananarnoe. NYExR'92	Rus	r	m	yrs	c	w	sa	g		m	On trial at (Geneva) N. Y. Ex. Station.
Ananas. D. Syns. Bromelia Ananas, Pother Ananas	Eur.?	r	m	yrs	tj	w	sa	vg		m	
Ananasapfel rother. Gb. Syn. of Red Pine											
Ananas de Liege. D. Syn. of Liege											
Ananasnoe. Gb. Syn. of Pineapple											
Ananas Reinette. IllB45											Not described.
Anasapfel Rother. MHSC'81. Syn. Red Duck Apple			m	yw			sa	vg		e	
Ancient Briton. MagofH'49											Do.
Anderson. IllH'95			m	rs				vg		m	
Anderson. Dap. Syn. of Cannon											
Andrews. L. Syn. Judge Andrews		r	m				sa?	g		e	
Andrews Favorite. L. Syn. Andrews' Favorite	Vt	robl	m				a	g		l	
Andrews' Favorite. Dap. Syn. of Andrews Favorite											
Andrews Red. IllB45											Do.
Andrew Sweet. Dap. Syn. Andrew's Sweet	N. S.	robc	ms				s	vg		l	
Andrew's Sweet. Dap. Syn. of Andrew Sweet											
Andrew Winter. NYExR'96	Ill.?	rc	s	gyr	fj	gw	msa	g		vl	Described by S. A. Beach in (Geneva) N. Y. Ex. R. '96.
Angel. L. Syn. Angel's Favorite	N. C		ml	yrs	tj	w	msa	g	m	vl	
Angel's Favorite. NWC. Syn. of Angel											
Angers. L. Syn. Belle d'Angers		rc	l	gyr	jc	y	sa	vg	d	m	
Angle. D. Syn. Angle Sweet		r	m	yrs	t	y	s	g		m	
Angle Sweet. W. Syn. of Angle											
Anglo-American. Hort'54. Syn. Read's Anglo-American	Ont	ob	m	yrs	tj	w	s	vg		m	Tree hardy and productive. Buckman's trial orchard.
Aniere. R. Syn. Aniere de Berthecourt											
Aniere de Berthecourt. BBL. Syn. of Aniere											
Anis. MHSC'81. Syn. Shro. to Ia. No. 32	Rus										Introduced by Iowa Ag. College.

Anis. K. Syn. of Fenouillet Gris											
Anisette. N. Syn. of Anisovka											
Anisim. MHSC'86. Syns. Anisimovka, Jonathan of the North	Rus.	re	m	yr			m	g	dm	m	Same as Anissim.
Anisimovka. Gb. Syn. of Anisim											
Anisimovka. Gb. Syn. of Anissim											
Anisimovskoe. Gb. Syn. of Anissim											
Anisimowskoe. Gb. Syn. of Anissim											
Anisjeltui. Gb. Syn. of Yellow Anis											
Anis koritchnevoe. Gb. Syn. of Cinnamon Anis											
Aniskrasnui. Gb. Syn. of Red Anis											
Anis Krupnui. Gb. Syn. of Large Anis											
Anis Kurski. Gb. Syn. of Kursk Anis											
Anis Kurskui. Gb. Syn. of Kursk Anis											
Anisovaya plodovitka. Gb. Syn. of Prolific Anis											
Anisovka. MHSC'81. Syns. Anisette, Anisowka, Gov. list No. 185	Rus.										Not described.
Anisowaja plodowitka. Gb. Syn. of Prolific Anis											
Anisowka. Gb. Syn. of Anisovka											
Anispestrui. Gb. Syn. of Mottled Anis											
Anis rospisnoi. Gb. Syn. of Pointed Anis											
Anis Rospisni. Gb. Syn. of Pointed Anisette											
Anis Sacharnui. Gb. Syn. of Sweet Anis											
Anis Schaltui. Gb. Syn. of Yellow Anis											
Anis Selanui. Gb. Syn. of Green Anis											
Anissim. Gb. Syns. Anisimovskoe, Anisimovka, Annissim's Apple, Anisimowskoe, Gov. list No. 471, Shro. to Ia. No. 14.	Rus.										Do.
Anis zelenui. Gb. Syn. of Green Anis											
Anjou. L. Syn. Reinette d'Anjou	Fr	rob	ml	rs	etj	y	sa	vg		l	Mr. Downing says, new; tree vigorous.
Anjou Pippin. IIIB45	Fr	oble	l				a			l	
Anna. L. Syns. Aunt Anna, Aunt Anna's Seedling	Ohio	ob	m	yrs	t	y	a			e	
Annabel. A'73											Not described.
Annaberger. D. Syn. of Rostocker											
Annanas. R. Syn. Annanas Reinette											Do.
Annanas Reinette. MoH'82. Syn. of Annanas											
Annas Gregoire. BBL											In Buckman's trial orchard.
Annate. Dnp. Syn. of Annette											
Anne. L. Syn. Princess Anne Beauty											Not described.
Annette. W. Syns. Annate, Bettie Brooks, Old Bettie	Va.	ob	m	gyb	tj	w	bsa			me	
Annette. AB. Syns. Black Annette, Blackannette	Ohio?	rob	m	grs	j	gw	sa	vg		vl	Distinct from preceding.
Annette (of Black). L. Syns. Black's Annette, Cornell's Early, Cornell's Favorite.	Va.?	robe	m				a			e	In Downing's Appendix.
Annette of Va. MichB31											Not described.
Annie. R. Syn. Annie Elizabeth											Do.
Annie Elizabeth. S&W. Syn. of Annie											
Annis Amova. MinnExR'90											Do.
Annissim's Apple. Gb. Syn. of Anissim											
Anthony's Apple. Gb. Syn. of Antonovka											
Anti. R. Syn. Anti-Know-Nothing											Of political significance.
Anti-Know-Nothing. Hort'56. Syn. of Anti											
Antoine. L. Syn. Archiduc Antoine	Eur.	r	m	yg	ftj	y	sa		e	ml	
Antonooka. Cat. Syn. of Antonovka											
Antonowka. Gb. Syn. of Antonovka											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Antonovka. MHSC'81. Syns. Anthony's Apple, Antonooka, Antonouka. Gov. list No. 236, Shro. to Ia. No. 26.	Rus.	oble	l				sa	p	m	m	
Antonowka de Mohileu. CanH'94. Syn. of Mohileu											
Antonowka Simple. CanH'94	Rus.		m	gy						l	
Api. D. Syn. of Lady											
Api Etoile. D. Syn. of Star Lady											
Api Gros. D. Syn. of Large Lady											
Api Gros Pomme de Rose. D. Syn. of Rose Lady											
Api Noir. D. Syn. of Black Lady											
Api Petite. Cole. Syn. of Lady											
Aport. MHSC'81. Syns. Gov. list No. 252, O'Porto, Shro. to Ia. No. 23	Rus.	e	ml				a	g			
Aporta. K. Syn. of Alexander											
Aport bielui. Gb. Syn. of White Aport											
Aport Flat. IaH'82	Rus.		l					vg		ml	Budd says distinct from Aport.
Aport Herbst. Gb. Syn. of Autumn Aport											
Aport letney. IaB31. Syn. of Summer Aport											
Aport lietnee. Gb. Syn. of Summer Aport											
Aport Orient. SDB76. Syn. of Aport Ourent											
Aport Oriental. NYExR'94. Syn. of Aport Ourent											
Aport Osennee. Gb. Syn. of Autumn Aport											
Aport Ourent. McExR'96. Syns. Aport Orient, Aport Oriental	Rus.	roble	m	yg		w	msa	g		e	
Aportovoe Simovoe. Gb. Syn. of Winter Aport											
Aportowoge Simowoe. Gb. Syn. of Winter Aport											
Aport Reptschati. Gb. Syn. of Repka Aport											
Aport rieptchatui. Gb. Syn. of Repka Aport											
Aport Rosa. MinnExR'90											Probably same as Rosy Aport.
Aport rosovoe. Gb. Syn. of Rosy Aport											
Aport rosovui. Gb. Syn. of Rosy Aport											
Aport Rosowui. Gb. Syn. of Rosy Aport											
Aport Rother. MinnExR'90											Not described
Aport Sladkui. Gb. Syn. of Sweet Aport											
Aport voronesh. N. Syns. No. 4 Voronesh, No. 12 Orel, Shro. to Ia. No. 23	Rus.						a	g		l	
Apple Butter. H. Syns. Butter Apple, Molasses, Sweet Bellflower	(?)	obe	l	y				vg	d		Of uncertain identity
Apple Butter Sweet. MagofH'53											Not described.
Apple "Lead." Gb. Syn. of Svinets											
Apple of Commerce. ArkB49. Syn. of Beach											
Apple Sweet. Gb. Syn. of Slast											
Arabian. IaH'83	Rus.		m	rs			a	g	km	ml	May be Oldenburg.

Arabian (apple). D. Syn. of Pigeon											
Arabian. Bai. Syn. of Arabka											
Arabian Seedling. MinnExR'90											Do
Arabka. MHSC'81. Syns. Arabian, Arabkoe, Arabskoe, Gov. list No. 181, Rgl. to Ia. No. 257, Shro. to Ia. No. 155.	Rus		l					g		l	
Arabkoe. Gb. Syn. of Arabka											
Arabskoe. Gb. Syn. of Arabka											
Arbroath Pippin. GenF'33. Syn. of Oslin											
Arbusowskoe. MHSC'86. Syn. of Watermelon											
Arbuzovskoe. Gb. Syn of Watermelon											
Arcad. Gb. Syns. Arcade, Arkad, Gov. list No. 203	Rus										Not described.
Arcade. Gb. Syn. of Arcad											
Archibald. TennBXI	Tenn	obl	l	rc	ftm	w	s	vg			Described in Tenn. B. X. 1.
Archiduc Antoine. D. Syn. of Antoine											
Archie. A'77											Cider and drying.
Arctic. MeExR'96	N. Y	re	l	yr	cj	y	sa	vg	km	l	
Areka. S&W											Not described.
Arista. CH	Wis	r	l	gwrs	f		sa	g		l	Catalogued by C. Hewitt.
Arkad. Gb. Syn. of Arcad											
Arkad dimtchatui. Gb. Syn. of Smoky Arcad											
Arkad dlinnui. Gb. Syn. of Long Arcad											
Arkad duimtschalaja. Gb. Syn. of Smoky Arcad											
Arkad jeltui. Gb. Syn. of Yellow Arcad											
Arkad krasivni. Gb. Syn. of Beautiful Arcad											
Arkad krasiwui. Gb. Syn. of Beautiful Arcad											
Arkad krasnui (Rgl). Gb. Syn. of Red Arcad											
Arkad kruglui roscovui. Gb. Syn. of Waxen Arcad											
Arkad kruglui Woskowoi. Gb. Syn. of Waxen Arcad											
Arkad rieptchatui. Gb. Syn. of Repka Arcad											
Arkad rospisnui. Gb. Syn. of Painted Arcad											
Arkad Scholti. Gb. Syn. of Yellow Arcad											
Arkansas. BulS. Syns. Arkansaw, Mammoth Black Twig	Ark	oble	vl	yr			msa	vg	km	l	Same as Black Twig of Mr. Lyon.
Arkansas Baptist. ArkB60. Syn. of Givens											
Arkansas Beauty. ArkB70		re	ml	yrs	fj	y	sa	vg		l	
Arkansas Belle. ArkB49	Ark		l	r						l	May be Gano. See MoH'99, 245.
Arkansas Black. P'86	Ark	re	ml	dr	fj	y		vg	km	l	
Arkansas Black Twig. Cat. Syn. of Black Twig. [Probably Arkansas]	Ark										
Arkansas Pippin. L. Syns. Mammoth Pippin, Mammoth Pippin of Arkansas.	Ark		vl				a		m	ml	
Arkansas Queen. A'77											Not described
Arkansas Red. Bai											Do.
Arkansaw. ArkB49. Syn. of Arkansas											
Arley. D. Syn. of Wyken											
Arlington. R. Syn. Arlington Pippin, South Lincoln Beauty											Do.
Arlington Pippin. AmGar'99. Syn. of Arlington											
Arlington Queen. TennBXI. Syn. of McCord											
Armburst. L. Syn. Armburst's Fall											Not described.
Armburst's Fall. Cat. Syn. of Armburst											
Armintrout. P'95	Va	oble		yrs	ftj	y	sa	vg		l	Described by Pomologist, '95, 19.
Armorel. BBL											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Armstrong. MagofH'53	Iowa; Pa							g		vl	Referred to in Hort'73, 227
Arnold. (LC). Syn. Arnold's Beauty	Ont	ob	m				sa	vg	d	vl	
Arnold's Beauty. Dap. Syn. of Arnold											
Arnold Cheese. R. Syn. Arnold's Cheese											Not described.
Arnold's Cheese. TJG&S. Syn. of Arnold Cheese											
Arnold Russet. ColExR'88											Not described.
Arnold Sweet. ColExR'88											Do.
Arnold Winter. R. Syn. Arnold's Winter											Do.
Arnold's Winter. MinnExR'90. Syn. of Arnold Winter											
Aromatic. W	South	r	m	rs			sa	vg	d	e	
Aromatic. W	Car	ob	l	rs				g	d	e	Probably Aromatic Carolina.
Aromatic. Gb. Syn. Tchutilotchnoe	Rus?										Probably Gov. list No. 977.
Aromatic Calville. Dap. Syn. of Aromatic Carolina											
Aromatic Carolina. Hort'49. Syn. Aromatic Calville	S. C.	rob	l				sa	vg	d	ml	
Aromatic Pippin. DomEnc											Not described.
Aromatic Russet. D	Eng	roblc	m	gru	f	gw	sa	vg	d	l	First described by Lindley.
Aromatic Spike. Gb. Syns. Curly Spiced Aromatic. Gov. list No. 354. Krivospitsoe aromatnoe, Kriwospisoe Aromatnoe.	Rus										
Aroostook. P'93. Syn. Aroostook Sweet	Me		s	ru				g		vl	Described by P. 1893, 285.
Aroostook Sweet. P'93. Syn. of Aroostook											
Arthur. CGP	Iowa							g		l	An Iowa seedling
Arundel Pearmain. GenF'33. Syn. of Hormead											
Ash Black. Cat	Ky										Not described.
Ashland. E	Ohio	oblc	m	yrs	tj	y	msa	vg	d	vl	
Ashmead. VanD. Syn. Ashmead's Kernel	Eng	rob	s	gyb	cj	y		g		vl	First published by Lindley.
Ashmead's Kernel. D. Syn. of Ashmead											
Ashmore. IndF'40. Syns. Fall Wine (erroneously) Hoosier's Red, Red Ashmore.	Am	roblc	m	gwrs	tj	w	sa	vg	d	ml	"Striped Ashmore of Downing," probably distinct
Astley. MoH'81											Not described.
Asterus. D. Syns. D'Astems, D'Asterus, Strifling d'Hiver	Eng	rob	l	grs	f		rsa	g	k	vl	From Ronalds.
Astracan. K. Syn. of White Astrachan											
Astracanischer Sommerapfel. D. Syn. of White Astrachan											
Astrachan. Cat	Ala										Not described.
Astrachaner. Gb. Syn. of Red Astrachan											
Astrachaner Weisser. Gb. Syn. of White Astrachan											
Astrachan Red. Lin. Syn. of Red Astrachan											
Astrachan Rouge. D. Syn. of Red Astrachan											
Astrachanskoe Skvasnoe. Gb. Syn. of Transparent Astrachan											

Astrachanskoe Skwasnoe. Gb. Syn. of Transparent Astrachan											
Astrachanskoe Zelenoe. Gb. Syn. of Green Astrachan											
Astravskoe. NYExR'92											On trial at Geneva station.
Atalanta. BBL											In Buckman's trial orchard.
Atkins. F	Va	r	ml	r		y	sa	g		vl	
Atlanta. BBL											Not described.
Atlins. R. Syn. Atlins Seedling											In Buckman's list.
Atlins Seedling. BBL. Syn. of Atlins											
Atston. EWR		r	ml	r	f	w	ma	vg	dk	ml	In E. W. Reid's catalogue.
Atwood. L. Syn. Atwood's Seedling											Not described.
Atwood's Seedling. Cat. Syn. of Atwood											
Auburn. P'95	Wis	r	ml	yrs	tj	y	msa	g		l	
Aucubafolia. AHCC&Co		rc	m	rs	f		sa			ml	In Downing's and Morris's catalogues.
Aucuba-leaved Reinette. BBL											In Buckman's list.
August. W	Ohio							g		e	
August. NYExR'96	Minn	rc	m	yrs	fj	y	msa	g		e	At Geneva station.
Augusta. R. Syn. Augusta Pippin											Not described.
Augusta Pippin. IllB45. Syn. of Augusta											
August Apple. E. Syn. of Early Pennock											
August Apple. D. Syn. of July											
August Dart. A'89. [Probably August Tart.]											Do.
Auguste. L. Syn. Caroline Auguste	Belg	r	m	gy	f	ws	a	vg	d	m	From the Verger.
Augustine. Hort'48	Va. ?	rc	l	yrs			s			e	
Augustine. A'67	S. C.		l	r				g			Possibly same as the preceding.
August Perfume. MagofH'41											Not described.
August Pippin. Dap. Syn. of Summer Paradise											
August Red. L. Syns. Passe Pomme Rouge, Rother August Apfel, Rothe Sommer pass pomm.		rob	s	yb	cj	ws		p		e	
August Redstreak. WRH											Do.
August Stripe. W	(?)	c	m	rs				g		e	
August Sweet. Cat	Iowa										Do.
August Sweet. D. Syn. of Bough											
August Sweeting. IndH'72											This may be Bough.
August Sweeting. Cole. Syn. of Bough											
August Tart. MagofH'53	(?)	c	l	rs			sa	g		e	
Augustus. L. Syn. Augustus Pearmain	Eng	rc	s	rs			sa	vg	d	ml	From Hogg.
Augustus Pearmain. D. Syn. of Augustus											
August Vandervere. W											
August White. IndH'81	Ind	c	l	rs			sa			e	Not described.
Aunt. L. Syn. Aunt's Apple	(?)	oblc	l	yrs	j	y	ba	g		m	First described by Coxe.
Aunt Anna. VanD. Syn. Aunt Anna's Seedling	Ohio	obl	m	yrs	t	y		g		m	From Ohio Pom. Socy.
Aunt Anna. W. Syn. of Anna											
Aunt Anna's Seedling. D. Syn. of Anna											
Aunt Anna's Seedling. D. Syn. of Aunt Anna											
Aunt Dorcas. MagofH'60. Syn. of Granite											
Aunt Ginnie. BBL. Syn. of Ginnie											
Aunt Hannah. M	Mass	rob	ml	yru	fr	y	msa	g		l	
Aunts. W. Syn. of Hannah											
Aunt's Apple. C. Syn. of Aunt											
Aunt Sallie. R. Syn. Aunt Sallie Everlasting											In J. Van. Lindley's catalogue.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Aunt Sallie Everlasting. JVL. Syn. of Aunt Sallie											
Aunt Sally. JVL. Syn. of Sally. [Probably same as Aunt Sallie.]											
Aunt Susan. VanD. Syn. Aunt Susan's Favorite	Md	rob	l	gyrs	tj	w	msa	g		e	
Aunt Susan's Favorite. MoH'63. Syn. of Aunt Susan											
Aurora. OntB37	Ont	ob	s	r	cj		a	g	k	ml	
Aurora. E. Syn. of Twenty Ounce											
Aurora. D. Syn. of Golden Reinette											
Aurore. GenF'33. Syn. of Golden Reinette											
Austin. L. Syn. Austin Sweet	Pa	rc	m	ru			s	g		ml	
Austin Apple. Dap. Syn. of Tom Austin											
Austin Pippin. IllB15											Not described.
Austin Sweet. D. Syn. of Austin											
Australian. R. Syn. Australian Aphis-proof											Do.
Australian Aphis-proof. ColExR'93. Syn. of Australian											
Australian Red. NYExR'83											Do.
Autumnal Bough. W. Syn. of Autumn Bough											
Autumnal Paradise. W. Syn. of Autumn Paradise											
Autumnal Swaar. GenF'38. Syn. of Fall Swaar											
Autumnal Sweet. W. Syn. of Autumn Swaar											
Autumnal Sweet Swaar. E. Syn. of Autumn Swaar											
Autumn Aport. MHSC'86. Syns. Aport Herbst, Aport Osennee, Autumn Orange, Gov. list No. 335, Osennui Aport, Shro. to Ia. No. 129.	Rus										Do.
Autumn Baldwin. IndH'76											Do.
Autumn Bough. NEF'26. Syns. Autumnal Bough, Autumn Sweet Bough, Bough Autumn, Fall Bough, Late Bough, Montgomery Sweet, Philadelphia Sweet, Sweet Bellflower, White Sugar.	Am	rc	m	gy	vt	w	s	vg	d	me	
Autumn Golden. L. Syn. Autumn Golden Pippin	Eng		s	gyru			sa	vg		m	From Ronalds.
Autumn Golden Pippin. D. Syn. of Autumn Golden											
Autumn Gray. L. Syn. Autumn Pomme Gris	Ont	obc	s	yru	tj	y	sa	vg	d	ml	
Autumn Mouse. GenF'33. Syn. of Mouse											
Autumn Orange. Gb. Syn. of Autumn Aport											
Autumn or *Fall Pippin.* Th. Syn. of Fall Pippin											
Autumn Paradise. A'60. Syns. Autumnal Paradise, Summer Sweet Paradise.		ob					s	g		me	
Autumn Pear. Gb. Syns. Gov. list No. 273, Gruscheffka Bsennaja, Gruschevka Osennaya.	Rus										Not described.
Autumn Pearmain. DomEnc. Syns. French Pearmain, Green Winter Pearmain, Jersey Pearmain, Winter Pearmain.	(?)	robe	m				sa	g		ml	
Autumn Pearmain. W. Syn. of Long Island Pearmain											
Autumn Pearmain. E. Syn. of Summer Pearmain (Am.)											
Autumn Pearmain. GenF'33. Syn. of Summer Pearmain (Eng.)											

Autumn Pearmain. H. Syn. of Watson											
Autumn Pearmain. T. Syn. of Winter Pearmain											
Autumn Pippin. DomEnc. Syn. of Fall Pippin											
Autumn Pippin. D. Syn. of Winter Harvey. [Mr. Lyon regarded this as doubtful.]											
Autumn Pomme Gris. Dap. Syn. of Autumn Gray											
Autumn Romanite. A'52	Pa	r	m	r		y	sa			m	
Autumn Rose. D. Syns. Roseau d'Automne, Roseau (incorrectly)	Fr	rc	m	ru						m	Described by Coxe, p. 107.
Autumn seek-no-further. C. Syn. of Watson											
Autumn Strawberry. GenF'48. Syn. of Late Strawberry											
Autumn Streaked. Gb. Syns. Gov. list No. 964, Herbst Strefling, Herbst Streifling, Shro. to Ia. No. 158.	Rus		l				sa	g			
Autumn Stripe. IllB45. Syn. of Chenango											
Autumn Swaar. Wg. Syns. Autumnal Sweet, Autumnal Sweet Swaar, Autumn Sweet, Sweet Golden Pippin, Sweet Swaar.		rob	m	y			s	g	k	m	
Autumn Sweet. L. Syn. Autumn Sweet Pearmain		c	m				s	g	dk	m	
Autumn Sweet. W. Syn. of Autumn Swaar											
Autumn Sweet Bough. Hort'46. Syn. of Autumn Bough											
Autumn Sweet Pearmain. Lin. Syn. of Autumn Sweet											
Avenarius. MHSC'86. Syns. Avenarius Sladkoe, Gov. list No. 15, Pipka Sladaya (Avenarius), Shro. to Ia. No. 51, Süssapfel Von Avenarius, Süssapfel von Toenarius.	Rus										Not described.
Avenarius Sladkoe. Gb. Syn. of Avenarius											
Avera. BBL. Syn. Avera's Favorite		rob	l	yr	j	y		g	dkc	me	
Avera's Favorite. JVL. Syn. of Avera											
Averill. MagofH'49. Syn. Wolf's Den	Conn	c	l				sa	p		ml	
Avery Sweet. D. Syn. of English Sweet											
Avery Sweeting. E. Syn. of English Sweet											
Avista. P'91	Wis	obc	m				msa			l	
Axley. R. Syn. Axley Favorite											Do.
Axley Favorite. BBL. Syn. of Axley											
Babbitt. A'91. Syn. Western Baldwin	{Mo.? Ill.?}	oblc	ml	rs	jc		a	g	dkm	ml	
Babcock No. 3. IllH'89											
Babcock No. 4. IllH'89											
Babcock No. 5. L.											
Babcock No. 7. IllH'99											
Babcock No. 10. IllH'96											
Babcock No. 13. L.											
Babcock No. 14. L.											
Babuschkino. MHSC'81. Syn. of Grandmother											
Babuschkino rannee. MHSC'81. Syn. of Early Grandmother											
Baccollnus. W.	South	robl	s	wrs	fj		sa	g		l	
Bache. L. Syns. Bache's Kernel, Best Bache	Eng	obl	m						c		From Hogg.
Bache's Kernel. D. Syn. of Bache											
Bachelor. A'56. Syn. of Buckingham											
Bachelor. D. Syn. of Buncombe											
Bachelor. W. Syn. of Equinitelee. ["E." is probably Buckingham.]											
Bachelor Blush. A'64. Syn. Bachelor's Blush	N. J.	ob	l	yb	tej	w	sa	vg		me	
Bachelor's Blush. W. Syn. of Bachelor Blush											
Bachelor Button. R. Syn. Bachelor's Button											Not described.
Bachelor's Button. A'79. Syn. of Bachelor Button											
Bachelor Glory. L. Syn. Bachelor's Glory	Eng	r	l				sa			ml	From Hogg.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Bachelor's Glory. D. Syn. of Bachelor Glory											
Bachelor Seedling. BBL											Not described
Back Creek. JGW. Syn. of Yellow Newtown											
Backhouse. L. Syn. Backhouse's Lord Nelson	Eng	re	l	yg				g		l	From Ronalds
Backhouse's Lord Nelson. D. Syn. of Backhouse											
Backhouse's Lord Nelson. D. Syn. of Nelson Codlin											
Baddow. L. Syns. Baddow Pippin, Ribston Pippin, Spring	Eng	rob	m	ygr	fe	w	sa	g		l	
Baddow Pippin. D. Syn. of Baddow											
Badger. L. Syn. Badger's Bellflower	Ohio	obl	l	rs			sa	g		l	
Badger's Bellflower. W. Syn. of Badger											
Baer. A'56	Pa	r	s	rs			sa	g		vl	May be same as Hiester, D.
Baer. D. Syn. of Hiester											
Bagby Russet. PFar'60. Syn. of Egyptian Russet											
Bagmatoff. A'83											Not described
Bag. R. Syn. Bag's Favorite	Mass		l	yr				vg			
Bag's Favorite. NEF'49. Syn. of Bag											
Bahr. IllH'96											Do
Balken. MontB20											Do
Bailey Crimson. A'99											Do
Bailey Golden. L. Syns. Bailey's Golden, Bailey's Golden Sweet	Me	obl	l	y			sa	g		l	
Bailey's Golden. D. Syn. of Bailey Golden											
Bailey's Golden Sweet. Cole. Syn. of Bailey Golden. [Doubtful if identical.]											
Bailey Spice. MagofH'50. Syn. Bailey's Spice	N. Y	re	m				a	g		me	
Bailey's Spice. W. Syn. of Bailey Spice											
Bailey Sweet. GenF'49. Syns. Bailey's Sweet, Chillicothe Sweet, Edgerly's Sweet, Howard's Sweet, Paterson's Sweet, Patterson, Patterson Sweet.	N. Y	roble	l	yrs	t	w	vs	vg	dkm	m	
Bailey's Sweet. W. Syn. of Bailey Sweet											
Bain. MoH'00. Syn. of Nixonite											
Baker. L. Syn. Baker Apple	N. Y	r	m				sa	g	k	m	
Baker. Hort'60. Syn. Scott	Conn	robe	l	yrs	c	y	sa	vg		ml	
Baker. A'77. [May be same as preceding.]	Va.?										Do
Baker Apple. W. Syn. of Baker											
Baker Easter. R. Syn. Baker's Eastern Pippin	Can		m	yrs			sa	g	d	vl	
Baker's Eastern Pippin. MHSC'77. Syn. of Baker Easter											
Baker Seedling. R. Syn. Baker's Seedling											
Baker's Seedling. NEF'49. Syn. of Baker Seedling											
Baker Sweet. L. Syns. Baker's Sweet, Late Golden Sweet, Long Stem Sweet, White Golden Sweet, Winter Golden Sweet.	Conn	r	ml	y	r	y	s	vg	dk	l	
Baker's Sweet. W. Syn. of Baker Sweet											
Balch. IllH'81. [Resembles Winesap.]											Do.

Balchin. R. Syn. Balchin Pearmain											Do.
Balchin Pearmain. BBL. Syn. of Balchin											
Baldhill. MagofH'47											Do.
Baldwin. NEF'26. Syns. Baldwin Pippin, Butters, Felch, Late Baldwin, Mahaska?, Pecker, Red Baldwin, Red Graft, Steele's Red Winter, Woodpecker.	Mass	re	ml	yrs	c	yw	sa	vg	dkm	l	The syn. Mahaska probably erroneous.
Baldwin Betwenlly. A'77. [Doubtfully distinct.]											Not described.
Baldwin (erroneously). D. Syn. of Connecticut Hunt											
Baldwin N. C. W	N. C	ob	l				a	g		l	Tabulated by Warder as distinct.
Baldwin Pippin. NEF'26. Syn. of Baldwin											
Baldwin Seedling. MinnExR'90											Not described.
Baldwin Summer. Dap. Syn. of Steve											
Baldwin Sweet. MagofH'41		r	ml	yrs		y	s	g		l	
Balgone Pippin. D. Syn. of Golden Pippin (Eng.)											
Balk. MagofH'42. Syn. of Friar											
Ball Apple. Hort'58. Syn. of Pawpaw											
Ballard. BBL											Do.
Ball's Choice. TennBl-IX. Syn. of Harwell											
Balm. D	Vt	robe	l	rs			sa	g		m	
Balsburg. IllB45											Do.
Baltimore. Th. Syns. American Beauty (incorrectly), Baltimore Pippin, Cable's Gilliflower, Flushing Spitzenberg (of the N. W.), Hubbell (erroneously), Mahaska, May Flower, Royal Pippin (of Ill.). Wakeman.	(?)	re	m	gyrs	tj	w	sa	vg	d	l	
Baltimore. AmF'80	Md	ob	l	rs							Descriptions imperfect.
Baltimore. WHyS. Syn. of Barker Liner											
Baltimore (erroneously). D. Syn. of Fallawater											
Baltimore Greening. E	Iowa	rob	l	gyb	t	y	msa	vg		l	
Baltimore (incorrectly). D. Syn. of Alfriston											
Baltimore, of some. Wg. Syn. of Gloria Mundi											
Baltimore, of some (incorrectly). E. Syn. of Vandevere											
Baltimore Pippin. E. Syn. of Baltimore											
Baltimore Pippin. D. Syn. of Ben Davis											
Baltimore Pippin. T. Syn. of Fallawater											
Baltimore Pippin. H. Syn. of Gloria Mundi											
Baltimore Red. Hort'56. Syn. of Ben Davis											
Baltimore Red. D. Syn. of Black Coal											
Baltimore Red Streak. D. Syn. of Ben Davis											
Baltimore Red Streak. D. Syn. of Black Coal											
Baltzbey. AHortA68. Syn. Baltzley's Sweet	Pa	rob	l	yb	tmj	w	s	g-vg		m	Probably same as Baltzley.
Baltzley. D	Va	ob	l	yb	ft	w	msa	g		m	
Baltzley's Sweet. Dap. Syn. of Baltzbey											
Banana. P'95. Syns. Flory, Winter Banana	Ind	ob	m	yb	ftj	y	msa	vg	d	l	
Banana Apple. A'95	N. J	re	l	gyb			s	g	km	l	
Banham. A'81											Not described.
Bank. Dap. Syn. Cave	Pa	obe	l	wyrs	tj	w	sa			ml	
Banks. A'95. Syn. Red Gravenstein	N. S			r	f				m	me	A sport of Gravenstein'
Banks Exhibition. BBL											In Buckman's list.
Banks Gravenstein. CanExR'01											Probably same as Banks.
Banner. GarM'62	Ill	r	m	yrs				g		e	Described by W. A. Taylor in A'97, 36.
Banta. R. Syn. Banta's Autumn	Ill							vg		m	
Banta's Autumn. IllH'71. Syn. of Banta											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Bantoe. R. Syn. Bantoe Black											Not described
Bantoe Black. MagofH'40. Syn. of Bantoe											
Baptist. Dap	Ky	rob	m				msa			l	
Bar. C. Syns. Bars, Bar	R. I.	r	l	y	j	w	s	g		l	
Baraboo. WisExR'93	Wis	r	m	yrs		w	sa	g			
Barb. MoH'88											Not described.
Barbour. A'56	Pa	robe	m	rs			sa	g			From Pa. Hort. Report
Barcelona. VanD. Syns. Barcelona Pearmain, Cassel Reinette, Glace Rouge, Kleine Casseler Reinette, Polinia Pearmain, Reinette des Carmes, Reinette Rouge, Reinette Roupe, Speckled Golden Reinette, Speckled Pearmain.	Eur.	r	m	yr	fe	yw	sa		d	l	
Barcelona Pearmain. GenF'33. Syn. of Barcelona											
Barchard. VanD. Syn. Barchard's Seedling	Eng	obe	m	yrs		w	s		k		
Barchard's Seedling. D. Syn. of Barchard											
Barcroft. A'97	Pa	rob	ms	gb			msa	g		l	
Bard. IllB45			ml	dr				p		l	
Bard. MagofH'47. Syn. of Dyer											
Bardey. R. Syn. Bardey's Sweet											Not described
Bardey's Sweet. IndH'93. Syn. of Bardey											
Bardin. D. Syn. of Fenouillet Rouge											
Bark. L. Syn. Bark Apple	Eng	re	m	ru					k	l	From Hogg.
Bark Apple. D. Syn. of Bark											
Barker. VanD. Syn. Billy Barker	N.C.	re	l	rs			a				From Gardener's Monthly.
Barker (Ia.). SDB76	Iowa	robl	m	yw	f	vw	a	g	k	m	Originated with Mrs. Barker, Story County, Iowa.
Barker Liner. L. Syns. Barker's Liner, Baltimore, Ezell	Tenn		ml	rs	j			vg			Possibly may be Gilpin.
Barker's Liner. WHyS. Syn. of Barker Liner											
Barkoff. ColB17											This may be Barloff of Gibb.
Barloff. Gb. Syns. Barloff's Apple, Barlovskoe, Barlowskoe, Gov. list No. 178.	Rus.										Not described
Barloff's Apple. Gb. Syn. of Barloff											
Barlovskoe. Gb. Syn. of Barloff											
Barlow. E. Syn. of Wick											
Barlowskoe. Gb. Syn. of Barloff											
Barn. R. Syn. Barn Apple											Not described.
Barn Apple. MagofH'36. Syn. of Barn											
Barnard. Dap	Iowa	rob	m				sa			l	
Barnard's Baking Sweet. Cat. Syn. of Barnard Sweet											
Barnard Sweet. L. Syn. Barnard's Baking Sweet							s				Do.
Barnes. L. Syn. Barnes' Best	Ind.?							vg	dk	vl	Thought to be Minkler.
Barnes' Best. H&Co. Syn. of Barnes											

Barnes Choice. R. Syn. Barnes' Choice											May be same as Barnes.
Barnes' Choice. MichB31. Syn. of Barnes Choice											
Barnes' Stripe. A'87. Syn. Winter St. Lawrence	Eng							g		l	Probably same as Murphy.
Barnes' Stripe. A'89. Syn. of Murphy											
Barnham. VanD. Syn. Barnham's Sweet	Conn	r	m	yw		y	r	g	k	l	
Barnham's Sweet. D. Syn. of Barnham											
Barnhill. R. Syn. Barnhill's Summer									km	e	
Barnhill's Summer. NWFG'52. Syn. of Barnhill											
Barnhilt. E	Am	c	s	yrs		w				ml	
Barnock. BBL											Not described.
Barnum. IaH'84											
Barr. MagofH'53. Syn. of Bar											
Barre. D. Syn. Colville Barre	Fr.?	rc	l	yg	j	yw	a			l	
Barrett. W	Conn	c	ml	yrs	jt	y	sa	g		l	
Barrett Russet. IllH'68											Do.
Barrett's Spitzenburgh. D. Syn. of Newtown Spitzenburg											
Barrles. IllH'89											Do.
Barry. E&B	N. Y	obc		yr	fe		a	g		vl	
Bars. Cole. Syn. of Bar											
Bar Seedling. JVL			m							l	
Barthold. BBL											Do.
Bartingme. BBL											Do.
Bartlett. H. [Hooper says synonym of Priestly.]		r	l	yrs		w	msa	g		l	From Country Gentleman.
Bartlett. E. Syn. of Bullett											
Bartlett. W. Syn. of Priestly											
Bartlett Seedling. CGen'59											
Barton. W	Ont.	obc	m	yb	ftj	w	msa	g	k	m	
Barton Favorite. BBL											Not described.
Barton Incomparable. L. Syn. Barton's Incomparable	Eng	rc	ms	yg	cj	yw	sa	vg	d	l	From Hogg.
Barton's Incomparable. D. Syn. of Barton Incomparable											
Barty. (LC) Syn. Barty Sweet											Not described.
Barty Sweet. BBL. Syn. of Barty											
Basil (the Great). Gb. Syns. Gov. list No. 971, Vasilis Largest, Vasilli, Vasilni Velikni, Wassilli Welikni.	Rus		vl					g	k		
Basketfull. MagofH'42											Do.
Basom. L. Syn. Basom Sweet		r		y			s				
Basom Sweet. MagofH'55. Syn. of Basom											
Bassett. L. Syn. Bassett Sweet	Ohio	e	m				s	g		e	
Ba sett Sweet. W. Syn. of Bassett											
Bastard Janet. IllB45. Syn. of Wright Janet											
Batchelder. MassH'70											
Batchelor. Hort'58. Syn. King Apple	N. C	rc	vl	gyrs	tfj	w	sa			me	Probably Buckingham.
Bates Cottage. CGen'69				rs			sa				
Batingme. BBL											Probably same as Bartingme.
Battle Ax. SBro. Syn. of Ben Davis											
Battlefield. W	South			y			s				
Battulen. BBL											Not described.
Battyanl. AlaB98											Do.
Batullen. Gb. Syn. V. R. S. to Ia. No. 31	Rus	rob		yru			a	g		e	Probaby same as Battulen.
Bauman. VanD. Syns. Baumann, Bauman's Reinette, Baumm's Reinett, Reinette Bauman.	Eur	rob	m	yg	f	yw	s			l	
Baumann. Gb. Syn. of Bauman											
Bauman's Reinette. Gb. Syn. of Bauman											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Baumm's Reinett. IllH'94. Syn. of Bauman. [Probably typographical.]											
Baxter. A'95. Syns. Baxter's Red, Larue, Pound Apple, Red Pound	Ont	re	vl	yrs			ma	g	m	l	
Baxter Pearmain. R. Syn. Baxter's Pearmain	Eng	robl	l	grs	f	y	sa	g	km	l	From Hogg.
Baxter's Pearmain. D. Syn. of Baxter Pearmain											
Baxter's Red. A'95. Syn. of Baxter											
Bay Apple. B. Syn. of Drap D'Or											
Bayard. WBro			ml	dr	f		ma			l	Probably identical with Dark Red Seedling.
Bayeux. L. Syn. Reinette de Bayeux	Belg	re	l	yr	t	w	a			l	
Bayfordbury Golden Pippin. D. Syn. of Golden Pippin (Eng.)											
Bay Lake. R. Syn. Bay Lake Sweet	Minn			yrs	f	w	s			l	
Bay Lake Sweet. MinnHort'96. Syn. of Bay Lake											
Bayles. L. Syn. Bayles' Sweet	Mo						s				
Bayles' Seedling. MJH. Syn. of British Columbia											
Bayles' Sweet. Cat. Syn. of Bayles											
Beach. ArkB49. Syns. Apple of Commerce, Lady Pippin, Richardson's Red.	Ark	rob	ml	gyrs	cj	y	sa	g	dm	vl	
Beachamwell. GenF'33. Syn. of Beachemwell											
Beachemwell. K. Syns. Beachamwell, Beachemwell Seedling, Matteaux's Seedling, Motteaux's Seedling.	Eng	r	ms	yrs	t	yw	sa			l	From Ronalds.
Beachemwell Seedling. NEF'32. Syn. of Beachemwell											
Beach Garden. BBL											Not described.
Beadell. D. Syn. Hanover Seedling	N. Y	robe	m	rs			sa	vg	d	m	
Beaman. L. Syn. Beaman's Seedling											Do.
Beaman's Seedling. F. Syn. of Beaman											
Bean. GenF'33. Syns. Bean Sweet, Buell's Sweet	N. Y	oblr	m	w	cj		s	g	k	l	
Bean Sweet. E. Syn. of Bean											
Bear. BBL. Syn. Bear Sweet	(?)	rc	m	yrs	tj		s	g	k	ml	
Bear's. WBKJ. Syn. of Dennis											
Bear Sweet. D. Syn. of Bear											
Beard. L. Syn. Beard Seedling	Ohio	r	m	rs				g		l	
Beard Burden. Hort'47. Syn. of Dyer											
Bearden. R. Syn. Bearden's Improved Shockley											Do.
Bearden's Improved Shockley. SCExR'98. Syn. of Bearden											
Beard's Seedling. W. Syn. of Beard											
Beau. K	N. Y	rob	l	ygb	cj	w			k	me	From Judge Buel.
Beaufin. L. Syns. Beaufin Norfolk, Cathead Beaufin, Norfolk Beaufin, Norfolk Beefing, Read's Baker.	Eng	ob	l	gr	f		sa	g	k	vl	
Beaufin Norfolk. D. Syn. of Beaufin											
Beaufort. L. Syn. Duke of Beaufort's Pippin	Eng	rob	l	grs	c	gw	sa			ml	From Lindley.
Beauman. R. Syn. Beauman Winter											Not described.

Beauman Winter. BBL. Syn. of Beauman											
Bean Rouge. D. Syn. of Hollandbury											Do.
Beautiful Arcad. Gb. Syns. Arkad Krasivui, Arkad Krasiwui, Beautiful Arcade, Gov. list No. 453.	Rus										
Beautiful Arcade. Gb. Syn. of Beautiful Arcad											
Beautiful Pippin. H. Syn. of Ribston											
Beauty. D. Syn. of Sutton											
Beauty of Alameda. Wn. Syn. of Alameda											
Beauty of America. E. Syn. of Sterling											
Beauty of Bath. SBro	Eng.?			gyrs			a				
Beauty of Kent. NEF'32. Syn. of Kent Beauty											
Beauty of Nordhaussan. BBL. Syn. of Nordhaussan		rob	l	grs	cj	w	sa			l	May be same as Pontoise.
Beauty of Pontoise. CanExR'01											
Beauty of the Dessert. CGen'60. Syn. Queen of the Dessert			s					vg	d	l	
Beauty of the Valley. IllB45											May be same as Alexander.
Beauty of the West. IllH'68											
Beauty of the West. MoH'73. Syn. of Alexander											
Beauty of the West. RNY'56. Syn. of Domine											
Beauty of the West. Lin. Syn. of Grosh											
Beauty of the West. GenF'33. Syn. of Western Beauty											
Beauty of the World. Dap. Syn. of Morganton											
Beauty of the World. JAY. Syn. of World Beauty											
Beauty Red. E. Syn. of Cooper										l	Not described.
Bechtold. R. Syn. Bechtold's Seedling	Pa										
Bechtold's Seedling. A'54. Syn. of Bechtold											Do.
Becker. TexBS	Tex										Do.
Bedford. BBL											
Bedfordshire. L. Syns. Bedfordshire Foundling, Cambridge Pippin	Eng	r	l	g	tj	y	a	g	k	l	
Bedfordshire Foundling. GenF'33. Syn. of Bedfordshire											
Bedford Sweet. D. Syn. of Red and Green											May be Beecher's Sweet crab.
Beecher. R. Syn. Beecher's Sweet											
Beecher's Sweet. WisB77. Syn. of Beecher											Not described.
Beechwood. R. Syn. Beechwood Sweet											
Beechwood Sweet. BBL. Syn. of Beechwood											
Beefsteak. MagofH'50. Syn. Garden Apple of some	Mass	obe	m	yr	etj	w	msa	vg	d	m	
Beckman. E&B'77. Syn. of Winter Rose											Do.
Beel. Cat. [May be same as Biel.]	Iowa										
Beel. Gb. Syn. of Biel											
Beeler. L. Syn. Beeler's Russet	Ind	robe	ms	yru	etj	y	sa	g	dk	ml	
Beeler's Russet. W. Syn. of Beeler											Do.
Beeler Sweet. R. Syn. Beeler's Sweeting											
Beeler's Sweeting. IndH'82. Syn. of Beeler Sweet											
Beel Krusawiza. Gb. Syn. of Handsome White											
Beel Krupnaja Prodolgonataja. Gb. Syn. of Large Long White											
Beelowoe Schollo Seroe. Gb. Syn. of White Russet											
Beel Rospisnaja. Gb. Syn. of Painted White											
Beel Skrute. MHSC'81. Syn. of Skrute											
Beel Sololofskaja. Gb. Syn. of Golden White											
Beel Tlikano Uskaja. Gb. Syn. of White Telikanoff											
Beel Wochins. Gb. Syn. of White Vochin											
Belaja Tebedka. Gb. Syn. of White Swan											Do.
Belbod Roozka. BBL											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Belborodooskoe. NYExR'93	Rus	rc	ml	gyr	cj	w	sa	g		e	
Belden. Lin. Syn. Red Cheek		rc	l	gy	c	y	sa	g		m	
Belden Sweet. W.	Conn	rc	ms	yb	tj	w	s	g		l	
Bell. Gb. Syn. of Melonen											
Bella. VanD	Conn	rc	ml	gyrs	ct	y	msa	g		l	
Bell (Melonen). Gb. Syns. Gov. list No. 61, Svoukoe ili dinnoe	Rus										Not described.
Bell Early. R. Syn. Bell's Early											May be Sops-of-Wine.
Bell's Early. A'52. Syn. of Bell Early											
Bell's Early. D. Syn. of Sops of Wine											
Belle. IllB45			s				s	p		l	
Belle Bonde. D. Syns. Belly Bounder, Billy Bond	Fr.?	rc	ml	gyrs	ct	w	sa	g	k	l	
Belle Bonne. GenF'33. Syns. Rolland, Winter Belle and Bonne, Winter Belle boon.		r	l	gyr	fj				k	l	From Hogg. May be Belle et Bonne.
Belle d'Angers. D. Syn. of Angers											
Belle de Boskoop. T. Syn. of Boskoop											
Belle de Pontoise. AndN. Syn. of Pontoise											
Belle des Jardens. IllB45											Not described.
Belle des Quermes. K. Syn. of Quermes											
Belle de Witt. MagofH'45	Ohio										Origin with T. S. Humrickhouse.
Belledge. D. Syn. Belledge Pippin	Eng	rob	ms	gy	fc		pa	vg	dk	l	From Lindley.
Belledge Pippin. D. Syn. of Belledge											
Belle Donce du Havre. Dap. Syn. of Havre											
Belle Dubois. D. Syn. of Rhode Island											
Belle du Havre. K. Syn. of Havre											
Belle et Bonne. Hort'49. Syn. Tenon Hills	Conn	rob	vl	y	cj	y	psa	g	m	l	
Belle et Bonne. E. Syn. of Golden Ball											
Belle et Bonne. D. Syn. of Sweet Belle											
Belle Fille. D. Syn. of Grey Reinette											
Belle Fille. D. Syn. of Winter Gray											
Belle Fleur. D. Syn. of Red Belle Fleur											
Belle Fleur. D. Syn. of Yellow Bellflower											
Bellefleur de France. D. Syn. of French Bellflower											
Belle Fleur Red. Lin. Syn. of Red Belle Fleur											
Belle Fleur Rouge. D. Syn. of Red Belle Fleur											
Bellefleur Yellow. Lin. Syn. of Yellow Bellflower											
Belle Grideline. D. Syn. of Grideline											
Belle Grisdeline. D. Syn. of Grideline											
Belle Josephine. D. Syn. of Gloria Mundi											
Belle Keeper. L. Syn. Belle's Winter Keeper											Not described.
Belle Pippin. TexB16											Do.

Belle Pool of Vt. BBL											Do.
Belle Rose. A'73. Syn. of Primate											
Belle Tart. Wg. Syn. of Wells											
Belle's Winter Keeper. Cat. Syn. of Belle Keeper											
Bell's Favorite. Dap. Syn. of Sops of Wine											
Bellflower. C. Syn. of Yellow Bellflower											
Bellflower Improved. IllH'98											Do.
Bellflower Improved. SBro. Syn. of Mason Orange											
Bellflower of Brent. C. Syn. of Brent											
Bellflower Pippin. W	Ill	obc	m	yb	ctj	y	sa	vg	d	l	
Bellflower Seedling. IllH'89											Do.
Bellflower White. H. Syn. of Ortley											
Bellflower Yellow. H. Syn. of Yellow Bellflower											
Bellis (Hun). BBL											Do.
Bellordoskoe. MinnBl											Probably Belborodooskoe.
Bell Pippin. WisB45											Not described.
Bell Pree. Hort'56			l	gy				vg			Probably Belpre Keeper of Downing.
Bell's Scarlet Pearmain. GenF'33. Syn. of Scarlet Pearmain											
Bell Seedling. L. Syn. Bell's Seedling	Ky	robl	m	rs	ftj	w	sa	g-vg	d	m	
Bell's Seedling. Dap. Syn. of Bell Seedling											
Belly Bound. H. Syn. of Golden Ball											
Belly Bounder. D. Syn. of Belle Bonde											
Belmont. K. Syns. Gate, Golden Pippin of some, Kelley White, Mamma Beam, Mother Beam, Waxen (not of Coxe), Waxen (of Coxe), White Apple.	Va. ? Pa. ?	roble	ml	y	ctj	y	msa	vg	d	ml	Some doubt as to the origin of Belmont.
Belpre. VanD. Syn. Belpre Keeper		r	ms	gw	tj	g	sa	g		l	
Belpre Keeper. D. Syn. of Belpre											
Belpre Russet. E. Syn. of Roxbury											
Belsford. R. Syn. Belsford's Small Harvest											Not described.
Belsford's Small Harvest. IndH'72. Syn. of Belsford											
Belui Naliv. Gb. Syn. of White Naliv											
Belvidere. A'77. Syn. of Gloria Mundi											
Belvidere Pippin. A'54. Syn. of Holland											
Belvoir. VanD. Syn. Belvoir Pippin	Eng	rob	s	yc	fc	gy	a			ml	From Lindley.
Belvoir Pippin. D. Syn. of Belvoir											
Belzer. MagofH'46		r	m	yrs	f	w	sa	g		e	
Bemis. R. Syn. Bemis Sweet	Vt	ob	l	w			s				
Bemis Sweet. A'73. Syn. of Bemis											
Ben. MagofH'38											Probably same as Eustis.
Ben. GenF'49. Syn. of Eustis											
Ben Bolt. BBL											Not described.
Ben Carter. IndH'81											Do.
Bendalls. ColExR'88											Do.
Ben Davis. Hort'56. Syns. Baltimore Pippin, Baltimore Red, Baltimore Red Streak, Battle Ax, Carolina, Carolina Red Streak, Funk Apple, Funkhouser, Hutchinson's Pippin, Joe Allen, Kentucky Pippin, Kentucky Red, Kentucky Redstreak, Kentucky Streak, Newman Apple, New York Pippin, Red Pippin, Robinson's Streak, Texan Red, Victoria Pippin, Victoria Red, Virginia Pippin, Watercore.	(?)	roble	ml	yrs	tj	w	sa	g	m	l	
Bender. Dap. Syn. of Shaffer											
Ben Ford. TennBl-IX. Syn. of Deaderick											
Benham. AmGar'90			l	gy	j		sa			e	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Benham. TennBI-X. Syn. of Claiborne											
Ben Harris. W. Syn. of Harris											
Benlon. MoH'00											Not described.
Benjamine. MoH'89											Do.
Benjamite. Dap. Syn. of Fallawater											
Bennefield. IndH'67											Do.
Bennet. D	Eng	oblc	m	ru					c		From Lindley.
Benning. R. Syn. Benning Stripe											May be Bennington Stripe.
Benning Stripe. Hort'54. Syn. of Benning											
Benninger. P'94	Pa		ml	gyrs	ftj	y	sa	g	km	m	
Bennington. D. Syn. of Sops of Wine											
Bennington Stripe. IllH'81											Not described.
Bennorton. P'95	N. Y.	rob	m	gyrsc	fcj	y	sa	g		vl	
Ben of Reading. MagofH'48. Syn. of Eustis											
Benoni. NEF'31	Mass	robc	ms	yrsc	jt	y	pmsa	vg	d	e	
Ben Peffer. MoH'83	Pa	obc	l	gyrs	tfj	yw	msa	vg	d	l	
Bentley. L. Syns. Bentley Sweet, Bentley's Sweet	Va.?	rob	m	ygs	fc	w	s	vg		l	
Bentley. P'94. Syn. of Bloomfield											
Bentley's Seedling. P'94. Syn. of Bloomfield											
Bentley Sweet. D. Syn. of Bentley											
Bentley's Sweet. E. Syn. of Bentley											
Benton. IllH'92. Syn. Benton Co. Beauty											Do.
Benton Co. Beauty. Cat. Syn. of Benton											
Benton Harbor. L. Syn. Benton Harbor Beauty											Do.
Benton Harbor Beauty. Cat. Syn. of Benton Harbor											
Benton Seedling. R. Syn. Benton's Seedling											Do.
Benton's Seedling. IllH'80. Syn. of Benton Seedling											
Benum. TennBX-1. Syn. of Claiborne											
Benwell. VanD. Syn. Benwell's Pearmain	Eng	rc	m	grs	cj	yw	ba			l	From Hogg.
Benwell's Pearmain. D. Syn. of Benwell											
Ben Woodward. Cat. Syn. of Woodward											
Bere Court. VanD. Syn. Bere Court Pippin	Eng	rob	m	yrs	cj		ba			m	Do.
Bere Court Pippin. D. Syn. of Bere Court											
Berenice. ColExR'92											Not described.
Beresina. Gb. Syns. Berezinskoe, Shro. to Ia. No. 122	Rus										Do.
Berezinskoe. Gb. Syn. of Beresina											
Bergadorf. Gb. Syns. Bergadorvskoe, Shro. to Ia. No. 84	Rus										Do.
Bergadorvskoe. MHSC'86. Syn. of Bergadorf											
Bergamot. MHSC'86. Syns. Bergamotnoe, Bergamotte, Bergamottnoe, Gov. list No. 424, Shro. to Ia. No. 88.	Rus										Do.
Bergamotnoe. Gb. Syn. of Bergamot											

Bergamotte. Gb. Syn. of Bergamot											
Bergamottnoe. Gb. Syn. of Bergamot											
Bergen. Dap	N. Y	r	m	gwrs	ftj	w	msa	g		l	
Bergner. IndH'88											Perhaps same as following.
Bergner. Hort'69. Syn. Bergner Apple	Mo	rob	l	yrs	cj	y	sa	vg	d	l	
Bergner Apple. AHortA'69. Syn. of Bergner											
Berlosovka. MHSC'81											
Berkeley. ABW											Not described.
Berkett. BBL											Do.
Berk Reinette. R. Syn. Berk's Reinette			s	yr	mjc	w	msa	g		l	
Berk's Reinette. CanExR'01. Syn. of Berk Reinette											
Berkely. L. Syn. Berkely Red	South	ob		rs			a				May be same as Berkeley.
Berkely Red. W. Syn. of Berkely											
Berkoff's Apple. Gb. Syn. of Borkoff											
Berkonskoe. Gb. Syn. of Borkoff											
Berks Co. Golden Pippin. A'77. Syn. of Berks Golden											
Berks Co. Mammoth. IndH'76. Syn. of Berks Mammoth											
Berks Golden. R. Syn. Berks Co. Golden Pippin	Pa	robe	l	y	ftj		sa	vg		l	
Berkshire. L. Syn. Berkshire Spy	Mass	rc	m	yb	ftj	wy	sa	g		l	
Berkshire Spy. Dap. Syn. of Berkshire											
Berks Mammoth. R. Syn. Berks Co. Mammoth	Pa	robe	vl	yrs	tj	yw		vg		ml	
Berlin. CH	Wis		m	rs						ml	
Berlin Colville. BBL											Not described.
Berliner Glossapfel. D. Syn. of Rostocker											
Bernard. MichB31											Do.
Berry. W. Syn. Berry Red	Va.? N. C.? Ky.?	ob	ml	gyrs	cj		sa			l	May be Nickajack.
Berry. Gb. Syns. Gov. list No. 455, Riabinouka, Riabinovka	Rus										Not described.
Berry. IndH'81											Possibly Nickajack.
Berry. Hort'61. Syn. of Nickajack											
Berry Bough. D. Syn. of Spice Sweet											
Berry Pippin. ColExR'92											Not described.
Berry Red. Cat. Syn. of Berry											
Bersdorp. ColExR'88				yrs						l	
Bersford. Dap. Syn. of Pryor											
Berton. L. Syn. Berton's Favorite											Do.
Berton's Favorite. Cat. Syn. of Berton											
Bess Pool. GenF'33. Syn. Best Pool	Eng	rc	ml	yrs	tj	w	sa			l	From Hogg.
Best Bache. D. Syn. of Bache											
Best Polo. IllH'94											May be Bests Pool, of Genesee Farmer, 1833.
Best Pool. D. Syn. of Bess Pool											
Best Red. MichB31											Not described.
Bethel. NEF'55. Syn. Bethel of Vermont, French Nonpareil, Shaker Pippin, Winter St. Lawrence.	Vt	r	ml	ys	ct			vg	m	l	
Bethel of Vermont. AmGar'87. Syn. of Bethel											
Bethel Sweet. NHB48											Perhaps same as Bethel.
Bethlehemite. E	Ohio?	obe	m	wyrs	cj	w	msa	vg	dm	l	
Betsey. D	Eng	robe	s	yrn	tj	gy	rs			l	From Hogg.
Betsey Favorite. R. Syn. Betsey's Favorite			sm	y			msa	g			
Betsey's Fancy. E. Syn. of Gray Vandervere											
Betsy Fancy. L. Syn. Betsy's Fancy	(?)	ob	ms	yr	ct		pmsa	g-vg	d	l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Betsy's Fancy. W. Syn. of Betsy Fancy											
Betsey's Favorite. IllB45. Syn. of Betsey Favorite											
Better than Good. A'52. Syn. Juicy Bite	Pa?	obl	m	gy	vtj	y	msa	g-vg	d	ml	
Bettie Brooks. Dap. Syn. of Annette											
Betts. BBL											Not described.
Betty Geeson. IndH'90											Do.
Betty Gleason. BBL											Do.
Bevan. MagofH'42. Syns. Bevan Favorite, Bevan's Favorite, Early Bevan, Striped June.	N. J	obc	m	yrs	fc	w	sa	g		e	
Bevan Favorite. E. Syn. of Bevan											
Bevan's Favorite. M. Syn. of Bevan											
Beverley. L. Syns. Beverley Red, Beverley's Red											Do.
Beverley Red. W. Syn. of Beverley											
Beverley's Red. NEF'30. Syn. of Beverley											
Bidet. IllB45											Do.
Bidgood. MichB31											Do.
Bidwell. BBL											Do.
Biel. Gb. Syns. Beel, Gov. list No. 248, White	Rus										Do.
Bielaya lebedka. Gb. Syn. of White Swan											
Biel Borodovskoe. Gb. Syn. of White Borodovka											
Biel duchovoya. Gb. Syn. of Scented White											
Bielevoe jeltosieroe. Gb. Syn. of White Russet											
Bielgorod. MHSC'86. Syns. Bielgorodskoe, Shro. to Ia. No. 86	Rus										Do.
Bielgorodskoe. Syn. of Bielgorod											
Biel krasavitsa. Gb. Syn. of Handsome White											
Biel krupnaya prodolgovatnaya. Gb. Syn. of Large Long White											
Bieloe Sladkoe. Gb. Syn. of White Sweet											
Biel Pelikanovskaya. Gb. Syn. of White Pelikanoff											
Biel rospisnaya. Gb. Syn. of Painted White											
Bielui Naliv. Gb. Syn. of White Naliv											
Bielui Rubets. Gb. Syn. of White Rubets											
Biel Vochina. Gb. Syn. of White Vochin											
Biel Zolatovskaya. Gb. Syn. of Golden White											
Bietigheimer. (LC). Syn. Red Bietigheimer	Ger	obc	vl	wyrs	fj	w	bsa	g	km	ml	
Bigerstoff. BBL											Do.
Big Estray. IaH'99. Syn. of Speer											
Big Fruit. Hort'58. Syn. of Tillaqua											
Bigg. VanD. Syn. Bigg's Nonsuch	Eng	rc	m	yrsc	tj	y	a		k	m	From Hogg.
Big Gal. MagofH'42. Syn. of Gal											
Bigger. L. Syn. Bigger's Late Red	South			r						l	
Bigger's Late Red. W. Syn. of Bigger											

Biggerstaff. JVL	N. C		l	rs		y	s	g		ml	
Bigg's Nonsuch. D. Syn. of Bigg											
Big Green. A'75. Syn. of Bower Nonpareil											
Big Hall. FDNCo											May be Nickajack or Pryor.
Big Hill. D. Syn. of Nickajack											
Big Hill. E. Syn. of Pryor											
Big Pippin. A&H	Ill.?										Not described.
Big Rambo. W. Syn. of Grosh											
Big Rambo. A'77. Syn. of Hoadley (Ohio)											
Big Rambo. FDNCo. Syn. of Western Beauty											
Big Red. IndH'72	N. C.?	obc	vl	yrs	tj	w	sa	vg		m	Some doubt as to identity.
Big Red. A'56. Syn. of Pottinger											
Big Red Sweet. W	South	r		y			s				
Big Romanite. E. Syn. of Pennock											
Big Romanite of some. Dap. Syn. of Greyhouse. [May-Seek-no-further.]											
Big Sweet. Dap. Syn. of Bower Nonsuch											
Big Sweet. D. Syn. of Victuals and Drink											
Big Tree. Dap. Syn. of Mother Favorite											
Big Vandervere. D. Syn. of Vandervere Pippin											
Billie's Favorite. P'95. Syn. of Harrah											
Bill Smith. GLA											Not described.
Billy. L. Syn. Billy's Pippin		ro	l	yrs			sa	vg			From Country Gentleman.
Billy Barker. GarM'60. Syn. of Barker											
Billy Bond. D. Syn. of Belle Bond											
Billy's Pippin. CGen'59. Syn. of Billy											
Birmingham. MagofH'52	Pa.?	ob	m	y	t	y	a		k	mc	
Birmingham Pippin. D. (Lind.) Syns. Brummage Pippin, Grumas Pippin, Grummage Pippin, Stone Pippin.	Eng.?	rob	s	yru	cj	g	bsa			vl	
Birmingham. (Strodes.) FDNCo											Not described.
Birth. NYExR'92											Do.
Bischoff. L. Syn. Bischoff's Reinette	Eng.?	rc	m	yru	j	wy	sa			l	From Hogg.
Bischoff's Reinette. D. Syn. of Bischoff											
Bishop. BBL											Not described.
Bishop's Bourne. A'75. Syn. of Bourne											
Bishop's Pippin of Nova Scotia. D. Syn. of Yellow Bellflower											
Bismarck. IllH'94. Syn. Prince Bismarck	{Foreign {N. Z	ob	vl	grs	etj	w	ma	g	km	l	{Two varieties, differing in description.
Bismarck. A'97. [Described by C. A. Green.]	Eur.		l	y					k		Appears to differ from preceding.
Bissing. AmGar'01	Wis.										
Black. VanD. Syns. Black American, Black Apple, Dodge's Black, Jersey Black, Small Black.	N. J.?	rob	m	dr		ws	msa	g	dkm	ml	
Black American. Lin. Syn. of American Black											
Black American. E. Syn. of Black											
Black Anis. ColExR'88											Not described.
Black Ann. Dap. Syn. of Black Coal											
Black Annette. E. Syn. Black's Annette	{N. E.? {Va.?	rob	m	dr	t	w		g		ml	
Black Annette. AB. Syn. of Annette											
Blackannette. E. Syn. of Annette											
Black's Annette. T. Syn. of Black Annette											
Black's Annette. W. Syn. of Cornell											
Black's Annette. Dap. Syn. of Annette (of Black)											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Black Apple. DomEnc. Syn. of Black											
Black Apple of Coxe. W. Syn. of Jersey Black											
Black Apple of some. D. Syn. of Red Detroit											
Black Bellflower. WVaB75											Not described
Black Ben Davis. IllH'99. Syn. of Gano											
Black Ben Davis. ArkB49. Syn. of Reagan?											Probably same as Gano.
Blackburn. W	Ky.?	rob	l	grs	cj	w	sa	g	km	m	This may be Buckingham
Blackburn (erroneously). W. Syn. of Buckingham											
Black Canada. W	Can	c	ml	rs			sa	g		ml	
Black Coal. K. Syns. Baltimore Red, Baltimore Red Streak, Black Ann, Cranberry (incorrectly), Cranberry Pippin (erroneously), Hoover, Welcome.		rc	ml	dr	cj	wrs	sa	g		ml	Probably same as Hoover.
Black Coal. B. Syn. of Hoover											
Black Detroit. D. Syns. Crimson Pippin, Detroit, Detroit Black, Grand Sachem, Red Detroit, Washington Pearmain.	Can.?	rc	vl	dr		w	sa	g		m	Leading name changed from Detroit Black.
Black Eyes. W. Syn. of Cheese											
Black Fameuse. ColExR'88											Not described
Black Gilliflower. Cole. Syns. Red Gilliflower, Red or Black Gilliflower		oblc	m	dr		w	sa	g	km	ml	
Black Hawk. NWFG'55	Ill	ob	l	gyb	cfmj	w	msa	g		l	
Black Hoop. CH	Ill.?										Probably same as Greyhouse.
Black Jack. Wg	Ohio	obc	m	ydr		wy	rs		k	l	
Black Jack. Dap. Syn. of Greyhouse. [May Seek-no-further?]											
Black Jellaflower. GenF'32. Syn. of Black Gilliflower											
Black Lady. (LC). Syns. Api Noir, Black Lady Apple	Eur	ob	s	dr				vg	d	l	
Black Lady Apple. Hort'51. Syn. of Black Lady											
Black Late. L. Syn. Black's Late Sweet	South									l	
Blackley. R. Syn. Blackley Pippin										ml	Not described.
Blackley Pippin. Hort'73. Syn. of Blackley											
Black's Late Sweet. W. Syn. of Black Late											
Blackman's No. 1. NWFG'52											
Blackman's No 2. NWFG'52											
Black Michigan. L. Syn. Black of Michigan	Can.?	ob	m	rs						l	
Black of Michigan. W. Syn. of Black Michigan											
Black Oxford. D	Me	robc	m	yb	c	w	msa	g		vl	
Black Pennock. Dap. Syn. of Greyhouse. [May Seek-no-further.]											
Black Pippin. A'56											Do.
Black Rambo. R. Syn. Black Sweet Rambo											Do.
Black Russian. ColExR'88											Do.
Blackshear. W	South	ob		rs							
Black Spitzenburg. Dap. Syn. of Flushing											

Blackston. R. Syn. Blackston's											
Blackston's. HMHS. Syn. of Blackston											
Blackstone. VanD. Syn. Blackstone Valley Sweet	Mass	obc	m	gyru	f	w	s	g	k	e	
Blackstone Valley Sweet. D. Syn. of Blackstone											
Blackston Tankerd. R. Syn. Blackston's Tankerd											Do.
Blackston's Tankerd. A'79. Syn. of Blackston Tankerd											
Black Swan. SDB65											Do.
Black Sweet. IndH'89. [Probably Moore Sweet.]	Ill										Do.
Black Sweet. W. Syn. of Moore Sweet											
Black Sweet Rambo. IllH'80. Syn. of Black Rambo											
Black Tom. W	Md	ob	m				a			m	
Black Tom. E. Syn. of Fenouillet Rouge											
Black Twig. A'71	Tenn.?	obc	m	yrc	ftj	y	msa	vg	dkm	l	May be Winesap.
Black Twig. L. Syn. Mammoth Black Twig											This is doubtless Arkansas.
Black Twig. (Ark.) L. Syn. Arkansas Black Twig	Ala.?										Do.
Black Twig. TennBI-IX. Syn. of Paragon											
Black Twig Junior. JIN	Tenn	rc	ml		j	y	bmsa	vg	dm	l	Doubtful as to identity.
Black Vandervere. H. Syn. of Greyhouse. [May Seek-no-further.]											
Black Warrior. D	Ala	rc	s	g		w	rsa	g		ml	
Black Winter. GenF'32. Syn. Black Winter Sweeting											May be Moore Sweet or Greyhouse.
Black Winter Sweeting. IllH'69. Syn. of Black Winter											
Blackwood. MHSC'81. Syns. Gov. list No. 407, Shro. to Ia. No. 19, Tchernoiderevo, Tchernoe dervo.	Rus		l							l	
Blackwood. P'94	Wash	rc	m	gb	ftj	y	msa	vg	d	l	
Blaine. P'91	Oreg	obl	m	yrs	f	w		g	d	l	Introduced in 1894.
Blaine. A'87	Wis										Distinct from preceding.
Blair. H. Syn. of Milam											
Blake. D	Me	r	ml	gy	fcj		sa	g		m	From Maine Report.
Blakeley. D	Vt	obc	l	yb	tj		pmsa	g		l	
Blakely. D. Syn. of Mangum											
Blakesly. R. Syn. Blakesly Seek-no-further											Not described.
Blakesly Seek-no-further. Syn. of Blakesly											
Blanchard. BBL											Do.
Blanche. R. Syn. Blanche precoce											Do.
Blanche precoce. IllB45. Syn. of Blanche											
Bland. VanD. Syn. Bland's Jubilee	Eng	rc	l	yru	tje	y	s	g		ml	From Hogg.
Blandilalie. D. Syn. of Haute Boute											
Bland's Jubilee. D. Syn. of Bland											
Blauberger. D. Syn. of Blue Mountain											
Bleachwood. ColExR'88											Not described.
Bleason. R. Syn. Bleason's Brag											Do.
Bleason's Brag. MichB31. Syn. of Bleason											
Bleckensderfer. D	Ohio	obc	m	yrsc	ftj	w	sa	p		l	
Bledsoe. TVM. Syn. Bledsoe's Favorite	Tex	ob	l	grs				g	dm	mc	
Bledsoe. E. Syn. of Bledsoe Pippin											
Bledsoe Pippin. D. Syn. Bledsoe	Ky	rob	vl	gy	ftcj	w	sa	g		l	From Trans. Ky. Hort. Socy.
Bledsoe's Favorite. JSK. Syn. of Bledsoe											
Blenheim. GenF'33. Syns. Blenheim Orange, Blenheim Pippin, Blooming Orange, Dutch Mignonne (erroneously), Kempster's Pippin, Northwick Pippin, Norwich Pippin, Woodstock Pippin.	Eng	rob	l	yru	ctjf	w	sa	vg	dk	l	
Blenheim Orange. H	Eng	obl	l					g		ml	
Blenheim Orange. IllH'93	Ark										May be distinct.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Blenheim Orange. GenF'33. Syn. of Blenheim											
Blenheim Orange. CAG. Syn. of Lord Nelson											
Blenheim Pippin. GenF'33. Syn. of Blenheim											
Blenheim Pippin. CAG. Syn. of Lord Nelson											
Blessed Calville. ColExR'91											Not described.
Blessing. A'83. Syn. of Twenty Ounce											
Blickensderffer. MagofH'47											Do.
Blinkbonny. A'62. Syns. Blinkbonny Seedling, Blinkbony	Can	rob	ms	wy	f	w	psa	g		me	
Blinkbonny Seedling. D. Syn. of Blinkbonny											
Blinkbony. Hort'51. Syn. of Blinkbonny											
Blockley. D. Syn. Blockley Pippin	Pa	rob	l	yb	c	y	msa	g		ml	
Blockley Pippin. H. Syn. of Blockley											
Blondin. W	Ind	obc	l	gyrs	tj	gy	sa	g	km	m	From seed of Milam
Blood. E	Ohio	r	m				sa	g		l	
Blood Red. BBL											Not described.
Bloom. IllH'98	Wis	rc	l	rs			a	g		ml	
Bloom. MeExR'93											Perhaps same as preceding.
Bloomfield. P'94. Syns. Bentley, Bentley's Seedling	Md	r	l	ygdr		y	sa	vg		m	
Blooming. L. Syn. Blooming Orange	Eng	rob	l	yrs	j	w	psa	g-vg	d	m	
Blooming Orange. Dap. Syn. of Blenheim											
Blooming Orange. W. Syn. of Blooming											
Bloomington. W	Ill	obl	m				s	g		l	
Bloomless. AmGar'90	Va										Not described.
Bloomless and Coreless (?). VanD. Syn. Bloomless, Seedless, and Coreless.	Va.?		s	ygr				g		ml	Curiosity only.
Bloomless, Seedless, and Coreless. JBW&B. Syn. of Bloomless and Coreless.											
Blue. L. Syns. Blue Spitzenburgh, Improved Red Spitzenburgh	Pa	robc	ml	yrb	ftmj	wy	msa	g		l	
Blue Anis. (LC)	Rus	obc	m	rs			sa	p		m	
Blue Bloom. Dap	Iowa	rob	l	wrs	ftj	w	sa	g		m	
Blue Bloom. NWFG'52		c	m	rs			sa	g		m	May be same as preceding.
Bluemont. KanExR'91											May be Blue Mountain.
Blue Mountain. D. Syns. Blauberger, Forelle, Trout Apple	Pa	rob	l	wcs	cj	w	bsa	g-vg		l	
Blue Mountain Sweet. CGen'59. Syn. of Mountain Sweet											
Blue Pearmain. NEF'31		rc	vl	dcs	m	y	sa	vg	dm	l	
Blue Rambo. Cat											Not described.
Blue Spitzenburgh. Dap. Syn. of Blue											
Blue Sweet. T	Mass	rc	m				s			l	
Blue Sweet. D. Syn. of Priest											
Bluff. L. Syn. Bluff Sweet	Ind	r	ms	g		gw	s	g		e	
Bluff Sweet. W. Syn. of Bluff											
Blufftown. R. Syn. Blufftown Seedling											Do.
Blufftown Seedling. IllH'96. Syn. of Blufftown											

Blunt. R. Syn. Blunt Seedling	Can		l	gyrs		y	sa	g		l	
Blunt Seedling. MHSC'77. Syn. of Blunt											
Blush. Wg. Syn. of Maiden Blush											
Blush Calville. Cat								vg		e	
Blushed Calville. MHSC'86. Syns. Kalvil krasnui, Shro. to Ia. No. 22	Rus		l								Do.
Blushing Bride. BBL											
Blush June. NWFG'52. Syn. of Red June. [These are distinct varieties. R.]											
Blunt. ColExR'89											Do.
Boalsburg. MagofH'53	Pa	oble	l	yrs	j	y	sa	g		l	
Boardman. P'86	Me	obe	ms	wrs	ftj	vw	sa	g		l	
Boas. MagofH'53. Syn. Kelter	Pa	obr	m	gyrs	fj	wy	psa	vg	d	l	
Boas. WHR. Syn. of Kelter											
Boatman's Seedling. A'81. Syn. of Wallace Howard											
Bode. Gb. Syns. Bode's Apple, Bodevskoe, Bodewskoe, Gov. list No. 385.	Rus										Do.
Bode's Apple. Gb. Syn. of Bode											
Bodevskoe. Gb. Syn. of Bode											
Bodewskoe. Gb. Syn. of Bode											
Bodickheimer.? D. Syn. of Bostocker											
Bogdanoff. MHSC'81. Syns. Bogdanoff (Riepka), God Given, Glorified Domine, V. R. S. to Ia. No. 16.	Rus		l				sa	vg		l	
Bogdanoff Glass. L. Syns. Bogdanoff's Glass, Steklianka Bogdanoff, V. R. S. to Ia. No. 17.	Rus										Do.
Bogdanoff's Glass. Gb. Syn. of Bogdanoff Glass											
Bogdanoff (Riepka). Gb. Syn. of Bogdanoff											
Bogdanoff White. IaB41. Syn. of White Bogdanoff											
Bohanon. E. Syns. Bohannon, Buchanon	Va.?	robe	ml	yeb	tj	y	sa	g	k	me	
Bohannon. MagofH'52. Syn. of Bohanon											
Bohemian. R. Syn. Bohemian Favorite		oble	m	ywb	je	w	msa			l	
Bohemian Favorite. CanExR'01. Syn. of Bohemian											
Bohemian Girl. MHSC'81											Do.
Boiken. Gb. Syns. Boikenapfel, V. R. S. to Ia. No. 32, Boyken	Rus		ml					g		m	
Boikenapfel. Gb. Syn. of Boiken											
Bokovoe. MHSC'86. Syn. Shro. to Ia. No. 42	Rus										Do.
Boltz. HSR&S	Pa	r	ms	yb	fj		sa	vg		l	
Bombarger. CanExR'88											Do.
Bombshell. BBL											Do.
Bond. MagofH'42. Syn. Bond's Red Winter											Do.
Bond's Red Winter. CGen'69. Syn. of Bond											
Bonegardner. BBL											Do.
Bonford. Hort'75. Syn. of Pryor											
Bon Homme. R. Syn. Bon Homme County	S. D.	rob	m	g		w	a	g		l	Origin Bon Homme County, South Dakota.
Bon Homme County. SDB76. Syn. of Bon Homme											
Bonne de Mai. D. Syn. of Drap d'Or											
Bonne Rouge. D. Syn. of Hollandbury											
Bonnet Carre. K. Syn. of White Calville											
Bonne Virginie. D. Syn. of Virginie											
Bon Sweet. A'83											Not described.
Bonum. Hort'56. Syns. Magnum Bonum, Sumnum Bonum	N. C	ob	m	yres	ftj	ws	msa	vg	d	ml	
Boorre. NWFG'55											Do.
Boravitski. W. Syn. of Oldenburg											
Bordeauer Gold Reinette. D. Syn. of Bordeaux											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Bordeaux. L. Syns. Bordeauer Gold Reinette, Gold Reinette von Bordeaux.	Fr.?	robe	vl	gyb	ftj	yw	sa	vg			From Hogg
Borden. L. Syn. Borden's Early		robe	m	yrs	cj	y	msa	g	k	e	
Borden's Early. MagofH'41. Syn. of Borden											Not described.
Border. R. Syn. Border Ruffian											Do.
Border Ruffian. IndH'74. Syn of Border											
Bordie. R. Syn. Bordie tricolor											Do.
Bordie tricolor. MagofH'41. Syn. of Bordie											
Boren. Cat											Do.
Boren Winter. IllB45. Syn of Winter Boren											
Boritz. AN&OCo	Ohio	rc	m	yr	ftj	wy	msa			vl	Do.
Borkoff. Gb. Syns. Berkoff's apple, Berkowskoe, Borkovskoe. Gov. list No. 212.	Rus.										Do.
Borkovskoe. Gb. Syn. of Borkoff											
Borouinka. Gb. Syn. of Borovinka											
Borovinka. MHSC'81. Syns. Boroninka, Gov. list No. 245, Mushroom, Shro. to Ia. No. 138.	Rus.	rc	ml				sa	g	km	me	Mr. Lyon says this is Oldenburg.
Borovinka. IaB31			ml						dm	e	Prof. Budd considers this distinct from Oldenburg
Borovinka Angliskaya. Gb. Syn. of English Borovinka											
Borovinka krasnaya. Gb. Syn. of Red Borovinka											
Borovinka lugovaya. Gb. Syn. of Meadow											
Borovinka of J. L. Budd. MichB118. Syn. of Oldenburg											
Borovinka sladkaya. Gb. Syn. of Sweet Borovinka											
Borovitsky. GenF'33. Syn. of Oldenburg											
Borowinka Krasnaja. Gb. Syn. of Red Borovinka											
Borowinka lugonaja. Gb. Syn. of Meadow											
Borowinka Sladkaja. Gb. Syn. of Sweet Borovinka											
Borsdorf. Gb. Syns. Borsdorfer, Gov. list No. 341	Rus.										Not described.
Borsdorf. Wg. Syns. Borsdorf Ognon, Reinette Plate, Zweibel Apfel, Zweibel Borsdorfer.	Ger.	rc	s	gy	f	w	sa			l	
Borsdorfer. Gb. Syn. of Borsdorf											
Borsdorfer Leipziger. Gb. Syn. of Leipsic											
Borsdorfer Reveler. Gb. Syn. of Revel Borsdorf											
Borsdorfer runder. Gb. Syn. of Round Borsdorf											
Borsdorff. K. Syn. of Borsdorffer											
Borsdorffer. GenF'33. Syns. Borsdorff, Borstorffer, Bursdorff, Bursdorffer, Edler Winter Borsdorffer, Garret Pippin, King, King George the Third, Le Grand Bohemian Borsdorffer, Queen's, Red Borsdorfer, Reinette Batarde, Reinette de Misnie, Winter Borsdorffer.	Ger.	roc	s	gyb	fc	yw	sa	g	d	l	
Borsdorf Ognon. D. Syn. of Borsdorf											

Borsdorf Revel apple. Gb. Syn. of Revel Borsdorf											
Borstorffer. GenF'33. Syn. of Borsdorffer											
Bortz (Albaugh Co.)'93	Ohio		m	yrb	tj	wy	sa	g		vl	
Borum. F											Perhaps a misprint for Bonum.
Bosklonoff. Gb. Syns. Bosklonoff's apple, Bosklonovka, Bosklonowka, Gov. list No. 429.	Rus.										Not described.
Bosklonoff's apple. Gb. Syn. of Bosklonoff											
Bosklonovka. Gb. Syn. of Bosklonoff											Do.
Bosklonowka. Gb. Syn. of Bosklonoff	Rus.?	rob	m	yrs	etj		sa	vg		l	
Boskoff. Cat.		rob	s	gr		y	sa	p		me	
Boskoop. L. Syn. Belle de Boskoop	Iowa										Do.
Boskoop Calville. CanExR'01											
Bosman. L. Syn. Bosman's German	N. W.										Do.
Bosman's German. Syn. of Bosman											Do.
Bosnian. (LC)	Eng	c	l	gyru	cj	y	sa	g	k	l	From Lindley.
Boss. Cat.											Not described.
Bossom. D	Mo.?		l	rs				vg		ml	
Bostic Queen. JBW&B. Syn. of Bostick											
Bostick. L. Syns. Bostic Queen, Bostick Queen, High Lo Jack of some											Do.
Bostick Queen. SBro. Syn. of Bostick											
Boston. NEF'26											Do.
Boston Codlin. NEF'33. Syn. of Boston Nonsuch											
Boston Nonsuch. MagofH'39. Syn. Boston Codlin											Do.
Boston Pippin. NEF'33. Syn. of Golden Pippin. (N. Eng.? N. Y.?)											
Boston Russet. GenF'33. Syn. of Roxbury											
Boston Star. CanH'96											Do.
Bosworth. HFH	Ky.?			r						l	
Botetourt. R. Syn. Lord Botetourt	Va.	r	l	r			msa			l	
Botigne. D. Syn. De Boutigne	Belg	oble	l	yb	fvj	y	s	g		l	
Bottcourt. L. Syn. Lord Bottcourt											Do.
Bottle Green. Cat	Ohio										Do.
Bottle Greening. AJofH	Vt	obc	m	gy	m	w	sa	vg	dk	l	
Botts. R. Syn. of Botts' Beauty	Ohio	obl	ml	yrs	tj		sa	g		ml	
Botts' Beauty. MagofH'46. Syn. of Botts											
Bough. C. Syns. August Sweet, August Sweeting, Bough Early Sweet, Bough Sweet, Bow, Cane Mash, Early Bough, Early Sweet, Early Sweet Bough, Early Sweetheart, July Bough, Large Bough, Large Early Bough, Large Sweet Bough, Large Yellow Bough, Niack Pippin, Pound's July, Sweet Bough, Sweet Harvest, Washington (incorrectly), Yellow Bough.	Am	oobl	ml	gy	vtc	w	s	vg	dk	e	
Bough Autumn. Lin. Syn. of Autumn Bough											
Bough, Early Sweet. Lin. Syn. of Bough											
Bough Sweet. G. Syn. of Bough											
Bouler. R. Syn. Bouler's Favorite		ob	l	rs			a	vg		l	
Bouler's Favorite. IllB45. Syn. of Bouler											
Bourassa. NAPC'49	Eur	re	m	yru	t	ws	psa	g		ml	
Bourke. IllH'01											Do.
Bourne. L. Syn. Bishop's Bourne	N. S.	re	m	gyrs	etj	w	sa	vg	d	ml	
Bourne Sweet. R. Syn. Bourne Sweeting											Do.
Bourne Sweeting. MagofH'40. Syn. of Bourne Sweet											
Bow. Th. Syn. of Bough											
Bow. DomEnc. Syn. of Red and Green											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Bowback. L. Syn. Bowback Sweet	Ohio	r	m				s			m	
Bowback Sweet. MagofH'41. Syn. of Bowback											
Bowen. A'83. Syn. Bowen Favorite	R. I.	robl	m					g	m	m	
Bowen Favorite. A'83. Syn. of Bowen											
Bowen Seedling. R. Syn. Bowen's Seedling	Kan	oble	ml	gyrs	fj	y	bmsa	vg		vl	
Bowen's Seedling. A'77. Syn. of Bowen Seedling											
Bower. R. Syns. Bower's Apple, Bower's Golden Pippin, Bower's Russet.	Mass		m	yb		yw	sa			l	
Bower's Apple. MagofH'52. Syn. of Bower											
Bowers Golden Pippin. GenF'33. Syn. of Bower											
Bower Nonpareil. R. Syns. Big Green, Big Sweet, Bower's Nonpareil	Va.?	ob	l	gyb	ftj	w	msa			l	Not described.
Bower's Nonpareil. Dap. Syn. of Bower Nonpareil											
Bower's Russet. GenF'33. Syn. of Bower											
Bowery. MinnB1											Do.
Bow Hill. R. Syn. Bower Hill Pippin											Do.
Bow Hill Pippin. BBL. Syn. of Bow Hill											
Bowker. D	Va.?	re	m	ybe	tj	w	pmsa	g		m	
Bowling. A. Syn. Bowling Sweet	Va.	r	m	yr	j		rs	g	k	m	
Bowling Sweet. D. Syn. of Bowling											
Bowman. L. Syn. Bowman's Excelsior		obe	l	gyrs	j			vg		l	
Bowman's Excelsior. A'85. Syn. of Bowman											
Rowne's Imperial Russet. Lin. Syn. of Columbian Russet											
Bowyer. L. Syn. Bowyer's Russet	Eng	re	s	yru	e	yw	bsa	g	d	m	From Lindley.
Bowyer's Russet. D. Syn. of Bowyer											
Boxford. M		ob	m	wrs	ej		sa	g		m	
Boxford. A'79. Syn. of Stump											
Box Russet. IdaB6. [Probably (Roxbury) Russet.]											Not described.
Boyd. A	Ky	obe	l	rs				g		l	
Boyd. MoB6. Syn. of Clayton											Boyd and Clayton are confused in Mo. See Mo. H '88, 329.
Boyd Delight. R. Syn. Boyd's Delight											Not described.
Boyd's Delight. CanExR'01. Syn. of Boyd delight											
Boyden. R. Syn. Boyden Sweet											Do.
Boyden Sweet. MagofH'43. Syn. of Boyden											
Boyken. AmGar'93. Syn. of Boiken											
Brabant. L. Syns. Brabant Bellefleur, Brabant Bellflower, Brabauche Belle Fleur, Iron Apple.	Hol	robl	l	gyrs	fj		sa	g	k	ml	
Brabant Bellefleur. K. Syn. of Brabant											
Brabant Bellflower. Cole. Syn. of Brabant											
Brabauche Belle Fleur. GenF'33. Syn. of Brabant											

Brace's Seek-no-further. W. (White Seek-no-further W.) Syn. of Green Seek-no-further.											
Bracken. Hort'47. Syn. Juneating, White Juneating?	Ky.?	obc	m				sa	g	d	ve	Similar to Early **Harvest.**
Bracken(?) H. Syn. of Early Harvest											
Bracken. H. Syn. of White Juneating											
Bracy's Seek-no-further. E. Syn. of Green Seek-no-further											
Bradanoff. CalExR'92											Not described.
Braddick. L. Syn. Braddick's Nonpareil	Eng	robe	s	yru		y	rs	g		ml	From Lindley.
Braddick's Nonpareil. GenF'33. Syn. of Braddick											
Bradford. (LC). Syn. Bradford's Best, Kentucky Red Streak, Kentucky Streak, Selma?, Winter Red Streak.	Tenn.?	re	m	gyrs	tj	w	sa	g-vg	d	l	
Bradford Best. R. Syn. Bradford's Best	Tex	r	m	r	fj	y		vg		vl	
Bradford's Best. Hort'58. Syn. of Bradford											
Bradford's Best. P'91. Syn. of Bradford Best											
Bradlee. MagofH'36											Not described.
Bradley. L. Syn. Bradley's Autumn	Mich	ro	l	wyb	mj	w	bsa	g	k	m	Distinct from preceding.
Bradley. A'85											
Bradley's Autumn. D. Syn. of Bradley											
Bradley's Winter. D. Syn. of Wealthy Favorite											
Bradwick. R. Syn. Bradwick Nonpareil											Not described.
Bradwick Nonpareil. BBL. Syn. of Bradwick											
Brady. A'95											Do.
Brakefield. BBL											Do.
Bramley. BBL											Do.
Bramtot. BBL											Do.
Branch. R. Syn. Branch Sweeting											Do.
Branch Sweeting. MagofH'53. Syn. of Branch											
Brandensburg. R. Syn. Brandensburg's Keeper			s	rs				g		vl	
Brandensburg's Keeper. TCF. Syn. of Brandensburg											
Brandy Apple. GenF'33. Syn. of Golden Harvey											
Brandywine. D	Del.?	re	ml	yrs	cjt	y	sa	g-vg	dk	l	
Brandywine. D. Syn. of Minkler											
Braunschweiger Milch. D. Syn. of Milch											
Brazil Crab. JAY. Syn. of Johnson Red											
Brazilian. TexB8											Do.
Bread and Cheese. C. Syn. of Rambo											
Breckenridge. CanExR'95	Ont	obl	ml	gyrs	j	w	sa	g		vl	
Breckenridge. Dap. Syn. of Brewington											
Breckinridge. P'95	Tenn.?	robl	m	wy	tj	w	sa	g-vg		m	
Breda. L. Syns. Reinette d'Aizerna, Reinette de Breda, Reinette Nelguin.		rob	m	yrru	fej	wy	sa			l	From Diel.
Breden. R. Syn. Breden Pippin	Can.?										Not described.
Breden Pippin. Hort'56. Syn. of Breden											
Breech. BBL											Do.
Breedon. L. Syn. Breedon Pippin	Eng	rob	s	yb	fe	y	bsa			m	From Lindley.
Breedon Pippin. GenF'33. Syn. of Breedon											
Bremer. JNCo	Iowa	obl		gyrs	j		sa	g	d	e	One of Thompson's seedlings.
Brennaman. MagofH'52	Pa	rob	ml	yrs	tj	w	psa	g	k	me	
Brent. L. Syn. Bellflower of Brent		ob	s	rs	frj	y				m	
Brentford Crab. D. Syn. of Isleworth											
Breskovka. MHSC'86. Syn. Shro. to Ia. No. 152	Rus		m					vg	dk	e	
Brett. ColExR'88. Syn. Hart's Seedling	Minn	rob	l	yds	j	w	sa	g		ml	
Brett No. 1. A'87											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of Apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Brett No. 2. A'87											
Brett No. 3. A'87											
Brewer. D	Mass	r	vl	yb	t	y	pmsa	g		m	
Brewer Pippin. L. Syn. Brewer's Pippin	Eng	r	m	yrs	ct	w	sa		k	m	From London Hort. Society.
Brewer's Pippin. D. Syn. of Brewer Pippin											
Brewington. Dap. Syns. Breckenridge, Brewington Pippin	Ky	robc	l	yrsc	ftj	w	msa	vg		l	
Brewington Pippin. Dap. Syn. of Brewington											
Brewster. MagofH'40											Not described
Briar. Cat											Probably Brier crab.
Brickle. IndH'76	Ind.?						a		k	m	
Brickley. L. Syn. Brickley Seedling	Eng	rc	s	gyr	fr	y	s			vl	From Lindley.
Brickley Seedling. D. Syn. of Brickley											
Bride. Cat											Not described.
Bridget. L. Syn. Scotch Bridget	Eng	rob	m		tj	w	s			ml	From Hogg.
Bridgeton. P'94	Me	rob	l	gyb	ftj	y	msa	vg	dm	m	
Bridgewater. L. Syn. Bridgewater Pippin	Eng	rob	l	yb		y	bpsa		k	m	Do.
Bridgewater Pippin. D. Syn. of Bridgewater											
Brierly. R. Syn. Brierly Wood											Not described.
Brierly Wood. BBL. Syn. of Brierly											
Brigg. L. Syn. Brigg's Auburn	Me	ob	l	yb	fm	w	psa	g		m	
Brigg's Auburn. Cole. Syn. of Brigg											
Brightwater. ArkB43	{Mo.? / Ark.?}	rc	l	gyrs	fj	gy	sa	g		l	
Brill. L. Syn. Brill's Seedling	N. J	oblc	l	y	tj	y	sa	g	m	m	
Brilliant. Dap	Ohio	ob	ml	yb	ctj	w	sa	g		ml	
Brilliant. IllH'98	Iowa										Said to be seedling of Fameuse.
Brill's Seedling. A'67. Syn. of Brill											
Brimer. D. Syn. Yoder	Pa	obc	m	wyb	ctj	w	sa	vg	d	l	
Brinckley. L. Syns. Brinckley Seedling, Brinckley White Sweet		rob	s	wg	ctj	w	s	vg		m	
Brinckley Seedling., GenF'33. Syn. of Brinckley											
Brinckley White Sweet. D. Syn. of Brinckley											
Bringewood. L. Syn. Bringewood Pippin	Eng	r	s	yru	fc	y	s			l	From Lindley.
Bringewood Pippin. GenF'33. Syn. of Bringewood											
Brinkley. A'91	Del.?		m					vg		vl	
Briody. ColExR'88											Not described.
Bristol. MagofH'48	Conn	rc	ms	dc	tj	vws		g-vg		l	Mag. of H. says "sweet." D. does not.
Bristol Pearmain. D	Eng	obl	s	gyrs	f	y				ml	From Hogg.
Briston. R. Syn. Briston's Ironclad											Not described.
Briston's Ironclad. MoH'97. Syn. of Briston											

British America. IllH'98											Do.
British Columbia. EON. Syns. Bayles' Seedling, Canada Reinette	B.C		ml	yrn				vg		l	
British Queen. BBL											Do.
Brittle. FF&S	Mass	ob	m	rs			msa	vg	k		
Brittle Sweet. D		rc	ml	gyrc	etj	y	s	vg		ml	
Brixey's No. 1. MoH'92											
Brixey's No. 2. MoH'92											
Broad Apple. Hort'75. Syn. of Pennock											
Broadax. FDNCo											May be same as Broadnax.
Broadcheek. Gb. Syns. Broadleaved, Gov. list No. 242, Schirokolitchiko, Schriokolitschiko.	Rus										Not described.
Broaden. L. Syns. Summer Broaden, Summer Broadened, Summer Colman.	Eng	rob	ml	gyb		gw	sa		k	m	From Lindley.
Broadend. R. Syns. Broad-End, Broading, Kentish Broading, Winter Broading.	Eng	rob	l	gyr	fc	yw	sa		k	ml	From Hogg.
Broad-End. GenF'33. Syn. of Broadend											
Broadeye. R. Syn. Broad-Eye Pippin	Eng	ob	l	gyr	fcj	yw	bsa		k	l	Do.
Broad-Eye Pippin. GenF'33. Syn. of Broadeye											
Broad Green. MHSC'86. Syns. Nalivnoe Zelenui Schirokui, Shro. to Ia. No. 68.	Rus										Not described.
Broading. GenF'33. Syn. Kentish Broading	Eng	rob	l	yrs	tc	w	sa	g		ml	
Broading. D. Syn. of Broadend											
Broadleaf. R. Syn. Broadleaf Hereford											Do.
Broadleaf Hereford. BBL. Syn. of Broadleaf											
Broadleaved. Gb. Syn. of Broadcheek											
Broadnax. BBL	Ill	ob	m	py				vg		l	May be same as Broadax.
Broad River. D. Syn. of Romanite											
Broadside. Hort'55	Pa.?										Not described.
Broadwater. Dap	Va	ob	ms	ywr	ftj	w	sa		dm	m	
Broadwell. E. Syn. Broadwell Sweet	Ohio	robc	ml	wyb	fj	w	rs	vg	dk	ml	
Broadwell Sweet. E. Syn. of Broadwell											
Brobouka. ColExR'88											Do.
Brockville. R. Syn. Brockville Beauty	Can										Do.
Brockville Beauty. A'89. Syn. of Brockville											
Brodie. ColExR'89											Do.
Brolkert. IllH'96											Do.
Bromelia Ananas. D. Syn. of Ananas											
Bronson. L. Syns. Bronson Sweet, Bronson's Sweeting	Conn	obc	m	yrs	emj	w	s	g		m	
Bronson Sweet. D. Syn. of Bronson											
Bronson's Sweeting. H. Syn. of Bronson											
Bronze. MagofH'53											Do.
Brooke Pippin. L. Syn. Brooke's Pippin	Va	rc	ml	gy	cjf	y	a	vg	d	l	Very similar to Yellow Newtown.
Brooke's Pippin. A'52. Syn. of Brooke Pippin											
Brooke's Pippin. D. Syn. of Green Newtown (?)											
Brookes. GenF'33	Eur	c	s	gb	fr	y	s			l	From Ronalds.
Brook's Pippin. F. Syn. of Green Newtown											
Brosdorfee. MoB10											Not described.
Broughton. D	Eng	c	s	gyrb	t	gy	bsa	vg	d	ml	From Hogg.
Brown. D. Syn. Nottingham Brown	Md.? Pa.?	ob	m	yrs	ctj	y	sa	vg	dm	m	Erroneously published in Bul. 8 as Nottingham.
Brown. TennBX-I. Syn. of Claiborne											
Brown Apple. K. Syn. of Fenouillet Gris											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904.—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Brown Beauty. L. Syn. Brown's Summer Beauty	Eng	re	m	gyb	j				d	m	From Ronalds.
Brown Cockle. D. Syn. of Cockle											
Brownell. L. Syn. Brownell's Fancy	Ill										May be Chenango.
Brownell's Fancy. Cat. Syn. of Brownell											
Browney. R. Syn. Browney Pine											Not described.
Browney Pine. SDB65. Syn. of Browney											
Brown Fall. D. Syn. of Fall Brown											
Brown Favorite. R. Syn. Brown's Favorite	Conn	robe	l	wyrs	tj	w	msa	vg		ml	
Brown's Favorite. A'77. Syn. of Brown Favorite											
Brownfield. IndF'40											Do.
Brown's Golden Sweet. E. Syn. of Tolman											
Browning. (LC)											Do.
Brownite. C. Syn. Brown's Winter, Brown Knight	Del.?	robe	ms		te					l	
Brown Kenting. D	Eng	r	ml	yru	c	y	ba	g	d	ml	From Hogg.
Brown Knight. DomEnc. Syn. of Brownite											
Brown's Late Queen. E. Syn. of Late Queen. [Probably Buckingham.]											
Brownlee. L. Syns. Brownlee's Russet, Brownlee's Seedling Russet, Reinette grise Brownlee's.	Eng	rob	l	grb	tj	gw	s	g	dk	vl	Do.
Brownlee's Russet. D. Syn. of Brownlee											
Brownlee's Seedling Russet. D. Syn. of Brownlee											
Brown Quaker. L. Syn. Brown's Quaker Beauty	Ill										Not described.
Brown's Quaker Beauty. Cat. Syn. of Brown Quaker											
Brown Seedling. L. Syn. Brown's Seedling	Va										Do.
Brown's Seedling. F. Syn. of Brown Seedling											
Brownsfield. IndH'72											Probably same as Brownfield.
Brownson. R. Syn. Brownson Sweet											Not described.
Brownson Sweet. MagofH'53. Syn. of Brownson											
Brown's Summer Beauty. D. Syn. of Brown Beauty											
Brown Superior. L. Syn. Brown's Superior	Ohio	r	l	rs			sa	g		l	
Brown's Superior. W. Syn. of Brown Superior											
Brown Sweet. R. Syn. Brown's Sweet			s				s	g		l	
Brown's Sweet. IllB45. Syn. of Brown Sweet											
Brown Sweeting. MoH'70. Syn. Brown's Sweeting											Not described. May be same as preceding.
Brown's Sweeting. Hort'54. Syn. of Brown Sweeting											
Brown's Winter. DomEnc. Syn. of Brownite											
Browny. Gb. Syn. of Cinnamon											
Brown's Yazoo. A'85. Syn. of Yazoo											
Browny Pine. Gb. Syn. of Cinnamon Pine											
Brubacker. D. Syn. of Fallawater											

Bruce. W.		c	l				s	g		e	
Bruce Summer. FTR. Syn. Bruce's Summer			l	gb	jf			vg		ml	May be same as preceding.
Bruce's Summer. A'73. Syn. of Bruce Summer											
Brummage Pippin. D. Syn. of Birmingham Pippin											
Brunswicker. A'73	N. B.	r	m	yrs			sa			ml	
Brunswicker. A'83											May be Oldenburg.
Brunswicker. A'83. Syn. of Oldenburg											
Brussels. R. Syn. Brussel's Pippin											Not described.
Brussel's Pippin. MagofH'37. Syn. of Brussels											
Bryan. BulS. Syn. Mrs. Bryan	Ga.	c	l.	yr				vg	dkm	me	
Bryan Beauty. R. Syn. Bryan's Beauty											Do.
Bryan's Beauty. WVaB75. Syn. of Bryan Beauty											
Bryant. P'92	Va.	rob	l	gys	ctj	y	msa	vg	dm	vl	
Brychenoff. UCExR'92											Do.
Buchanan. L. Syns. Buchanan's, Buchanan's Pippin, Buchanan's Seedling, James.	Ohio.	rob	m	yrsc	fcj	y	sa	vg	k	l	
Buchanan. D. Syn. of Bohanon											
Buchanan. W. Syn. of Ohio Pippin											
Buchanan's. W. Syn. of Buchanan											
Buchanan's Pippin. H. Syn. of Buchanan											
Buchanan's Seedling. D. Syn. of Buchanan											
Buckeye. IndH'88											May be Lansingburg.
Buckingham. Hort'56. Syns. Bachelor, Blackburn (erroneously), Buncomb, Byer's, Byer's Red, Equinetelee, Equinetely, Fall Queen, Fall Queen of Kentucky, Frankfort Queen, Garvis Seedling, Henshaw, Iola, Jackson Red, Kentucky Queen, King, Ladies' Favorite of Tenn., Large Summer Pearmain, Large Winter Queen, Late Queen, Lexington Queen, Meigs, Merit, Ne Plus Ultra, Neverfail, Ox Eye of some in Ky., Queen, Red Gloria Mundi, Red Horse of some, Sol. Carter, Strawn Seedling, Winter Cheese, Winter Queen.	Va.?	obc	ml	gyrs	tjm	y	sa	vg	dkm	ml	
Buckley. T. Syn. of Chenango											
Buckman. Hort'65											Reported by Dr. Stayman.
Buckman's Golden Pearmain. K. Syn. of Golden Pearmain											
Buck Meadow. NYAg'48	Conn	rc	ml	yrs	tj	y	sa	g		l	
Buckram. A'62. Syn. of Hicks											
Bucks. L. Syns. Bucks County, Bucks County Pippin	Pa	rob	m	gyrs	fmj	w	sa	g		vl	
Bucks County. E. Syn. of Bucks											
Bucks County Pippin. E. Syn. of Bucks											
Bucks County Seedling of some. Dap. Syn. of Yardley											
Buckskin. BBL											Not described.
Buda. R. Syn. Buda Summer											Do.
Buda Summer. AlaB98. Syn. of Buda											
Buel. L. Syns. Buel's Favorite, Gray Pippin, Spotted Pippin		r	m	gy	f	w		g		m	
Buel's Favorite. MagofH'54. Syn of Buel											
Buel Sweet. L. Syn. Buel's Sweet		rc	s	yrb	cmj	w	s	g		l	
Buel's Sweet. D. Syn. of Buel Sweet											
Buelli's Sweet. IllH'80. Syn. of Bean											
Buff. Hort'52. Syns. Buff Apple, Granny Buff	N. C	rob	l-vl	wyrsc	c	w	bsa	g	d	ml	
Buffalo. AmF'58											
Buff Apple. F. Syn. of Buff											
Buffcoat. BBL											Do.
Buffington. A. Syn. Buffington's Early	Pa	ob	ms	ywb	tj		sa	g		e	
Buffington's Early. GenF'33. Syn. of Buffington											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Bufftown. R. Syn. Bufftown Seedling											Not described.
Bufftown Seedling. IllH'96. Syn. of Bufftown											Do.
Buldose. BBL											
Buler. R. Syn. Jonathan (of Buler)		ob	ml	gyrs	fjt	w	sa	g	k	m	
Bulla. IndH'88	Ind.?	c	l	y				g		l	
Bullet. E. Syn. of Bullett											
Bullett. T. Syns. Bartlett, Bullet, Priestly of some		oblob	m	yr		gy	sa	g		vl	
Bullett. D. Syns. Crutchfield Greening, Green Abram, North Carolina Greening.	South	ob	m	grs	fmj	w	sa	g		vl	
Bullett. D. Syn. of Green Abram											
Bull Golden. L. Syn. Bull's Golden Reinette	Eng	rob	m	yeb	tj	y	s	g		ml	From Hogg.
Bull Head. IllB45											Not described.
Bullman. R. Syn. Bullman's Strawberry											May be Red Canada.
Bullman. MoH'90. Syn. of Red Canada											
Bullman's Strawberry. IllH'88. Syn. of Bullman											
Bullock. VanD. Syns. American Golden Russet, Bullock's Pippin (Fall Winesap, erroneously), Fox Apple (of some), Golden Russet, Hunt's Russet, Little Pearmain, Long Tom, Sheepnose, Sheep's Snout.	Am	ro	ms	yru	vtj	y	sa	b	d	m	
Bullock's Pippin. C. Syn. of Bullock											
Bullock's Pippin of some. D. Syn. of Ewalt											
Bullock's Pippin or *Sheepnose* (incorrectly). Dap. Syn. of Hunt Russet											
Bull's Golden Reinette. D. Syn. of Bull Golden											
Bullripe. Hort'47. Syn. of Dyer											
Bully Pippin. Dap. Syn. of Ewalt											
Bun. MagofH'38											Not described.
Bunch. R. Syn. Bunch Apple											Do.
Bunch Apple. IllH'70. Syn. of Bunch											
Buncomb. A'60. Syn. of Buckingham. [Some doubt as to their identity.]											
Buncombe. D. Syns. Batchelor, Bunkum, Jackson's Red, Kirby's Red, Lady Finger Pippin, Meig's, Power's, Red Fall Pippin, Red Gilliflower, Red Lady Finger, Red Vandevere, Red Winter Pearmain, Robertson's Pearmain, Southern Fall Pippin, Tinson's Red.	N. C.? South?	robc	ml	ywr	tjm	wy	sa	g-vg	dk	l	
Bunker. A'85											Do.
Bunkerhill. R. Syn. Bunker Hill											
Bunker Hill. Dap. Syn. of Bunkerhill	N. Y	rc	m	wyrs	ftj	ws	sa	vg	d	m	
Bunkum. D. Syn. of Buncombe											
Bunnell. A'85											Do.
Buran. IllH'68											Do.
Burbank. R. Syn. Burbank's Bellflower											Do.
Burbank's Bellflower. OntExR'82. Syn. of Burbank											
Burchard. IllB45			ms	yru				g		l	

Burk. MoH'99. Syn. Burke	Mo		l	gyr						l	
Burke. IllH'99. Syn. of Burk											
Burleigh. L. Syns. Lord Burghley, Lord Burleigh	Eng	rob	m	ycb	tj	y	s	g	d	vl	
Burley. R. Syn. Burley's Sweet			m	y			s	g		l	May be same as preceding.
Burley's Sweet. IllB45. Syn. of Burley											
Burlin. MagofH'38											Not described.
Burlington. P'86	Iowa	rc	m	y	ftj	y	msa	vg-b	dk	vl	
Burlington. A'95. Syn. of Burlington Pippin											
Burlington. D. Syn. of Newtown Spitzenburg											
Burlington Greening. L. Syn. Greening Burlington											Do.
Burlington Greening. C. Syn. of Rhode Island											
Burlington Pearmain. DomEnc											
Burlington Pippin. Dap. Syns. Burlington, Town House	Vt.?	obc	ml	wyrs	tj	ws	psa	g	dm	ml	
Burlington Spitzenberg. DomEnc. Syn. of Newtown Spitzenburg											
Burloffka. Gb. Syn. of Burlovka											
Burlovka. Gb. Syns. Burloffka, Burlowka, Gov. list No. 183	Rus										Do.
Burlowka. Gb. Syn. of Burlovka											
Burnan. R. Syn. Burnan's Sweet											Do.
Burnan's Sweet. IllB45. Syn. of Burnan											
Burner. R. Syn. Burner Green											Do.
Burner Green. IllH'68. Syn. of Burner											
Burnett. MagofH'53	N. Y										Do.
Burnham. R. Syn. Burnham Sweet	Conn.?		l	y			s	vg		l	
Burnham Sweet. A'71. Syn. of Burnham											
Burnhap. L. Syn. Burnhap Greening	Vt	r	ml				sa			ml	
Burnhap Greening. T. Syn. of Burnhap											
Burning. R. Syn. Burning Coal											Do.
Burning Coal. IllH'96. Syn. of Burning											
Burns. Hort'72. Syn. Burns Seedling. [Reported by J. H. Haynes, of Indiana.]											Do.
Burns Seedling. GenF'33. Syn. of Burns											
Burnt Island. K. Syn. of Fenouillet Gris											
Burr. L. Syn. Burr's Seedling	Eng	rc	m	yb	tj	y	sa			m	From Hogg.
Burr. Gb. Syn. of Lapouchoe											
Burr Apple. GenF'33. Syn. of Golden Burr											
Burrell. L. Syn. Burrell's Red	Eng	c	ml	r	j		a			ml	From Ronalds.
Burrell's Red. D. Syn. of Burrell											
Burr Knot. GenF'33. Syn. of Golden Burr											
Burroughs. L. Syn. Burrough's Greening	Vt	rc	m	gy	jc		psa	g		l	
Burrough's Greening. D. Syn. of Burroughs											
Burrow. TennBX-I. Syn. Giles Beauty	Tenn	rob	l	yrs	ctj	y	sa	vg			
Burrowsaw. R. Syn. Canada Burrowsaw											
Burr's Seedling. D. Syn. of Burr											
Burr Seeknofurther. R. Syn. Burr's Seeknofurther											Not described.
Burr's Seeknofurther. PHF. Syn. of Burr Seeknofurther											
Burr Sweet. L. Syn. Burr's Winter Sweet	Mass.	obc	m	yrs	tj	y	s	vg		l	
Burr's Winter Sweet. MagofH'53. Syn. of Burr Sweet											
Bursdorff. K. Syn. of Borsdorffer											
Bursdorffer. D. Syn. of Borsdorffer											
Burstopen. R. Syn. Burst Open		ob	m	wyrs	tmj	w	msa	g		m	
Burst Open. D. Syn. of Burstopen											
Burton. ColExR'88											Do.
Burton Ice. R. Syn. Burton's Ice Core			l					g		m	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Burton's Ice Core. TCF. Syn. of Burton Ice											
Buschbohn. Gb. Syns. Buschbon, Gov. list No. 162	Rus										Not described.
Buschbon. IaH'83. Syn. of Buschbohn											
Bush. Hort'53	Pa	obc	ml	yb	fm	w	msa	vg		m	
Bush Beauty. L. Syn. Bush's Beauty	Ohio	robe	m	wrs	ct	w	a	g	m	m	
Bush's Beauty. W. Syn. of Bush Beauty											
Bushnell. A'77	Ohio	ob	m				sa	g		me	
Bushwhacker. D	N. J	re	l	y				g		vl	
Bushy. Gb. Syn. of Kustoe											
Bushy Peter. SDB4											Do.
Bustamenter. S&W											Do.
Butskaya Zelenka. Gb. Syn. of Green Butskaya											
Butter. D	Pa	r	ml	y		w	rvs	g	k	m	The numerous so-called varieties which appear under this name are not certainly distinct sorts. Butter appears to be a favorite name for any good apple, and has thus been largely used, without having any distinctive meaning or application further than its convenience.—Ragan.
Butter. E. Syn. Butter Apple		r	ms	yr	t	yw	s	vg		l	
Butter. W	Ind	r	s				s	g		l	
Butter. F			l				s		k	m	
Butter. W	Pa	r	ml	y			s	g		m	
Butter. W		obl	l				sa	g		m	
Butter. E	Pa.?	r	m	ru			s	g		l	
Butter. E. Syn. of Molasses											
Butter. MagofH'47. Syn. of Butter Sweet											
Butter Apple. H. Syn. of Apple Butter											
Butter Apple. E. Syn. of Butter											
Buttermore. R. Syn. Buttermore's Seedling	Minn		ml	grs		yg	a			l	
Buttermore's Seedling. MinnHort'96. Syn. of Buttermore											
Butternut. MinnExR'90											Not described.
Butter of some. E. Syn. of Sweet Bellflower											
Butter Pipka. Gb. Syn. of Gorke Pipka											
Butter Pippin. D. Syn. of Golden Pippin											
Butters. D. Syn. of Baldwin											
Butter Sweet. MagofH'47. Syns. Butter, Fulkersons	Ohio	ob	s	yr	tfj	y	vs	vg	k	ml	
Butter Sweet of Pa. BBL											Do.
Button. W		ob		rs			s				
Button Core. W	Mass	r	ml				sa	g		l	
Buyer. R. Syn. Buyer's Seedling											Do.
Buyer's Seedling. A'54. Syn. of Buyer											
Buzby. L. Syn. Buzby's Early	N. J	rob	m				sa	g		me	

Buzby's Early. RNY'70. Syn. of Buzby											
Buzkafa Selonka. Gb. Syn. of Green Butskaya											
Byam. L. Syns. Byam's Sweet, Byram's Sweet		obc	m	yrb	tj	w	rs	g		m	
Byer's. W. Syn. of Buckingham											
Byer's Red. D. Syn of Buckingham											
Byfield. Dap. Syn. of Rock Sweet											
Byford. R. Syn. Byford Wonder											Do.
Byford Wonder. BBL. Syn. of Byford											
Byram's Sweet. D. Syn. of Byam											
Byson. L. Syns. Byson Wood, Byson Wood Russet	Eng	ob	ms	gyru	fcj	g	s	g	d	l	From Hogg.
Byson Wood. GenF'33. Syn. of Byson											
Byson Wood Russet. GenF'33. Syn. of Byson											
Caas. K. Syn. of Cos											
Cabane du Chien. Dap. Syn. of Hilaire											
Cabashea. Cole. Syns. Cabashire Sweeting, Kings, Twenty-ounce Pippin		robc	vl	yrs	c	w	sa	p	kc	l	
Cabashire Sweeting. GenF'33. Syn. of Cabashea											
Cabbage. IllH'68							s	vg		e	
Cabbagehead. AmF'51. Syn. Cabbage Head	N. J.?	obc	l	y	cj	y	bsa	g		ml	
Cabbage Head. T. Syn. of Cabbagehead											
Cabell. MagofH'53											Not described.
Cabin. W.		ob	m				sa	p		l	
Cable's Gilliflower. E. Syn. of Baltimore											
Cache. W. Syn. Cache's Seedling	Ill	rc	m	gcb	mj	w	sa	g-vg	d	ml	
Cache's Seedling. IllB45. Syn. of Cache											
Cadeau du General. D. Syn. of Vaugoyeau											
Cadwallader. A'83. Syn. Cadwallader's Golden	Ill	rob	m	yb	tjm	yw	sa	g-vg	d	ml	
Cadwallader's Golden. Dap. Syn. of Cadwallader											
Cagle. R. Syn. Cagle Seedling											Do.
Cagle Seedling. BBL. Syn. of Cagle											
Caillot Rosat. D. Syn. of Red Calville											
Cain. E. Syn. of Kane											
Cake. W. Syns. Cake Apple, Connecticut Cake	Conn	ob	m	yb	jt		psa	g		vl	
Cake Apple. D. Syn. of Cake											
Caldwell. JVL											Do.
Caldwell. GenF'33. Syn. of Rymer											
Caleb. Wg. Syn. Caleb Sweet	Pa	obc	m	yb	c	y	rs	g	k	m	
Caleb Sweet. A'52. Syn of Caleb											
Calef. NEF'50. Syns. Calef Sweet, Calef's Sweet, Magoon Sweet, Magoun Apple.	N. H.	rob	l	y		w	vs	g		ml	From Maine Report.
Calef Sweet. B. Syn. of Calef											
Calef's Sweet. T. Syn. of Calef											
Calf Pasture. Hort'59. Syn. of Chittenham											
California. L. Syn. California Red June	Ohio									e	Not described.
California. Cat. Syn. of Occident											
California Red June. Cat. Syn. of California											
Calistoga. Wn	Cal									l	
Calkins. IllH'81	Iowa?										Do.
Calkins Pippin. MassH'75	N. S.	reobl	l	wru	tj	w	bsa	g		l	
Calkin's Pippin. D. Syn. of Champlain											
Calkin's Pippin. D. Syn. of Summer Pippin											
Callasaga. MagofH'53. Syn. of Cullasaga											
Calumet. CanExR'93	Que	robl	ml	gyrs	fj	w	sa	g		l	
Calvert. JRJ			vl	rs				g		me	May be Colvert.

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Calville Ananas de Liege. D. Syn. of Liege											
Calville Blanc. D. Syn. of Summer White											
Calville Blanche à Cote's. D. Syn. of Cote											
Calville Blanche d'Ete. Lin. Syn. of Summer White											
Calville Blanche d'Hiver. GenF'33. Syn. of White Calville											
Calville Boisbunel. BBL											Not described.
Calville d'Angleterre. GenF'33. Syn. of Cornish Gilliflower											
Calville d'Automne. D. Syn. of Red Autumn											
Calville d'Hiver de Mensfeld. D. Syn. of Mensfeld											
Calville de Quillius. AndN. Syn. of Quillius											
Calville des Prairies. D. Syn. of Prairie											
Calville d'Ete. D. , Syn. of Summer Calville											
Calville Etoile. D. Syn. of Star Reinette											
Calville Etoille. D. Syn. of Etoile											
Calville Malingre. GenF'33. Syn. of Malingre											
Calville of Abbottsford. SDB76.		ob	m	y	j	w	sa	g		m	
Calville of St. Hilaire. MichB31											Do.
Calville Precoce. R. Syn. Calville Rouge Precoce											Do.
Calville Rouge. D. Syn. of Red Autumn											
Calville Rouge. D. Syn. of Red Calville											
Calville Rouge d'Anjou. D. Syn. of Red Calville											
Calville Rouge d'Automne. D. Syn. of Red Autumn											
Calville Rouge d'Automne. K. Syn. of Red Calville											
Calville Rouge d'Automne (incorrectly). D. Syn. of Framboise											
Calville Rouge d'Ete. D. Syn. of Summer Calville											
Calville Rouge d'Hiver. D. Syn. of Red Calville											
Calville Rouge de Micoud. K. Syn. of Micoud											
Calville Rouge Normande. D. Syn. of Red Calville											
Calville Rouge Precoce. BBL. Syn. of Calville Precoce											
Calville Royale d'Hiver. D. Syn. of Red Calville											
Calville Saint Sauveur. D. Syn. of Sauveur											
Calville Summer-red. Gb. Syn. of Red Summer Calville											
Calville Tulipee. D. Syn. of Tulip											
Calville vraie des Allemande. D. Syn. of Red Calville											
Calville Weisser Sommer. Gb. Syn. of White Summer Calville											
Calville White Winter. W. Syn. of White Calville											
Camac's Sweet. MagofH'53. Syn. of Camak											
Camack. L. Syn. of Camak											
Camack Sweet. L. Syn. of Camak											
Camack's Sweet. W. Syn. of Camak											
Camack's Winter Sweet. D. Syn. of Camak											

Camak. R. Syns. Camac's Sweet, Camack, Camack Sweet, Camack's Sweet, Camack's Winter Sweet, Camak's Sweet, Camak's Winter Sweet, Grape Vine.	N.C	re	m	gyb	fj	y	bps	g	k	l	
Camak's Sweet. AHortA'69. Syn. of Camak											
Camak's Winter Sweet. Hort'58. Syn. of Camak											
Cambridge Pippin. GenF'33. Syn. of Bedfordshire											
Cambusnethan. L. Syns. Cambusnethan Pippin, Cambuthnethan Pippin, Watch Apple, Winter Redstreak.	Scot	r	m	gyrs	j	y	sa	g-vg	d	m	
Cambusnethan Pippin. GenF'33. Syn. of Cambusnethan											
Cambuthnethan Pippin. MagofH'38. Syn. of Cambusnethan											
Cameron. R. Syn. Cameron Pearmain											Do.
Cameron Pearmain. MoH'92. Syn. of Cameron											
Camfield. DomEnc. Syn. of Campfield											
Camnesar. D. Syn. of White Spanish											
Camnesar. K. Syn. of Fall Pippin											
Campbell. D. Syn. Campbell's Seedling	Ohio	rob	m	grs	ctj	gw	bsa	g-vg		l	
Campbell Red. R. Syn. Campbell's Red	Ont			r	fj	ws	sa	g	m	ml	
Campbell's Red. CanH'98. Syn. of Campbell Red											
Campbell's Seedling. IllH'68. Syn. of Campbell											
Campbellite. MoH'66. D. Syn. of White Pearmain											
Campfield. GarCal. Syns. Camfield, Canfield, Newark Sweeting, Sweet Maiden's Blush.	N.J.	rob	ml	gyr	fr	w	s	g	ck	vl	
Camsack. R. Syn. Camsack's Sweet							s				Probably Camak.
Camsack's Sweet. MichB31. Syn. of Camsack											
Can. D	N.Y.	obl	ml	ye		w	psa	g		m	
Canada. IllB45			m	de		w		g			
Canada Baldwin. MHSC'78	Que	ob	m				sa		dkm	vl	
Canada Black. PFar'61	Can.?	r	l	dr			sa	g		ml	
Canada Burrowsaw. GenF'33. Syn. of Burrowsaw											
Canada Champion. Cat											Not described.
Canada Late Strawberry. MichB31. Syn. of Canada Strawberry											
Canada Peach. N. Syn. of Peach (Montreal)											
Canada Pippin. Cat. Syn. Canada White Pippin											Do.
Canada Pippin. H. Syn. of White Pippin											
Canada Pippin. H. Syn. of Canada Reinette											
Canada Red. Hort'47. Syn. of Red Canada											
Canada Reinette. D. Syns. Canada Pippin, Canada Reinette Grise (?), Canadian Reinette, De Bretagne, Grosse Reinette d'Angleterre, Januarea, Mela Januarea, Pomme du Caen Portugal, Praire Rambour Reinette, Reinette Canada, Reinette de Caen, Reinette du Canada, Reinette du Canada a Cortes, Reinette du Canada Blanche, Reinette Grosse du Canada, Wahr Reinette, White Pippin of O.	Eur.?	obe	vl	gy	fj	w	sa	vg	dm	l	
Canada Reinette. MJH. Syn. of British Columbia											
Canada Reinette (?). H. Syn. of White Pippin											
Canada Reinette Gris. D. Syn. of Grey Canada											
Canada Reinette Grise (?). D. Syn. of Canada Reinette											
Canada Russet. MagofH'39				ru							Do.
Canada Seedling. MagofH'39	Can.	oble	m	dr						l	Exhibited by H. Corse, of Montreal, Oct. 29, 1839.
Canada Strawberry. R. Syn. Canada Late Strawberry											Not described.
Canada Sweet. D. Syn. of Hog Island											
Canada White Pippin (?). Cat. Syn. of Canada Pippin											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Canadian Reinette. K. Syn. of Canada Reinette											
Canajoharie. AmGar'99	N. Y	rob	m	wyr	t		m	g	d	l	
Candy. P'95	Tenn	r	s	wrsc	fj	w	sa	g-vg	d	m	
Cane. E. Syn. of Kane											
Canecreek. R. Syns. Cane Creek, Cane Creek Sweet, Cane Creek Sweeting	N. C	r	m	gy	fm	w	rs	g		e	
Cane Creek. L. Syn. of Canecreek											
Cane Creek Sweet. W. Syn. of Canecreek											
Cane Creek Sweeting. W. Syn. of Canecreek											
Cane Mash. Cat. Syn. of Bough											
Cane Spitzenburgh. DomEnc. Syn. of Kaighn											
Canfield. Cat											Not described
Canfield. GenF'32. Syn. of Campfield											
Cann. E. Syns. Cann Apple, Sweet Cann, Winter Bough, Winter Sweet Bough.		rc	l	gyc	cmj	w	s	g	km	l	
Cann Apple. C. Syn. of Cann											
Cannahan. MagofH'44. Syn. of Carnahan											
Cannahan's Favorite. MagofH'44. Syn. of Carnahan											
Cannon. MagofH'44			vl	gr				vg		ml	
Cannon Pearmain. E. Syns. Alpian, Anderson	Va.?	rc	m	yrs		y	bsa	g	km	vl	
Cano. OL			l	r			sa	g	m	l	May be Gano.
Can of Coxe. Probably of Cole. Syn. of Seaver											
Canon. W	South	ob	m				s			m	
Canterbury. L. Syns. Canterbury Reinette, Reinette de Canterbury	For	robc	l	gy	cj	w	a			l	From Album de Pomologie.
Canterbury Reinette. D. Syn. of Canterbury											
Cantrel. P'95. Syns. Frazier Favorite, Pride of Washington	Wash	rc	vl	yrsc	j	yg	sa	g		l	
Capendu. D. Syn. of Court Pendu Plat											
Capital. W	Ind	rob	s	gy	j	y	bsa	g	d	l	
Capitola. JSK	Tex		l					vg	m	l	
Capp. R. Syn. Capp Mammoth	Ill										Not described.
Capp Mammoth. BBL. Syn. of Capp											
Capron. L. Syns. Capron's Pleasant, Uxbridge Spice		rob	ml	gy	tj	y	sa	g		m	
Capron's Pleasant. MagofH'41. Syn. of Capron											
Captain. IllB45. Syn. of Red Astrachan											
Capt. Howson. Cat. Syn. of Howson											
Capt. Moses. W	Ga	c	m	yr	jc		s	vg	m	vl	
Capt. Paine's. Cat. Syn. of Paine											
Caradeuc. L. Syn. Mrs. De Caradeuc	South	ob					sa				
Caraway. L. Syn. Caraway Russet	Eng	ob	ms	bru	fcj		s			l	From Hogg.
Caraway Russet. D. Syn. of Caraway											
Caraway Russet. K. Syn. of Fenouillet Gris											
Carbage. MagofH'53		rc	m	y	tj		s			m	

Cardinal. Gb. Syns. Gov. list No. 148, Kardinal	Rus										Not described.
Cardinal (Ia.). SDB76	Iowa	e	vl	r		w	sa			m	Originated in Dallas County, Iowa.
Cardinal Cellini. BBL. Syn. of Celini											
Cardinal (Peter). BBL											Not described.
Cardinal Red. D	Eur	obc	m	dr	fj	w	sa	g		l	
Carey. R. Syn. Carey's Pippin	Ohio	r	l				s	g		l	
Carey's Pippin. W. Syn. of Carey											
Carey Seedling. L. Syn. Carey's Seedling	Ohio	r	s	yb	t	wy	sa	g		m	
Carey's Seedling. D. Syn. of Carey Seedling											
Carhouse. MagofH'37											Probably Carthouse.?
Carlisle. L. Syn. Carlisle Codlin	Eng	oob	m	gy	tcj	w			k	me	From Hogg.
Carlisle Codlin. GenF'33. Syn. of Carlisle											
Carlough. MichB117	N. J	re		gyb			s	vg	dk	l	
Carlton. R. Syn. Carlton Island Seedling											
Carlton Island Seedling. E&B'77. Syn. of Carlton											
Carmel. L. Syns. Carmel Sweet, Carmell Sweet, Speckled Sweet	N. Y	ob	m	gyb	jt	w	s	vg		m	
Carmelite. R. Syn. Carmelite Reinette		e	l	gy	t	w	msa			e	
Carmelite Reinette. CanExR'01. Syn. of Carmelite											
Carmel Sweet. D. Syn. of Carmel											
Carmell Sweet. W. Syn. of Carmel											
Carmine. ColExR'91											Not described.
Carnahan. E. Syn. Cannahan's Favorite, Cannahan, Carnahan's Favorite.	Ohio	rc	l	yrs	ft		psa	g		l	
Carnahan's Favorite. D. Syn. of Carnahan											
Carnation. D	South	ob	m	rru	j	w	psa	vg	d	me	From Gardening for the South.
Carnel's (Carnel's II) Favorite. H. Syn. of Cornell											
Carolina. A'60. Syn. of Ben Davis											
Carolina. W. Syn. of Nickajack											
Carolina Baldwin. W. Syn. Caroline	South? N. J.?	ob	m	yrs	cjm	y	sa	vg	d	me l	Downing and Warder differ in descriptions.
Carolina Beauty. P'95	N. C	obc	ml	ydr	cj	y	sa	g	km	l	
Carolina Greening. W	South	ob					sa				May be Green Cheese.
Carolina Greening. D. Syn. of Green Cheese											
Carolina Horse. W	South	r	l				sa	g		me	
Carolina June. A'95. Syn. of Red June											
Carolina June. PFar'52. Syn. of Striped June (?). [Very probably Red June.]											
Carolina, of some. E. Syn. of White Juneating											
Carolina Pippin. IndH'66	South	r	l	rs			sa				
Carolina Queen. T. Syn. Carolina Winter Queen	N. C.?	rob	ml	rs			sa				This may be Buckingham or Nix.
Carolina Red. IllB45			m					g		l	
Carolina Red. F. Syn. of Red June											
Carolina Red June. H. Syn. of Red June											
Carolina Redstreak. D. Syn. of Ben Davis											
Carolina Red Stripe. D. Syn. of Redstripe											
Carolina Russet. W	N. C	rob	m	ru			sa	g		vl	
Carolina Spice. D. Syn. of Nickajack											
Carolina Striped June. D. Syn. of Striped June (?). [Very probably Red June.]											
Carolina Sweet. D		rob	ml	yb		y	s	p		e	
Carolina Watson. D. Syn. Caroline Watson	South	obc	l	grs	cm	w	sa	g		e	
Carolina Winter. Dap. Syn. of Nix											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Carolina Winter Queen. E. Syn. of Carolina Queen											
Carolina Winter Queen. H. Syn. of Nix											
Caroline. Hort'68	Ohio		m	gy						me	
Caroline. GenF'33	N. J	ob	m				sa			l	
Caroline. D. Syn. of Carolina Baldwin											
Caroline. D. Syn. of Caroline (Eng.)											
Caroline. D. Syn. of Caroline (Ohio)											
Caroline. D. Syn. of White Juneating											
Caroline. D. Syn. of Nickajack											
Caroline Auguste. D. Syn. of Auguste											
Caroline (Eng.). L. Syn. Caroline	Eng	r	ml	yrs	fj		bsa		k	ml	From Lindley.
Caroline June Red. F. Syn. of Red June											
Caroline (Ohio). L. Syn. Caroline	Ohio	rob	m	gyb	tm	w	sa	vg		me	
Carolines. IndH'80											Not described.
Caroline Watson. W. Syn. of Carolina Watson											
Carroll. L. Syn. Carroll's June	Mo										Do.
Carroll's June. Cat. Syn. of Carroll											
Carondelet. IllH'68											Do.
Carpenter. D. Syns. Carpenter Apple, Carpenter No. 1	Ohio	rob	m	yeb	fr	y	psa	g		l	
Carpenter Apple. Hort'57. Syn. of Carpenter											
Carpenter Horse. L. Syn. Carpenter's Horse											Do.
Carpenter's Horse. FSP. Syn. of Carpenter Horse											
Carpenter N. C. A'77		ob	l	gyb	ftj	y	sa	vg		l	
Carpenter No. 1. W. Syn. of Carpenter											
Carpenter Seedling. L. Syn. Carpenter's Seedling											Do.
Carpenter's Seedling. Cat. Syn. of Carpenter Seedling											
Carpenter Sweet. L. Syn. Carpenter's Sweet	Conn	robe	m	gyrs	ftj	w	s	vg	km	m	
Carpenter's Sweet. T. Syn. of Carpenter Sweet											
Carpenter Winter. R. Syn. Carpenter's Winter											Do.
Carpenter's Winter. IllB45. Syn. of Carpenter Winter											
Carpentin. L. Syns. Carpentin Reinette, Der Carpertin, Kleine Graue Reinette.	Ger	robl	s	gyrs	tj	yw	sa	g		vl	From Hogg.
Carpentin. Dap. Syns. Carpentin Reinette, Petite Reinette Grise	Ger	ob	s	rru	fctj	w	sa	vg	d	ml	Downing considers these as distinct varieties.
Carpentin Reinette. GenF'33. Syn. of Carpentin											
Carpentin Reinette. Dap. Syn. of Carpentin											
Carr. R. Syn. Carr's Red			vl	gr							
Carrell's Seedling. D. Syn. of Pinner											
Carroll. R. Syn. Carroll's Seedling	Eng		l					vg		l	
Carroll's Seedling. MagofH'51. Syn. of Carroll											

Carrolus. R. Syn. Carrolus Seedling											
Carrolus Seedling. GenF'33. Syn. of Carrolus											
Carr's Pound Sweet. TCF. Syn. of Carr Sweet											
Carr's Red. TCF. Syn. of Carr											
Carr Sweet. R. Syn. Carr's Pound Sweet			l	y			s			ml	
Carse of Gowrie. D. Syn. of Glammis											
Carson. A'75		ob		grs				g			
Carter. H. Syn. Carter Apple	N. C.? / Va.?	c	m				sa			l	
Carter. W	Mass	rob	ml	yrs	tej		sa	g-vg	d	ml	
Carter. ArkB60	Ark	r	m	yr	f	y	msa	vg		l	
Carter. T. Syn. of Mangum											
Carter. W. Syn. of Patton											
Carter Apple. MagofH'52. Syn. of Carter											
Carter Blue. L. Syns. Carter's Blue, Lady Fitzpatrick, Patton	Ala	rob	l	grs	c	yw	sa	vg		m	
Carter's Blue. D. Syn. of Carter Blue											
Carter of Ala. D. Syn. of Mangum											
Carter of Va. T.	Va.		m	y	tj		p				
Carter's Winter. D. Syn. of Mangum											
Carthouse. DomEne. Syn. of Gilpin											
Carver (Pa.). D	Pa	r	l	gy	jt	y	sa	g		e	
Carver. D	Pa.? / Ohio?									l	
Carver (of N. Y.). IllB45. Syn. of Red Astrachan											
Cary. L. Syns. Cary's Favorite, Cary's Summer		rob	l	ye	tj	y	sa	g		e	
Cary's Favorite. Hort'60. Syn. of Cary											
Cary (Ohio). L. Syn. Cary's Seedling	Ohio	rob	m	gy				g	dk	m	
Cary's Seedling. H. Syn. of Cary (Ohio)											
Cary's Summer. D. Syn. of Cary											
Cas. GenF'33. Syn. of Cos											
Case. D	Conn	rob	m	rs	jtc	w	sa	g		m	
Casey. WisB45	Wis		vl	grs						ml	
Casey Early. CH. Syn. of Early Casey											
Casey Winter. CH	Wis		m	wyb				g	dk	l	
Cash. IllH'89. Syn. Cash Sweet		obc	m	wb	fr	w	s			m	
Cash Sweet. MagofH'53. Syn. of Cash											
Cass. MagofH'43											Not described.
Casseler. R. Syn. Grosse Casseler											Do.
Cassel Reinette. D. Syn. of Barcelona											
Caster. MoH'73											Do.
Castle. L. Syn. Castle Major	Eng	rob	m	gy	fj		ba		k	l	From Lindley.
Castle Major. D. Syn. of Castle											
Catalling. W		c		rs			sa				
Catface. D. Syn. Cat Face	Ky	obc	l	gyrs	t	w	bsa	g		l	From Ernst's MS.
Cat Face. E. Syn. of Catface											
Catherine. N	Minn									m	
Cat Head. C. Syn. of Catshead											
Cathead Beaufin. D. Syn. of Beaufin											
Cathead Greening. D. Syn. of Catshead											
Cathead (incorrectly). D. Syn. of Fall Pippin											
Cathead, of some. D. Syn. of Red Cathead											
Cathead Sweet. D		rc	l	gyb	t	w	s	g		m	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Catherine. SDB76	Minn	rob	ml	yb	j	w	sa	g		m	
Cathlin. R. Syn. Cathlin Pippin											
Cathlin Pippin. BBL. Syn. of Cathlin											
Catline. DomEnc. Syns. Gregson Apple, Winter Grickson, Winter Grixon.	Md	ob	ms	yrb	tj		rs	g	c	ml	
Cato. D	Md.?	ob	s	wrs	t	ws	sa	g		l	
Caton. MagofH'53											Not described.
Catooga. T. Syns. Cattoogaja, Corbin, Cuttugaja	South	r	l	y	tj	wy	sa	g	k	m	
Cat Pippin. E. Syns. Haymaker, Hommacher Apfel, Honemaker Pippin, West Spitzenberg.	Pa		ml	g	j	g	sa			l	Doubtless identical with Cat. See A. 1852, 85.
Catsbury. C		ob	m						c		
Catshead. D. Syns. Cat Head, Cathead Greening, Greening Cathead, Large Summer Russet, Round Cathead.		r	vl	g	t		sa	g		m	
Cat's Head. D. Syn. of Newbury											
Cattel. W	Ohio		m					g		m	
Cattell. W. Syn. of Ohio Nonpareil											
Cattoogaja. D. Syn. of Catooga											
Caux. L. Syn. Reinette de Caux	Fr	rob	l	yrb	tj	yw	sa				
Cave. IllH'96											Not described.
Cave. Dap. Syn. of Bank											
Cayuga Red Streak. D. Syn. of Twenty Ounce											
Caywood. Hort'61	N. Y.	ob	m	yrb	f	y	psa	g		vl	
C. C. Wellford. Hort'56. Syn. of Wellford											
Cedar. R. Syn. Red Cedar	Ky	robe	l	gyrs	mj	y	sa	g		m	Differs from Red Cedar of W. D.
Cedar Falls. D	N. C	ob	l	yr	f	y	sa	g		l	From W. N. White's notes.
Celestia. W	{N. C.? Ohio?}	rc	l	gy	ctj	y	sa	vg	dk	m	
Celestial Sparks. IllH'83. Syn. of Sparks											
Celina. IndH'85. Syn. of Cellini											
Celleni. A'85. Syn. of Cellini											
Cellini. MagofH'58. Syns. Cardinal Cellini, Celina, Celleni, Kardinal Celine.	Eng	rob	m	yes	tj	w	bsa	vg	k	m	
Centennial (Ct.). Dap	Conn	robe	m	yrsc	ftj	ws	sa	vg	km	ml	
Centennial (Pa.). Dap	Pa		l	rs			sa			l	
Centers. W	N. C	c	m				sa			m	
Chadwick. R. Syn. Chadwick's Favorite											Not described.
Chadwick's Favorite. MichB31. Syn. of Chadwick											
Challenge. E	Ohio	obc	l	y	tj	y	s	vg	d	vl	
Challenger. IllH'97			m	g							May be same as above.

Challenge Sweet. MassH'72		r	l	yrs			s	g	k		
Chalmer's Large. D. Syn. of Dutch Codlin											
Chaltram Pippin. Hort'56. Syn. of Niekajack											
Champagne. MHSC'86. Syns. Champanskoe, Shro. to Ia. No. 112	Rus		m				a			ve	
Champagne Pipka. MHSC'86. Syns. Champagne Pippin, Gov. list No. 181, Pipka Champanskaya, Shro to Ia. No. 124.	Rus		m				sa	g	dk		
Champagne Pippin. IaB41. Syn. of Champagne Pipka											
Champagner. R. Syn. Champagner Lievlandischer											Not described.
Champagner fruher. Gb. Syn. of Early Champagne											
Champagner Lievlandischer. IndH'87. Syn. of Champagner											
Champaigne. L. Syns. Champaigne Reinette, Reinette de Champagne, Soskrieger.		rob	m	yru	m	y	vsa	vg		ml	From the Verger.
Champaign Pippin. IndH'94	Rus	oble	l	wyr				vg		e	May be same as Champagne Pipka.
Champaigne Reinette. D. Syn. of Champaigne											
Champanskoe. Gb. Syn. of Champagne											
Champion. ArkB49. Syn of Collins											
Champion Red. ArkB49. Syn. of Collins											
Champlain. NEF'53. Syns. Calkin's Pippin, Geneva Pearmain, Haverstraw Pippin, Large Golden Pippin, Nyack Pippin, Paper or Paper Skin, Sour Bough, Summer Pippin, Tart Bough, Underdunk, Vermont, Walworth.	Vt.?	robe	ml	gyb	tmj	w	psa	g	km	me	
Champlain. D. Syn. of Summer Pippin											
Champ Sweet. Dap. Syn. of Hartford											
Champ Sweeting. K. Syn. of Hartford											
Chance. GenF'33				gw				vg	dk	ml	
Chancelor. R. Syn. Chancelor of Oxford			ms	yrs				g-vg		e	
Chancelor of Oxford. IllB45. Syn. of Chancelor											
Chandler. K. Syns. Chandler's Red, Late Chandler, Winter Chandler	Conn	rob	l	grs	tjm	gw	sa	g		ml	
Chandler. WVaB75. [May be same as preceding.]											Not described.
Chandler. Cat. Syn. of Glory of Russia											
Chandler's Red. F. Syn. of Chandler											
Chaney. D.	Pa	robe	m	gyb	fmj	w	sa	g-vg	d	l	
Changeable. B(Ph)N'87											Do.
Chapman. L. Syn. Chapman's Orange	Mich		s	yr	j		sa			m	
Chapman's Orange. Cole. Syn. of Chapman											
Charlamoff. MHSC'86. Syn. Charlamouskoe, Charlamowskoe, Charlowminski, Gov. list No. 262, Shro. to Ia. No. 105.	Rus	rob	ml	rs				g		m	
Charlamoff (of C. Tuttle). IllH'91	Rus.?		l					p		m	This is considered distinct from C. of Prof. Budd.
Charlamouskoe. MHSC'81. Syn. of Charlamoff											
Charlamowskie. MoH'67. Syn. of Oldenburg. [W. C. Flagg gave "C." as a synonym of Oldenburg.]											
Charlamowskoe. Gb. Syn. of Charlamoff											
Charles. CanB37	Ont		s	y	j	y	msa			me	
Charles Apple. K. Syn. of Mala Carle											
Charles Pearmain. D. Syn. of Rushock											
Charles Ross. AmGar'99. Syn. Thomas Andrew Knight	Eng		ml	ygb							
Charley. L. Syn. Charley's Winter	Va	obc	ms	yr	cj	y	sa	g		l	
Charley's Winter. D. Syn. of Charley											
Charlotte. MagofH'53. Syn. Charlotte Sweet											Not described.
Charlotte Sweet. W. Syn. of Charlotte											
Charlottenthaler. MHSC'86. Syn. of Thaler											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Charlottenthaler gelber. Gb. Syn. of Thaler											
Charlottenthalskoe jeltoe. Gb. Syn. of Thaler											
Charlowminski. MagofH'41. Syn. of Charlamoff											
Charter. L. Syns. Governor Charter, Governor Charter's Seedling	Ill.?	rc	m	yb	fj	w	pmsa		m	m	From Prairie Farmer.
Chartreaux. L. Syn. Princesse Noble des Chartreaux			ml	g	f	yw	a			l	From the Verger.
Chase. L. Syn. Chase's Seedling	Me	r	m	yr	tmj	w	sa	g		me	
Chase Golden. L. Syn. Chase's Golden											Not described.
Chase's Golden. Cat. Syn. of Chase Golden											
Chase's Seedling. D. Syn. of Chase											
Chattahoochee. W. Syn. Chattahoochee Greening	Ga	robc	m	gyb	ct	yw	bpsa	g	m	vl	
Chattahoochee Greening. W. Syn. of Chattahoochee											
Chatingue. MagofH'35. Syn. Chestnut											Do.
Chataignier. MoH'67											Do.
Chatham Pippin. D. Syn. of Nickajack											
Cheat. D. Syn. of Domine											
Cheat. MagofH'49. Syn. of Wells											
Cheatau Pippin. D. Syn. of Nickajack											
Cheataw. D. Syn. of Nickajack											
Chebucto. R. Syn. Chebucto Beauty											Do.
Chebucto Beauty. GarM'63. Syn. of Chebucto											
Cheese. W	Pa	ob	ml	grs	ft	w	sa	g		ml	
Cheese. W	Ind	ob	l	rs			sa	g		ml	May be same as preceding.
Cheese. D. Syn. of Mangum											
Cheese. Dap. Syn. of Summer King											
Cheese Apple. Dap. Syn. of Clermont											
Cheese Apple. D. Syn. of Summer Cheese											
Cheeseboro. W. Syns. Cheeseborough Russet, Forever Pippin, Howard Russet, Kingsbury Russet, Pumpkin Sweet of some, Sweet Russet, York Russet, York Russeting.		c	l	gru	cm		sa	p		m	
Cheeseborough Russet. MagofH'51. Syn. of Cheeseboro.											
Cheese of Pa. BBL											Not described.
Cheevor. IllB45			ml	y			s				
Chelmsford. R. Syn. Chelmsford Wonder											Do.
Chelmsford Wonder. BBL. Syn. of Chelmsford											
Cheltenham. D. Syn. Calf Pasture	Pa	r	m	yrs	tj	wy	psa	g		m	
Chenango. (LC). Syns. Buckley, Chenango Strawberry, Early Sugar Loaf, Frank, Jackson Apple, Late Strawberry (erroneously), Sherwood's Favorite, Smyrna, Strawberry.	N. Y	oblc	m	wrsc	tj	w	psa	vg	dm	me	
Chenango Strawberry. Hort'54. Syn. of Chenango											
Cheney. A'64	Conn	ob	m	yc	tj	w	psa	vg	d	m	

Cherokee. L. Syn. Cherokee Red	South										Do.
Cherokee Red. W. Syn. of Cherokee											
Cherry. R. Syn. Cherry Neverfail			vl						km	ml	Said to resemble Buckingham.
Cherrycreek. R. Syn. Cherry Creek											Not described.
Cherry Creek. IndH'72. Syn. of Cherrycreek											
Cherry Neverfail. BAC. Syn. of Cherry											
Cherry Red. A'89											Do.
Chesapeake. Cat											Do.
Cheseborough Russet. A'60											May be same as Cheeseboro.
Chestatee. W	South	robe	m				sa	g		m	
Chester. D. Syns. Chester Apple, Chester Redstreak	Pa	ob	m	wyb	tj	w	psa	g		m	
Chester Apple. A'56. Syn. of Chester											
Chester County. Dap	Pa	robe	ml				sa	g		l	
Chester Early White. OklExR'98. Syn. of Chester White											
Chesterfield. R. Syn. Chesterfield Pippin											Do.
Chesterfield Pippin. Hort'57. Syn. of Chesterfield											
Chester Pearmain. D	Eng	obe	m	yrs	tj	yw		g		ml	From Hogg.
Chester Red. W	South										Probably same as Chester.
Chester Redstreak. D. Syn. of Chester											
Chester Spitzenberg. D. Syn. of Chester Spitzenburg											
Chester Spitzenburg. R. Syn. Chester Spitzenberg	Pa	rob	m	yrs	cj	y	sa	g		l	
Chester White. R. Syn. Chester Early white											Not described.
Chestnut. MagofH'35. Syn. of Chatingue											
Chestoa. Hort'58. Syn. Rabbit's Head	South	oble	l	yrs	cj	w	sa	vg		l	
Chestood. IllB45											Do.
Chicago. SBro										l	
Chicago. NYB90											May be Island or Chicago crab.
Chicago. D. Syn. of Island											
Chief Good. E. Syn. Summum Bonum	Ky	rob	l	yrs	tj	w	sa			m	
Childs. Dap	Me	rob	m	wrs	ftj	w	sa			ml	
Chili. C	Pa	obl	m				s		d	m	
Chillicothe. W	Ohio	ob	l				sa	g		l	
Chillicothe Redstreak. RNY'61. Syn. of Chillicothe Streak											
Chillicothe Streak. L. Syn. Chillicothe Redstreak	Ohio	c	l				sa	g		l	
Chillicothe Sweet. Dap. Syn. of Bailey Sweet											
Chimney. W. Syn. of Fameuse											
China Rose. L. Syns. Rose, Rose Apple of China	Eng	obl	l	grs	j		p			m	
Chippin. P'94	Conn	re	s	gys	fcj	y	sa	vg	dm	vl	
Chippin of Wine. BBL											Not described.
Chisman. IaH'91. Syn. Chisman's Beauty											Do.
Chisman's Beauty. IaH'84. Syn. of Chisman											
Chittenden. IllH'77											Do.
Choice. L. Syns. Melt-in-the-Mouth of some, People's Choice	Pa	oble	m	rs	fj	y	bsa	g		l	
Choice Kentuck. Cat											Do.
Choice Kentuck. JIN. Syn. of Kentuck											
Choice Kentuck. WHyS. Syn. of Smith											
Cholomonski. MagofH'40											Do.
Chrisman. JW&S	Iowa			y	tj		sa	vg		vl	
Christapfel. Gb											
Christ Birth. MHSC'81. Syn. of Christmas											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Christ's Deutsche Goldreinette. D. Syn. of Christ Gold											
Christ Gold. L. Syns. Christ's Deutsche Goldreinette, Christ's Gold Reinette.	Ger	ob	ml	yb	fj		sa			vl	From Hogg.
Christ's Gold Reinette. L. Syn. of Christ Gold											
Christ's Gold Reinette. K. Syn. of Dutch Mignonne											
Christiana. MagofH'57	Del	ob	m	ycr	mj	yw	sa	g-vg		m	
Christiana. Cat											Perhaps same as preceding.
Christie. L. Syn. Christie's Pippin	Eng	ob	m	gyrs	t	y	sa	vg	d	ml	
Christie's Pippin. GenF'33. Syn. of Christie											
Christmas. MHSC'86. Syns. Christ's Birth, Gov. list No. 477, Roschdestwenskoe, Roshdestenskoe, Shro. to Ia. No. 161.	Rus.										Not described.
Christmas. Gb											
Christy. Hort'47. [Exhibited at St. Louis, Sept. 15, 1847.]											May be same as Christie.
Chronical. MagofH'53. Syn. Cotton Apple	Ind	re	ml	gyrs	cf	yw	sa	g	km	vl	
Chucked Egg. D. Syn. of Teuchat											
Chugounka. A'83											Not described.
Church. L. Syn. Church's Late Sweet	South	re	m	ye	cm	y	sa	g		vl	
Churchill. L. Syn. Churchill Greening		obe	l	ygr	t	y	bsa	g		l	
Churchill Greening. D. Syn. of Churchill											
Church's Late Sweet. D. Syn. of Church											
Cider. PFar'63. Syn. of Plumb Cider											
Cider. IllH'71. Syn. of Smith											
Cider Apple. C	N. J. or Pa.	ob	m				sa		c	m	Not mentioned by late authors.
Cider Mill. IndH'72											Not described.
Cillagos. AlaB98											Do.
Cinnamon. Gb. Syns. Browny, Koritchnevoe, Kovitschneoe, Gov. list No. 322.	Rus.										Do.
Cinnamon Anis. Gb. Syns. Anis kovitchnevoe, Shro. to Ia. No. 111	Rus.										Do.
Cinnamon Pine. Gb. Syns. Browny Pine, Gov. list No. 375, Kovitchnevoe ananasnoe, Kovitschewoe ananasnoe, Shro. to Ia. No. 48, Shro. to Ia. No. 101.	Rus.										Do.
Citron. L. Syn. Citron des Carmes	Fr	obl	s	gy				p		ml	From Ronalds.
Citronat. Gb. Syn. V. R. S. to Ia. No. 27	Rus.										Not described.
Citron des Carmes. D. Syn. of Citron											
Citronen. Gb. Syns. Citronenapfel, Citronen Reinette, Reinette de Citron, V. R. S. to Ia. No. 26.	Ger	re	l	yb	fj	vw	bs	g	d	vl	From Hogg.
Citronenapfel. Gb. Syn. of Citronen											
Citronen Reinette. D. Syn. of Citronen											
Claghead. MdB13											Not described.

Claiborne. TennBX-I. Syns. Benham, Benum, Brown, Yearry	Tenn?	robc	ml	gyrs	fj	y	sa	g	dk	e	
Clampett. TCF. Syn. Clampit				rs	j				dm		
Clampit. A'58. Syn. of Clampett											
Clapper. L. Syns. Clapper Flat, Flat Apple	N. Y	obc	ml	gyr	tj	y	psa	g	k	m	Resembles Gravenstein.
Clapper Flat. A'58. D. Syn. of Clapper											
Clara. L. Syn. Clara Pippin	Eng	ro	s	y	fr	y	bs			l	From Hogg.
Clara Pippin. D. Syn. of Clara											
Claremont. L. Syn. Claremont Pippin											Not described.
Claremont Pippin. Cat. Syn. of Claremont											
Claremont Pippin. Cat. Syn of Easter											
Clareval. L. Syn. Reinette de Clareval	Fr	rob	m	gyb	fj	w	sa			l	From Diel.
Clarlon. Cat.											Not described.
Clark. Dap. Syn. Lewis	Pa	obc	ml	wb	fct	w	sa	g	dkm	ml	
Clark's W. Syn. of Clarke											
Clarke. D. Syn. Clark's	N. Y	rc	ml	wyrs	tjc	w	sa	vg	d	m	
Clarke Delaware. L. Syn. Clarke's Delaware	Md	robl	m	yrb	mtj	w	sa	vg		l	
Clarke's Delaware. D. Syn. of Clarke Delaware											
Clarke Pearmain. D. Syns. Clarke's Pearmain, Clark's Pearmain, Columbian Russet, Gloucester Pearmain, Golden Pearmain, Yellow Pearmain.	N. C	robc	m	gyrs	fc	y	sa	vg	dk	ml	
Clarke's Pearmain. NEF'30. Syn. of Clarke Pearmain											
Clark Greening. L. Syn. Clark's Greening	Va	ob		g			sa				
Clark's Greening. W. Syn. of Clark Greening											
Clark Orange. L. Syn. Clark's Orange	Wis	rc	ml	yrs	j	w	sa	g	dk	ml	
Clark Orange. (LC). Syn. Clark's Orange	Ohio										Do.
Clark's Orange. A'77. Syn. of Clark Orange											
Clark's Pearmain. W. Syn. of Clarke Pearmain											
Clark Prolific. R. Syn. Clark's Prolific	Iowa	obc	ml	wyb	vtj	w	sa	g		l	
Clark's Prolific. T. Syn. of Clark Prolific											
Clark Seedling. R. Syn. of Clark's Seedling		rc	vl	y	fj	yw	msa	vg	dm	l	
Clark's Seedling. A'77. Syn. of Clark Seedling											
Clark's Seedling. H. Syn. of London Sweet											
Clarkson. D	Mich	obc	ml	wcb	ftj	w	sa	g	k	m	
Clarkson Seedling. R. Syn. Clarkson's Seedling		ob	l	yr							May be same as preceding.
Clarkson's Seedling. A'58. Syn. of Clarkson Seedling											
Claude. GarM'59											
Clay. R. Syn. Clay Apple	Ill							vg		m	
Clay. Gb. Syn. of Glints											
Clay Apple. IllH'71. Syn. of Clay											
Claybank. CGen'59. Syns. Griffith, Stillwater Blush	Ohio	ob	m				sa	g		m	
Claybank. Dap. Syn. of Griffith											
Claygate. L. Syn. Claygate Pearmain	Eng	rc	m	yr	t	y	sa	g		l	
Claygate Pearmain. D. Syn. of Claygate											
Clayton. MoH'63. Syn. Boyd	Ind	robc	ml	gyrs	f	y	bsa	g-vg	dkm	l	
Cleopatra. BBL											Not described.
Clepington. D	Eng	rob	s	y				vg	d	m	
Clermont. Dap. Syns. Cheese Apple, Jackson's Roman Stem	Ohio	ob	m	ru			sa			vl	
Cleveland. Cat	Ky										Do.
Cley. L. Syn. Cley Pippin	Eng	r	s	y				vg	d	l	
Cley Pippin. GenF'33. Syn. of Cley											
Cliff Rose. BBL											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Clifton Nonsuch. D. Syn. of Fearns											
Climan. R. Syn. Climan Pippin											Not described.
Climan Pippin. IllH'01. Syn. of Climan											
Climax. Cat											Do.
Climb. L. Syn. Climb Sweet											Do.
Climb Sweet. W. Syn. of Climb											
Cline. L. Syn. Cline's Codlin	Pa?	ob	m				sa	g		me	
Cline's Codlin. RNY'70. Syn. of Cline											
Cling Tight. D. Syn. of Domine											
Clissold's Seedling. D. Syn. of Lodgemore											
Closeburn. R. Syn. Closeburn's Seedling											Resembles Hawthornden.
Closeburn's Seedling. MagofH'58. Syn. of Closeburn											
Closeset. R. Syn. Close Set	Ohio	r	m				sa	g		m	
Close Set. W. Syn. of Closeset											
Clothes-Yard Apple. D. Syn. of Granite											
Cloth of Gold. W. Syn. of Drap d'Or											
Clotz. A'77		robc	l	gyb	tfj	yw	sa	vg		l	
Cloud. W	South	ob		rs			sa				
Cluster. L. Syn. Cluster Apple		oblc	s			w		g		l	
Cluster. A'77	Utah										Not described.
Cluster. D. Syn. of Cluster Sweet											
Cluster Apple. D. Syn. of Cluster											
Cluster Golden. L. Syns. Cluster Golden Pippin, Cluster Pippin, Thickset, Twin Cluster Pippin.		rob	s	yru	fe	y	sa			l	From Hogg.
Cluster Golden Pippin. D. Syn. of Cluster Golden											
Cluster Pearmain. IndF'40	Ind	rob	ml	ygrs	j	yw	bpsa	g-vg	dk	m	
Cluster Pippin. D. Syn. of Cluster Golden											
Cluster Sweet. W		ob	m				s			m	
Clyde. RNY'71. Syns. Clyde Beauty, Mackie's, Mackie's Clyde Beauty	N. Y	rc	l	grb	tj	w	bsa	g		ml	
Clyde Beauty. E. Syn. of Clyde											
Clyman. Wn. Syn. Clyman Russet	Cal										Not described.
Clyman Pippin. Wn	Cal										Do.
Clyman Russet. Wn. Syn. of Clyman											
Coate's. D. Syn. of Yorkshire											
Coate's Greening. E. Syn. of Wood Greening											
Coates Seeknofurther. GenF'33. Syn. of Yorkshire											
Coates Winter. R. Syn. Coates' Red Winter											Do.
Coates' Red Winter. A'54. Syn. of Coates Winter											
Coats Sweet. MichB31											Do.
Cobashea. A'54											Do.

Cobbett's Fall. K. Syn. of Fall Pippin											
Cobbett's Fall Pippin. GenF'33. Syn. of White Spanish											
Cobham. D.	Eng	rob	ml	gyru	c	gy	s			m	From Lindley.
Cobourg. L. Syn. Cobourg Pippin	Eng	obc	s	g	fr		a			l	From Ronalds.
Cobourg Pippin. D. Syn. of Cobourg											
Cocca. A'89											Not described
Coccagee. GenF'33. Syn. Cocko Gee	Irc	rc	m	gy		y	a		c	m	From Hogg.
Cochran. P'95	Tenn.?	rc	l	gyr	f	y	sa	vg	dk	me	
Cockle. L. Syns. Brown Cockle, Cockle Pippin, Nutmeg Cockle, Nutmeg Pippin, White Cockle.	Eng	rc	m	gru	fc	y	sa	g		vl	
Cockle Pippin. GenF'33. Syn. of Cockle											
Cocklin. L. Syn. Cocklin's Favorite, Grandfather	Pa	rob	ms	wcb	vtjm	w	sa	vg		m	
Cocklin's Favorite. E. Syn. of Cocklin											
Cocko Gee. D. Syn. of Coccagee											
Cockpit. D.	Eng	rob	m	y	t		bsa	vg	dk	m	
Codlin. H. Syn. Royal Codlin		rob	m					g	k	me	
Codlin. H. Syn. of Keswick											
Codlin. H. Syn. of Old Codlin											
Codlin, English. Lin. Syn. of English Codlin											
Codling. DomEnc. Syn. of English Codlin											
Codling. IndF'40. Syn. of Trenton Early											
Codling. C. Syn. of Old Codlin											
Codling Keswick. W. Syn. of Keswick											
Coe. W. Syn. of Coe Golden											
Coe Golden. L. Syns. Coe, Coe's Golden Drop	Eng	rc	s	ycb	cj	y	bsa	g-vg	d	l	
Coe's Golden Drop. D. Syn. of Coe Golden											
Coe Greening. R. Syns. Coe's Greening, Coe's Late Greening	Conn		m	gb	fc		sa	g		vl	
Coe's Greening. A'85. Syn. of Coe Greening											
Coe Housewife. R. Syn. Coe's Housewife											Not described.
Coe's Housewife. MagofH'44. Syn. of Coe Housewife											
Coe's Late Greening. A'81. Syn. of Coe Greening											
Coe's Spice. MagofH'45. Syn. of Dyer											
Coeur d'Alene. BBL.											Do.
Coeur de France. R. Syn. Reinette Couer de France	Fr.?	r	s	dr		y		vg	d	ml	
Coeur de Pigeon. D. Syn. of Pigeon											
Coffelt. ArkB60. Syn. Coffelt Beauty	Ark	rob	ml	yrs	t	gy	msa	vg		vl	
Coffelt Beauty. SBro. Syn. of Coffelt											
Coffman. P'95. Syns. Summer Red, Koffman June	Tenn	robl	m	gyrs	fj	w	sa	g		e	
Coffman Favorite. R. Syn. Coffman's Favorite											Do.
Coffman's Favorite. IllH'86. Syn. of Coffman Favorite											
Co. Gent. L. Syn. Country Gentleman	N.J										Do.
Coggswell. MagofH'51. Syn. of Cogswell											
Cogswell. MagofH'49. Syns. Coggswell, Cogswell Pearmain, Cogswell's Pearmain, Mahaska, Ohio Nonpareil, Walbridge (?).	Conn	rob	ml	yrs	ftj	y	sa	vg-b	dm	l	
Cogswell Pearmain. MagofH'49. Syn. of Cogswell											
Cogswell's Pearmain. F. Syn. of Cogswell											
Cogulllette. IllH'96											Do.
Cohill. R. Syn. Cohill of Abbotsford											Do.
Cohill of Abbotsford. BBL. Syn. of Cohill											
Colburn. IllH'83											Do.
Cole. GenF'33. Syns. Cole Apple, Cole's Queen Apple, Duling, Scarlet Perfume.	Eng	robc	m	yc	fj	wy	sa	vg	d	m	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Cole Apple. K. Syn. of Cole											
Cole Ben Davis. SBro. Syn. of Cole Davis											
Cole Davis. R. Syn. Cole Ben Davis											Not described.
Coleman. L. Syn. Coleman's Red											Do.
Coleman. D. Syn. of Twenty Ounce											
Coleman's Red. Cat. Syn. of Coleman											
Cole's Queen Apple. F. Syn. of Cole											
Cole's Quince. Cole. Syn. of Quince (Cole)											
Colfax. P'94	Wash	robl	vl	yrs	fcj	y	sa	g	k	l	
Collett. DomEnc			l	rs			ma	g	c	ml	
Colley. A'60											Do.
Collins. ArkB49. Syns. Champion, Champion Red, Collins' Red, Coss' Champion, Coss' Red.	Ark	rob	ml	yrsc	mj	y		g	m	l	
Collins' Red. ArkB49. Syn. of Collins											
Colman. SDB76	Iowa	rob	l	yrs	j	w		vg	dm	ml	Origin with A. F. Colman, Corning, Iowa.
Colonel Vaughn's. D. Syn. of Vaughan Pippin											
Colonial. R. Syn. Colonial Pippin											Not described.
Colonial Pippin. BBL. Syn. of Colonial											
Colonial Washington. BBL											Do.
Colorado. L. Syn. Colorado Orange	Colo										Do.
Colorado Favorite. ColB17											Do.
Colorado Orange. Cat. Syn. of Colorado											
Colorado Red. ColB17											Do.
Colorado Seedling. ColB17											Do.
Colored Harbord's Pippin. GenF'33. Syn. of Harbord											
Colton. AmGar'91. Syn. Early Colton		rc	m	gyr	ft	w	sa	g	d	e	
Columbia. W. Syns. Columbia Hyde, Granny Hyde, Hyde	Conn	ob	m	gyrs	frmj	w	sa		dm	l	
Columbia Hyde. Dap. Syn. of Columbia								g-vg			
Columbian. D	Pa	obc	m	yrcs	tj	wy	sa	vg		m	
Columbian Russet. Lin. Syn. Brown's Imperial Russet		rob	m	ru			sa	b	d	vl	Warder says "much like Golden Pearmain."
Columbian Russet. D. Syn. of Clarke Pearmain											
Columbus. L. Syn. Columbus Red		r	m	rs			sa	g		l	
Columbus Red. W. Syn. of Columbus											
Colvert. D. Syn. Prussian		obc	l	gyrs	t	gw	bsa	g	k	m	
Colville Barre. D. Syn. of Barre											
Comak's Sweet. F. Syn. of Camak											
Commerce. IllH'97. [This is probably Beach.]											Not described.
Companion. W	South	ob					sa				

Company. MagofH'42										vl	Do.
Competitor. A'97	Va.?		l	rs				g-vg		ml	
Compote. GenF'33. Syn. of Padley											
Compote d'Orloff. IllB45. Syn. of Red Astrachan											
Compton. IllB45. Syn. Compton Climax											Do.
Compton Climax. CanH'93. Syn. of Compton											
Comstock. MagofH'50											Do.
Comstock's Garden. D. Syn. of Garden											
Con. R. Syn. Con's Seedling		c	m	r						l	
Conant. L. Syns. Conant's Red, Conant's Red Winter, Conant's Sweet	Ohio	rob	m	yru	fj	y	sa			m	
Conant's Red. W. Syn. of Conant											
Conant's Red Winter. MagofH'41. Syn. of Conant											
Conant's Sweet. T. Syn. of Conant											
Concombre Ancien. K. Syn. of Fall Pippin											
Concombre Ancien. E. Syn. of White Spanish											
Concombre des Chartreux. D. Syn. of Saint Julien											
Concord. R. Syn. Concord Pearmain											Do.
Concord Pearmain. A'81. Syn. of Concord											
Condit. L. Syn. Condit Sweet	N. J.	r	s	wyb	tj	y	ps	g		m	
Condit Sweet. D. Syn. of Condit											
Conford. Dap. Syn. of Pryor											
Conger. BBL											Do.
Congress. MagofH'47. Syns. Congress Apple, Jackson Apple, Tyler Apple.	Mass.	robe	l-vl	yrs	cjt	w	bsa	g		m	
Congress Apple. A'73. Syn. of Congress											
Conic June. Dap. Syn. of Kirkbridge											
Conkey. (LC)											Do.
Conkling. R. Syn. Conkling's Seedling											Do.
Conkling's Seedling. Hort'65. Syn. of Conkling											
Connecticut Apple. E. Syn. of Golden Ball											
Connecticut Cake. D. Syn. of Cake											
Connecticut Hunt. L. Syns. Baldwin (erroneously), Guttry, Hunt's Connecticut.		rob	l	rs	c	y	sa	g		l	
Connecticut Red. L. Syns. Connecticut Red Cheek, Connecticut Red Side, Connecticut Red Streak.	Conn	rob	ml	gyb	ctj	w	sa	g-vg	d	m	
Connecticut Red Cheek. Dap. Syn. of Connecticut Red											
Connecticut Red Side. Dap. Syn. of Connecticut Red											
Connecticut Red Streak. Dap. Syn. of Connecticut Red											
Connecticut Seek-no-further. D. Syn. of Westfield											
Connecticut Summer Sweet. D. Syn. of Connecticut Sweet											
Connecticut Sweet. L. Syn. Connecticut Summer Sweet	Conn.?	r	m	yrs		y	s			e	
Connett. L. Syn. Connett's Sweet		rob	l	yr	ft	y	s	vg	dk	l	
Connett's Sweet. T. Syn. of Connett											
Conquest de Vegers. MagofH'43. Syn. of Vegers											
Conrad. L. Syn. Conrad's Eating		ob					sa				
Conrad's Eating. W. Syn. of Conrad											
Cons. Dap	Pa.?	rc	s	wrs	tjm	w	sa	g-vg	d	e	
Con's Seedling. TCF. Syn. of Con. [Con may be same as Cons. R.]											
Constantine. IaH'80. Syn. Grand Duke Constantine	Rus.		l	rs	f		sa	g	km	m	
Contin. L. Syn. Contin Reinette	Scot	r	m	yr	f	y	pa			m	From Hogg.
Contin Reinette. D. Syn. of Contin											
Continental. BBL											Not described.
Converse. JVC											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Conway. MagofH'35		ob	m	gyb	cj	y	sa	vg		l	
Cook (Cal). BBL											Not described.
Cook Favorite. L. Syn. Cook's Favorite	Ind.	c	m				sa	g	k	e	
Cook's Favorite. W. Syn. of Cook Favorite											
Cook Greening. L. Syn. Cook's Greening		r	l	g			sa	g		l	
Cook's Greening. MagofH'53. Syn. of Cook Greening											
Cooke's Greening. D. Syn. of Wood Greening											
Cook Red. L. Syn. Cook's Red Winter	S.C		ml							l	
Cook's Red Winter. W. Syn. of Cook Red											
Cook Seedling. L. Syn. Cook's Seedling	Mo										Do.
Cook's Seedling. AlaB30. Syn. of Cook Seedling											
Cook's Seedling. Wn. Syn. of Sonoma											
Coole. R. Syn. Coole's Seedling											Do.
Coole's Seedling. S&W. Syn. of Coole											
Cooledge. L. Syn. Cooledge's Favorite	Mass.	rc	m	rs			sa	g		m	May be Coolidge.
Cooledge's Favorite. D. Syn. of Cooledge											
Coon. PFar'60	Ky.?		l	g	vj		sa	vg		mc	
Cooner. A'60											Not described.
Coon Red. L. Syn. Coon's Red	Ind.? Ill.?	rob	l	ybr	fvtj		sa	vg	dk	m	
Coon's Red. IllB45. Syn. of Coon Red											
Cooper. MagofH'47. Syns. Beauty Red, Lady Washington, Seeknofurther of some.		rob	l	gyrs	tj		sa	g	dk	m	
Cooper's Early White. D. Syn. of Early Cooper											
Cooper Market. L. Syns. Cooper's Market, Cooper's Red, Cooper's Redlin, Cooper's Redling, Redling, Regular, Ridley, Rigley, Wrigley.	N.J	obc	m	yrsc	t	w	sa	g	m	vl	
Cooper's Market. Hort'54. Syn. of Cooper Market											
Cooper of Ohio. FDNCo											Do.
Cooper Pride. R. Syn. Cooper's Pride	Ark	oblc	m	gy						ml	
Cooper's Pride. LTS. Syn. of Cooper Pride											
Cooper's Red. T. Syn. of Cooper Market											
Cooper's Red. Dap. Syn. of Etowah											
Cooper's Redlin. A'64. Syn. of Cooper Market											
Cooper's Redling. H. Syn. of Cooper Market											
Cooper Russet. L. Syn. Cooper's Russeting	N.J	obc	s	yru			s		ck	ml	
Cooper's Russeting. DomEne. Syn. of Cooper Russet											
Cooper Yellow. R. Syn. Cooper's Yellow	Ga	ob	l	yb	c		bs	vg		ml	
Cooper's Yellow. A'73. Syn. of Cooper Yellow											
Coos. R. Syn. Coos River											Do.
Coos River. BBL. Syn. of Coos											

Cope. R. Syn. Cope's Red Sweet	Ohio	obl	m	rs			s	g		l	
Cope's Red Sweet. W. Syn. of Cope											
Cope Sweet. L. Syn. Cope's Sweet	Ohio	r	m				s	g		l	
Cope's Sweet. W. Syn. of Cope Sweet											
Copmanthorpe Crab. D. Syn. of Dutch Mignonne											
Copperschmidt. A'79. Syn. of Ralls											
Copp's Mammoth. Dap. Syn. of Gloria Mundi											
Coquillette. JVC	Ill	ob	m	yr			sa	vg		e	
Coral. L. Syn. Coral Blush	Scot	r	m	gy	cj	y	bsa		k	ml	From Lindley.
Coral Blush. D. Syn. of Coral											
Corbin. D. Syn. of Catooga											
Cordwall. D. Syn. of Rymer											
Core. Cat											Not described.
Coriandre Rose. D. Syn. of Court-Pendu Plat											
Cork. R. Syn. Cork Russet	Mass.?	obl	l	ru			s	g	k	l	
Cork Russet. MagofH'35. Syn. of Cork											
Corlies. Hort'66. Syns. Corlies' Sweet, Corlies' Sweeting	N.J	re	m				s	g	ck	m	
Corlies' Sweet. C. Syn. of Corlies											
Corlies' Sweeting. Lin. Syn. of Corlies											
Cornell. (LC). Syns. Black's Annette, Cornell's Fancy, Carnel's Favorite, Cornell's Favorite.	Pa.? Va.?	oble	m	yrc	tmj	w	sa	vg	d	e	
Cornell's Early. Dap. Syn. of Annitte (of Black)											
Cornel's Early. Lin. Syn. of Sine-qua-non											
Cornell's Fancy. D. Syn. of Cornell											
Cornell's Favorite. Dap. Syn. of Annette (of Black)											
Cornell's Favorite. D. Syn. of Cornell											
Cornell's Savewell. D. Syn. of Savewell											
Corner. P'94	N.Y	ob	m	yrs	ftj	y	msa	vg	d	ml	
Cornfield. W	South	rob	m	yrs	ft	y	sa	g	d	ml	
Cornish Aromatic. GenF'33	Eng	r	m	rru		y	sa	g		m	
Cornish Gilliflower. GenF'33. Syns. Calville d'Angleterre, Cornish July Flower, Cornwallisser, Egg Top of some, July Flower, Nelken Apfel, Pomme Regelans, Red Gilliflower.	Eng	re	m	gyrs	fr	y	sa	g	dk	vl	
Cornish July Flower. GenF'33. Syn. of Cornish Gilliflower											
Cornish Spice. D		ob	s	gy	cj	y	sa	g		m	
Cornwall. L. Syn. Cornwall Golden Sweet	Vt.?	re	ms	yb	ftmj	w	s			ml	
Cornwall Golden Sweet. Dap. Syn. of Cornwall											
Cornwallisser. D. Syn. of Cornish Gilliflower											
Corona. P'94. Syn. Corona Pippin	N.Y	rob	l	y	f	y	msa	g	dm	l	
Corona Pippin. P'94. Syn. of Corona											
Corp Choice. P'94	Ohio	rob	m	gys	tj	y	msa	vg	d	l	
Corse. L. Syn. Corse's Favorite	Can	ob	m	yg	j	w	bsa	g	k	m	
Corse's Favorite. IndF'40. Syn. of Corse											
Corse's St. Lawrence. T. Syn. of St. Lawrence											
Corse Sweet. R. Syn. Corse's Sweeting											Do.
Corse's Sweeting. MagofH'45. Syn. of Corse Sweet											
Corset. R. Syn. Corset Hill											Do.
Corset Hill. BBL. Syn. of Corset											
Corwin. MagofH'53											Do.
Cos. NEF'29. Syns. Caus, Cas	N.Y	r	l	gyb	t	w	sa	g-vg	dm	l	
Coss' Champion. ArkB49. Syn. of Collins											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Coss' Red. SBro. Syn. of Collins											
Costard. D. Syns. Coulthard, Prussian Pippin	Eng	robl	l	yg	tj	gw	bsa			ml	From Hogg.
Costard (Green). BBL											Perhaps same as preceding.
Costin. L. Syn. Costin's Seedling											Not described.
Costin's Seedling. Cat. Syn. of Costin											
Cote. L. Syn. Calville Blanche à Cote's	Fr	c	m	gyr	ft	w	a			l	From the Verger.
Cotsville. L. Syn. Cotsville Spitzenberg	Ohio	rc	m	web	tj	ws	pmsa	vg	d	l	
Cotsville Spitzenberg. D. Syn. of Cotsville											
Cotterals. R. Syns. Cotterals No. 1, Cotterals Seedling	Minn	obl	l	gyb		w	a		k	m	
Cotterals No. 1. SDB76. Syn. of Cotterals											
Cotterals Seedling. SDB76. Syn. of Cotterals											
Cotton. A'58			l	y				vg		ml	
Cotton Apple. D. Syn. of Chronical											
Coulon. L. Syn. Reinette Coulon	Belg	robc	vl	gy	c	w	sa	g		ml	From Annals of Pomology.
Coulthard. D. Syn. of Costard											
Count Orloff. NYExR'92	Rus	c	m	gr		w		p		l	Perhaps same as Orloff.
Country Gentleman. Cat. Syn. of Co. Gent											
Courpendu. DomEnc. Syn. of Court-Pendu Plat											
Court Blanche. R. Syn. Court-Pendu Blanche											Not described.
Court de Wick. MagofH'46. Syn. of Wick											
Courtney. R. Syn. Courtney Seedling											Do.
Courtney Seedling. MoH'92. Syn. of Courtney											
Court of Wick. GenF'33. Syn. of Wick											
Court of Wick Pippin. D. Syn. of Wick											
Court of Wyck. Syn. of Wick											
Court-pendu. C. Syn. of Court-Pendu Plat											
Court Pendu Blanche. MoH'67. Syn. of Court Blanche											
Court Pendu de Tournay. D. Syn. of Tournay											
Court Pendu Dore. D. Syn. of Golden Reinette											
Court-pendu Extra. GenF'33. Syn. of Court-Pendu Plat											
Court-Pendu Gris. GenF'33. Syn. of Fenouillet Rouge											
Court-pendu Musque. D. Syn. of Court-Pendu Plat											
Court-Pendu Plat. GenF'33. Syns. Capendu, Coriandre Rose, Courpendu, Court-pendu, Court-pendu Extra, Court-pendu Musque, Court-pendu Plat rougeatre, Court-pendu Rond Gros, Court Pendu Rose, Court-pendu Rouge Musque, Garnon's Apple, Pomme de Berlin, Princess Noble Zoëte, Russian, Wallaton Pippin.	Fr	ob	m	gyc	c	y	bsa	g		ml	
Court-pendu Plat rougeatre. D. Syn. of Court-Pendu Plat											
Court-pendu Rond Gros. D. Syn. of Court-Pendu Plat											
Court Pendu Rosat. D. Syn. of Court-Pendu Rose											
Court Pendu Rose. D. Syn. Court Pendu Rosat	Fr	rob	s	yr	fj	w	a	g			From Annals of Pomology.

Court Pendu Rose. D. Syn. of Court-Pendu Plat											
Court-pendu Rouge Musque. D. Syn. of Court-Pendu Plat											
Cousin. R. Syn. Cousin German											Not described.
Cousin German. IllH'90. Syn. of Cousin											
Cove. A'91	Tenn		l	r				vg	m	l	
Covington. A'60											Do.
Cowan. R. Syn. Cowan's Seedling											Do.
Cowan Queen. R. Syn. Cowan's Queening											Do.
Cowan Queening. GenF'33. Syn. of Cowan Queen											
Cowan's Seedling. A'75. Syn. of Cowan											
Cowan Winter. L. Syn. Cowan's Winter											Do.
Cowan's Winter. Cat. Syn. of Cowan Winter											
Cowarne. L. Syns. Cowarne's Queening, Northern Greening	Eng.?	rc	vl	yr	t	w			k	ml	From Ronalds.
Cowarne Queen. L. Syns. Cowarne Queening, John Apple, Northern Queening, Walmer Court.											
Cowarne Queening. L. Syn. of Cowarne Queen											
Cowarne's Queening. D. Syn. of Cowarne											
Cowarne Red. D	Eng	rc	m	yr					c		From Hogg.
Cowen. R. Syn. Cowen Seed											Not described.
Cowen Seed. BBL. Syn. of Cowen											
Cox Orange. L. Syn. Cox's Orange Pippin	Eng	ob	m	yrc	fj	y	bsa	vg	d	m	
Cox's Orange Pippin. D. Syn. of Cox Orange											
Cox Pomona. L. Syn. Cox's Pomona	Eng	obc	m	gyc	cj	w	bsa	g	k	m	
Cox's Pomona. D. Syn. of Cox Pomona											
Cox Red Leaf Russet. BBL. Syn. of Cox Russet											
Cox Russet. R. Syn. Cox Red Leaf Russet											Do.
Cox Seedling. MagofH'52. Syn. Cox's Seedling											Do.
Cox's Seedling. A'52. Syn. of Cox Seedling											
Craam. GenF'33. Syn. of Cram											
Crab Hagloe. Lin. Syn. of Hagloe Crab											
Crackling. E	Ohio	robe	l	gyr	ctj	yw	sa	g	k	m	
Crackson. MichB31											Do.
Craddock. TennBI-IX	Tenn	rc	l	wy	fj		sa	g		ml	
Crafton. GarCal											Do.
Craghead. MoH'86											
Crain. BBL											Do.
Craine Spice. R. Syns. Craine's Spice, Craine's Spicy Winter	Ill	obc	ms	dr	ft	ws	a	g		ml	
Craine's Spice. Dap. Syn. of Craine Spice											
Craine's Spicy Winter. IllH'68. Syn. of Craine Spice											
Cram. D. Syns. Craam, Kraam, Kram		r	m				s	g		l	
Crampton's Seedling No. 1. WisHort'99											
Crampton's Seedling No. 2. WisHort'99											
Crampton's Seedling No. 3. WisHort'99											
Cranberry. MagofH'53	Ga	rc	m	yrs		w		g			
Cranberry (incorrectly). Hort'75. Syn. of Black Coal											
Cranberry Pippin. D	N.Y	rob	m	gyb	mj	w	bsa	g	km	l	
Cranberry Pippin (incorrectly). Dap. Syn. of Black Coal											
Cranberry Russet. W	Ohio	ob	ml	ru	tmj		ba	g	k	ml	
Crane's Pippin. E. Syn. of Ortley											
Crane Spice. R. Syn. Crane's Spice. [Probably Craine Spice.]											Do.
Crane's Spice. IllB45. Syn. of Crane Spice											
Cratchfield. NEF'32	Va							g		l	
Crawford. D		robe	m	yc	tj	y	sa	vg		ml	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Crawford. ArkB60. Syn. Crawford Pippin	Ark	rob	ml	yr	mj	y	sa	vg		ml	Probably same as preceding.
Crawford Keeper. Hort'57. Syn. Crawford's Keeper	Ohio	rc	m	gyr	mj	yw	bs	g-vg	d	l	
Crawford's Keeper. W. Syn. of Crawford Keeper											
Crawford Pippin. ArkB60. Syn. of Crawford											
Cray. L. Syn. Cray Pippin	Eng	c	ms	yb	c	y	s		d	m	From Hogg.
Cray Pippin. Syn. of Cray											
Crayton. A'67			ml							l	From Sumner's manuscript.
Crayton Seedling. A'81											Not described.
Cream. NEF'31	N. Y	rob	ms	y	ftj	y	ps		dk	m	
Cream. IllH'92. Syn. of Ned											
Crede. L. Syns. Crede's Quittenreinette, Credo's Gutten Reinette	Ger	r	m	gy	vfj	w	sa			l	From Hogg.
Crede's Quittenreinette. D. Syn. of Crede											
Credo's Gutten Reinette. D. Syn. of Crede											
Creed's Marigold. D. Syn. of Marigold											
Creek. A'67	Pa	obc	m	gyrs	tjm	w	psa	vg	d	l	
Creek. IllB21. Syn. of Ned											
Creeper. D	Eng	rc	ms	grs	tj	w	s			m	Do.
Crego. L. Syn. Crego Red Streak	N. Y	rob	m	wrs	tj	w	sa	p		m	
Crego Red Streak. D. Syn. of Crego											
Creighton. W	Ohio	ob	m				sa	g		ml	
Cresco. IaH'97	Iowa	robl	m	pyb		w	psa	g		m	Origin with J. B. Mitchell, Cresco, Iowa.
Creswell. P'95		rc	l	gysc			sa	g		ml	
Crib. W	Ohio	obl	m				sa	g		l	
Crimea. Gb. Syn. V. R. S. to Ia. No. 18	Rus	r	l					vg		l	
Crimean Bogdanoff. CanExR'01											Not described.
Crimean Naliv. Gb. Syns. Gov. list No. 563, Juicy Krimtarter, Krimskoe Nalivnoe, Krimskoo Naliwnoe.	Rus										Do.
Crimean (Vochin). L. Syns. Gov. list No. 228, Krimskoe Vochina, Krimskoe Wochina, Vochin's Crimean.	Rus										Do.
Crimson. R. Syn. Sweet Crimson	Ky										Do.
Crimson Beauty. CanExR'95	Ont.?	ob	m	brc	fj	w	msa	g		l	
Crimson Devonian. BBL. Syn. of Devonian											
Crimson Nonpareil. MagofH'45	Ohio?										Do.
Crimson Pippin. D. Syn. of Black Detroit											
Crimson Pippin. Cole. Syn. of Red Detroit											
Crimson Prolific. Cat											Do.
Crimson Queen. L. Syns. Crimson Queening, Herefordshire Queening, Red Queening, Scarlet Queening, Summer Queening.	Eng	c	m	dc	tj	ws	s			l	From Hogg.
Crimson Queening. D. Syn. of Crimson Queen											
Crispin. D		robl	l	grs	c	w	sa	g		vl	

Crittenden. D	Ky	r	m	yr	j		vs	g		vl	
Crocker. A'87	Wis	robl	l	rs			msa				
Crockett. R. Syn. Crockett Co. Keeper	Tenn							g		l	
Crockett Co. Keeper. TCF. Syn. of Crockett											
Crockson. BBL											Not described.
Crofton. L. Syn. Crofton Pippin	Ire	rob	ms	gr	frj					ml	From Ronalds.
Crofton Pippin. D. Syn. of Crofton											
Crook. L. Syn. Crook's Seedling	Ind		m	rsy				g	m	m	
Crooked Limb. W. Syn. of Dumpling											
Crooked Limb Pippin. E. Syn. of Dumpling											
Crooked Red. IllB45. Syn. of Pennock											
Crooked Spiced. IaH'83. Syn. of Crooked Spike											
Crooked Spike. MHSC'86. Syns. Crooked Spiced, Curly Spiced Apple, Gov. list No. 197, Krivospitsa, Krivospitsoe, Kriwospizoe, Shro. to Ia. No. 159.	Rus										Not described.
Crook's Seedling. D. Syn. of Crook											
Cropsey. L. Syn. Cropsey's Favorite	Ill	r	m	y	fj	y	bsa			ml	
Cropsey's Favorite. W. Syn. of Cropsey											
Cross. T	Md	rob	l-vl	gwrs	tj	w	msa		km	me	
Cross. MHSC'81. Syns. Gov. list No. 413, Skrijapel, Shro. to Ia. No. 15, Skrischapfel.	Rus	ob	ml				sa	vg		l	
Crossed Barbel. Gb. Syn. of Polumiron											
Cross No. 15 M. P'92											
Crotcher. Hort'67	Md.?	obc	m	wb	ctj	sw	sa	vg		me	
Crotts. DelExR'95											Do.
Crouse. RNY'71			m	gyrs		gw	sa	g		ml	
Crowegg. GenF'36. Syn. Crow's Egg		oblo		gy			s			m	
Crowegg. D	Ky.?	e		yrs	c	y	sa	g		ml	
Crowegg. L. Syn. Crow's Egg	Ind	oble	m				s	g		ml	
Crow's Egg. K. Syn. of Crowegg											
Crow's Egg. W. Syn. of Crowegg											
Crowell. R. Syn. Crowell's Beauty											Do.
Crowell's Beauty. WmP. Syn. of Crowell											
Crowley. MagofH'53											Do.
Crown. MagofH'44	Mass	obl	l	r				vg			
Crownest. L. Syn. Crow Nest	South	robl	ml				sa	g	k	ml	
Crownest. D	Ohio	rob	ml	gyru	t	g	bsa	g	k	ml	
Crow Nest. L. Syn. of Crownest											
Crownest (Russet). R. Syn. Crow Nest (Russet). [May be Crownest of D. and W.].											Do.
Crow Nest Russet. MagofH'52. Syn. of Crownest (Russet)											
Crowninshield. R. Syn. Crowninshield Sweet	Mass	r	m	y			s			me	
Crowninshield Sweet. MagofH'41. Syn. of Crowninshield											
Crown Prince Rudolph of Austria. CanExR'01. Syn. of Rudolph											
Crumpton. TWW&S		ob	m	dr				vg		e	
Crutchfield Greening. Dap. Syn. of Bullett											
Cuba. P'94	Wis	oble	ml	yr	fj	y	msa	vg		l	
Cull. Cat											Do.
Cullasaga. W. Syn. Callasaga	N.C	rc	ml	yrsc	mj	y	sa	g		l	
Cullawhee. Hort'58	South	obc	ml	yrs	tj	w	bsa	g		l	
Cullen. A'87. Syn. Cullins' Keeper		robl		wg			sa			vl	
Cullins. KHN. Syn. Cullins' Keeper	Kans	obl		wg	tc		b			vl	Probably same as preceding.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Cullins' Keeper. KHN. Syn. of Cullins or Cullen											
Culloden. W	South	c		rs			sa				
Culvert. DDH. [This may be Colvert.]			l	rs	t		sa			ml	
Cumberland. E. Syns. Cumberland Seedling, Cumberland Sweeting(?)	Pa	obc	m	yrc	fj	y	bsa	g-vg		m	
Cumberland Black. D. Syn. of Dodge Crimson											
Cumberland Seedling. E. Syn. of Cumberland											
Cumberland Spice. C	N. J	rc	ml	gy	tj	w	psa	g	dk	ml	
Cumberland Spice. Wg. Syn. of Ortley											
Cumberland Sweeting. H. Syn. of Cumberland (probably)											
Cummings. Cat	Ill										Not described.
Cumming's Rambo. A'77. Syn. of Grosh											
Cummings Red. JVL											Do.
Cunningham. P'93. Syn. Cunningham Cheese	Va	ob	m	gyrs			bmsa	vg			
Cunningham Cheese. P'93. Syn. of Cunningham											
Cup. MagofH'53											Do.
Curiosity. RNY'70	Wis								k		
Curly Spiced Apple. Gb. Syn. of Crooked Spike											
Curly Spiced Aromatic. Gb. Syn. of Aromatic Spike											
Curry. L. Syn. Curry's Red Winter	N. C.?	obl	m	yru	f	w				l	From Southern Cultivator.
Curry's Red Winter. Hort'69. D. Syn. of Curry											
Curtes Levantine. MagofH'52. Syn. of Levantine											
Curtis. NEF'30		r	m				sa?	g	d	me	
Curtis Early. R. Syn. Curtis Early Striped. [May be Striped Shropsavine.]											Not described.
Curtis Early Striped. MagofH'39. Syn. of Curtis Early											
Curtis Greening. W	Ill?	obl	ml	y		y	bsa	g		l	Identical with Illinois Greening.
Curtis Greening. Dap. Syn. of New Greening (?)											
Curtis Pippin. W			m				sa	g		l	
Curtis Russet. CGen'60			m	yru	j		psa	vg			
Curtiss Early Stripe. Cole. Syn. of Striped Shropsavine. [Probably same as Curtis Early.]	Ill	obl									
Curtis Sweet. D	Vt	re	l	yc	fvt	w	s	g		m	
Cushing. MagofH'38.											Not described.
Cushman's Black. D. Syn. of Red Calville											
Custard. D	N. Y	robc	ms	yr	vtjm	w	msa	vg	d	m	
Custard. IllB21. Syn. of Ned											
Custer. R. Syn. Custer's Golden Sweet			m	y			s			l	
Custer's Golden Sweet. WisB45. Syn. of Custer											
Cut. L. Syns. Cut Pippin, Haymaker, Hommacher Apfel, Honemaker Pippin, West's Spitzenberg.	Pa		ml	g	j	g	sa	g		l	

Cut Apple. Gb. Syn. of Rubets											
Cut Pippin. A'52. Syn. of Cut											
Cuttahee. BBL											Do.
Cuttugaja. D. Syn. of Catooga											
Cut-Wine Apple. Gb. Syn. of Wine Rubets											
Cyclone. BBL											Do.
Cypert. L. Syn. Cypert Limbertwig											Do.
Cypert Limbertwig. Cat. Syn. of Cypert											
Cyprian. MagofH'53											Do.
Cyrus. R. Syn. Cyrus Russell											Do.
Cyrus Russell. MoH'63. Syn. of Cyrus											
Czar. L. Syn. Czar of Russia											Do.
Czar of Russia. Cat. Syn. of Czar											
Czar Thorn. Gb. Syns. Czar's Thorn, Gov. list No. 206, Shro. to Ia. No. 140, Tsarkui Schip, Tsarskui Schip, Zarski Schip	Rus										May be same as Czar.
Czar's Thorn. SDB76. Syn. of Czar Thorn											
Dabney. P'95	Tenn	rob	l	gyrs	tj	y	sa	vg		me	
Dacomie. Cat											Not described.
Daddy. D. Syn. of Rebecca											
Dahlonega. W	South	rc	m	gyc	tj	w	sa	g		l	
Dahlton. D. Syn. of Dalton											
Dahlton Pippin. A'68. Syn. of Dalton											
Dainty Apple. D. Syn. of Hoary Morning											
Daisy. MeExR'96	Minn	ob	m	yb	j	w	sa	g		ml	
Dale. L. Syn. Dale's Seedling	Pa	robc	m	wrs	ftm	w	msa		k	m	
Dale's Seedling. Dap. Syn. of Dale											
Dale's Sweet Fall Queen. D. Syn. of Sweet Queen											
Dallas. KanFM. Syn. Mrs. Dallas	Kans	robc	m	ysc	j	y	sa	g		vl	
Dalton. W. Syns. Dahlton, Dahlton Pippin		ob	m	gyb	jtm	w	sa	g		m	
Dam. AlaB98											Do.
Dame Jeannette. D. Syn. of Jeannette											
Dames. Cat	Ill										Do.
Dan. L. Syn. Dan Pearmain	Ind	rob	ms	yrs	tm	y	bsa	vg	dkm	l	
Dana. MagofH'46. Syn. Dana's Baker	Ohio	ob	s	yrs	f	y	sa	g	d	me	
Dana's Baker. H. Syn. of Dana											
Dana Greening. D		ob	ms	gy	c	w	psa	g		l	
Dana's Striped Sweet. D. Syn. of Dana Sweet											
Dana Sweet. L. Syn. Dana's Striped Sweet	Ohio	ob	ms	yrs	ejm	w	ps	g		l	
Dancer. Hort'54											Exhibited at N. W. Fruit Growers' convention, 1853.
Daniel. IndF'40	Ind	rob	m	gyrs	ftj	w	sa	g		me	
Daniel. R. Syn. Daniel's Apple		rc	m	gc	ctj	w	sa	p		m	
Daniel's Apple. IndF'40. Syn. of Daniel											
Dan Pearmain. W. Syn. of Dan											
Dan Pry. A'77											Not described.
Dansie Pipka. Gb. Syns. Pipka Dantsigskaya, Shro. to Ia. No. 25	Rus										Do.
Dantzic Kant. CanExR'01		r	ml	gr	cj	w	sa	g		me	
Dantzig. L. Syn. Dantzig's Ribbed			l	r				vg	d	l	
Dantziger. R. Syns. Dantziger Kant, Dantziger Kantapfel	Prus		l		fj			g		l	
Dantziger Kant. IaB90. Syn. of Dantziger											
Dantziger Kantapfel. IndB53. Syn. of Dantziger											
Dantzig's Ribbed. AndN. Syn. of Dantzig											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Danvers. L. Syns. Danvers' Sweet, Danvers' Winter Sweet, Epse's Sweet, Epse's Sweeting.	Mass.	robl	m	gy	f	y	s	vg	dk	l	
Danvers' Sweet. A'95. Syn. of Danvers											
Danvers' Winter Sweet. M. Syn. of Danvers											
Danziger. R. Syn. Danziger Kantapfel											Not described.
Danziger Kantapfel. MHSC'81. Syn. of Danziger											
Dapper. MagofH'53	Ga	rob	s	y							From Pennsylvania report.
Dapple. L. Syn. Old Dapple		c	m				sa	g		ml	
Darby. L. Syn. Darby Pippin	Pa	obl	l				sa			l	
Darby Pippin. W. Syn. of Darby											
D'Arcy. R. Syn. D'Arcy Spice											Not described.
D'Arcy Spice. BBL. Syn. of D'Arcy											
Dark Red. BBL. Syn. Dark Red Seedling	{Ill.? {Ark.?		ml	r	f			vg	km	l	
Dark Red Seedling. IllH'89. Syn. of Dark Red											
Dark Red Streak. IndF'40. Syn. of Murphy											
Darling. L. Syn. Darling Pippin	Eng	oble	m	gy	fj	y	psa			ml	From Lindley.
Darling Pippin. D. Syn. of Darling											
Darling Russet. MagofH'44. Syn. of Darlington											
Darlington. E. Syns. Darlington Russet, Darling Russet	Ohio	r	m	ru		w		g-vg		vl	
Darlington Russet. E. Syn. of Darlington											
Darrow. R. Syn. Darrow's Winter Sweet											
Darrow's Winter Sweet. NWFG'52. Syn. of Darrow											
Darte. L. Syn. Darte's Hybrid. [Probably Dartt]											Not described.
Darte's Hybrid. Cat. Syn. of Darte											
Dartmouth. T. Syn. Dartmouth Sweet	Mass.	ob	m	y	mjt	y	s	g		m	
Dartmouth Sweet. D. Syn. of Dartmouth											
Dartt's Greenwood. SDB26. Syn. of Greenwood											
Dartt's Porch. MinnExR'90. Syn. of Porch											
Davage. Dap. Syn. Davidge. ["Davidge," probably correct.]	Ill	ob	m	wr	fj	w	sa	g-vg	d	vl	Judge Brown, of Illinois, in IllH'69, said it was Davidge.
Davenport. R. Syns. Davenport Pippin, Golden Pippin	N. Y.		ml	y	c		msa				
Davenport Pippin. Hort'69. Syn. of Davenport											
David. R. Syn. David's Winter		rob	ml	yr	tj	y	sa			l	
Davidge. IllH'69. Syn. of Davage. [Davidge probably correct. See IllH'69,30].											
Davidson. A'77	Va		m	y				vg		m	
Davidson's Mutton. FDNCo. Syn. of Mutton											
David's Winter. A'89. Syn. of David											
D'Asterus. K. Syn. of Asterus											

Davis. C				ru					ke	m	
Davis. Hort'49	Miss		m							l	
Davis. D	Mich	rob	s	yrsm	fej	w	sa	g		vl	
Davis. A'73 [Probably distinct]											Not described.
Davis. D. Syn of Ortley											
Davis Golden. R. Syn. Davis Golden Pippin											
Davis Golden Pippin. PFar'52. Syn. of Davis Golden											
Davis Ortley. L. Syn. Davis' Ortley	Ind	obl	l				sa	g		l	
Davis' Ortley. W. Syn. of Davis Ortley											
Davis Russet. IllH'74											Do.
Davis Sweet. AJofHI	Ohio	robc	m	yrc	f	y	s	g		vl	
Davis White Bellflower. D. Syn. of Ortley											
Dawes. A'77. Syns. Dawes Nonsuch, Dawes Porter	Mass	robc	m	yr	ftj	wy	sa	vg		m	
Dawes Nonsuch. A'77. Syn. of Dawes											
Dawes Porter. A'77. Syn. of Dawes											
Dawson. L. Syn. Dawson's Cluster	Ohio	oblob	m	gyb	tj	yw	sa	g		m	
Dawson's Cluster. W. Syn. of Dawson											
Day. W. Syn. Royal Pippin	Ky	rc	ml	wyrs	f	w	bsa	p	km	l	
Day (Me.). N	Me	obc	ml	gy	t		sa	vg		m	
Dayton. D. Syn. Haley	Me	rc	m	wyrs	tj		sa	g		ml	
Dayton Pippin. IndH'72											Do.
Deacon. L. Syn. Deacon's Pryor	Ky	r	l	ru			sa	g		l	
Deacon Job. MagofH'47. Syn. of Job											
Deacon's Pryor. W. Syn. of Deacon											
Deaderick. P'95. Syn. Ben. Ford, Ozark Pippin	Tenn	rc	l	y	mj	y	sa	g		l	
Deal. L. Syn. Deal's Red	Ind	ob	m				sa	g		l	
Deal's Red. W. Syn. of Deal											
Dean. A'73. Syns. Deane, Nine Ounce	Me.?	robc	m	rs			sa			m	
Deane. Hort'69. Syn. of Dean											
Dean Sweet. R. Syn. Dean's Sweeting	Ind	r	m				s	g	k	l	
Dean's Sweeting. W. Syn. of Dean Sweet											
De Boutigne. D. Syn. of Botigne											
De Bretagne. GenF'33. Syn. of Canada Reinette											
Decarie. Dap	Que	obc	m				sa			m	
December. L. Syn. December Russet	Ohio									l	
December Russet. H. Syn. of December											
Decker. MagofH'53											Do.
Defiance. W	Ohio	obc	m	yrs	t	w	sa	g		me	
Degruchy. W	South		l				sa			l	
Delasure. W	do	r					sa				
Delaware. K. Syn. Trumpington		ob	m	gyr	fr		sa			m	From Ronalds.
Delaware. D. Syn. of Rambo											
Delaware Bottom. Hort'68	Md.?	ob		yb			sa	g	k	ml	
Delaware Harvey. A'75											Not described.
Delaware Late Spice. Cat. Syn. of Delaware Spice											
Delaware Red. (LC). Syn. Delaware Red Winter. [Probably Lawver.]	Ohio										Do.
Delaware Red Winter. Cat. Syn. of Delaware Red											
Delaware Red Winter. JWK. Syn. of Lawver											
Delaware Spice. L. Syn. Delaware Late Spice											Do.
Delaware Superior. AmF'50											
Delaware Sweet. ColExR'88											Do.
Delaware Winter. A'87. [Probably Lawver.]											Do.
Delicious. SBro	Iowa	oblc		yrs				vg		l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Delight. E	Ohio	rob	m	yrub	fm	y	msa	g		l	
De Long. A'75. Syn. Iowa	Iowa	robe	ml				sa		dk	m	
Democrat. PFar'53. Syn. Varich	N. Y	rc	ml	wyrc	tj	ws	sa	vg		l	
Democrat. W	Ohio	rc	m	yb	j	y	bsa	g-vg	d	ml	
Demorest. P'95	Ga	rob	m	yrcs	ftj	w	msa	vg		e	
Demurry. W	South										Not described.
Denandere. L. Syn. Denandere Pippin											Do.
Denandere Pippin. Cat. Syn. of Denandere											
Dennis. R. Syn. Bear's Dennis											Do.
Dennison's Redding. NEF'50. Syn. of Redding											
Denver. R. Syn. Denver's Sweet. [May be Danvers.]											Do.
Denver's Sweet. WashB26. Syn. of Denver											
Deoma. SDB76	Minn	rob	l	yb	j	w	sa	g	k	l	
Department Cross. IaB90	Rus		l							ml	
Deploge. R. Syn. Deploge's Seedling	Ill		ml				sa	vg		ml	
Deploge's Seedling. IllH'75. Syn. of Deploge											
Deptford. R. Syn. Deptford Inn				br				g	k	l	
Deptford Inn. GenF'33. Syn. of Deptford											
De Rateau. K. Syn. of Fall Pippin											
De Ratteau. E. Syn. of White Spanish											
Derby. L. Syn. Derby Seeknofurther	Vt	ob	ml	yrs				vg	dm	l	
Derby Seeknofurther. A'73. Syn. of Derby											
Der Carpentin. D. Syn. of Carpentin											
Derrickman. D. Syn. of Richard											
Derrick's Graft. D. Syn. of Richard											
Derry. L. Syns. Derry Nonsuch, Dinsmore, Londonderry	N. H	oblc	m	yc	jt	y	sa	g		vl	
Derry Nonsuch. D. Syn. of Derry											
Dery. CanExR'93. Syns. Alexis Baldwin, Dery's Seedling, Pomme de Fer.	Que	ob	ml	gr	f	gw	sa			vl	
Dery's Seedling. CanExR'93. Syn. of Dery											
De Saint Julien. GenF'33. Syn. of Saint Julien											
Deseret. R. Syns. Pride of the Valley, Deseret Pippin	Utah?	obl	l	y			s			m	
Deseret Pippin. A'69. Syn. of Deseret											
Des Femmes. IllB45			ml				a			l	
D'Espagne. GenF'33. Syn. of White Spanish											
D'Espagne (erroneously). K. Syn. of Fall Pippin											
Deterding. R. Syn. Deterding's Early Red		obc		rs						e	Probably the Red Astrachan.
Deterding's Early. MoH'63. Syn. of Red Astrachan											
Deterding's Early Red. MoH'63. Syn. of Deterding											
Detroit. E. Syn. of Black Detroit. [It is doubtful if this and the following are distinct.]											

Detroit. D. Syn. of Red Detroit											
Detroit. Hort'47. Syn. of Ortley											
Detroit Black. D. Syn. of Black Detroit											
Detroit of the West. Cole. Syn. of Ortley											
Detroit Red. D. Syn. of Red Detroit											
Deutscher Skrut. Gb. Syn. of German Skrute											
Deux Annee. DomEnc. Syn. John Apple	Eng	obc	s						c	vl	
Deux Ans. L. Syn. Hunt's Deux Ans	Eng	robc	m	ru	fj	yw	a		d	vl	
Deux Recollettes. IllH'68											Not described.
D'Eve. D. Syn. of Doux											
De Vilbis. R. Syn. De Vilbiss' Seedling											Do.
De Vilbiss' Seedling. IndH'97. Syn. of De Vilbis											
Devonian. R. Syn. Crimson Devonian											Do.
Devonshire. R. Syns. Devonshire Buckland, Dredge's White Lily, Lily Buckland, White Lily.	Eng	rob	ml	y	cj	y	bs		k	l	From Hogg.
Devonshire Buckland. D. Syn. of Devonshire											
Devonshire Duke. L. Syn. Duke of Devonshire	Eng	r	m	gyb	ej	y	s	g	d	vl	Do.
Devonshire Golden. L. Syn. Devonshire Golden Ball	Eng	r	l	gy		s	a			l	From Ronalds.
Devonshire Golden Ball. D. Syn. of Devonshire Golden											
Devonshire Quarrenden. NEF'32. Syn. of Quarrenden											
Devonshire Queen. D.	Eng	rob	ml	gyrs	j		a		dk		Do.
Devonshire Red. L. Syn. Devonshire Red Streak	Eng	re	m	yrs	t	y	bsa	g		m	
Devonshire Red Streak. D. Syn. of Devonshire Red											
Devonshire Royal Wilding. DomEnc. Syn. of Devonshire Wilding											
Devonshire Wilding. D. Syn. Devonshire Royal Wilding	Eng	r	m	yg	f		a		c		
Dewees. W	Ind	c	ml				sa	g		ml	
De Wigers. R. Syn. De Wigers Conquest		r		py				g	d	vl	
De Wigers Conquest. GenF'33. Syn. of De Wigers											
Dewey. L. Syn. Dewey's Seedling											Not described.
Dewey's Seedling. Cat. Syn. of Dewey											
De Witt. C. Syn. of Doctor											
De Wolf. KanExR'89											Do.
Dexter. A'60											Do.
Dick. L. Syn. Dick's Seedling	Pa	r	m	gsc	f		sa	g		ml	
Dick Dowdy. BAC	Mo	r	bl	rs				vg	m	l	
Dickenson. A'85. Syn. Dickerson	Pa			ygrs	j		sa	vg		l	Probably same as Dickinson.
Dickerson. FDNCo. Syn. of Dickenson											
Dickey. P'91	Ohio	ob	m	yrs	fm	y	sa	vg		l	
Dickie Red. BBL											Not described.
Dickie Summer. BBL											Do.
Dickinson. IndH'85	Pa	roblc	ml				sa	g		l	Probably same as Dickenson.
Dick Morton. TJG&S											Not described.
Dick's Seedling. A'56. Syn. of Dick											
Dickskill. Lin	N. Y	ob	m	gyrs	cjt	w	msa	g		ml	
Dickson. L. Syn. Dickson's Emperor	Scot		l	yrs	j	yw		g		ml	
Dickson. NYExR'93	Pa	rc	vl	yrs	fcj		bmsa	vg		l	
Dickson's Emperor. Hort'51. Syn. of Dickson											
Dickson's Emperor. E. Syn. of Emperor											
Diel. L. Syns. Diel Kernobst, Diel Reinette, Reinette Diel	Belg	rob	ms	yrc	fcj	w	sa		d	l	Raised by Van Mons.
Diel Bellflower. R. Syn. Diel's Bellflower											Not described.
Diel's Bellflower. ArizB15. Syn. of Diel Bellflower											
Diel Kernobst. D. Syn. of Diel											
Diel Reinette. D. Syn. of Diel											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Diener. R. Syn. Diener's Winter											Not described.
Diener's Winter. WisB45. Syn. of Diener											
Dietzer. L. Syn. Dietzer Rothe Mandel Reinette	Ger	r	m	yrs	fj	y	sa			ml	From Hogg.
Dietzer Rothe Mandel Reinette. D. Syn. of Dietzer											
Dillaways. W	Ohio										Not described.
Dillingham. E	Ohio	rc	m	gy	fj	y	s	g		l	
Diltz. A'83. Syn. of Mann											
Dinant. BBL											Do.
Dinsmore. D. Syn. of Derry											
Dinton Nonpareil. GenF'33. Syn. of Broddick											
Dinwiddie. F. Syn. Dinwiddie's Seedling	Va										Do.
Dinwiddie's Seedling. FDNCo. Syn. of Dinwiddie											
Dick's Graft. D. Syn. of Richard											
Disbro. R. Syn. Disbro's Sweet											Do.
Disbro's Sweet. MinnExR'90. Syn. of Disbro											
Disharoon. D	Ga	rc	m	gw	jt	yw	psa	g		m	
Ditmars. Cat	Mo										Do.
Ditus. Syns. Ditus Day, Ditus Day No. 2	Minn	rob	s	gyrs		w	psa	g		vl	Originated with Ditus Day, Farmington, Minn.
Ditus Day. SDB76. Syn. of Ditus											
Ditus Day No. 2. MinnHort'96. Syn. of Ditus											
Dixie. L. Syn. Golden Dixie	Va	robc	m				sa	g		ml	
Dixie. Dap. Syn. of Shockley											
Dixon. P'95	W.Va	obl	l	yrsc	tj	y	sa	g		l	
Dixon Sweet. K&S			m	rs			s				
Dlimoe. Gb. Syn. of Long											
Dlinnoe. Gb. Syn. of Long											
Dobb. L. Syn. Dobb's Kernel Golden Pippin	Eng	ob	s	y	fc		sa			l	From Ronalds.
Dobbel Bellefleur. D. Syn. of French Belleflower											
Dobbin. R. Syn. Dobbin's Early											Not described.
Dobbin's Early. JW. Syn. of Dobbin											
Dobb's Kernel Golden Pippin. D. Syn. of Dobb											
Dobrui krestianin. Gb. Syn. of Good Peasant											
Dockham. R. Syn. Dockham Russett	Wis	ob	l	yr	tj	w	sa	vg-b	d	m	
Dockham Russett. A'77. Syn. of Dockham											
Doctor. DomEnc. Syns. American Nonpareil, Dewitt, Doctor Dewitt, Red Doctor, Newby.	Pa	rob	m	yrs	tj		bsa	g	d	ml	Newby is here added as a synonym of Doctor.
Dr. Berckmans. BBL											Not described.
Dr. Briggs. BBL	Ill										Do.
Doctor Curd. MichB31											Do.
Doctor Dewitt. W. Syn. of Doctor											

Dr. Dickinson. IllH'96											Do.
Dr. Dunn's Sweeting. P'95. Syn. of Kimball											
Doctor Fulcher. RNY'61. Syn. of Fulcher											
Dr. Haines. Cat											Do.
Dr. Harvey. D. Syn. of Harvey											
Doctor Helsham's Pippin. D. Syn. of Helsham											
Doctor Hogg. L Syn. Dr. Hogg	Eng	rc	m	wy	tj	w	sa		k	l	From Flora and Pomona.
Dr. Hogg. Dap. Syn. of Doctor Hogg											
Dr. Howsley. MoH'83	Kans	obc	l	yrs	tj	y	sa	g		ml	
Dr. Kelser. BBL											Not described.
Dr. Long. BBL											Do.
Dr. Matthews. TCF	Tenn.?	rc	l	yrs				vg		me	Introduced in 1894.
Doctor Noyes. JWK. Syn. of Noyes											
Dr. Spavia. R. Syn. Dr. Spavia Bovatinkio											Not described.
Dr. Spavia Bovatinkio. BBL. Syn. of Dr. Spavia											
Doctor Walker. D. Syns. Dr. Walker, Litsey, Geneton Improved	Ky	obc	m	gyrs	tj	w	msa			vl	
Dr. Walker. Dap. Syn. of Doctor Walker											
Dr. Watson. MoH'63. Syn. of Watson											
Dr. Whitsell's Winter. IllB45. Syn. of Whitsell											
Dodd Favorite. R. Syn. Dodd's Favorite											Do.
Dodd's Favorite. IllB45. Syn. of Dodd Favorite											
Dodds. IllB45											Do.
Dodge's Black. E. Syn. of Black											
Dodge Crimson. L. Syns. Cumberland Black, Dodge's Crimson	Tenn	rc	m	dr	ftj	ws	sa	g-vg	d.	ml	
Dodge's Crimson. D. Syn. of Dodge Crimson											
Dodge Early. L. Syns. Dodge's Early, Dodge's Early Red	Mass.?	r	m				sa	g		e	
Dodge's Early. W. Syn. of Dodge Early											
Dodge's Early Red. MagofH'41. Syn. of Dodge Early											
Dodge's Early Red. D. Syn. of Sops of Wine											
Doe. TennBX-1	Tenn	ob	ml	gyb	f	yw	msa	vg		m	
Doggett. MagofH'36											Do.
Doherty. R. Syn. Doherty Striped											Do.
Doherty Striped. A'75. Syn. of Doherty											
Dolbear. R. Syn. Reinette Dolbear			l				a	g		l	
Dole. L. Syn. Dole's Red	Ohio	r	m				sa	g		l	
Dole's Red. W. Syn. of Dole											
Dolgol Squoznol. AJofHVI	Rus	oblc	m	pg				g		me	
Dollars and Cents. W. Syn. of Gilpin											
Dollins Pippin. Dap. Syn. of Piedmont											
Domine. C. Syns. American Nonpareil, Cheat, Cling Tight, Domini, Dominie, English Beauty, English Rambo of some, English Red Streak, Hogan, Red Streak, Striped Domine Pippin, Striped Rhode Island Greening, Wells, Wells of Ohio, Williamson, Winter Rambo of some.		ob	m	gyrs	tj	w	psa	g	dkm	l	
Domini. GenF'33. Syn. of Domine											
Dominie. F. Syn. of Domine											
Dominion. Cat											Do.
Dominion Winter. WisB45											Do.
Domino. BBL											Do.
Donahoe. Dap. Syn. of Red Canada											
Donahoo's Seedling. Cat. Syn. of Donahue											
Donahue. D. Syn. Donahoo's Seedling	Md	rob	ms				sa	vg		ml	
Donahue Late. R. Syn. Donahue's Late Blossom											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Donahue's Late Blossom. IllB45. Syn. of Donahue Late											
Dona Maria. BBL											Not described.
Donneghan. Bul8	Vt	r	m	gwr			s	vg	dmk	me	
Donnelan. L. Syn. Donnelan's Seedling	Am	r	m				sa			m	
Donnelan's Seedling. E. Syn. of Donnelan											
Door. BBL											Do.
Doozen. MagofH'47											Do.
Dor. Cat											Do.
Dora. L. Syn. Dora's Beauty											Do.
Dora's Beauty. OntExR'82. Syn. of Dora											
Dorchester. L. Syn. Mitchell of Dorchester											Do.
Dorè. L. Syns. Reinette Dore, Reinette Doree, Reinette Jaune Tardive, Reinette Rousse.	Fr	r	m	yb	f	w	sa	g		m	
Dorkham. R. Syn. Dorkham Russet		rc	m	yre	j	w	sa	g		l	
Dorkham Russet. CanExR'96. Syn. of Dorkham											
Doubbel Bellefleur. D. Syn. of French Bellflower											
Double Bellefleur. D. Syn. of French Bellflower											
Double Star. A'73											Do.
Doucin. Hort'59. Syn. Dutch Paradise	Italy			yr			s				
Dougherty. IndH'90											Do.
Douglas. R. Syn. Douglas (No. 3)	Minn	rob	l	wyrs	j	w	sa	g		m	
Douglas (No. 3). SDB76. Syn. of Douglas											
Douse. IllH'84. [This may be Hawley.]											Do.
Douse. Hort'47. Syn. of Hawley											
Doux. L. Syns. D'Eve, Doux d'Argent, Doux d'Angers, Ostogate	Fr.?	obc	m	yb	fcj	w	msa	g	d	l	
Doux d'Angers. D. Syn. of Doux											
Doux d'Argent. D. Syn. of Doux											
Dow. L. Syn. Dow's Winter Pippin	N. Y	ab	l	gyc	tj	g	bsa	g		m	
Dowell. L. Syn. Dowell's Pippin	Eng	rc	m	gru	fcj		sa	g	d	m	
Dowell's Pippin. D. Syn. of Dowell											
Down. R. Syn. Down's (C.) Large Fall Red											Do.
Down's (C.) Large Fall Red. MagofH'47. Syn. of Down											
Downing. IllH'84	Ill		l							m	
Downing Blush. L. Syns. Downing's Winter Maiden's Blush, Greenfield (Probably Greenville).	Ohio	rob	l	gyb	fcj	w	msa	g	dkm	l	
Downing Favorite. R. Syn. Downing's Favorite			ml	rs				vg		me	
Downing's Favorite. IllH'83. Syn. of Downing Favorite											
Downing Paragon. R. Syn. Downing's Paragon	Ill	robl	m	gyb	jt	w	s	g-vg	d	ml	
Downing's Paragon. Hort'54. Syn. of Downing Paragon											
Downing's Winter Maiden's Blush. HG&Co. Syn. of Downing Blush											These are probably the same.
Downing's Winter Maiden's Blush. FF&S. Syn. of Greenville											

Downton. NEF'32. Syns. Downton Golden Pippin, Downton Pippin, Elton Pippin, Elton Golden Pippin, Golden Pippin, Knight's Golden Pippin, Knight's Pippin, St. Mary's Pippin.	Eng	rob	m	y	ct	y	a	vg	d	m	
Downton Golden Pippin. K. Syn. of Downton											
Downton Nonpareil. A'58											Not described.
Downton Pippin. NEF'26. Syn. of Downton											
Downy. D. Syn. of Hoary Morning											
Dows. MagofH'47. Syn. of Hawley											
Dowse. E. Syn. of Hawley											
Dow's Winter Pippin. D. Syn. of Dow											
Doyle. TVM	Tex		l	rs				vg		me	
Doyleston. Dap	Wis. ?	robc	m	wrs	ft	w	sa	g		ml	
Dpicen. R. Syn. Dpicen Sweet											Do.
Dpicen Sweet. IllB45. Syn. of Dpicen											
Drake. R. Syn. Drake No. 1											Do.
Drake No. 1. MinnExR'90. Syn. of Drake											
Drap d'Or. M. Syns. Bay Apple, Bonne de Mai, Cloth of Gold, Drap d'Or of France, Early Summer Pippin, Embroidered Pippin, Fennouillet Jaune, Pomme de Caractére, Vrai Drap d'Or.	Eur	rob	l	y	cj		msa	g		me	
Drap d'Or. D. Syn. of Fenouillet Jaune											
Drap d'Or of France. C. Syn. of Drap d'Or											
Draper. R. Syn. Draper Best											Do.
Draper Best. BBL. Syn. of Draper											
Dredge's Beauty of Wilts. D. Syn. of Harvey Pippin											
Dredge's Fair Maid of Wishford. D. Syn. of Wishford											
Dredge's Fame. D. Syn. of Fame											
Dredge Golden. L. Syn. Dredge's Golden Pippin	Eng. ?	ob	m	y	f		s			l	From Ronalds.
Dredge's Golden Pippin. D. Syn. of Dredge Golden											
Dredge's White Lily. D. Syn. of Devonshire											
Drumore. W											Not described.
Du Bois. P'94	N. Y	ob	ml	yr	j	y	msa	g		l	
Dubrell. IllH'68		ob		dr				vg		ml	
Du Canada. GenF'33. Syn. of Canada Reinette											
Duc d'Arsel. GenF'33. Syn. of Nonpareil											
Duchess de Brabant. D. Syn. Reinette Duchesse de Brabant	Fr. ?		l	yrc	fcj	yw	a			ml	From Annals of Pomology.
Duchess No. 8. IllH'96	Iowa	r	l	gyb	f	gy	a		k	m	
Duchess of Oldenburgh. NEF'32. Syn. of Oldenburg											
Duchess Seedling. (LC)	NW										
Duchovoe. Gb. Syn of Scented											
Duchowoe. Gb. Syn. of Scented											
Duckett. Hort'58	South	ob	l	yb	tj	w	psa	g		m	
Duckpond. AmF'58											
Dudley. P'91. Syn. Dudley's Winter	Me	r	ml	rs				g		l	May be same as North Star.
Dudley's Winter. A'91. Syn. of Dudley											
Dudley's Winter. CanExR'96. Syn. of North Star											
Dufferin. L. Syn. Lady Dufferin											Not described.
Duffey. BBL											Do.
Duffield. Dap	Iowa	ob	m				sa	g		l	
Duffield Pippin. D	Pa	rob	m	gy	tj	y	psa	g	d	vl	
Du Halder. D. Syn. of Halder											
Duif Apple. D. Syn. of Pigeon											
Duke. Cat											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Dukeberry. R. Syn. Dukeberry Winter Blush	Ohio?	rc	l	gyb		w	sa			l	This may be Tewksbury.
Dukeberry Winter Blush. MagofH'41. Syn. of Dukeberry											
Duke of Beaufort's Pippin. D. Syn. of Beaufort											
Duke of Devonshire. D. Syn. of Devonshire Duke											
Duke of Wellington. CAG. Syn. of Wellington											
Duke of York. BBL											Not described.
Dula. R. Syn. Dula Beauty											
Dula Beauty. A'03. Syn. of Dula											
Dulaney. BBL. Syn. Dulaney's Choice	Ill										Do.
Dulaney's Choice. Cat. Syn. of Dulaney											
Dulce Doman. D. Syn. Sweet Home	Pa	ob	m	gyr	fmj	y	s	g-vg	k	l	
Dulin. L. Syn. Dulin's Red	Ky	obc	m				sa	g		l	
Dulin's Red. Dap. Syn. of Dulin											
Duling. MagofH'53. Syn. Duling's Sweet	Ohio	rc					sa	g		m	
Duling. D. Syn. of Cole											
Duling's Sweet. W. Syn. of Duling											
Dumelow. W. Syns. Dumelow's Crab, Dumelow's Seedling, Noneantum Wonder, Normanton Wonder, Wellington.	Eng	r	ml	yb	c	y	ba	g		l	
Dumelow of England. BBL											Do.
Dumelow (of Wisconsin). IllB'45. Syns. Dumelow's Seedling, Summer Seek-no-further.			l	yr			a		k	ml	Probably same as Dumelow.
Dumelow's Crab. E. Syn. of Dumelow											
Dumelow's Seedling. GenF'33. Syn. of Dumelow											
Dumelow's Seedling. IllB45. Syn. of Dumelow (of Wisconsin)											
Dumonceau. L. Syn. President De Fay's Dumonceau	Belg	ob	vl	yrs	t	yw	a			l	From Annals of Pomology.
Dumpling. C		obl	l	rs			sa				
Dumpling. MagofH'53. Syns. Crooked Limb, Crooked Limb Pippin, French Pippin (of Indiana), Watrous Dumpling, Watson's Dumpling.		robl	l	yb		w				ml	
Dumpling. A'54. Syn. of Alsace											
Dunbar. MagofH'53											Not described.
Duncan. D	Eng.?	robc	m	yb	cj	y	pa			ml	From Hogg.
Dundee. D. Syn of Golden Reinette											
Dunlap. R. Syn. Dunlap's Sweet							s				Not described.
Dunlap's Aurora. E. Syn. of Twenty Ounce											
Dunlap July. R. Syn. Dunlap's July			l						m	e	
Dunlap's July. TCF. Syn. of Dunlap July											
Dunlap's Sweet. IllB45. Syn. of Dunlap											
Dunley. W	Ohio										Do.
Dunsmore. R. Syn. Dunsmore Sweet											Do.
Dunsmore Sweet. BBL. Syn. of Dunsmore											
Duplin. L. Syn. Pride of Duplin											Do.

Durable. L. Syn. Durable Keeper	Ind	r	l	rs			sa	g		vl	
Durable Keeper. RNY'61. Syn. of Durable											
Durell. L. Syn. Durell's Beauty											Do.
Durell's Beauty. Cat. Syn. of Durell											
Durham. L. Syn. Durham Winter Pearmain		r					s				
Durham Winter Pearmain. W. Syn. of Durham											
Dusten. D	N. H	ob	m	wy	tj	w	psa	g		m	
Dutch Buckingham. JVL			l	rs		y	b			ml	
Dutch Codlin. GenF'33. Syns. Chalmer's Large, Dutch Codling, French Codlin, Glory of the West, White Codlin.	Eur	robl	vl	y	mj	w	sa	g	k	me	
Dutch Codlin (erroneously). E. Syn. of Fallawater											
Dutch Codling. W. Syn. of Dutch Codlin											
Dutchess. E. Syn. of Oldenburg											
Dutchess County Sweet. RNY'57. Syn. of Yankee Spy											
Dutch Horse. IndH'81											Do.
Dutchman. R. Syn. Streaked Dutchman											Do.
Dutch Mignonne. GenF'33. Syns. Christ's Golden Reinette, Comanthorpe Crab, Grosser Casselar Reinette, Paternoster Apfel, Pomme de Laak, Reinette Dorèe, Settin Pippin.	Hol	robe	m	yrs	ctj	y	sa	g-vg	km	l	
Dutch Mignonne. D (early editions)		rob	l				sa	g		ml	Not same as preceding.
Dutch Mignonne (erroneously). Dap. Syn. of Blenheim											
Dutch Paradise. CB116. Syn. of Doucin											
Dutch Pearmain. Syn. of Golden Pearmain											
Dutch Tulip. D. Syn. of Tulip											
Duverson's June. Dap. Syn. of Margaret											
Duzenbury. D. Syn. Duzenbury Apple	N. Y	roble	m	gyrs	ctmj	wy	sa	vg		vl	
Duzenbury Apple. A'67. Syn. of Duzenbury											
Dwight. L. Syns. Dwight Apple, Stevenson Pippin	Ark	rob	ml	rs			sa	g		l	
Dwight Apple. Dap. Syn. of Dwight											
Dyer. K. Syns. Bard, Beard, Bullripe, Coe's Spice, Golden Spice, Harris Whitehall, Holly Crown, Mygatt's Bergamott, Pinneo's Favorite, Pomme Royal, Pomme Royale, Pomme Water, Smithfield Spice, Tompkins, Tompkins Apple, White Spice, Woodstock.	Fr.?	r	m	gyb	vtj	w	msa	vg-b	d	m	
Dykeman. A'77		obe	m	yrs	tj	yw	sa	vg		me	
Eardrop. R. Syn. Ladies' Ear Drop	N. Y	obl	m	yb			sa	g		l	
Earle. L. Syn. Granny Earle	Mass	ro	s	grs	ct	w	sa	vg		ml	
Earle. A'89. [Said to be a synonym of Tall Top.]											Not described.
Earle Green. R. Syn. Earle's Greening											Do.
Earle's Greening. MagofH'44. Syn. of Earle Green											
Earliest. Gb. Syns. Earliest Early, Gov. list No. 173, Skerospelka Rannaja, Slerospielka rannaya.	Rus										Do.
Earliest Early. Gb. Syn. of Earliest											
Earl of Yarmouth's Pearmain. D. Syn. of Oxnead											
Early Almond. BBL											Do.
Early Arkansas. R. Syn. Early Ark. Beauty			l	yr				g		e	
Early Ark. Beauty. TCF. Syn. of Early Arkansas											
Early Autumn. L. Syns. Generale, Herbststrich Apfel, Passe Pomme Cotellee, Passe Pomme d'Automne, Passe Pomme Rouge d'Automne, Pomme d'Outre Passe, Rother Herbststrichapfel.	Ger	rob	m	yrs	tj	ws	sa	g	k	m	From Hogg.
Early Baldwin. Dap. Syn. of Primate											
Early Bellflower. IllB45		obe	m	rs				vg		me	
Early Bevane. JVL. Syn. of Bevan											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Early Blue. ColExR'89											Not described
Early Borden. MagofH'40											Do.
Early Bough. M. Syn. of Bough											
Early Bow. WVaB75. [May be Bough.]											Do.
Early Breakfast. P'91	Ind	ob	l	rs	t			vg		e	
Early Brook. A'77	Conn	obc	m	yrs	tj	w	sa	vg		me	
Early Calkins. A'75											Do.
Early Casey. R. Syn. Casey Early			m	rs				g		e	
Early Champagne. Gb. Syns. Champagner fruher, Fruher Champagner, Gov. list No. 68.	Rus										Do.
Early Chandler. Hort'49		r	ms	yrs	tj	y	psa	g	k	e	
Early Chandler. H. Syn. of Chandler (?)											
Early Cider. W		c	m				sa		c	e	
Early Cinnamon. MHSC'86. Syns. Gov. list No. 558, Konitschenewoe Rannoe, Koritchnevoe rannee, Shro. to Ia. No. 46.	Rus										Do.
Early Colton. Bul8. Syn. of Colton											
Early Congress. MassH'70. Syn. of Gravenstein											
Early Cooper. Syns. Cooper's Early White, Early White	Am	rob	m	yb	c	w	sa	g		me	
Early Cooper. Lin. Syn. of Irish Peach											
Early Crofton. GenF'33. Syn. of Irish Peach											
Early Dutch. MagofH'43											Do.
Early Edward. A'69. Syn. Edward Early	Am									e	
Early French Reinette. K. Syn. of Early Harvest											
Early French Reinette of Coxe. C. Syn. of Early Harvest											
Early George. W. Syn. of George											
Early German. IllB45											Do.
Early Golden Sweet. Lin. Syn. of Golden Sweet											
Early Grandmother. MHSC'86. Syns. Babuschkino rannee, Shro. to Ia. No. 126.	Rus										Do.
Early Greening. W	Pa	ob	m	rs			sa			me	
Early Harvest. M. Syns. Bracken, Early French Reinette, Early French Reinette of Coxe, Early July Pippin, Early June, French Reinette, Glass Apple, Harvest Early, Harvest, July Pippin, Large Early Harvest, Large White Juneating, Large Yellow Harvest, Maralandica, Oats, (incorrectly), Prince's Early Harvest, Prince's Harvest, Princess' Harvest, Prince's Yellow Harvest, Sinclair's Yellow, Tart Bough, Yellow Harvest, Yellow Juneating.	Am	rob	m	py	tjc	vw	sa	vg-b	dk	e	
Early Jack. H. Syn. of Jack											
Early Jennetting. D. Syn. of White Juneating											
Early Joe. MagofH'46	N. Y	obc	ms	yrs	tj	w	sa	b	d	me	

Early Julien. D	Scot	rob	m	y	j	yw	bsa			me	From Lindley.
Early July Pippin. Dap. Syn. of Early Harvest											
Early June. E. Syn. of Early Harvest											
Early June. H. Syn. of Egg Top											
Early June. E. Syn. of Margaret											
Early Lippincott. WJN	N. J.	r	m	rs	t		sa			e	
Early Long Stem. Hort'59. Syn. Early Spice	Ill.?	oblc	s	gy	tj	w	sa	g		me	
Early Luster. A'51. Syn. of Luster											
Early Margaret. GenF'33. Syn. of Margaret											
Early Marrow. D. Syn. of Marrow											
Early May. IIIH'96. [May be White Juneating.]											Not described.
Early May. Hort'52. Syn. of White Juneating											
Early Melon. P'95	Rus.	rc	l	ysc	mfj	y	sa	g		m	
Early Nonpareil. GenF'33. Syns. Hick's Fancy, Lacy's Nonpareil, New Nonpareil, Stagg's Nonpareil, Summer Nonpareil.	Eng	rob	m	yru	tj	yw	bsa			m	From Lindley.
Early Nonpareil. D	Ill.?	rob	m	wrs	tj	ws	sa	g		m	May be same as preceding.
Early Nonsuch. W		r	ms				sa	g		me	
Early Norfolk. AmGar'91	Va.	ob	ml	yrs		w	sa	g	m	e	
Early Pear. R. Syn. Early Pear Apple	N. C		ml	yrs				vg		e	
Early Pear Apple. JAY. Syn. of Early Pear											
Early Pennock. MagofH'46. Syns. August Apple, Harmony, Heicke's Summer Queen, Indian Queen, New Jersey Redstreak, Shaker, Shaker Yellow, Sleeper's Yellow, Summer Pennock, Warren Pennock.		rc	vl	yrs	c	w	sa	g	km	me	
Early Pipka. Gb. Syns. Pipka lietnaya, V. R. S. to Ia. No. 1	Rus.										Not described.
Early Prolific. Gb. Syns. Gov. list No. 332, Plodovitka ranniaya, Plodowitka ramaja.	Rus.										Do.
Early Queen. Lin. Syn. of Summer Queen											
Early Queening. D. Syn. of Queening											
Early Red. MHSC'86. Syns. Shro. to Ia. No. 69, Skoraspieloe lorasnoe	Rus.										Do.
Early Red (N. Y.). L. Syn. N. Y. Early Red											Do.
Early Red. GenF'33, Syn. of Margaret											
Early Red. A'56. Syn. Philadelphia Queen		rob	ml	rs	f	ws	msa	p	km	e	
Early Red June. Cat											Do.
Early Red Juneating. K. Syn. of Margaret											
Early Red Margaret. GenF'33. Syn. of Margaret											
Early Red Margaret (incorrectly). W. Syn. of Redstripe											
Early Red Market. Cat											Do.
Early Red Pippin. Lin. Syn. of Harvest Redstreak											
Early Redstreak. MagofH'53	Pa.?	r	m	yrs	tje	w	sa			me	
Early Redstreak. W. Syn. of Harvest Redstreak											
Early Red Streak. H. Syn. of Redstripe											
Early Red Stripe. IndF'40. Syn. of Redstripe											
Early Red Sweet. D. Syn. Early Red Sweeting	Pa	r	m				s			me	
Early Red Sweet. Dap. Syn. of June Sweet											
Early Renwick. A'85. Syn. of Renwick											
Early Ripe. D. Syn. Weidner	Pa.?	rob	m	py	tj	w	sa	g		me	
Early Rivers. NEF'33											Do.
Early Russ. MoH'87. Syn. of Red Astrachan											
Early Russet. Dap. Syn. of Steve											
Early Russian. GJC											
Early Scarlet. A'85					tej	w	sa			e	
Early Scarlet Bough. Hort'56. Syn. of Scarlet Bough											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Early Spaulding. R. Syn. Spaulding's Early Seedling	Mass		l	rs	tj			vg		e	
Early Spice. D	Eng	r	m	py		w		p	k	me	From Hogg.
Early Spice. D	N. C	r	s	y		y					
Early Spice. D. Syn. of Early Long Stem											
Early Spitzenburg. A'79											Not described.
Early Stickney. Hort'72. Syn. of Stickney											
Early Strawberry. M. Syns. American Red Juneating, Early Strawberry Apple, Red Juneating, St. John's Strawberry, Striped Shropshire, Tennessee Early Red.	N. Y	rc	s	rs	t	ws	sa	vg	dm	e	
Early Strawberry Apple. D. Syn. of Early Strawberry											
Early Stripe. MHSC'86. Syns. Polosatk alietnaya, Shro. to Ia. No. 145	Rus										Do.
Early Striped Juneating. GenF'33. Syn. of Margaret											
Early Striped Sweet. A'85											Do.
Early Sugarloaf. IllH'83. [May be Chenango.]											Do.
Early Sugar Loaf. A'97. Syn. of Chenango											
Early Summer. R. Syn. Early Summer Red Streak											Do
Early Summer Pearmain. C. Syn. of Summer Pearmain											
Early Summer Pippin. T. Syn. of Drap d'Or											
Early Summer Red Streak. MagofH'47. Syn. of Early Summer											
Early Sweet. C		obl	m		t	w	s			me	
Early Sweet. Hort'66	Ohio	r	ms	wy	tmj	w	s	g		me	
Early Sweet. IaB31. Syn. Vor. No. 9		c	ml	y		y	vs	vg		e	
Early Sweet. Dap. Syn. of Hightop Sweet											
Early Sweet Bough. D. Syn. of Bough											
Early Sweet Heart. BBL											Do.
Early Sweetheart. AmGar'01. Syn. of Bough											
Early Tart. D	Pa.?	rc	m	pye	tj	w	bsa	g	k	me	
Early Tart Harvest. D. Syn. of Primate											
Early Tart Harvest. D. Syn. of Tart Harvest											
Early Tennessee. Cat											Do.
Early Translucent. MHSC'86. Syns. Shro. to Ia. No. 115, Skvosneena Skorospielaya.	Rus										Do.
Early Washington. Dap. Syn. of Sops of Wine											
Early Wax. D. Syn. Wax Apple	Eng	oblr	ms	y	t	yw	s			me	From Hogg
Early White. Dap. Syn. of Early Cooper											
Early White Sweet. IllH'97											Not described.
Early Williams. MassB2. [May be Williams.]										e	Do.
Early Yellow. L. Syns. Early Yellow Reinette, Reinette Jaune Hatif		c	m	yr	j		sa			me	
Early Yellow Reinette. D. Syn. of Early Yellow											
Early York. MagofH'53		r		rs			sa			me	

Easter. K(?). Syns. Claremont Pippin, Easter Pippin, Forsyth (not of Coxe), French Crab, Ironstone Pippin, Pasque Apple, Young's Long Keeper.	Eng	ob	m	gb	vf		sa	g		vl	
Easter Pippin. D. Syn. of Easter											
Eastern Pippin. H. Syn. of Ironstone											
East Grinstead. D. Syn. of Grinstead											
Eastwood. L. Syn. Eastwood's Sweet											Do.
Eastwood's Sweet. Cat. Syn. of Eastwood											
Eating (Conrad's). FDNCo											Do.
Eaton. MagofH'52	N. Y.?	oble	l	grs	tj	w	sa	g-vg		m	
Eberhard. R. Syn. Eberhard Seedling			m	gyrs	cj	gy	sa	g		l	
Eberhard Seedling. MinnHort'97. Syn. of Eberhard											
Eccle's Summer. NCExR'89. Syn. of Eckel											
Eckel. R. Syns. Eccle's Summer, Eckel's Red Sweet June, Eckel's Summer.	N. C		l	r			s	g		e	
Eckel's Red Sweet June. JAY. Syn. of Eckel											
Eckel's Summer. JVL. Syn. of Eckel											
Ecklinville. R. Syn. Ecklinville Seedling		obc	vl	gr	je	w	msa	vg		me	
Ecklinville Seedling. CB116. Syn. of Ecklinville											
Edel-Konig. D. Syns. Edelkonig Reinette, Reinette Edelkonig, Roi-Tres-Noble.	Ger	robe	l	yr	tj	ws	bsa	g-vg	k	m	From Hogg.
Edelkonig Reinette. Dap. Syn. of Edel-Konig											
Edelsdorfer. AndN		rob	s	yr	f		sa		d	l	
Eden. BBL											Not described.
Edgar. L. Syn. Edgar's	Eng	r	m	yr					dk	m	From Ronalds.
Edgar's. D. Syn. of Edgar											
Edgar County Redstreak. A'83. Syn. of Walbridge											
Edgar Redstreak. Dap. Syn. of Walbridge											
Edgar Russet. IllH'69											Not described.
Edgerly's Sweet. E. Syn. of Bailey Sweet											
Edgermont. L. Syn. Howard's Edgermont	Pa	rob	l	gyrs	etj	y	sa	g		m	
Edingburg. L. Syn. Edingburg Seedling											Do.
Edingburg Seedling. Cat. Syn. of Edingburg											
Edith. MHSC'86	Can.		ml	yrs	f	y			dk		
Edler. L. Syn. Edler Greening											Do.
Edler Greening. Cat. Syn. of Edler											
Edler rosenstreifling. Gb. Syn. of Noble Redstreak											
Edler Winter Borsdorffer. D. Syn. of Borsdorffer											
Edmonston. DelExR'95											Do.
Edmonton's Aromatic. E. Syn. of Kerry											
Edmonton's Aromatic Pippin. D. Syn. of Kerry											
Edwards. A'85. [May be Nickajack.]											Do.
Edwards. T. Syn. of Nickajack											
Edward's. D. Syn. of Edward Winter											
Edward Early. Dom Enc. Syn. of Early Edward											
Edwards Favorite. NYExR'96		ob	m	gyrs	je	w	sa	g		vl	
Edward Russet. Syn. Edward's Russet		obl	m	yru				vg	d	vl	
Edward's Russet. Lin. Syn. of Edward Russet											
Edward Shantee. D. Syn. of Nickajack											
Edward Sweet. R. Syn. Edward's Sweet											Do.
Edward's Sweet. UCExR'92. Syn. of Edward Sweet											
Edwards Transparent. MoH'86				wyb				g		me	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Edward Winter. A'91. Syn. Edward's	N. C	rob	m	gys	jf		r			vl	From Country Gentleman.
Egg. D. Syn. of White Paradise											
Eggermont. D. Syn. Eggermont's Calville	Eng.?	ob	m	py	fj	w	visa			m	From Hogg
Eggermont's Calville. D. Syn. of Eggermont											
Eggtop. R. Syns. Early June, Egg Top, Eve, Round Top, Sheepnose, Wine (of some).		rco	m	rs	tjm	w	sa	g		m	
Egg Top. MagofH'44. Syn. of Eggtop											
Egg Top (of some). E. Syn. of Cornish Gilliflower											
Egypt. BBL											Not described
Egyptian. (LC). Syn. Egyptian Queen	Ill										Do.
Egyptian Belle. MagofH'60	Ill	rob	l	ywrs	jf	w	sa			me	From Gardener's Monthly
Egyptian Queen. Dap	Ky.?	obc	l				sa	g		vl	
Egyptian Queen. IllH'86. Syn. of Egyptian											
Egyptian Russet. W. Syn. Bagby Russet	Ill	rc	m	yru	tj	y	sa	vg	d	l	
Egypt Red Summer. W. Syn. of Egypt Summer											
Egypt Red Winter. W. Syn. of Egypt Winter											
Egypt Summer. L. Syn. Egypt Red Summer	Ill	r	m	rs			sa	g		me	
Egypt Winter. L. Syn. Egypt Red Winter	Ill	ob	m	rs			sa	g		l	
Eicke. IllH'94	Nebr	c	m	crs	fj		msa	g	k	vl	
Eighteen Ounce Apple. D. Syn. of Twenty Ounce											
Eiser. Gb. Syns. Eiserapfel, V. R. S. to Ia. No. 46	Rus										Not described.
Eiserapfel. Gb. Syn. of Eiser											
Elarkee. Hort'58	South	c	m				sa	vg		m	
Elder. R. Syn. Elder Apple	Ohio		l	rs			msa	vg		l	
Elder Apple. JRJ. Syn. of Elder											
Eldon. L. Syn. Eldon Pippin	Eng.?	rob	s	yb	vj	y	s	g		l	From Hogg
Eldon Pippin. D. Syn. of Eldon											
Eldorado. W	South	r					sa				
Elford. L. Syn. Elford Pippin	Eng.?	r		ygru	c	y	bsa	vg	d	m	Do.
Elford Pippin. D. Syn. of Elford											
Elgin. L. Syn. Elgin Pippin	Miss	c	l				sa	vg		l	
Elgin Beauty. SDB76. [May be Elgin (crab).]	Minn	rc	s	yrs	mj	w	s	g		m	Originated with O. D. Rollins, Elgin, Minn
Elgin Pippin. W. Syn. of Elgin											
Elgin Pippin. D. Syn. of White Spanish											
Elias. Magof H'53											Not described.
Elicke. L. Syns. Elicke's Winter, Elicke's Winter Sweet	Pa	ob	m	yrc	ct	y	vs	g	k	ml	
Elicke's Winter. W. Syn. of Elicke											
Elicke's Winter Sweet. MoH'68. Syn. of Elicke											
Elizabeth. D. Syn. of Golden Reinette											

Elkhorn. P'86	Ark	ob	vl	yrs	fcj	y		vg		l	
Ella. Dap	Ont.	robc	m				sa			l	
Ella Park. MoH'70	Mo. ?	rob	m	dr	fj		a		m	vl	
Elleck. R. Syn. Elleck's Winter Sweet											Do.
Elleck's Winter Sweet. MoH'68. Syn. of Elleck											
Ellendale. IllH'96											Do.
Ellijay. Hort'58	Ga	re	l	pyb	tj	w	sa	g	k	m	
Ellin. R. Syn. Ellin's Choice											Do.
Ellin's Choice. CanExR'01. Syn. of Ellin											
Ellis. D	Conn	r	s	gyb	fj		psa	g		vl	
Ellsworth. D. Syn. Miller's Seedling	N. Y.	r	m	yb	ftj	w	sa	vg-b	d	l	
Ellwill. L. Syn. Ellwill's Late	South									l	
Ellwill's Late. W. Syn. of Ellwill											
Elsie. R. Syn. Elsie Rathke											Do.
Elsie Rathke. GarM'85. Syn. of Elsie											
Elston Pippin. K. Syn. of Downton											
Elston. IndH'88	Ohio	robl	l	y	tj	yw	s	g-vg		ml	
Elton Golden Pippin. GenF'33. Syn. of Downton											
Elton Pippin. GenF'33. Syn. of Downton											
Elwell. BWS	Ga. ?		l	grs				g			
Elzear. MHSC'88	Can		m	dr							
Embroidered Apple. DomEnc. Syn. of Drap d'Or											
Embroidered Pippin. D. Syn. of Drap d'Or											Do.
Embroidered Pippin. K. Syn. of Fenouillet Jaune											
Embroidered Tallow. A'83											
Emersine. L. Syn. Emersine Sweet	Ohio	ob	m				s	g		l	
Emersine Sweet. W. Syn. of Emersine											
Emma. R. Syn. Emma's Favorite											Do.
Emma's Favorite. MoH'86. Syn. of Emma											
Emmins. L. Syn. Emmins Sweet							s				Do.
Emmins Sweet. Cat. Syn. of Emmins											
Emperor. GarM'60	Ill	r	m	yrs	ftj	w	msa	g		l	From Prairie Farmer.
Emperor. E. Syn. Dickson's Emperor	Scot	ob	l				sa	g		ml	
Emperor Alexander. K. Syn. of Alexander											
Empress. CanExR'95		ob	ml	gyb	fj	w	msa	vg			
Empress (Ill.). Cat											Not described.
Empress (of Russia). Bai											Do.
Endicott. R. Syns. Endicott Pippin, Perkin's Long	Mass	oble	l	y						ml	
Endicott Pippin. MagofH'41. Syn. of Endicott											
Ene. L. Syn. Ene's Winter Sweet	Ky	ob	m	gyb	f	y	s	g		ml	
Ene's Winter Sweet. D. Syn. of Ene											
Enfield. W. Syn. Enfield Pearmain	Conn	r	ms	dr	tfj		sa	g		l	
Enfield Pearmain. MagofH'38. Syn. of Enfield											
England. L. Syn. Glory of England	Eng	ob	l	yc	tj	gy	a		k		From Hogg.
England Seedling. BBL											Not described.
Englischer Pepping. Gb. Syn. of English Pippin											
Englischer Wintergoldparmane. MoH'67. Syn. of Wintergold											
English Beauty. D		robe	l	yrc	tj	w	sa	vg		l	
English Beauty of Pa. D. Syn. of Domine											
English Borovinka. MHSC'86. Syns. Borovinka Angliskaya, Shro. to Ia. No. 9	Rus										Do.
English Cheese. Cat											Do.
English Codlin. Wg. Syns. Codlin English, Codling, Old English Codling	Eng	oble	l				sa	g	k	m	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
English Codlin. D. Syn. of Old Codlin											
English Codlin. Hort'59. Syn. of Trenton Early											
English Codlin (incorrectly). Dap. Syn. of Settle											
English Crab. Hort'58	Eng	ob	s	dr		y	sa	g		l	
English Gilliflower. D	Eng.?	robc	l	pyrs	tj	y	msa	g-vg		ml	
English Golden. L. Syn. English Golden Pippin	Eng	r	m				sa	g	d	l	
English Golden. D. Syn. of Golden Russet (N. Y.)											
English Golden Pippin. T. Syn. of English Golden											
English Golden Pippin. Lin. Syn. of Golden Pippin											
English Golden Reinette. Lin. Syn. of Golden Reinette											
English Golden Russet. D. Syn. of Golden Russet (N. Y.)											
English Granat Reinette. D. Syn. of Granat											
English Hagloe. IndF'40. Syn. of Summer Hagloe											
English King. A'73. Syn. of Alexander											
English Nonpareil. GarCal. Syn. of Nonpareil											
English Nonsuch. E. Syn. of Nonsuch											
English Pearmain. W		ob	l				sa	g		m	
English Pearmain. Cole. Syn. of Herefordshire											
English Pearmain (incorrectly). Dap. Syn. of Long Red											
English Pippin. Gb. Syns. Englischer Pepping, Gov. list No. 587, Longfield, Pepping Englischer.	Rus										Not described.
English Pippin. GenF'33. Syn. of Golden Reinette											
English Pippin. Gb. Syn. of Longfield											
English Rambo of some. D. Syn. of Domine											
English Rambo of some. MagofH'49. Syn. of Wills											
English Red. L. Syn. English Red Sweeting	Eng	obl		rs			s				
English Redstreak. W	Ind	ob	l	rs			sa	g		l	
English Redstreak. W	Eng	r	l	rs			sa	g		l	Probably same as preceding.
English Red Streak. H. Syn. of Domine											
English Red Streak (incorrectly). D. Syn. of Wine											
English Red Stripe. D. Syn. of Redstripe											
English Red Sweeting. W. Syn. of English Red											
English Reinette. D. Syn. Reinette d'Angleterre	Eng.?	rc	m	ye	cj	y	sa	vg		ml	
English Russet. D. Syns. Long-Limbed Russet, Pokeepsie Russet, Poughkeepsie Russet, Winter Russet.		rc	m	gyru	fc	yw	psa	g	dm	vl	
English Russet. Wg	Ky.?	rob	l	ru			sa	g	dk	l	
English Seedling. A'77		robc	l	yrs	etj	yw	sa	vg		m	
English Summer Pearmain. E. Syn. of Summer Pearmain (Eng.)											
English Summer Pearmain. H. Syn. of Watson											

English Sweet. D. Syns. Avery Sweet, Avery Sweeting, English Sweeting, Hurlbut Sweet, Ramsdale's Sweeting, Ramsdell Red, Ramsdell's Red Pumpkin Sweet, Ramsdell's Red Winter, Ramsdell's Sweet, Ramsdell's Sweeting, Red Pumpkin Sweet.	Eng.?	oble	ml	dr	vt	y	vs	g-vg	dk	ml	
English Sweet, (erroneously). D. Syn. of Hog Island											
English Sweeting. MagofH'46. Syn. of English Sweet											
English Vandevere. D. Syn. of Smokehouse											
English Winter Calville. CanExR'01. Syn. of Winter Calville											
English Winter Redstreak (of some). MagofH'48. Syn. of Wells											
Enis. R. Syn. Enis Winter Sweet	South	c	m	gyru			vs	p		l	
Enis Winter Sweet. IllH'72. Syn. of Enis											
Enormous. IaH'80. Syns. Gov. list No. 398, Krupneena	Rus		vl	rs				p		ml	
Eper. AlaB98											Not described.
Epes. R. Syn. Epes' Sweet. [May be Danvers.]							s				Do.
Epes' Sweet. A'79. Syn. of Epes											Do.
Episcopal. D. Syn. of Fall Pippin											
Epling. R. Syn. Epling's Winter											Do.
Epling's Winter. A'81. Syn. of Epling											
Eppes' Sweeting. MagofH'42. Syn. of Danvers											
Epse's Sweet. Lin. Syn. of Danvers											
Epsy. D	Vt	oble	s	dr		w	bsa	g		ml	
Epting Premium. L. Syn. Epting's Premium	South						sa				
Epting's Premium. A'67. Syn. of Epting Premium											
Epting Red. L. Syn. Epting's Red Winter			l	grs	j			vg		ml	From Sumner's manuscript.
Epting's Red Winter. A'67. Syn. of Epting Red											
Equinetelee. W. Syns. Bachelor, Iola	South	ob	ml	rs	tj		sa	vg	d	ml	Probably same as Buckingham.
Equinetelee. W. Syn. of Buckingham											
Equinetely. MagofH'57. Syn. Sol Carter	South	rc	l				sa	vg			Do.
Equinetely. A'69. Syn. of Buckingham											
Erdbeer. Gb. Syns. Erdbeerapfel, Gov. list No. 584, Red Calville	Rus										Not described.
Erdbeerapfel. Gb. Syn. of Erdbeer											
Erdbeerapfel. Gb. Syn. of Winter Livland											
Erd Beere. D. Syn. of Red Autumn											
Erdber Streifling. R. Syn. Erdber's Streifling	Rus.?		m	gyrs						ml	
Erdber's Streifling. IndH'90. Syn. of Erdber Streifling											
Erie. L. Syn. Erie Sweet	Pa	rob	m	wy	tjm	w	s	g		m	
Erie Sweet. D. Syn. of Erie											
Ernst's Apple. W. Syn. of Ohio Pippin											
Ernst's Pippin. D. Syn. of Ohio Pippin											
Ernst Sweet. R. Syn. Ernst's Sweeting	Ohio						s				From Transactions Ohio Horticultural Society.
Ernst's Sweeting. Syn. of Ernst Sweet											
Esopus. Th. Syns. Æsopus Spitzenberg, Æsopus Spitzenburg, Esopus Spitzenberg, Esopus Spitzenburg, Esopus Spitzenburgh, Spitzenberg, Spitzenburgh, Spitzenburgh Esopus, True Spitzenburgh.	N. Y	roble	l	yr	fej	y	sa	b	dkm	ml	
Esopus Seedling. L. Syn. Esopus Spitzenburg Seedling	Cal		ml					g		ml	Introduced in 1880.
Esopus Spitzenberg. C. Syn. of Esopus											
Esopus Spitzenburg. F. Syn. of Esopus											
Esopus Spitzenburgh. NEF'29. Syn. of Esopus											
Esopus Spitzenburg Seedling. Wn. Syn. of Esopus Seedling											
Esopus Vandervere. Lin. Syn. of Newtown Spitzenburg											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Esperen. L. Syns. Esperen's Reinette, Reinette d'Esperen	For	robe	l				sa	g		l	
Esperen's Reinette. Dap. Syn. of Esperen											
Esquire Miller's Best Sort. D. Syn. of Progress											
Essex. L. Syn. Essex Pippin	Eng	rob	s	ygb	fc	y	bsa	g		l	From Hogg.
Essex Pippin. GenF'33. Syn. of Essex											
Estalline. SDB76. Syns. Esteline, Estelline	Minn	rob	ms	gyrs	j		a	g		ml	Originated by O. F. Brand, Faribault, Minn.
Esteline. MinnB83. Syn. of Estalline											
Estelline. MinnExR'90. Syn. of Estalline											
Esten. Hort'47	R. I	robl	l	yb	cj	y	sa	g		m	
Ethlyn. MinnHort'98	Iowa	r	ms	yrs	f	y	a	vg		l	
Etoile. D. Syns. Calville Etoille, Reinette Etoille	Hol.?	rob	l	r	t	w	sa			ml	From Album de Pomologie
Etowah. A'73. Syns. Cooper's Red, Etowah Seedling	Ga	obc	m				sa			l	
Etowah Seedling. RNY'71. Syn. of Etowah											
Etris. ArkB49. Syn. Etris Beauty	Ark	robl	ml	wrsc						l	May prove to be Gano.
Etris Beauty. AHG. Syn. of Etris											
Eureka. Dap	Conn.?	robe	m	wrs	ftj	w	sa	vg	mk	m	
Eureka. IllH'00	Wi	rob	l	pyrsc	fmj	w	s	vg		vl	Distinct from Eureka of Downing. A Tolman seedling.
Eustis. GenF'49. Syns. Ben, Ben of Reading	Mass	robe	l	yrs	fc	y	msa	vg		ml	
Eutaw. A'95	Am									m	
Evaline. OntExR'82	Iowa	rc	m	gy	jc	w	sa	g	k	l	Originated in northern Iowa.
Evans. ArkB49. Syn. Walker's Sweet	Ark	obc	ml	yrs	ftc	y	msa			vl	
Evans Early. R. Syn. Evans' Early											Not described.
Evans' Early. IndH'72. Syn. of Evans Early											
Evans June. MagofH'53											Do.
Evans Late. R. Syn. Evans' Late											Do.
Evans' Late. IndH'72. Syn. of Evans Late											
Evans (of Idaho). BBL											Do.
Evan Seedling. R. Syn. Evan's Seedling											Do.
Evan's Seedling. MichB31. Syn. of Evan Seedling											
Evart. OreB22											Do.
Eve. D. Syn. of White Paradise											
Eve Apple of the Irish. GarCal. Syn. of Margaret											
Evening Party. MagofH'53	Pa	ob	ms	yrs	jte	w	sa	vg	d	ml	
Eve (of the Irish). E. Syn. of Eggtop											
Eve of Scotland. D. Syn. of Manks											
Everbearing. NYExR'94. Syns. Illinois Imperial, Simon's Red		rob	ml				sa	vg		me	
Everbearing Illinois Imperial. SBro. Syn. of Jefferis											

Everlasting. L. Syns. Green Everlasting, Yellow Everlasting	N. Y	r	m	gy			sa	g		vl	
Everlasting Hanger. DomEnc. Syn. of Hanger											
Evesham. L. Syn. Evesham Russeting			l						c	m	
Evesham Russeting. C. Syn. of Evesham											
Ewalt. Wg. Syns. Bullock's Pippin (of some), Bully Pippin, Lady's Blush, Red Cheek Bellflower.	Pa	re	l	ye	t	w	bsa	g-vg		l	
Ewing. L. Syn. Press Ewing	Ky	ob	m	yes	fjet	y	sa	g-vg	d	l	
Ewing Missourian. R. Syn. Ewing's Missourian	Mo.?										Do.
Ewing's Missourian. MoH'87. Syn. of Ewing Missourian											
Excel. D	Conn	obc	l	yrs	tj	y	bsa	g-vg		l	
Excelsior. Wn	Cal	ob	l					vg	dk	m	
Excelsior. JWK	Md		ml	r						m	
Excelsior. IllH'80	Minn		ml				sa	vg	km	e	
Exquisite. D	Ill	ob	ms	yrs	j	w	msa	g-vg	d	m	
Extra. R. Syn. Extra Ben Davis	Ark.?		l	yrs				g		l	
Extra Ben Davis. SBro. Syn. of Extra											
Extreme. L. Syn. Wheeler's Extreme	Eng	ob	s	yru	t	yw	s			ml	From Hogg.
Ey Colton. Cat. [Doubtless intended for Colton.]											Not described.
Eyer. L. Syn. Eyer's Greening	Eng	r	m	pg		g	sa		k	l	From Lindley.
Eyer's Greening. D. Syn. of Eyer											
Ey Hagloe. Cat. [Doubtless same as Summer Hagloe.]											Not described.
Ey Sugarloaf. Bai											Do.
Ey Transparent. Cat. [Probably same as Yellow Transparent.]											Do.
Ey Trenton. Bai. Syn. of Trenton Early											
Ey William. Cat. [Probably same as Williams.]											Do.
Ey Winter. Cat											Do.
Ezell. WHyS. Syn. of Barker Liner											
Fabin. R. Syn. Fabin's Sweet							s				Do.
Fabin's Sweet. S&W. Syn. of Fabin											
Fahnestock. MagofH'53. Syn. Fahnestock's Sweeting	Ohio									e	
Fahnestock's Sweeting. H. Syn. of Fahnestock											
Fail-me-never. D. Syn. of Fail-Never											
Fail-Never. L. Syns. Fail-me-never, Neverfail	Scot	ob	ml	dr		w	s	g	k	l	From Lindley.
Fair. L. Syn. Fair's Nonpareil	Eng.?	r	s	yb	fcj		visa			l	From Hogg.
Fairbanks. Cole	Me.	obc	m	pyrs	j	y	visa	g		m	From Maine Pomological Report.
Fairfield. L. Syn. Fairfield Summer Queen		robc	m	pyrs	j	y	bsa	vg		me	
Fairfield Summer Queen. D. Syn. of Fairfield											
Fair Maid. MagofH'53	Pa	rob	ml	rs			sa	g			
Fair Maid of Taunton. D. Syn. of Taunton Maid											
Fairmount. R. Syn. Fairmount Pine	Ohio	obc	ml	gyb	c	w		g		l	
Fairmount Pine. MagofH'44. Syn. of Fairmount											
Fair's Nonpareil. D. Syn. of Fair											
Fair Winter. W		r		rs			sa				
Fairy. AJofHVII	Eng	obe	s	pye	fevj	y	sa	vg	d	l	From Florist and Pomologist.
Falder. W	Pa	obl		rs			sa			l	
Falder. D. Syn. of Fallawater											
Fallx. NYB90											Not described.
Fall. Dap. Syn. of Southern Porter											
Fallawalder. D. Syn. of Fallawater											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Fallawater. Lin. Syns. Baltimore (erroneously), Baltimore Pippin, Benjamite, Brubacker, Dutch Codlin (erroneously), Falder, Fallawalder, Fall de Walldes, Fallenwalder, Falwalder, Frenwalder, Green Mountain Pippin, Molly Whopper, Mountain Green, Mountain Pippin, Pfarrer Walter, Pim's Beauty of the West, Pound, Talpehocken, Tulpehocken, Winter Blush, Tulpehocking.	Pa	rc	vl	ygb	jct	gw	pmsa	g	km	ml	
Fall Beauty. E. Syn. Fall Queen. [Probably Buckingham.]											
Fall Bough. Lin. Syn. of Autumn Bough											
Fall Brown. A'73. Syn. Brown Fall	N. J.?	ob	ms	wr	ftmj	w	sa	g-vg		m	
Fall Butter. W	Ind	r	l	gy	j	yw	s	g	dk	ml	
Fall Chandler. W		c					sa			m	
Fall Cheese. AFM	Va		l	grs		w	sa			ml	May be same as Mangum.
Fall Cheese of Va. E. Syn. of Mangum											
Fall Cheese. H. Syn. of Summer Cheese											
Fall de Walldes. D. Syn. of Fallawater											
Fallenwalder. E. Syn. of Fallawater											
Fall Gem. P'94	Ill	rc	m	ywse	tj	w	sa	vg	d	m	
Fall Geneting. D. Syn. of Fall Jenneting											
Fall Gennetting. E. Syn. of Fall Jenneting											
Fall Green. MoH'65											Not described.
Fall Greening. D	N. Y	rob	m	gy	t	gw	psa	g-vg	m	ml	Mr. Downing describes two varieties under the same name.
Fall Greening. D		ob					sa			m	
Fall Grening. W		ob					sa			m	
Fall Green Sweet. W, Syn. of Victuals and Drink											
Fall Harvey. M	Mass	rob	l	py	jc	w	psa	g-vg	k	m	
Fall Janeton. MoH'70. Syn. of Fall Jenneting											
Fall Janetting. Cat											Not described.
Fall Jenneting. MagofH'46'. Syns. Fall Geneting, Fall Gennetting, Fall Janeton, Fall Jennetting, Summer Jenneting.	Conn	obc	l	gyb	tj	w	bsa	g	m	m	
Fall Jennetting. E. Syn. of Fall Jenneting											
Fall Limbertwig. D		robc	m	pyr	tj	w	bsa	g		m	
Fall Mellow. MHSC'77. Syn. of Mellow											
Fall Norway. Cat											Do.
Fall (of the West). Syn. of Fall Swaar											
Fall Orange. Syns. Hogpen, Holden, Holden Pippin, Jones' Pippin, Long Island, Long Island Graft, Newell, New York Bellflower, Orange, Red Cheek, Speckeled, Westbrook, White Graft of Wis., White Newell.	Mass	r	l	pyb	tj	w	sa	g	k	m	
Fall Orange. E. Syn. of Orange											
Fall Pearmain. D	Conn	rc	m	yrse	tj	w	sa	g-vg		m	

Fall Pippin. Dom Enc. Syns. Autumn or Fall Pippin, American Fall (erroneously), Cobbett's Fall, Camnesar, Cathead (incorrectly), Concombre Ancien, De Rateau, D'Espagne (erroneously), Episcopal, Golden Pippin (erroneously), Holland Pippin (erroneously), Autumn Pippin, Large Fall Pippin, Philadelphia Pippin, Pound Pippin, Pound Royal (of some), Reinette Blanche d'Espagne, York Pippin.	Am.?	roblob	vl	yg	vt	w	psa	g-vg	dkm	m	
Fall Pippin (erroneously). GenF'33. Syn. of White Spanish											
Fall Pippin of Louisville. W. Syn. of White Fall											
Fall Queen. W. Syn. Ladies Favorite	South	oblc	l				sa	vg		m	Perhaps same as Buckingham.
Fall Queen. E. Syns. Fall Beauty, Horse Apple, Mundy's, Oldfield, Red Gloria Mundi.		rc	ml				sa		k	e	
Fall Queen. A'56. Syn. of Buckingham											
Fall Queen. Dap. Syn. of Haas											
Fall Queen. W. Syn. of Winter Queen. [Same as Buckingham.]											
Fall Queen of Kentucky. T. Syn. of Buckingham											
Fall Red. MoH'73											Not described.
Fall Redstreak. A'77. Syn. Late Redstreak	Wis	robc	l	yrs	tj	yw	sa	vg-b		me	
Fall River. ColExR'91											Do.
Fall Romanite. D. Syn. of Rambo											
Fall Russet. MoH'70											Do.
Fall Russia (Kan.) Cat											Do.
Falls. R. Syn. Falls Seedling	Minn	r	m	yrs	ft	y	s	vg		m	
Fall St. Lawrence. A'89. Syn. of St. Lawrence											
Fall Seek-no-further. D. Syn. Winter Seek-no-further		ob	vl	yrs	tmj	w	sa	g		m	Probably same as Watson.
Fall Seek-no-further. D.	Iowa	r	m	gb	t	w	msa	vg		ml	
Fall Spitzenburg. IndH'72	Vt	rc	m	rs	tj		sa	g		m	
Falls Seedling. MinnHort'95. Syn. of Falls											
Fall Strawberry. Cole. Syn. of Late Strawberry											
Fall Stripe. PFar'60. Syn. Saxton	Mass. or Conn.	rob	ml				sa	g		m	
Fall Swaar. L. Syns. Autumnal Swaar, Fall (of the West), Fall Swaar of the West.		rc	l	yru	tj	y	sa	vg	dkm	me	
Fall Swaar (of the West). D. Syn. of Fall Swaar											
Fall Sweeting. A'60											Not described.
Fall Vandervere. E. Syn. of Vandevere											
Fall Vandevere. W	Ohio	rob	l				sa	g		m	
Fall Vandevere. IllH'84. Syn. of Newtown Spitzenburg											
Fall Vandevere. D. Syn. of Vandevere											
Fall Willow. WVaB75											Do.
Fall Wine. MagofH'48. Syns. Fall Wine of the West, House, Hower, Musk Spice, Ohio Wine, Sharpe's Spice, Sweet Wine, Uncle Sam's Best, Wine Apple, Wine-full, Wine (of Cole).		rob	ml	drs	jt	y	msa	vg-b	d	m	
Fall Wine (erroneously). E. Syn. of Ashmore											
Fall Wine of the West. IllH'84. Syn. of Fall Wine											
Fall Winesap. CGen'61		rc	m	ygb	ftj	w	sa	g		m	
Fall Winesap (erroneously). E. Syn. of Bullock											
Falwalder. D. Syn. of Fallawater											
Fama Gusta. C	Eng	roble	m	yb	t	y	s	g	k	m	
Fame. L. Syn. Dredge's Fame	Eng.?	r	m	yru	fe	gy	bs			l	From Hogg.
Fameuse. M. Syns. Chimney, Pomme de Neige, Sanguineus, Snow, Snow Apple, Snow Chimney.	Fr.? Can.?	rob	m	gyre	vtj	w	sa	b	dkm	me	

Catalogue of the known varieties of apples referred to in the American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Fameuse Baldwin (of some). Dap. Syn. of Hilaire											
Fameuse Noire. AmGar'01	Que	rob	m	ydr	cj	w	rmsa	vg		l	
Fameuse Sucre. T	Que	ob	m				sa	vg	d	m	
Family. W. Syn. McCloud's Family	Ga	obc	m	yrs	tj	w	sa	vg		me	
Family Favorite. BBL, Syn. of Vandevere Improved											
Fancher. W		r	l	yb	f	w	vs	vg	k	m	
Fanny. D	Pa	robe	l	drc	tj	ws	sa	vg		me	
Farleigh. L. Syns. Farleigh Pippin, Farley Pippin	Eng	obc	m	yb	fr	g				l	From Lindley.
Farleigh Pippin. GenF'33. Syn. of Farleigh											
Farley. L. Syn. Farley's Red	Ky	roblc	ms	yrc	vfcj	w	msa	vg	dm	vl	
Farley Pippin. D. Syn. of Farleigh											
Farley's Red. MoH'63. Syn. of Farley											
Farmer's Profit. Dap. Syn. of Hubbardston											
Faros. D. Syn. Gros Faros		rob	m	yr	j	gw	msa			l	
Farrar. L. Syns. Farrar's Summer, Robinson's Superb	Va		l		cj					m	
Farrar's Summer. W. Syn. Farrar											
Farris. NYB84											Not described.
Farthing. R. Syn. Farthing's (No Bloom)	N. C		m	rs				g			
Farthing's (No Bloom). JVL. Syn. of Farthing											
Fat Apple. D. Syn. of Fett											
Father. D. Syn. Father Apple	N. Y	ob	m	gy	vtj	w	sa	g		ml	
Father Abraham. C		ob	s	rsc			sa				From Transactions Ohio Pom. Society.
Father Abraham. H	Va	ob	s	yrs					dk	l	
Father Abraham. C. Syn. of Abraham											
Father Abraham (of Ill.). W. Syn. of Abram											
Father Abram. F. Syn. of Abram											
Father Apple. H. Syn. of Father											
Father Apple. D. Syn. of Pittsburg											
Faust. W. Syns. Faust's Winter, Foust	N. C	r	m	yb	mj	wy	psa	g-vg	d	m	
Faust Rome Beauty. NYB15											Probably same as Rome.
Faust's Rome Beauty. NYExR'95. Syn. of Rome											
Faust's Winter. D. Syn. of Faust											
Favorite. E	Ky	r	s	yrs	j	y	msa	g		ml	
Favorite. A'85	N. S									e	
Favorite of Edgewood. JVL											Not described.
Fawcett. R. Syn. Fawcett's Seedling	Ont		vl	gr			a	vg	d	ml	
Fawcett's Seedling. CanH'02. Syn. of Fawcett											
Fawn Head. Cat											Do.
Fay. R. Syn. Fay's Early Joe											Do.

Fayette Black. CGen'59											
Fay's Early Joe. MichB31. Syn of Fay											
Fay Russet. L. Syn. Fay's Russet	Vt	obe	ms	pyru	t		psa	vg		vl	
Fay's Russet. D. Syn of Fay Russet											
Fay's Russet. Hort'75. Syn. of Hunt Russet											
Fay Seedling. MagofH'52	Mass	r	m	yr			sa	g		m	This may be Hunt Russet.
Fay Sweet. L. Syn. Fay's Sweet		ob					s				
Fay's Sweet. W. Syn. of Fay Sweet											
Fearns. L. Syns. Clifton Nonsuch, Fearns Pippin, Ferris Pippin, Florence, Florence Pippin.	Eng	rob	m	gyb	fj	yw	rsa			l	From Lindley.
Fearns Pippin. C. Syn. of Fearns											
Feast. R. Syn. Feast Fine Red											Not described.
Feast Fine Red. BBL. Syn. of Feast											
Federal. MagofH'53	Ohio	r	s				sa	vg		l	From Transactions Ohio Pom. Society.
Federal Pearmain. GenF'33	Eng	rob	m	gyb	fj	yw	rpsa		d	l	From Hogg.
Felch. MagofH'49. Syn. of Baldwin											
Felix. Hort'72. [Possibly a crab.]	Wis										Not described.
Fell. L. Syn. Fell's Winter Sweet	Ill.?	r	m	gybc	m	w	rs	g	k	vl	
Fell's Winter Sweet. D. Syn. of Fell											
Felt. L. Syn. Felt's Strawberry	N. Y	c	l				sa	vg		e	
Feltonville. NEF'54	Mass										Do.
Felt's Strawberry. A'58. Syn. of Felt											
Fenley. A'60. Syn. of Finley											
Fenner. R. Syn. Fenner Sweet	R. I										Do.
Fenner Sweet. A'60. Syn. of Fenner											
Fenouillet. MoH'67											Do.
Fenouillet de la Cline. IllB45											Do.
Fenouillet Gris. K. Syns. Anis, Brown Apple, Burnt Island, Caraway Russet, Rome d'Anis, Spice Apple, Winter Anis Rennet.	Fr.?	r	s	yru			psa	g		ml	
Fenouillet Jacune. A'58. [Probably a misprint for F. Jaune.]											Do.
Fenouillet Jaune. C. Syns. Drap d'Or, Embroidered Pippin, Pomme de Caractère, Yellow Fenouillet.	Fr	r	s	yru	f	w	sa	g		l	
Fenouillet Jaune. D. Syn. of Drap d'Or											
Fenouillet Rouge. GenF'33. Syns. Bardin, Black Tom, Court Pendu Gris, Red Spice.		r	s	gru	f		sa	g		ml	
Fen-Sapson. MagofH'37											Do.
Fenton. Hort'73	Pa	ob	ml	wyrs	fj	w	sa		dk	m	
Fenton Sweet. F. Syn. of Higby											
Fenton Sweet. W. Syn. of Trumbull											
Fenton Sweeting. E. Syn. of Trumbull											
Ferdinand. Hort'49	S. C	obe	l	dy	tjm	y	sa	g-vg		l	
Ferguson. MoH'88	Mo			dr	fj		sa	vg		vl	
Ferris. E. Syns. Long Island Seeknofurther, Rhode Island Seeknofurther, Seek-no-further, Westchester, Westchester Seeknofurther.		obe	l	wgre	tj	w	sa	vg	dm	ml	
Ferris (Del.). A'52. Syn. Ferris	Del	robe	ms	wrs	j	gw	sa	g		vl	
Ferris. D. Syn. of Ferris (Del.)											
Ferris Pippin. D. Syn. of Fearns											
Ferris Wheel. SDB76	Iowa	obe	m	ye		w	s	g		m	Originated with J. C. Ferris, Hampton, Iowa.
Fesendin. NEF'31											
Fess. A&H	Ind										Not described.

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Fett. D. Syn. Fat Apple		rob	ms	rc	c	ws	sa	g		ml	
Fidler. R. Syn. Fidler's Pippin	Ind										Not described.
Fidler's Pippin. IndF'40. Syn. of Fidler											
Field. D	Pa	r	m	wrc	cj	y	psa	g		ml	
Fillbasket. L. Syns. Kentish Fillbasket, Lady de Gray's, Potter's Large Grey Seedling, Potter's Large Seedling.	Eng	r	vl	ygb	tj		sa	g	k	ml	
Fillup. IllH'93	Iowa	ob	m	r				vg		l	
Findley. D. Syn. of Finley											
Findley Apple. D. Syn. of Summer Cheese											
Findley Queen. WVaB75											Do.
Fine Early. IllB45											Do.
Fine Red. R. Syn. Fine Juicy Red											Do.
Fine Juicy Red. IllB45. Syn. of Fine Red											
Finis. MagofH'46	Mass			rs	t	w	a	g		vl	
Fink. H. Syn. Fink's Seedling	Ohio	ob	s	wyc	fc	w	psa	g-vg		vl	
Fink's Seedling. NAPC'49. Syn. of Fink											
Fink's Seedling. E. Syn. of Tewksbury											
Finley. Hort'60. Syn. Fenley, Findley, Horse (erroneously)	Ky	obc	l	py	cj	y	psa	g-vg	km	me	
Finley Pippin. IllH'69	Ind.?		ml							ml	
Firm Waller. IllB45. Syn. of Waller											
First Early. IllH'89	Ill		m					vg		ve	
First and Last. D	Eng	rc	m	yc	t	y	bs		k	vl	From Hogg.
First-of-all. IllH'01											Not described.
Fish. D	Rus.?		vl								
Fisher. MagofH'52										vl	A handsome long keeper
Fisher Greening. R. Syn. Fisher's Greening			vl	gy				g			
Fisher's Greening. B(Ph)N'87. Syn. of Fisher Greening											
Fishkill. L. Syn. Fishkill Beauty	N. Y	rob	ml	wyb	vtj	w	sa	g		m	
Fishkill Beauty. D. Syn. of Fishkill											
Fish Seedling. R. Syn. Fish's Seedling	N. H	ob	m	drs	tm	gw	rsa	g		m	
Fish's Seedling. D. Syn. of Fish Seedling											
Fisk. L. Syns. Fisk's, Fisk's Fall Seedling, Fisk's Seedling	N. H	ob	m	rs			s	g		m	
Fiske. D		rob	l	pyrc	ctj	w	sa	g-vg		l	
Fisk's. W. Syn. of Fisk											
Fisk's Fall Seedling. IllB45. Syn. of Fisk											
Fisk's Seedling. T. Syn. of Fisk											
Five Crowned Pippin. GenF'33. Syn. of London Pippin											
Five Quartered Gilliflower. Dap. Syn. of Scollop Gilliflower											
Five Square. A'77											Not described.
Fixlin. Hort'49	S. C	ob	l	rs				g	k	m	

Flag. R. Syn. Flag Boy's											Do.
Flag Boy's. Hort'46. Syn. of Flag											
Flake. L. Syn. Flake's Fall	Pa	obc	l	yrc	tmj	w	msa	vg		m	
Flake's Fall. A'67. Syn. of Flake											
Flamingo. W	South	obl		rs			s				
Flanders. NEF'62. Syn. of Garland											
Flanders Pippin. D	Eng	ob	m	gyb	tj	w	bsa		k	m	From Hogg.
Flanders Reinette. D. Syn. Reinette de Flanders		r	m	y	f	yw	s			ml	From Album de Pomologie.
Flat. IllH'93											Not described.
Flat Aport. CanB37											Do.
Flat Apple. D. Syn. of Clapper											
Flateye. R. Syn. Flat Eye	Mo	ob	l	gyb		y	bsa	g	km	m	
Flat Eye. AHortA'71. Syn. of Flateye											
Flat Graft. WVaB75											Do.
Flat Miron. Gb. Syns. Flattened Barbel, Gov. list No. 467, Miron ploskui.	Rus										Do.
Flat Pippin. D. Syn. Needles	Ohio	ob	l	gwr	j	w	sa	g		m	
Flat Pippin. D. Syn. of Pittsburg											
Flat Red. IllH'68											Do.
Flat Russet. IllH'68											Do.
Flat Sweet. (Am.) W	Am	obc	l	yru			s	g	k	l	
Flat Sweet. (Eastern.) D. Syns. Flat Sweeting, Hornet Sweeting	East	obc	l	yru	tj	w	s	g	k	l	
Flat Sweet. (Ill.) D	Ill	ob	ms	yrsc	fjm	ws	msa	g		me	
Flat Sweeting. Th. Syn. of Flat Sweet (Eastern)											
Flattened Barbel. Gb. Syn. of Flat Miron											
Flat Top. Cat											Do.
Flat Vandevere. Dap. Syn. of Grindstone											
Flat Voronesh. Gb. Syns. Voroneshskoe Polskoe, V. R. S. to Ia. No. 8	Rus										Do.
Flax. R. Syn. Flax Pippin											Do.
Flax Pippin. A'83. Syn. of Flax											
Fleet. L. Syn. Fleet's Nonpareil		obc	m	yw	cj	w	bsa	g	k	me	
Fleet's Nonpareil. D. Syn. of Fleet											
Fleiner. Wg	Ger	oble	m	wyc	tj	w	ba	g	d	m	
Fleming. Dap. Syn. of Forney											
Flesh and Blood. MHSC'77. Syn. of Mountain Beet											
Fletcher. IllH'98	Ind	ob	m	rs			sa	vg	d	ml	
Fletcher Kernel. R. Syn. Fletcher's Kernel				y				g	d	l	
Fletcher's Kernel. GenF'33. Syn. of Fletcher Kernel											
Fletcher Russet. Dap	Mass	obc	m	gyru	ftj	w	psa	g	d	l	
Flint Russet. D. Syn. of Pumpkin Russet											
Flora. W	South	ob	m	yc		w	msa	g ?		me	
Flora Bell. Cat	Iowa ?										Do.
Florence. ArkB60	Ark	robl	m	yrs	tf	y	msa	g		ml	
Florence. Cat. Syn. of Fearns											
Florence Pippin. D. Syn. of Fearns											
Flory. AHortA'69. Syns. Flory's Bellflower, Sheep Shire	Ohio	rc	m	y	tmj	y	sa	g		m	
Flory. AJC. Syn. of Banana											
Flory's Bellflower. PFar'67. Syn. of Flory											
Flower of Kent. MagofH'51. Syn. of Kent Flower											
Floy. R. Syn. Floy's Bellflower. [Probably intended for Flory.]											Do.
Floy's Bellflower. MichB31. Syn. of Floy											
Floyd. BBL											Do.

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Flushing. Th. Syns. Black Spitzenberg, Flushing Spitzenburgh, Joe Berry?, Newtown Spitzenburg?, Ox Eye?, Red Market (of Mich.), Spitzenberg-Flushing.	Am.... N. Y.?...	rc	......	gyr	jc	w	sa	g	m	ml	
Flushing. H. Syn. of Newtown Spitzenburg											
Flushing Seeknofurther. E. Syn. of Green Seeknofurther											
Flushing Spitzenberg (of the N. W.). W. Syn. of Baltimore											
Flushing Spitzenburgh. Lin. Syn. of Flushing											
Focht. W	Pa	obc	l	pyb	tj	w	sa	g	k	ml	
Fokin's Apple. Gb. Syn. of Vochin											
Fokinskoe. Gb. Syn. of Vochin											
Fonaric. MHSC'86. Syn. Fonarik nalivnui, Fonaric nalivnoe, Rgl. to Ia. No. 428, Shro. to Ia. No. 95.	Rus										Not described
Fonaric nalivnoe. Gb. Syn. of Fonaric											
Fonarik nalivnui. Gb. Syn. of Fonaric											
Fonville. JVL	N. C	rob	ml	grs	t	y		g		l	
Foote. A'85											Do.
Foote Bellflower. R. Syn. Foote's Seedling Bellflower											
Foote Nonpareil. R. Syn. Foote's Nonpareil	Mass	oblc	s	yc	ft		sa	vg		m	
Foote Nonsuch. L. Syn. Foote's Nonsuch	Mass	ob	m	dr	ftj	ws	sa			vl	
Foote's Nonpareil. D. Syn. of Foote Nonpareil											
Foote's Nonsuch. D. Syn. of Foote Nonsuch											
Foote Sweet. R. Syn. Foote's Pound Sweet											
Foote's Pound Sweet. AJofHVII. Syn. of Foote Sweet											
Foote's Seedling Bellflower. AJofHVII. Syn. of Foote Bellflower											
Forange. D	Ohio		l	py	fr	w	s	g		me	
Ford. W. Syn. Ford Apple	N. Y	rc	l	y	mt	yw	a	g		ml	
Ford Apple. D. Syn. of Ford											
Forden. BBL											Do.
Forelle. D. Syn. of Blue Mountain											
Forest. D. Syn. Red Codlin	N. Y	roblc	m	yrc	ctj	y	rsa	vg		l	
Forest. TVM	La.?		l	y				g			
Forest Crab. IllH'79. [May be a native crab.]											Do.
Forest Queen. A'71											Do.
Forest Red. R&P			m	dr	fr		sa	vg		e	
Forest Styre. MagofH'37. Syns. Stire, Styre	Eng	rob	s	pyb	f		ba		c		From Lindley
Forest Styre. D. Syn. of Styre											
Forest Sweet. W	Ohio	ob	ml				s	g		l	
Forever Pippin. E. Syn. of Cheeseboro											
Forge. D	Eng	rob	ms	wyrs	tj	yw	psa	vg		l	
Forman. L. Syn. Forman's Crew	Eng	obc	ms	ygb	j	gy	rsa			l	From Lindley

Forman's Crew. GenF'33. Syn. of Forman											
Formosa Pippin. GenF'33. Syn. of Ribston											
Forney. T. Syns. Fleming, Perkins	N. C	roble	l	wrs	tmj	w	sa	vg	dm	m	
Fornwalder. D. Syn. of Fallawater											
Forren. R. Syn. Forren Hill											Not described.
Forren Hill. BBL. Syn. of Forren											
Forster. IaH'96											Do.
Forsyth (not of Coxe). D. Syn. of Easter											
Forsyth's Seedling. IllB45. Syn. of Late Strawberry											
Forsyth's Seedling. Hort'58. Syn. of Nickajack											
Fort Massie. A'58	Ohio	oble	ml	gyrs	fj			b			
Fort Meigs. W	Ohio	ob	ml	rs			sa	g		l	
Fort Miami. E. Syn. Scandiana Mala	Ohio	roble	m	pyb	fcj	y	sa	vg		vl	
Fosburg. MinnHort'98		robl	l	yrs	mj	y	a	g	k	me	
Foster. MagofH'57				yr			s			e	Named by a committee of the Mass. Hort. Society.
Foster. W	Ohio	ob	m	y			sa	g		m	
Foster. MoH'86			l					vg		m	
Foster. TennBI-ix. Syn. of Wetmore											
Foster's Best. IllB45. Syn. of Pennock											
Foster Fall. R. Syns. Foster's Large Striped Fall, Foster's Striped Fall											Not described.
Foster's Large Striped Fall. MagofH'47. Syn. of Foster Fall											
Foster's Striped Fall. MagofH'53. Syn. of Foster Fall											
Foster Sweet. D	Mass	robe	m	wyrs	jt	w	msa	g-vg		me	
Foster Yellow. R. Syn. Foster's Yellow Fall											Do.
Foster's Yellow Fall. MagofH'53. Syn. of Foster Yellow											
Fouldon. L. Syns. Fouldon Pearmain, Horrex's Pearmain	Eng	r	m	pyb	fe	yw	ba			l	From Lindley.
Fouldon Pearmain. GenF'33. Syn. of Fouldon											
Foundling. MagofH'48. Syns. Funtling, Groton Shirley	Mass	robe	m	ygrs	tj	y	sa	vg	d	me	
Fountain. MagofH'36											Not described.
Fountain Hill. Hort'73	Iowa	ob	ms	pgr	fetj	w	sa	vg	d	m	
Fourth of July. Gen'F62. Syn. of July											
Fourth of July. Cat. Syn. of Siberian August. [This may be a crab.]											
Foust. D. Syn. of Faust											
Fowler. D. Syn. of Smith											
Fox. L. Syns. Fox Apple, Fox Sheepnose, Sheepnose	Ohio	robe	ml	wrs	etj	w	sa	g	d	m	
Fox Apple. Dap. Syn. of Fox											
Fox Apple (of some). Hort'73. Syn. of Bullock											
Foxite. W	Ind	r	l	y			sa	g		m	
Foxley. NEF'26											
Fox Sheepnose. Dap. Syn. of Fox											
Foxwell. A'79											Do.
Fox Whelp. NEF'26	Eng	r	m	yrs	f				e	m	From Lindley.
Fraise. D	Fr	re	s	yr	ft		sa				From Society Van Mons.
Fraker. R. Syn. Fraker's Seedling	Kans		ml	r	fe	y	a	g	m	vl	
Fraker's Seedling. KanFM. Syn. of Fraker											
Framboise. D. Syns. Framboos, Calville Rouge d'Automne, (incorrectly)	Ger	robl	ml	gyrs	ftj	w	sa			me	From Annals of Pomology.
Framboos. D. Syn. of Framboise											
Framingham. R. Syn. Framingham Nonsuch											Not described.
Framingham Nonsuch. VtB61. Syn. of Framingham											
Franche. R. Syn. Franche Pepin											

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Franche Pepin. GenF'33. Syn. of Franche											
Franchot. D	N. Y	rc	m	yrs	jc	y	psa	g		ml	
Franclin. Dap	Pa	ob	m	gwr	ftj	wy	sa	vg		m	
Frank. W. Syn. of Chenango											
Frank Bassett. JTL		rc	l	r				vg	m	l	
Frankfort Queen. A'60. Syn. of Buckingham											
Franklana. P'94	Ill	rc	l	yrc	ftj	y	msa	vg	d	ml	
Franklin. W. Syn. Franklin Green Pippin		rob	m	yb	cj		sa			m	
Franklin. Dap. Syn. of Fronclin											
Franklin Golden. W. Syn. Hughes American Golden Pippin	Am	obl	l	y	tfj	y	a	vg	d	l	
Franklin Golden Pippin (Ill.). D. Syn. of Franklin (Ill.)											
Franklin (Ill.). L. Syns. Franklin Golden Pippin (Ill.), Golden Pippin (Pa.).	Pa.? Ill.?	rc	m	py	tmj	y	msa	vg		ml	
Franklin's Golden Pippin. M. Syn. of Sudlow											
Franklin Green Pippin. GenF'33. Syn. of Franklin											
Franklin June. Hort'65. Syn. Franklin's June			m								Not described.
Franklin's June. IllB45. Syn. of Franklin June											
Franklin Sweet. A'77	Me		m	y	j	w	s	g		l	
Frank Rambo. D. Syn. of Summer Rambo											
Franzosische Edelreinette. D. Syn. of French Reinette											
Franz Rennette. D. Syn. of French Reinette											
Fraser. R. Syn. Fraser River Beauty											Do.
Fraser River Beauty. CanExR'01. Syn. of Fraser											
Frazer. BBL											Do.
Frazer Hardskin. R. Syn. Frazer's Hard Skin											Do.
Frazer's Hard Skin. JVL. Syn. of Frazer Hardskin											
Frazier Favorite. P'95. Syn. of Cantrel											
Fred Wills. MoH'63. Syn. of Wills											
Freel Seedling No. 1. IaH'97											
Freel Seedling No. 2. IaH'97											
Freel Seedling No. 3. IaH'97											
Freel Seedling No. 5. IaH'97											
Freeman. D	N. J	oc	m	r	t	ws	sa	vg		vl	
Freeman. MoH'85. Syn. of Freeman Red											
Freeman Red. NWFG'55	Mo		vl	dr				vg		l	
Freeze and Thaw. Hort'53	Pa	obc	m	yrs	f	w	sa	p		ml	
Fremont. L. Syn. Fremont Pippin	Pa	rc	m	pyc	cj	w	bsa	vg		l	
Fremont Pippin. D. Syn. of Fremont											
French. D	N. E	obc	ml	yrs	c	y	ra	g		m	
French. W	Pa.?	r					sa				

French Bellflower. D. Syns. Bellefleur de France, Doubbel Bellefleur, Double Bellefleur.	Fr	rc	vl	yeb	tm	yw	s				From Annals of Pomology.
French Cider. S&W											Not described.
French Codlin. K. Syn. of Dutch Codlin											
French Crab. D	Fr	r	ml	gy	f		psa			vl	From Ronalds.
French Crab. D. Syn. of Easter											
French Crab. D. Syn. of Metoiree											
French Golden Reinette. Lin. Syn. of Konig											
French Nonpareil. D		rob	m	gyr	cj	w	pmsa	g-vg		ml	
French Nonpareil. CanH'91. Syn. of Bethel											
French Paradise. CB116	Fr			yr							
French Pearmain. Hort'75. Syn. of Autumn Pearmain											
French Pippin. W	Pa.?	obl	l				sa	g		l	
French Pippin. W. Syns. Hower, Hoover (?)	N. J	rob	l	gyb	t	y	psa	g		ml	
French Pippin. W	Ohio	ob	l				sa	g		ml	
French Pippin. D		rob	l	gyb	t	y	psa	g		ml	
French Pippin. D. Syn. of French Russet											
French Pippin. Dom Enc. Syn. of Newark Pippin											
French Pippin of Central Pennsylvania. A'56											
French Pippin of Indiana. E. Syn. of Dumpling											
French Pippin of Newark. Dom Enc. Syn. of Newark Pippin											
French Pippin (of some). E. Syn. of Roman Stem											
French Pippin (of some). E. Syn. of Holland											
French Rambo. JVL	?		l	yes				vg		me	
French Rambo, of some. A'77. Syn. of Grosh											
French Reinette. Dom Enc. Syns. Franzosische Edelreinette, Franz Rennette, Reinette Blanche, Reinette Blanche dite Prime, Reinette de Normandy, Reinette Franche, Weisse Reinette.	Fr	roble	l	yrub	f	yw	sa				
French Reinette. G. Syn. of Early Harvest											
French Royal. W		obl	m				sa	g		l	
French Russet. D. Syn. French Pippin	Fr	r	m	yr	t	w	sa		k	ml	Do.
French Spitzenburgh. Dap. Syn. of Summer Spitzenburg											
French Sweet. L. Syn. French's Sweet	Mass.	rob	ml	yb	cj	y	s	g	k	m	
French's Sweet. E. Syn. of French Sweet											
French Violet. C	Fr	obl	ml				sa				
French Wine. Dap	Ger	ob	vl	wrs	cj	w	bsa	g	km	m	
Freshling. MagofH'53											Not described.
Friar. MagofH'42. Syn. Balk	Eng	c	ml	gr					c		From Hogg.
Fridd. R. Syn. Fridd's Winter											
Fridd's Winter. WisHort'02. Syn. of Fridd											
Frisland. L. Syns. Frisland Reinette, Reinette de Frisland	Ger	robc	l	yb		w	sa	g		ml	From Album de Pomologie.
Frisland Reinette. D. Syn. of Frisland											
Frith Pippin. D. Syn. of Manks											
Frith Pitcher. E. Syn. of Manks											
Frogmore. R. Syns. Frogmore Nonpariel, Frogmore Prolific		rc	l	gb	fcj	w	a		k	me	
Frogmore Nonpareil. Hort'58. Syn. of Frogmore											
Frogmore Prolific. CanExR'01. Syn. of Frogmore											
Fronclin. A'52. Syn. Franklin	Pa	ob	ms	wr	tj	yw	a	g		m	
Front Door. D	W. Va	ob	ml	yrs	tj	w	sa	g	d	me	
Fruher Champagner. Gb. Syn. of Early Champagne											
Fry's Pippin. GenF'33. Syn. of Wick											
Fulcher. L. Syn. Doctor Fulcher	Ky	robl	m	yc	ftj	y	sa	g	d	ml	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Fulkerson. TennBI-x	Tenn	ob	ms	gy	fj	y	sa	vg	d	l	
Fuller. W	South	ob					sa				
Fuller. D. Syn. of Smith											
Fullerton. L. Syn. Fullerton Sweet	N. Y	rc	ms	py	jt	w	vs	vg		m	
Fullerton Sweet. D. Syn. of Fullerton											
Fulton. NAPC'49. Syns. Fulton Pippin, Stewart's Golden	Ill	ob	m	yb	jtm	y	msa	g-vg	d	ml	
Fulton Early. (LC)											Not described.
Fulton Pippin. NWFG'52. Syn. of Fulton											
Fulton Strawberry. W	Ill	ob	m	wrs	j	ws	psa	g		m	
Fulton Summer. R. Syn. Fulton's Summer											Do.
Fulton's Summer. IllB45. Syn. of Fulton Summer											
Fulwood. D. Syns. Green Fulwood, White Fulwood	Eng	r	l	grs	fc	gw	ba		k	l	
Funk Apple. MoH'95. Syn. of Ben Davis											
Funkhouser. D. Syn. of Ben Davis											
Funtling. E. Syn. of Foundling											
Funtore. Gb. Syn. of Pound											
Funtowoe. Gb. Syn. of Pound											
Fuqua (perhaps erroneously). MoH'85. Syn. of Requa											
Furnas. RNY'71. Syn. Furnas Apple	Nebr. ?	robc	m	yb		w	a	g-vg			
Furnas Apple. A'71. Syn. of Furnas											
Furstlicher Tafelapfel. Gb. Syn. of Royal Table											
Gabriel. IndF'40. Syns. Garden of Indiana, Ladies' Blush		rob	m	wgsc	tj	y	rsa	g-vg	d	m	
Gabriel. W	South	c		rs			sa				
Gaesdouker. L. Syn. Gaesdouker Gold Reinette	Ger	ob	ms	yrub	fj	y	rsa			l	From Hogg.
Gaesdouker Gold Reinette. D. Syn. of Gaesdouker											
Gaines. R. Syn. Gaines' Swedisher											Not described.
Gaines' Swedisher. MichB31. Syn. of Gaines											
Gal. R. Syn. Big Gal. [Exhibited at Mass. Hort. Socy. from N. H. in 1842.]	N. H										Do.
Galesburg. BBL											Do.
Galloway. R. Syn. Galloway Pippin											Do.
Galloway Pippin. S&W. Syn. of Galloway											
Gallup. L. Syn. Gallup's Russet	Ohio	c	l	ru			sa	g		l	
Gallup's Russet. W. Syn. of Gallup											
Galusha. W	Ill	ob	ml	rs			sa	g		l	
Gam. MassB44											Do.
Gamble. MagofH'53											Do.
Ganges. D	Eng. ?	obl	ml	gr		y	sa		k		From Lindley.
Gann. OreB22											Not described
Gano. A'85. Syns. Black Ben Davis, Payton, Red Ben Davis	Tenn.? Mo.?	rob	l	yrs		yw	msa	g	m	l	

Gano No. 1. MoH'83											
Gano No. 2. MoH'83											
Gano No. 3. MoH'83											
Gano No. 4. MoH'83											
Gano No. 5. MoH'83											
Garden. Gb. Syns. Garden Apple, Gov. list No. 214, Sadovskoe, Sadowskoe.	Rus	ob	s	yrs	j	w	s	g	d	me	Hansen says this is identical with Kustoe.
Garden. D. Syn. Comstock's Garden		rob	m	wrs		ws	sa		k	m	
Garden. W	South	rob	ml	ygrs	tfj	yw	sa	vg-b	dkm	me	
Garden Apple. Gb. Syn. of Garden											
Garden Apple, of some (incorrectly). D. Syn. of Beefsteak											
Garden Beauty. A'71											Not described.
Gardener. R. Syn. Gardener's Bonne											Do.
Gardener's Bonne. MichB31. Syn. of Gardener											
Gardener Sweet. R. Syn. Gardener's Sweeting											Do.
Gardener's Sweeting. NEF'29. Syn. of Gardener Sweet											
Garden Gem. IllH'99											Do.
Gardenia. P'93	Va	r	ml	ydrs	fj	y	msa	vg			
Garden of Indiana. W. Syn. of Gabriel											
Garden Royal. MagofH'48	Mass	robc	ms	gyrs	vtj	y	rsa	b	d	me	
Garden Stripe. D		rob	ms	yrs	tj		sa	g		me	
Garden Sweet. D	N. C	roblc	m	yc	tj	yw	rs	vg	k	m	
Gardener's Apple. D. Syn. of Mother											
Garden Walk. HFH	Ky		ml	gyrs				vg		me	
Gardner Pearmain. L. Syn. Gardner's Sweet Pearmain	N. Y	ob	m	yrs	tj	w	s	g		m	
Gardner Redstreak. Cat											Do.
Gardner's Swaar. IllB45. Syn. of Swaar											
Gardner Sweet. D. Syns. Gardner Sweeting, Gardner's Sweet Pearmain		r	m	wb	f		s			l	
Gardner's Sweet Pearmain. D. Syn. of Gardner Pearmain											
Gardner Sweeting. K. Syn. of Gardner Sweet											
Gardner's Sweet Pearmain. Lin. Syn. of Gardner Sweet											
Garfield. A'83	Ga.? Ill.?	oblc	l	grs	cf	yw	sa	vg	dkm	l	
Garfield. A'91. [Probably distinct from preceding.]	R. I.?										Do.
Garfield Sweet. CH	Wis		vl	yr			s			l	
Garland. P'95. Syn. Flanders	N. H.?	robl	m	yrcs	mj	w	rmsa	vg		m	
Garnon's Apple. D. Syn. of Court-Pendu Plat											
Garr. R. Syn. Garr's Seedling											Do.
Garret Pippin. D. Syn. of Borsdorffer											
Garrett. R. Syn. Garrett Seedling											Do.
Garrett Seedling. BBL. Syn. of Garrett											
Garrettson. A'62. Syns. Garrettson's Early, Garretson's Early, John Garretson's Early, John Garretson's Early Apple, Somerset Harvest.	N. J	rc	m	y	tj	w	bsa	g	dk	c	
Garretson's Early. E. Syn. of Garrettson											
Garrettson's Early. E. Syn. of Garrettson											
Garrickson. R. Syn. Garrickson's Early. [Possibly Garrettson.]											Do.
Garrickson's Early. A'54. Syn. of Garrickson											
Garr's Seedling. IllH'97. Syn. of Garr											
Garst. A'97	Tenn	rob	l	gyr	ftj	ys	rsa	vg	dm	ve	
Garter. D	Eng	obl	m	yr					c		
Garvis Seedling. Dap. Syn. of Buckingham											
Gascoyne. R. Syn. Gascoyne Scarlet											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Gascoyne Scarlet. BBL. Syn. of Gascoyne											
Gaston. IllH'68. Syn. Gaston's Winter	Ill.?										Not described.
Gaston Seedling. R. Syn. Gaston's Seedling	S.C	c	vl	grn	j	w	sa	g		ml	
Gaston's Seedling. Hort'69. Syn. of Gaston Seedling											
Gaston's Winter. MagofH'53. Syn. of Gaston											
Gatch. W. Syn. Thomas Gatch	Ohio	c	ml	rs			sa	g		l	
Gate. D. Syn. of Belmont											
Gatwood. L. Syn. Gatwood's Bounding Rock											Do.
Gatwood's Bounding Rock. Cat. Syn. of Gatwood											
Gaualtlan. ColExR'88											Do.
Gault. MagofH'53. Syn. Gault's Bellflower		r	l	py	c	w				ml	
Gault's Bellflower. E. Syn. of Gault											
Gaumont. D	Fr.?	roblob	l	y	cj	y	rsa			m	
Gavel. MichB152.											Do.
Gavet. R. Syn. Gavet Pippin	N.S.	ob		gyr	fj	w	ma			m	
Gavet Pippin. MichB177. Syn. of Gavet											
Gavoor. IdaB6											Do.
Gay's Romanite. D. Syn. of Pennock											
G. C. Ward. R. Syn. G. C. Ward's Fine Early											Do.
G. C. Ward's Fine Early. IndH'72. Syn. of G. C. Ward											
Geflammter. Gb. Syn. V. R. S. to Ia. No. 36	Rus.										Do.
Gelbe. R. Syn. Gelbe Gestreift											Do.
Gelbe Gestreift. IllB45. Syn. of Gelbe											
Gelber Stettiner. Gb. Syn. of Yellow Stettin											
Gem Sweet. P'95	W. Va	rc	l	gysc	ftj	y	s	vg		me	
Generale. D. Syn. of Early Autumn											
General Greig. Gb. Syn. Gov. list No. 408	Rus.										Do.
General Haskell. D	Ky		m	r						vl	
General Lyon. Dap. Syn. of Lyon											
General Marion. Dap. Syn. of Marion											
General Taylor. A'81											Do.
Genesee Chief. A'54		rc	l	wc	tj	w	sa	g	k	m	
Geneton. W. Syn. of Ralls											
Geneton Improved. SBro. Syn. of Doctor Walker											
Geneva. L. Syns. Geneva Pippin, Winter Pippin of Geneva	N. Y.?	rob	l	y	tj	y	visa	vg-b	d	vl	
Geneva Pearmain. D. Syn. of Champlain											
Geneva Pearmain. D. Syn. of Summer Pippin											
Geneva Pippin. D. Syn. of Geneva											
Geniton. Cat. Syn. of Ralls											
Gennet Moyle. DomEnc. Syn. of Moyle											

Gennetting. D. Syn. of White Junneating											
Genniting. H. Syn. of White Junneating											
Gentle. L. Syn. Gentle's Large Red		rc	l	yrs	jt	w	sa	g		m	
Gentle's Large Red. D. Syn. of Gentle											
Gentle's Large Seed. IllB45. Syn. of Largeseed											
George. MagofH'53. Syn. Early George	Ohio	rob	m	pyru	fj	w	sa	g		e	
George Webster. ColB17. Syn. of Webster											
Geo. Wilson. IllH'98											Do.
Georgia June. D. Syn. of Red June											
Gerard. P'95	Pa	obc	l	yrsc	fcj	yw	sa	vg		m	
German. Cat											Do.
German Bough. BBL											Do.
German Calville. MHSC'86. Syns. German Kalville, Gov. list No. 324, Kalvil Niemetskui, Neemezki Kalville, Niemetskui Kalvil, Shro. to Ia. No. 89.	Rus										
German Cluster. BBL											Do.
German Ice. MHSC'86											Do.
Germanite. W. Syn. of Jarminite											
German Kalville. MinnB1. Syn. of German Calville											
German Ledenets. Gb. Syns. Ledenets Niemetskui, Shro. to Ia. No. 71	Rus										Do.
German Prolific. MHSC'86. Syns. Plodovitka Niemetskaya, Shro. to Ia. No. 70.	Rus										Do.
German Rambo. A&H											Do.
German Seedling. BBL											Do.
German Skrout. MHSC'86. Syn. of German Skrute											
German Skrute. Gb. Syns. Deutscher Skrut, German Skrout, Gov. list No. 371, Shro. to Ia. No. 91, Skrute Niemetskui.	Rus										Do.
German Spitzenberg. Dap. Syn. of Greyhouse. [May seek-no-further]											
Geroskoe. R. Syn. Geroskoe Selenke Gruner											Do.
Geroskoe Selenke Gruner. NYExR'83. Syn. of Geroskoe											
Gerry. R. Syn, Gerry's Sweeting											
Gerry's Sweeting. MassH'76. Syn. of Gerry											
Gestreifter. L. Syns. Gestreifter Sommer Zimnetapfel, La Canelle	Ger	rob	s	pyrs	fj	yw	sa	vg	d	me	From Hogg.
Gestreifter Sommer Zimnetapfel. D. Syn. of Gestreifter											
Getman. SDB76. Syns. Getman's Bean. Getmanski bob, Getmanskui bob, Gov. list No. 225	Rus	robl	m	yg	j	w	a	g	k	m	
Getman's Bean. Gb. Syn. of Getman											
Getmanski bob. Gb. Syn. of Getman											
Getmanskui bob. Gb. Syn. of Getman											
Gewiss. L. Syns. Gewiss Good, Gewiss Guth, Indeed Good	Pa	robc	m	yc	jtc		sa	g		ml	
Gewiss Good. D. Syn. of Gewiss											
Gewiss Guth. D. Syn. of Gewiss											
Gheimer. Cat. Syn. of Red Bertin											
Giant. MagofH'53	Pa	rc	l	rs	t	gw	sa	p			
Giant. A'51. Syn. of Mauck											
Giant Swaar. A'87. Syn. of Soiree											
Gibbins. L. Syn. Sir Wm. Gibbins											Not described.
Gibboney. PaExR'95	Pa	oble	m	yrs	ctj	w	sa		d	m	
Gibbons. L. Syn. Sir William Gibbons	Eng	rob	l	yrs	ej	yw	sa		k	ml	
Gibbon's Smathhouse. E. Syn. of Vandevere											
Gibbon's Smokehouse. E. Syn. of Vandevere											
Gibbs. FDNCo	Del		ml	wb			msa			vl	
Gibbs Golden. R. Syn. Gibbs' Golden											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Gibbs' Golden. IllH'96. Syn. of Gibbs Golden											
Gibson's Vandevere. A'56. Syn. of Smokehouse											
Gideon. MagofH'36. [Exhibited at Mass. Hort. Socy., Sept. 17, 1836.]	Mass.						s			m	
Gideon. A'82	Minn	rc	m	y			a	g	k	e	
Gideon Best. L. Syn. Gideon's Best. [Probably same as Peter]											Not described.
Gideon's Best. Cat. Syn. of Gideon Best											
Gideon's Best of All. FDNCo. Syn. of Peter											
Gideon No. 7. NYExR'94											
Gideon No. 9. MichB31											Do.
Gideon No. 12. MichB31											
Gideon No. 13. MichB31											
Gideon No. 24. MichB31											
Gideon No. 28. MichB31											
Gideon No. 30. DelExR'95											
Gifford. R. Syn. Gifford's Surprise	Ind		ml	rs		w	sa			m	
Gifford's Surprise. IndH'91. Syn. of Gifford											
Gilbert. A'91. Syn. Gilbert's Seedling	Tenn	rob	l	yrs	cj	gy	sa	vg	km	l	
Gilbert. MagofH'53. [Probably distinct from preceding.]											Do.
Gilbert's Seedling. IllH'93. Syn. of Gilbert											
Giles. MagofH'43	Conn	c	m	dr	tj		sa	vg		m	
Giles Beauty. TennBI-X. Syn. of Burrow											
Gill. ArkB60. Syn. Gill's Beauty	Ark	rob	l	gyr	cj	w	msa	g	m	l	
Gill's Beauty. ArkB60. Syn. of Gill											
Gillett. L. Syn. Gillette's Winesap	Ohio?	rob	l	wrs	cjt	w	sa	vg		ml	
Gillett June. R. Syn. Gillett's June											Do.
Gillett's June. MagofH'53. Syn. of Gillett June											
Gillett's Profusion. W. Syn. of Profusion											
Gillett's Seedling. D. Syn. of Rome											
Gillett Sweet. L. Syns. Gillett's Sweet, Gillett's Sweet Bellflower	Ohio										Do.
Gillett's Sweet. MagofH'53. Syn. of Gillett Sweet											
Gillett's Sweet Bellflower. W. Syn. of Gillett Sweet											
Gillett's Winesap. W. Syn. of Gillett											
Gilliflower Red. Lin. Syn. of Red Gilliflower											
Gilliflower Scalloped. H. Syn. of Scollop Gilliflower											
Gilmore. FDNCo	Va		l	r					m	l	
Gilpin. DomEnc. Syns. Carthouse, Dollars and Cents, Gray Romanite, Little Red Romanite, Little Romanite, Red Romanite, Romanite, Romanknight, Romanite of the West, Small Red Romanite, Small Romanite.	Va	robl	ms	yrs	fj	y	rmsa	g	dm	vl	

Gilpin Seedling. L. Syn. Seedling Gilpin	Ill. ?	r	ml	rs			sa	g		vl	
Giltner. L. Syn. Giltner's		ob	ml	rs			sa	g		m	
Giltner's. W. Syn. of Giltner											
Ginetting. GarCal. Syn. of White Juneating											
Ginnie. L. Syn. Aunt Ginnie	Ill	obc	ml	rs			sa	g		m	
Ginseng. MagofH'40											Do.
Gipsey. Gb. Syns. Gipsy Girl, No. 1227 Ia. from Rgl, No. 56 Vor, Tsiganka	Rus			yb	tj	ws	bsa	g		me	
Gipson. L. Syns. Gipson's Kentucky, Gipson's Kentucky Seedling	Ky	r	ms	gr	j	yw	sa			vl	
Gipson's Kentucky. D. Syn. of Gipson											
Gipson's Kentucky Seedling. GarM'61. Syn. of Gipson											
Gipsy Girl. N. Syn. of Gipsey											
Girkin Pippin. D. Syn. of Wyken											
Givens. ArkB49. Syn. Arkansas Baptist	Ark	rob	l	yrs	f	wy	msa	vg	m	vl	
Glace de Zelande. K. Syn. of White Astrachan											
Glace Rouge. D. Syn. of Barcelona											
Gladney. L. Syns. Gladney Red, Gladney's Red	Miss	r	m	yrs	fmj	y	sa	g		l	
Gladney Red. W. Syn. of Gladney											
Gladney's Red. D. Syn. of Gladney											
Gladstone. W&TSCo	Eng	robl	l	yrs	j	y	sa	g	km	me	
Glammis. L. Syns. Carse of Gowrie, Glammis Castle, Late Carse of Gowrie, Tower of Glammis.	Scot	re	l	pyc	tj	w	a	g	k	ml	
Glammis Castle. GenF'33. Syn. of Glammis											
Glanz. L. Syns. Glanz Reinette, Tyrole Glanz-reinette	Ger	rob	m	yb	fj	vw	rsa			ml	From Hogg.
Glanz Reinette. D. Syn. of Glanz											
Glass. MHSC'86. Syns. Shro. to Ia. No. 85, Steklianka	Rus	oblob		yb	f	w	s	vg		e	
Glass Apple. A'81. Syn. of Early Harvest											
Glass Apple. Hort'54. Syn. of Summer Rose											
Glass Green. Gb. Syn. of Green Glass											
Glass Revel. Gb. Syn. of Revel Glass											
Glass Winter. Gb. Syn. of Winter Glass											
Glassy Sand. Gb. Syn. of Sandy Glass											
Glast. A'85											Not described.
Glastenbury. R. Syn. Glastenbury Seeknofurther											
Glastenbury Seeknofurther. GmF'46. Syn. of Glastenbury											
Glazenwood Gloria Mundi. D. Syn. of Gloria Mundi											
Gleason. R. Syn. Gleason's											Do.
Gleason's. IllH'99. Syn. of Gleason											
Gleason Sweet. D		rc	m	yc	tj	w	s	g		ml	
Glen. R. Syn. Glen Apin											Do.
Glen Apin. A'97. Syn. of Glen											
Glendale. W	Ohio	rc	l	yrs		y	msa	g	d	m	
Glenloch. TennBI-IX	Tenn	rob	l	yres	fj	y	bsa	g		ml	
Glenville. P'95. Syn. Glenville Sweet	W. Va	ob	l	yres	ftj	y	sa	vg-b		m	
Glenville Sweet. WVaB75. Syn. of Glenville											
Glints. Gb. Syns. Clay, Glintsovo, Glinzowoe, Gov. list No. 490	Rus										Do.
Glintsovo. Gb. Syn. of Glints											
Glinzowoe. Gb. Syn. of Glints											
Globe. A'91	D. C. ?	rc	m	rs				g		l	
Gloege. (LC)	Wis	r	m	y			sa	vg	m	l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Gloria Mundi. DomEnc. Syns. American Gloria Mundi, American Mammoth, Baltimore (of some), Baltimore Pippin, Belle Josephine, Belvidere, Copp's Mammoth, Glazenwood Gloria Mundi, Josephine, McHenry Pippin, Mammoth Pippin, Melon, Mississippi, Monstrous Pippin, Mountain Flora, New York Gloria Mundi, Ox Apple, Pound, Tennessee Mammoth.	Am	rob	vl	gy	ct		sa	g		ml	
Glorified Domine. A'83. Syn. of Bogdanoff. [This synonym given by Prof. Budd.]											
Glory of England. D. Syn. of England											
Glory of Russia. Cat. Syn. Chandler											Not described.
Glory of the West. K. Syn. of Dutch Codlin											
Glory of the West. D. Syn. of Western Glory											
Glory of York. GenF'33. Syn. of Ribston											
Gloss. GenF'33											
Gloucester. DomEnc. Syn. Gloucester White	Va	rob	m	y	jc	y	psa	g	dc	m	
Gloucester Cheese. E. Syn. of Mangum											
Gloucester Cheese. H. Syn. of Summer Cheese											
Gloucester Pearmain. D. Syn. of Clarke Pearmain											
Gloucester White. C. Syn. of Gloucester											
Gloucester White (incorrectly). Dap. Syn. of Settle											
Glover. R. Syn. Glover's Seedling											Do.
Glover's Seedling. MagofH'53. Syn. of Glover											
Glover Early. R. Syn. Glover's Early											Do.
Glover's Early. A'73. Syn. of Glover's Early											
Glover Sweet. R. Syn. Glover's Sweet											Do.
Glover's Sweet. MagofH'53. Syn. of Glover Sweet											
Glowing Coal. JTL			vl	r				vg	m	me	
Goble. L. Syns. Goble Russet, Sweet Seek-no-further		oblob	ml	yru		wy	s			ml	
Goble Russet. E. Syn. of Goble											
Goble Russet. H. Syn. of Golden Pearmain											
Godbey. P'95	Ill	robl	l	yrcs	fcj	y	sa	vg		m	
Goddard. NHB40											Do.
God Given. A'83. Syn. of Bogdanoff											
Goff. RNY'56	Ohio	ob	ml	w	ft	w	bsa		km	me	
Gogar. L. Syns. Gogar Pippin, Stone Pippin	Scot	r	m	gb	j	gw	ba			l	
Gogar Pippin. D. Syn of Gogar											
Goin. TennB1-X	Tenn	rob	l	yrs	ftj	y	sa	vg		l	
Golay. W	Ind	obc	m	yrs	tj	yw	brsa	g-vg	d	vl	
Gold. ArkB60. Syn. Gold Apple	Ark	oblc	ml	yc	ftj	y	sa	vg		ml	
Gold Apple. IllB45. Syn. of Gold											

Golden. E. Syn. Golden Apple	Ohio	r	m	y		y	a			e	
Golden Apple. Lin. Syn. of Golden											
Golden Apple. D. Syn. of Golding											
Golden Arcad. Gb. Syns. Gov. list No. 231, Solotoi Arkad, Yellow Arcadian, Zolotoi arkad.	Rus										Do.
Golden Ball. M. Syns. Belly Bound, Belle et Bonne, Connecticut Apple	Conn	r	l	y	ct		sa	g		l	Mag. of H.'42, 250, says originated in Maine.
Golden Banana. MichB31											Not described.
Golden Bell. MoH'01	Mo		l					vg		l	
Golden Burr. D. Syn. Burr Knot	Eng	r	l	yb					k	ml	From Ronalds.
Golden Dixie. F. Syn. of Dixie											
Golden Drop. W.	South										Not described.
Golden Drop. GenF'33. Syn. of Wick											
Golden Gate. WVaB75											Do.
Golden Gem. Cat											Do.
Golden Goss. D	N. Y	rc	ml	yb	fjm	w	sa	g-vg		m	
Golden Gray. L. Syns. Pomme Gris d'Or, Swazie's Pomme Gris	Ont.?	robc	s	yru	ftj	w	sa	vg-b	d	vl	Perhaps same as Swayzie.
Golden Harvey. Syn. Brandy Apple	Eng	r	s	yru	ft	y	sa	g	d	vl	
Golden Knob. D		rob	s	yrub	cjt	gw	s			l	
Golden Luster. D	Eng	c	m	yrs	f	y	sa		k	l	
Golden Medal. NYB15. Syn. of Gold Medal											
Golden Merienwerder. CanExR'01. Syn. of Merienwerder											
Golden Monday. D. Syn. of Monday											
Golden Mundi. GenF'33. Syn. of Golden Russet											
Golden Noble. MagofH'47	Eng	rc	ml	y	t	y	psa		k		From Lindley.
Golden Nonparell. D		r	s	yrub	c		a			m	
Golden Pearmain. C. Syns. Dutch Pearmain, Goble Russet, Red Russet (of some), Ruckman's Golden Pearmain, Ruckman's Pearmain, Yellow Pearmain.	Eng	rc	m	y	fcj	y	s	vg		m	
Golden Pearmain. D	Eng	oblrc	s	yrs	fr					ml	From Ronalds.
Golden Pearmain (of Kentucky). W	Ky	rob	ms	yrub	f	y	a	vg-b	d	l	May be Columbian Russet.
Golden Pearmain. D. Syn. of Clarke Pearmain											
Golden Pearmain. Th. Syn. of Ruckman											
Golden Pippin (Eng.). DomEnc. Syns. Balgone Pippin, Bayfordbury Golden Pippin, English Golden Pippin, Herefordshire Golden Pippin, Koening's Pippelin, London Golden Pippin, Milton Golden Pippin, Old Golden Pippin, Pepin d'Or, Pomme d'Or, Reinette d'Angleterre, Russet Golden Pippin, Warter's Golden Pippin.	Eng	r	s	dy	c	y	a	vg	d	l	
Golden Pippin (Mass.). D. Syn. Pittstown Pippin	Mass	robc	ml	gyb	tj	y	sa	g	k	m	
Golden Pippin (N. Eng.? N. Y.?). D. Syns. Boston Pippin, Butter Pippin, Golden Pippin, American, Golden Pippin of Westchester Co., Large Golden Pippin, Mammoth, New York Greening, Pound Royal (of some), Pound Sour, York Pippin.	N. E.? N. Y.?	r	vl	gy	cjt	y	sa	g-vg		m	
Golden Pippin (Va.). Dap	Va	obc	s	y	tj	yw	sa	vg		l	
Golden Pippin. Hort'69. Syn. of Davenport											
Golden Pippin. Wg. Syn. of Downton											
Golden Pippin (Pa.). D. Syn. of Franklin (Ill.)											
Golden Pippin. D. Syn. of Golding											
Golden Pippin. E. Syn. of Ortley											
Golden Pippin, American. W. Syn. of Golden Pippin											
Golden Pippin (erroneously). H. Syn. of Fall Pippin											
Golden Pippin (of some). E. Syn. of Belmont											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Golden Pippin, of some. D. Syn. of Lowell											
Golden Pippin of *Westchester Co.* B. Syn. of Golding											
Golden Pippin of *Westchester Co.* T. Syn. of Golden Pippin											
Golden Queen. BBL											Not described.
Golden Red. D	N. Y	rob	ms	yr	cmj	y	psa			l	
Golden Reinette. D. Syns. Aurore, Court Pendu Dore, Dundee, Elizabet, English Golden Reinette, English Pippin, Golden Rennet, Kirke's Golden Reinette, Megginch Favorite, Princesse Noble (of the French) Reinette d'Aix, Reinette Giden, Reinette Golden, Wygers, Wyker Pippin, Yellow German Reinette.	Eur	rob	ms	yrb	c	y	rbsa	g	d	ml	
Golden Reinette. Gb. Syns. VRStolaNo10, Zolotoi renet	Rus										Do.
Golden Reinette de Vanderlaans. D. Syn. of Vanderlaans											
Golden Rennet. DomEnc. Syn. of Golden Reinette											
Golden Rose. W	South										Do
Golden Russet (Eng.). D. Syns. English Golden, English Golden Russet, Golden Mundi, Russet Golden.	Eng	rob	ms	yru	fc	wy	sa	g-vg	dm	l	
Golden Russet (Mass.). L. Syns. Golden Russet, Golden Russet of Massachusetts.	Mass	robe	m	yru	tm	yw	rmsa	vg	d	vl	
Golden Russet (N. Y.). E. Syns. American Golden Russet, English Golden, English Golden Russet, Limber Twig Russet, Russet Golden.	Eng.?	rob	m	gyru	tj	gy	sa	g-b	dk	l	Probably identical with Golden Russet (Eng.)
Golden Russet. Lin. Syn. of Bullock											
Golden Russet. M. Syn. of Golden Russet (Mass.)											
Golden Russet. A'75. Syn. of Hunt Russet											
Golden Russet. D. Syn. of Perry Russet											
Golden Russet of Mass. Hort'75. Syn. of Hunt Russet											
Golden Russet of Massachusetts. D. Syn. of Golden Russet (Mass.)											
Golden Russet of N. E. Dap. Syn. of Hunt Russet											
Golden Russet (not of N. Y.). Dap. Syn. of Hunt Russet											
Golden Seedling. W	Mo.?	rob	l	gyb	j	y	sa	g	d	vl	
Golden Spice. E. Syn. of Dyer											
Golden Spy. Dap	Pa	robc	m	py	fctj	w	sa	vg		vl	
Golden Streak. D	Eng	rob	m	yrs		y	pa		c		From Hogg.
Golden Swartz. MichB31											Not described.
Golden Sweet. D. Syns. Early Golden Sweet, Lalle, Orange Sweet, Orange Sweeting, Plymouth Colony, Sawyer Sweet, Summer Sweet, Sweeting, Trenton Early.	Conn	r	l	py	t		rs	g-vg	km	me	
Golden Sweet. D. Syn. of Northern Sweet											
Golden Sweet. K. Syn. of Orange Sweeting											
Golden Vining. K. Syn. of Hubbard Pearmain											

Golden White. Gb. Syns. Beel Solotofskaja, Biel Zolotovskaya, Gov. list No. 978.	Rus	obc	m	yrs			sa	g		m	
Golden Wilding. Hort'68	N. C	rob	m	y	fct	y	sa	g		l	
Golden Winter. L. Syn. Golden Winter Sweet	N. Y	ob		y			s			l	
Golden Winter Sweet. W. Syn. of Golden Winter											
Golden Worcester. D. Syn. of Worcester											
Golden Yellow. HuC	Tenn		ml	yr				g		l	
Goldfinch. DOM	Va.?							g		l	
Golding. D. Syns. American Golden, American Golden Pippin, Golden Apple, Golden Pippin, Golden Pippin of Westchester Co., Newtown Greening, New York Greening, Ribbed Pippin.	Am. / N. Y.?	robc	ml	y	jc	y	brsa	vg	dm	ml	
Gold Medal. R. Syn. Golden Medal											Do.
Gold Patch. SDB65											Do.
Gold Pearmain. MoH'87											Do.
Gold Reinette. MoH'67											Do.
Gold Reinette von Bordeaux. D. Syn. of Bordeaux											
Gold Ridge. BBL											Do.
Golds Golden. BBL											Do.
Golubinoe Beeloe. Gb. Syn. of White Pigeon											
Golubinoe (bieloe not of Rgl.) Gb. Syn. of White Pigeon											
Goode. A'97. Syn. Goode's No. 10	Iowa	r	l	y			sa	g		vl	
Goode's No. 10. A'95. Syn. of Goode											
Good Husbandman. Gb. Syn. of Good Peasant											
Good Peasant. Syns. Dobrui krestianin, Good Husbandman, Gov. list No. 387, Shro. to Ia. No. 31.	Rus		l				sa	vg		m	
Good Peasant. IllH'91. Syn. of Longfield. [Same as Good Peasant, Ill. H.'91, 144.]											
Good Russet. W	Ohio	r	ml	ru			sa	g		l	
Goodspeed. IaH'90											
Goodyear. A'52. Syn. Goodyear's Seedling	Pa	r	m	r	fj		sa	g		vl	
Goodyear. MoH'70. [Probably distinct from "G" of Downing and Elliott.]	Mo.?		m	r						l	Said to be identical with Lyon.
Goodyear's Seedling. D. Syn. of Goodyear											
Gooseberry. D	Eng	rc	l	gyb	ejt	y	sa	g	k	l	
Gooseberry Pippin. D	Eng	r	s	yrs	ftj		bmsa	g	d	ml	
Goosepen. F											Not described.
Gorden Ball. Cat											Do.
Gordon. BBL. Syn. Gordon's Seedling	N. C	c	ml	rs			sa	g		l	
Gordon Cluster. R. Syn. Gordon's Cluster	Md	r	m	rs				vg		e	
Gordon's Cluster. P'91. Syn. of Gordon Cluster											
Gordon's Seedling. W. Syn. of Gordon											
Gore. A'67	South / S. C.?										Do.
Gorin. R. Syns. Gorin's New Russet, Gorin's Russet	Ky.?		m	ru				vg		l	
Gorin's New Russet. A'75. Syn. of Gorin											
Gorin's Russet. A'71. Syn. of Gorin											
Gorke Pipka. Gb. Syns. Butter Pipka, Gov. list No. 265, Pipka Gorkaya, Pipka Gorkuja.	Rus										Do.
Goss. R. Syn. Goss' Beauty											Do.
Goss' Beauty. ColB17. Syn. of Goss											
Goss' Seedling. No. 53. IaH'88											
Gothouse. MoH'70											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Goudle. IllB45											Not described.
Gould. L. Syn. Gould's Sweet	Pa.?	robc	m	y	mtj	y	s	g	k	l	
Gould's Sweet. D. Syn. of Gould											
Gourmand. R. Syn. Gourmand Russet											Do.
Gourmand Russet. MagofH'40. Syn. of Gourmand											
Governor. NEF'31	Vt	r	l	yr	j		a	g	k	ml	
Governor Charter. D. Syn. of Charter											
Governor Charter's Seedling. PFar'60. Syn. of Charter											
Gov. Morrow. W. Syn. of Morrow											
Gov. Seward. E. Syn. of Twenty Ounce											
Gowden. Hort'56. Syn. of Nickajack											
Goyeau. Dap	Ont	r	l	py	ftj	y	sa	g	dk	me	
Grab. IllB45											Do.
Gracey. GarM'60	Ill	rc	ml	pg	c	gw	sa			me	From Gardener's Monthly
Gracie. NYB15. [Perhaps same as Gracey.]											Not described
Grafensteiner. Gb. Syn. of Russian Gravenstein											
Grafensteiner Russicher. Gb. Syn. of Russian Gravenstein											
Graff Stein. Hort'75. Syn. of Gravenstein											
Graft. MagofH'41. [Said to be large and handsome.]			l								Do.
Grafton Sweet. D. Syn. of Seaver											
Grafton Sweeting. Lin. Syn. of Seaver											
Graham's Red Warrior. D. Syn. of Nickajack											
Graham White. DOM											Do.
Grain d'Or. L. Syn. Reinette Grain d'Or		rob	l	y	fj	y	bsa			ml	From Album de Pomologie
Gramar's Pearmain. KanExR'89. Syn. of Grammer											
Grammer. R. Syn. Gramar's Pearmain, Grammer's Pearmain											Not described
Grammer's Pearmain. PFar'62. Syn. of Grammer											
Granat. L. Syns. English Granat Reinette, Pomme Granate	Ger	rob	m	pyc	fcj	yw	rsa	g	d	l	From Hogg
Grand Duke Constantine. MHSC'86. Syn. of Constantine											
Grandfather. W	N. E	robe	ml	wrs			sa	g		m	
Grandfather. D. Syn. of Cocklin											
Grandmother. MHSC'81. Syns. Babuschkino, Gov. list No. 469, Grandmother's Apple, Shro to Ia. No. 6.	Rus	robe	ml	gb	fj	w	sa	g		l	
Grandmother. D. Syn. of Stillwater											
Grandmother's Apple. Gb. Syn. of Grandmother											
Grandmother's Apple. MagofH'60. Syn. of Granite											
Grand Richard. Gb. Syn. of Richard											
Grand Sachem. NEF'29. Syn. of Black Detroit											
Grand Sultan. NYExR'92	Rus	robl	ml				sa	p		e	May be Yellow Transparent. See A'83, 113

Grand Sultan. A'83. Syn. of Yellow Transparent										
Grand Turk. S&W										Not described.
Grane. R. Syn. Grane Portugiesische Reinette										Do.
Grane Portugiesische Reinette. MoH'87. Syn. of Grane										
Grange. NEF'26	Eng	r	ms	y	fc	y	b		dc	m	From Ronalds.
Grange. A'87. [Probably distinct from preceding]		robc	l	gy			ma			l	
Grange Pearmain. L. Syns. Grange's Pearmain, Grange's Pippin	Eng	rc	l	yrs	tj	yw	ba		k	ml	From Hogg.
Grange's Pearmain. D. Syn. of Grange Pearmain										
Grange's Pippin. D. Syn. of Grange Pearmain										
Granite. A'73. Syns. Aunt Dorcas, Clothes-Yard Apple, Granite Beauty, Grandmother's Apple.	N. H.	robl	ml	pyrs	tjm	w	sa	g-vg	d	ml	
Granite Beauty. NEF'56. Syn. of Granite										
Granite Sweet. A'99	Wis.										Not described.
Graniwinkle. DomEnc. Syn. of Granniwinkle										
Granniwinkle. C. Syns. Graniwinkle, Vanwinkle	N. J.	rc	m	yrs	fjt	w	s	vg	kc	m	
Granny Buff. Hort'52. Syn. of Buff										
Granny Earle. D		ro	s	grs	ct	w		vg		ml	From Magazine of Horticulture.
Granny Earle. MagofH'47. Syn. of Earle										
Granny Hyde. Hort'75. Syn. of Columbia										
Granny Payne. A'95	N. Y.	rc	l	gy				vg	km	ml	
Granny Spice. IllB45		r	m	y			sa	vg		e	
Grantham IllB45. Syn. of Jefferis										
Grape. R. Syn. Grape Apple											Not described.
Grape Apple. MagofH'48. Syn. of Grape										
Grape Vine. D. Syn. of Camak										
Grassy Mountain. A'97											Do.
Grattan. Dap	Mich	robc	l-vl	y	ctj	y	bsa	g-vg	dmk	m	
Grauech. R. Syn. Sauer Grauech											Do.
Grau Osnabrucker Reinette. D. Syn. of Osnabruck										
Graue Portugiesische Reinette. D. Syn. of Portugal Gray										
Grauer. R. Syn. Grauer Kurzstiel										
Grauer Kurzstiel. MHSC'85. Syn. of Grauer										
Grauwe Franse Rennett. D. Syn. of Winter Gray										
Grave. BBL											Do.
Gravenstein. NEF'32. Syns. Early Congress, Graff Stein, Grave Slije, Ohio Nonpareil.	Ger	rob	l	yrs	tc		sa	vg	km	m	
Grave Slije D. Syn. of Gravenstein										
Gray. FTR	Tex										Do.
Gray Anis. A'83											Do.
Gray Apple. Dap. Syn. of McAfee										
Gray Apple. D. Syn. of Pomme Gris										
Grayest. MinnExR'90. Syn. of Serinkia										
Grayhouse. Wg. Syn. of Greyhouse. [May Seek-no-further, Hoops.]										
Gray's Keeper. Dap. Syn. of McAfee										
Gray Pearmain. WVaB75											Do.
Gray Pippin. D. Syn. of Buel										
Gray Romanite. D. Syn. of Gilpin										
Gray Romanite. Dap. Syn. of Greyhouse. [May Seek-no-further, Hoops.]										
Gray Romanite. D. Syn. of Rambo										
Gray Russet. FDNCo											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Gray Vandervere. E. Syns. Betsey's Fancy, Great Vandervere, Indian Apple, Vandervere Pippin (of some), White Vandervere, Windower.	Pa.?	rob	l	rs			sa		k	l	
Gray Vandervere. W. Syn. of Vandevere											
Greasy Back. D. Syn. of Pittsburg											
Greasy Pippin. D. Syn. of Lowell											
Greasy Pippin. D. Syn. of Ortley											
Great Bearer. P'94	Pa	obc	s	yrs	ftj	y	msa	g	mc	l	
Great Duke. MinnExR'90											Not described
Great Keeper. W		ob		ru			sa			vl	
Great Mogul. MHSC'86. Syns. Shro. to Ia. No.54, Vilikui Mogul	Rus		ml							m	
Great Newtown. R. Syn. Great Newtown Pippin											Do.
Great Newtown Pippin. NYB15. Syn. of Great Newtown											
Great Pearmain. D. Syn. of Winter Pearmain											
Great Unknown. Hort'69. Syn. of Unknown											
Great Vandarer. MagofH'53. Syn. of Vandervere Pippin.											
Great Vandervere. E. Syn. of Gray Vandervere											
Green. Cat. Syn. Winter Cheese											Do.
Green Abram. L. Syns. Bullett, North Carolina Greening	South	ob	m	grs	fmj	w	sa	g		vl	
Green Abram. D. Syn. of Bullett											
Green Anis. Gb. Syns. Anis Selanui, Anis Zelenui. Gov. list No. 986, Green Anisette.	Rus										Do.
Green Anisette. Gb. Syn. of Green Anis											
Green Astrachan. MHSC'86. Syns. Astrachanscoe Zelenoe, Shro. to Ia. No. 74.	Rus										Do.
Green Balsam. S&W											Do.
Green Bellflower. D. Syn. of Ortley											
Green Bietigheimer. MoH'85											Do.
Green Butskaya. Gb. Syns. Butskaya Zelenka, Buzkafa Selonka, Gov. list No. 38, Russian Green.	Rus										Do.
Green Cannon. R. Syn. Green Cannon Pearmain											Do.
Green Cannon Pearmain. A'97. Syn. of Green Cannon											
Green Cheese. D. Syns. Carolina Greening, Green Crank, Greening, Greenskin, Southern Golden Pippin, Southern Greening, Turner's Cheese, Winter Cheese, Winter Greening, Yellow Crank.	Tenn	ob	m	gy	tjc	yw	rsa	vg		l	
Green Choice. L. Syn. Green's Choice	Pa	rc	m	yrs	tj		msa	g	dm	m	
Green's Choice. MagofH'52. Syn. of Green Choice											
Green Citron. Gb. Syn. of Stranger (Green)											
Green Codlin. GenF'33. Syns. Leadington, Monstrous									k		Do.
Green Cossings. GenF'33. Syn. of Ryner											

Green Crank. Hort'58	South	rob	l	gy			sa	g	dk	l	May be same as Green Cheese.
Green Crank. D. Syn. of Green Cheese											
Green Crimean. Gb. Syns. Gov. list No. 399, Krimskaja Selonka, Krimskaya Zelenka.	Rus		l					vg	dm		
Green Cut. Gb. Syn. of Green Rubets											
Green Domine. D	Pa.?	ob	m	gyrs	f	w	psa	g		l	
Green Everlasting. DomEnc. Syn. of Everlasting											
Green Everlasting. E. Syn. of Grindstone											
Green Fameuse. AmGar'01	Que	rob	m	yb	tc	w	sa	g		ml	
Green Fay. R. Syn. Greening Fay. [Large, handsome and good.]			l								Not described.
Greenfield. EWR. Syn. of Downing Blush. [Probably Greenville.]											
Greenfield. R. Syn. Greenfield Seedling	Ont	rc	ms	wgrs	ct	w	sa	g	k	vl	
Greenfield Seedling. CanH'91. Syn. of Greenfield											
Greenflat. R. Syn. Green Flat		ob		gy			sa				
Green Flat. W. Syn. of Greenflat											
Greenflower. R. Syn. Green Flower	Pa	c		gy			sa				
Green Flower. W. Syn. of Greenflower											
Green Fulwood. GenF'33. Syn. of Fulwood											
Green Gage. IndH'72											Do.
Green Gillflower. W		e		gy			s				
Green Glass. Gb. Syns. Glass Green, Gov. list No. 187, Steklianka Selonka, Steklianka zelenka.	Rus	oble	m	yrs	e	g	sa	p	km	me	
Green Golden. R. Syn. Green's Golden											Do.
Green's Golden. OklB2. Syn. of Green Golden											
Green Hop. PFar'60											
Green Horse. W	South										Do.
Greening. D. Syn. of Green Cheese											
Greening. T. Syn. of Rhode Island											
Greening. Gb. Syn. of Zelenka											
Greening Burlington. Lin. Syn. of Burlington Greening											
Greening Cathead. Lin. Syn. of Catshead											
Greening Fay. MagofH'47. Syn. of Green Fay											
Greening Pomaria. A'67. Syn. of Pomaria											
Greening Rhode Island. Lin. Syn. of Rhode Island											
Green's Inn. AmGar'01. Syn. of Rhode Island											
Green Keeper. JTL											Do.
Green Limbertwig. Cat											Do.
Green Limbertwig. IllB45. Syn. of Limbertwig											
Green Mountain. L. Syn. Green Mountain Pippin	Ga	robl	m	gy	cjt	w	psa	g		ml	
Green Mountain Pippin. E. Syn. of Fallawater											
Green Mountain Pippin. PFar'48. Syn. of Green Mountain											
Green Mountain Pippin. D. Syn. of Virginia Greening											
Green Mountain Russet. IllB45											Do.
Green Newtown. L. Syns. American Newtown Pippin, Brooke's Pippin, Brook's Pippin, Green Newtown Pippin, Green Winter Pippin, Hunt's Fine Green Pippin, Hunt's Green Newtown Pippin, Large Newtown Pippin, Newtown Pippin, Newtown Pippin Green, Petersburg Pippin.	N. Y.	rob	m	g	vjc	gw	sa	b	dkc	vl	Distinct from Yellow Newtown.
Green Newtown Pippin. C. Syn. of Green Newtown											
Green Nonpareil. K. Syn. of Petworth											
Green Pearmain. W	South	ob		gy			sa				
Green Pippin. W	Ind	r	l	g			sa	g		l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Green Prince. MHSC'81. Syn. Gruner Fustenapfel	Ger.		ms	g						vl	
Green Reinette. D. Syns. Groene Franse Reinette, Groene Renet, Grune Reinette, Reinette Verte.	Eng.?	rob	m	yg	tj	yw	sa			vl	From Hogg
Green Rubets. Gb. Syns. Gov. list No. 462, Green Cut, Rubets Zelenni, Rubez Selonnin.	Rus.										Not described
Green Russet. IndF'40	N. C	rob	l	grub			sa	g	k	ml	
Green Seeknofurther. R. Syns. Brace's Seek-no-further, Bracy's Seekno-further, Flushing Seeknofurther, Green Seek-no-further, Pomme Royal (of some), Pound Royal, Seeknofurther of Coxe, Seeknofurther White, White Seeknofurther.	N. Y	re	l	yg	ctj	w	psa	vg		ml	
Green Seek-no-further. E. Syn. of Green Seeknofurther											
Greenskin. R. Syn. Green Skin	N. C	ob	ml	g			sa	g		ml	
Greenskin. D. Syn. of Green Cheese											
Green Skin. T. Syn. of Greenskin											
Green Stranger. Gb. Syn. of Stranger											
Green Streaked. Gb. Syns. Gov. list No. 177, Polosstaja Sehlenka, Zelenka polosataya.	Rus.										Do.
Green Street Apple. D. Syn of Wanstall											
Green Styre. BBL											Do.
Green Sweet (Mass.). M. Syn. Honey Greening	Mass.	robe	m	g	tj	w	s	g	km	l	
Green Sweet (Ind.). D	Ind.	re	ml	g	tj	y	s	g		me	May be Victuals and Drink.
Green Sweet (Rus.). Gb. Syns. Green Sweeting, Gov. list No. 169, Regel, Selenka Sladkaya, Zelenka Sladkaya.	Rus.			rs						l	
Green Sweet. D. Syn. of Pelham											
Green Sweeting. Wg		r	l	g			s	vg		l	Of uncertain identity.
Green Sweeting. Gb. Syn. of Green Sweet											
Green Sweet, of Ind. W. Syn. of Victuals and Drink											
Green Tiffin. D. Syn. of Green Tiffing											
Green Tiffing. R. Syns. Green Tiffin, Mage's Johnny	Eng	re	m	yru	ct	w	a			m	From Hogg, who spells it Green Tiffing.
Green Transparent. Gb. Syns. Gov. list No. 335, Skvosnoi Zelenni, Skwosnoi Selennoe.	Rus.										Not described
Greenup. L. Syns. Greenup's Pippin, Greenus' Pippin	Eng	r	ml	pyb	tj	yw	s			m	From Hogg
Greenup's Pippin. AmF'37. Syn. of Greenup											
Greenus' Pippin. D. Syn. of Greenup											
Green Vandevere. T. Syn. of Vandevere											
Greenville. A'97. Syns. Downing's Winter Maiden's Blush, Winter Maiden's Blush.		ob	ml	wyb				vg		l	Probably Winter Maiden Blush. Pomologist, '94, 23
Greenwich. P'94	Conn	rob	l	gyrs	ftj	y	msa	vg	dm	m	
Green Winter. W	Ohio	c	l	y			s	vg		l	

Green Winter Pearmain. Dap. Syn. of Autumn Pearmain											
Green Winter Pearmain. F. Syn. of Winter Pearmain											
Green Winter Pippin. D. Syn. of Green Newtown											
Green Woodcock. D. Syn. of Woodcock											
Gregg. P'94	Ind	ob	l	gyrs	etj	y	sa	vg	dm	m	
Gregg. A'56											Condemned by A. 1856, page 99.
Gregory. L. Syn. Gregory's Red	Va.?										Not described.
Gregory's Red. F. Syn. of Gregory											
Gregson Apple. C. Syn. of Catline											
Greist. L. Syn. Greist's Fine Winter	Pa	rob	l	yrs	etj	y	sa	g		l	
Greist's Fine Winter. D. Syn. of Greist											
Gremuschka. Gb. Syn. of Rattle											
Grenadier. BBL											Do.
Gresham. Cat											Do.
Gretman. R. Syn. Gretman's Bean											Do.
Gretman's Bean. MinnExR'90. Syn. of Gretman											
Grey. R. Syn. Grey Apple			m					g			
Grey Apple. IllB45. Syn. of Grey											
Grey Canada. L. Syns. Canada Reinette Gris, Grey Canada Reinette		ob	l	yru	e	w	bsa			m	
Grey Canada Reinette. D. Syn. of Grey Canada											
Grey French. L. Syn. Grey French Reinette, Reinette Franche Grauwe, Reinette Grise, Reinette Grise Francaise.	Fr	rob	m	ru	mj	y	rsa			m	From Lindley.
Grey French Reinette. D. Syn. of Grey French											
Greyhouse. DomEne. Syns. Big Romanite (of some), Black Jack, Black Pennock, Black Vandervere, German Spitzenberg, Grayhouse, Gray Romanite, Hard Red, Hoopes, Hoop, Hoopes' Pearmain, Hoops, Hopsey, Hopson, Keystone, Lopside, Lopsided Pearmain (May, erroneously), May Seek-no-further, Pilliken, Red Everlasting (Romanite, incorrectly).	Pa.? N. J.?	ob	ml	rs	f	y	msa	p-g	dkm	vl	May Seek-no-further and Hoops are now considered as synonyms of Greyhouse.
Greyhouse, incorrectly (?) Dap. Syn. of (?) May Seek-no-further. [Really Greyhouse.]											
Grey Leadington. D. Syn. of Leadington											
Grey Leadington Pippin. D. Syn. of Leadington											
Grey Pippin. IndH'88											Not described.
Grey Reinette. D. Syns. Belle Fille, Prager, Reinette Grise, Reinette Grise d'Hiver, Reinette Grise Extra.	Fr	r	m	ygb	fe	y	bsa			l	From Hogg.
Grey Sweet. R. Syn. Grey's Sweeting											Not described.
Grey's Sweeting. MagofH'53. Syn. of Grey Sweet											
Grideline. L. Syns. Belle Grideline, Belle Grisdeline	Eng	r	m	yrru	e	y	bsa			l	From Hogg.
Gridley. R. Syn. Gridley Pearmain											Not described.
Gridley Pearmain. BBL. Syn. of Gridley											
Griest. L. Syn. Griest's Favorite	Pa	r	ml	rs			sa				Probably identical with "Greist" of Downing.
Griest's Favorite. W. Syn. of Griest											
Griffith. W. Syns. Claybank, Sweet Maiden's Blush	Ohio	rob	m	pyb	ftj		a			me	From L. S. Mote's manuscript.
Griffith. W. Syn. of Claybank. [Perhaps identical with preceding.]											
Grimes. L. Syns. Grimes Golden, Grimes' Golden, Grimes' Golden Pippin, Grims' Golden.	W. Va	robe	m	y	etj	y	rsa	vg-b	dkm	ml	
Grimes Golden. RNY'56. Syn. of Grimes											
Grimes' Golden. B. Syn. of Grimes											
Grimes' Golden Pippin. Hort'63. Syn. of Grimes											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Grims' Golden. F. Syn. of Grimes											
Grimuschka. Gb. Syn. of Rattle											
Grindstone. D. Syns. American Pippin, Flat Vandevere, Green Everlasting, Stone.		ob	ms	grs	fj	w	a	g	ke	vl	
Grinstead. L. Syns. East Grinstead, West Grinstead Pippin	Eng	re	m	grs	t	gw	bsa			l	From Ronalds.
Grise. GenF'33. Syn. of Pomme Gris											
Groene Franse Reinette. D. Syn. of Green Reinette											
Groene Renet. D. Syn. of Green Reinette											
Grooveland. L. Syn. Grooveland Sweet		robe	m	yb	ctj	w	s	g		l	
Grooveland Sweet. D. Syn. of Grooveland											
Gros Api Rouge. D. Syn. of Lady											
Gros Coeur de Pigeon. D. Syn. of Pigeon											
Gros Faros. D. Syn. of Faros											
Grosh. GarM'60. Syns. Beauty of the West, Big Rambo, Cumming's Rambo, French Rambo (of some), Grosh's Mammoth, Large Rambo, Large Summer Rambo, Lothringer Rambour, Mammoth Rambo, Monstrous Rambo, Musgrove's Cooper, Naylor Rambo, Ohio Beauty, Pickaway Rambo, Rambour Lorraine, Summer Rambo, Sweet Rambo (incorrectly), Western Beauty.	Ohio?	robe	vl	gyrs	ctj	wy	sa	g-vg	dk	ml	
Grosh's Mammoth. A'77. Syn. of Grosh											
Groskoe. R. Syn. Groskoe Selenka Gruner	Rus	rob	m	w	fcj	w		g		e	
Groskoe Selenka Gruner. NYExR'92. Syn. of Groskoe											
Gros Locart. K. Syn. of Locart											
Gros Mogul. MichB31											Not described.
Gros Pigeonnet. Dap	For	rob	m	pyrs	cj	wy	sa	g		ml	
Gros Pomier. Dap. Syn. of Haas											
Gros Pommier. Dap. Syn. of Haas											
Grosse Casseler. MoH'67. Syn. of Casseler											
Grosse Kasseler Reinette. MoH'87. Syn. of Kasseler. [Probably same as preceding.]											
Grosse Pigeonnette. (?) IllB45		r	ml	r			sa	g			Perhaps same as Gros Pigeonnet.
Grosser Bohn. Gb. Syns. Grosser bohnapfel, V. R. S. to Ia. No. 35	Rus										Not described.
Grosser bohnapfel. Gb. Syn. of Grosser Bohn											
Grosser Casselar Reinette. D. Syn. of Dutch Mignonne											
Grosser Edler Prinzessinapfel. D. Syn. of Princesse Noble											
Grosse Reinette d' Angleterre. GenF'33. Syn. of Canada Reinette											
Grosser Erdbeere. W	Eur	r	ml	rs			sa	g		e	
Grosser Mogul. BBL. [Perhaps same as Gros Mogul.]											Do.
Grosse Verte. IllB45. Syn. of Gros Vert											

Grosvenor. R. Syn. Lord Grosvenor											Do.
Gros Vert. Dap. Syns. Grosse Verte, Large Green	For	ob	m	gy	tj	yw	psa	g-vg		l	
Gros Vor. UCExR'92											Do.
Groton. Cole. Syn. of Foundling											
Grouzin. D	N. J. ?	rc	m	grs	tj	w	msa	g		m	
Grove. L. Syn. Red Grove								vg			Do.
Grover Cleveland. A'95	Tex										Do.
Grub. L. Syn. Grub's Summer		obl		rs			sa			e	
Grub's Summer. C. Syn. of Grub											
Grumas Pippin. D. Syn. of Birmingham Pippin											
Grummage Pippin. D. Syn. of Birmingham Pippin											
Grundy. JNCo. Syns. Old Grundy, Thompson's Seedling No. 38	Iowa	obl	l		tj		sa		d	me	Originated by J. S. B. Thompson, Grundy County, Iowa.
Grune Reinette. D. Syn. of Green Reinette											
Grune Reinette. GenF'33. Syn. of Nonpareil											
Gruner Fustenapfel. WHSC'81. Syn. of Green Prince											
Grunling Von Rhode Island. D. Syn. of Rhode Island											
Gruschaobrasnoe. Gb. Syn. of Pyriform											
Gruscheffka. Gb. Syn. of Pear											
Gruscheffka Bsennaja. Gb. Syn. of Autumn Pear											
Gruscheffka Moskaloskaja. Gb. Syn. of Moscow Pear											
Gruscheffka Revelskaja. Gb. Syn. of Revel Pear											
Gruscheffka Sladkaja. Gb. Syn. of Sweet Pear											
Gruscherka. Gb. Syn. of Pear											
Gruscherka Moskouskaya. Gb. Syn. of Moscow Pear											
Gruscherka Osennaya. Gb. Syn. of Autumn Pear											
Gruscherka Revelskaya. Gb. Syn. of Revel Pear											
Gruscherka Sladkaya. Gb. Syn. of Sweet Pear											
Gruschovka. CanExR'01		obc	m	gyrs	jc	w	sa			e	
Gruskirka. SDB76	Swed	roble	ms	pyw		w	sa	g		m	
Gruver. L. Syn. Gruver's Early	Pa	r	m	wyrs	j	w	psa	g		e	
Gruver's Early. D. Syn. of Gruver											
Guderstrup. R. Syn. Guderstrup's Gravenstein											Not described.
Guderstrup's Gravenstein. BBL. Syn. of Guderstrup											
Guerin. CanExR'98	Que	r	l	gyrs	fj	w	sa	vg		m	
Guernsey. L. Syn. Guernsey Pippin		r	s	yru	fcj		s			ml	
Guernsey Pippin. D. Syn. of Guernsey											
Guilford. L. Syn. Guilford Red	N. C	obc	m	yrc	fj	yw	sa			l	
Guilford Red. Dap. Syn. of Guilford											
Gulby. IllH'97. [Probably intended for Gully.]											Do.
Gullett. W		obc	l	gyrs	j					l	
Gulley Apple. A'52. Syn. of Gully											
Gully. E. Syn. Gulley Apple	Pa		s	wb	j	w				e	
Gully. W. Syn. of Mangum											
Gum. R. Syn. Gum Sweeting	Iowa?										Exhibited at Chicago, Oct., '53, by H. Finley, of Iowa.
Gumpper. E&B'77											
Gum Sweeting. Hort'54. Syn. of Gum											
Gurkow. BBL											Not described.
Guseman. R. Syn. Guseman Sweet											Do.
Guseman Sweet. WVaB75. Syn. of Guseman											
Guthrie. MoH'88											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Gutshall. Cat											Not described
Guttry. D. Syn. of Connecticut Hunt											
Guy. BBL											Do.
Grosditchoe. Gb											
Haas. Hort'70. Syns. Fall Queen, Gros Pomier, Gros Pommier, Horse (of some) Hoss, Ludwig, Maryland Queen.	Mo	obc	ml	gyrs	vtj		sa	g-vg	km	m	
Haas. D. Syn. of Horse											
Haas. D. Syn. of Ludwig											
Habersham. L. Syn. Habersham Pearmain		o	m	c	f	w	sa			mc	From Gardening for the South.
Habersham Late. AlaB30											Not described.
Habersham Pearmain. D. Syn. of Habersham											
Hackleford. IaH'86											Do.
Hackman. P'95	Kans	obc	m	yres	tj	yw	sa	vg-b		m	
Hagenkopt. (LC). Syn. Hagenkopft	Rus										Do.
Hagenkopft. BBL. Syn. of Hagenkopt											
Haggerston. R. Syn. Haggerston Pippin		r		gr				g	d	vl	
Haggerston Pippin. GenF'33. Syn. of Haggerston											
Haglo-Crab. MagofH'37. Syn. of Hagloe Crab											
Hagloe. Hort'48. Syn. of Summer Hagloe											
Hagloe Crab. Th. Syns. Crab Hagloe, Haglo-Crab	Eng	obl	s	py			sa	g	c	l	
Hague. W. Syn. Hague Pippin	Ind	rc	ml	pyrs	cmj	y	sa	g	dk	l	
Hague Pippin. A'60. Syn. of Hague											
Hailey. RNY'72	Me							g		m	
Hain. D	{Pa.? / N.C.?}	robl	l	yrs	jt	w	rs	g		l	
Haines. Dap. Syn. Haines Seedling	Ga	rob	l	rs			sa	g	km	e	
Haines Seedling. TCF. Syn. of Haines											
Halder. L. Syn. Du Halder	Hol.?	rc	l	y	ft	w	sa			vl	From Annals of Pomology.
Haley. D. Syn. of Dayton											
Haley Eureka. R. Syn. Haley's Eureka											Not described.
Haley's Eureka. TexB16. Syn. of Haley Eureka											
Half Glassy. Gb. Syns. Gov. list No. 276, Polu Stekianka, Podustekliauka.	Rus										Do.
Hall. D. Syns. Hall Apple, Hall's Red, Hall's Seedling, Jenny Seedling, Jenny's Seedling.	N. C	obc	s	rc	fj	y	visa	vg	d	l	
Hall Apple. MoH'73. Syn. of Hall											
Hall Door. D	Eng	ob	l	grs	c	w	sa		k	ml	From Ronalds.
Hall Early. L. Syn. Hall's Early											Not described.
Hall's Early F. Syn. of Hall Early											
Halleck. L. Syn. Halleck's Favorite, Hallock's Favorite	Ohio	ob	m				sa	g		m	

Halleck's Favorite. W. Syn. of Halleck											
Hall Greening. R. Syn. Hall's Greening											Do.
Hall's Greening. A'89. Syn. of Hall Greening											
Halliday. W	Va	ob					s			l	
Hall Keeper. BBL											Do.
Hall's No. 1. JVC											
Hall's No. 3. JVC. Syn. of Savoy											
Hall's No. 5. JVC. Syn. of Idura											
Hall's No. 6. JVC. Syn. of Shilpit											
Hallock's Favorite. IllB45. Syn. of Halleck											
Hall's Red. D. Syn. of Hall											
Hall's Seedling. Hort'55. Syn. of Hall											
Hall Sweet. L. Syn. Hall's Sweet		rob	l	yrs	mjc		s	g		m	
Hall's Sweet. D. Syn. of Hall Sweet											
Hallum. D. Syn. of Allum											
Hambledon. L. Syn. Hambledon Deux Ans	Eng	rob	m	yrs	j	y	psa	g		m	
Hambledon Deux Ans. GenF'33. Syn. of Hambledon											
Hambling. R. Syn. Hambling's Seedling											Do.
Hambling's Seedling. BBL. Syn. of Hambling											
Hamburg. SDB76	Minn	re	m	drs	tj	w	sa	vg	d	ml	Fameuse seedling. Originated by S. A. Alling, Homer, Minn.
Hames. D. Syn. Hames' Seedling	Ga	rob	l	rs			sa	g	m	e	
Hames's Seedling. A'77. Syn. of Hames											
Hamilton (South). W. Syn. Wonder (?)	South	r	l	yr	j	y	bsa	g		m	Claimed by J. S. Kerr to have originated in Texas.
Hamilton. A'69. Syn. Hamilton's	Ind.? Ill.?	e	l	y			sa	g		l	A. '69, 93. It is claimed to have originated in Illinois.
Hamilton. JVC. Syn. of Hamilton Blush											
Hamilton. D. Syn. of Pine creek											
Hamilton's. W. Syn. of Hamilton											
Hamilton Black. (LC)											Not described.
Hamilton Blush. IaH'94. Syns. Hamilton, Jeffery's No. 1	Wis	r	ml	gyb			sa	g	dk	l	
Hammond. A'67	South?		ml	g	j					l	From Sumner's manuscript.
Hampers. S&W		rob		rs			r			e	Resembles Red Astrachan.
Hampshire Greening. E. Syn. of Rhode Island											
Hampshire Greening. K. Syn. of Shaker Greening											
Hampshire Sweet. S&W											Not described.
Hampshire Yellow. GenF'33. Syn. of King of Pippins											
Hampton Bellflower. Hort'69	Ohio		l	pyb	t	w	bpsa	g		m	
Hampton Early. R. Syn. Hampton's Early Red											Do.
Hampton's Early Red. IndH'72. Syn. of Hampton Early											
Hampton Fall. L. Syn. Hampton's Fall Sweet	Ohio	r	m	yrs	t		s	g		m	
Hampton's Fall Sweet. D. Syn. of Hampton Fall											
Hampton Honey. L. Syns. Hampton's Honey, Hampton's Honey Sweet	Ohio	oble	m	yrs	t	w	s	g		vl	
Hampton's Honey. W. Syn. of Hampton Honey											
Hampton's Honey Sweet. D. Syn. of Hampton Honey											
Hampton Late. L. Syns. Hampton's Late Sweet, Sweet Jersey	Ohio	re	m	wrs	tj	ws	psa	g-vg		m	
Hampton's Late Sweet. D. Syn. of Hampton Late											
Hampton Red. L. Syn. Hampton's Red Winter Sweet	Ohio	ob	ml	rs			s	g		l	
Hampton's Red Winter Sweet. W. Syn. of Hampton Red											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Hampton Russet. L. Syn. Hampton's Russet	Ohio	roblob	s	yru	tf	y	bsa	g	d	ml	
Hampton's Russet. W. Syn. of Hampton Russet											
Hampus. MHSC'86	Swed		m	yb				vg	dkm	e	
Hancock. D	Pa	r	l	ygrs	cmj	y	psa	g		l	
Handsome White. Gb. Syns. Beel Krasawiza, Biel Krasavitsa, Gov. list No. 450.	Rus										Not described.
Hanger. L. Syn. Everlasting Hanger	Eng	robl		gy	j		rsa		c		
Hangon. D. Syn. of Titus											
Hanigan. NWFG'52											Do.
Hanlon. L. Syn. Hanlon's Sweet	Ohio		l	rs	j		s			ml	
Hanlon's Sweet. JRJ. Syn. of Hanlon											
Hannah. GenF'40. Syns. Aunts, Shreeve, Shreve	Ohio?	rob	l	yrs	c	w	bsa	g	km	m	
Hanover. IndH'93											Do.
Hanover Seedling. D. Syn. of Beadell											
Hans Mutterche. GenF'33. Syn. of Menage											
Hansome. R. Syn. Hansome's Choice											Do.
Hansome's Choice. IllH'81. Syn. of Hansome											
Hans Uli. MoH'87. Syn. of Uli											
Hanwell. L. Syn. Hanwell Souring	Eng	obc	m	gyb	cf	w	ba	g	k	vl	
Hanwell Souring. D. Syn. of Hanwell											
Hapgood. Hort'46											Do.
Harbert. R. Syn. Harbert's Reinette		rc	ml	gy	cj	w	sa	g		ml	
Harbert's Reinette. CanExR'01. Syn. of Harber											
Harbord. L. Syns. Colored Harbord's Pippin, Harbord's Pippin	Eng	rc	l	yru	j	w	ba			l	From Hogg.
Harbord's Pippin. D. Syn. of Harbord											
Harbour. P'87	N. C	rob	s	yrs	cfj	y	sa	vg		l	
Hardin. JNCo. Syn. Thompson's Seedling No. 46	Iowa	ob	l	gr			sa			ml	One of Thompson's seedlings.
Harding. R. Syn. Harding's Favorite											Not described.
Harding's Favorite. IndH'82. Syn. of Harding											
Hardingham's Russet. E. Syn. of Pine Russet											
Hardison. R. Syn. Hardison's July				dr				g	m	e	
Hardison's July. TCF. Syn. of Hardison											
Hard's Limber Twig. IllH'72. Syn. of Peak Fall											
Hardling. MagofH'53											Do.
Hard Red. IllH'95. [Probably Greyhouse.]											Do.
Hard Red. Dap. Syn. of Greyhouse. [May Seek-no-further, Hoops.]											
Hardskin. D. Syn. of Holly											
Hardwick. MoH'70. (Ga.)	Mo							vg		vl	Probably distinct from Swaar.

Hardwick. D. Syn. of Swaar											
Hardy. MHSC'86	Can		m	g				g	dk	l	
Hare. Wg. Syn. Watermelon	N. J.?	robe	l	g	vtj	w	s	vg		m	
Hare. Hort'75. Syn. of Summer Paradise											
Hare Head. L. Syns. Hare's Head, Hasenkopp (Saitchia golova)	Rus										Not described.
Hare's Head. Gb. Syn. of Hare Head											
Hare Pipka. MHSc'86. Syns. Gov. list No. 202, Pipka Saitchia, Saitchia pipka, Saitschia Pipka, Shro. to Ia. No. 2.	Rus										Do.
Hare Pippin. Dap. Syn. of Summer Paradise											
Hare Repka. SDB76	Rus	c	m	y		w	a	g		e	
Hargis. JGH&S											Do.
Hargreave. L. Syn. Hargreave's Green Sweet	Eng	r	m	yrs	tj	y	s			m	
Hargreave's Green Sweet. D. Syn. of Hargreave											
Hargrove. A'91	N. C	re	m	yb	fj	w	bsa	g-vg		ml	
Harkness New Favorite. E. Syn. of Red Gilliflower											
Harlan. R. Syns. Harlan's Large Fall, Harlan's Wine Apple											Do.
Harlan's Large Fall. IndF'40. Syn. of Harlan											
Harlan's Wine Apple. IndH'72. Syn. of Harlan											
Harlow. P'94	Colo	obe	l	gwr	tj	vw	a	g	k	e	
Harman Seedling. R. Syn. Harman's Seedling											Do.
Harman's Seedling. FDNCo. Syn of Harman Seedling											
Harmon. NYAg'48	N. Y	e	vl	yg			sa	g	k	m	
Harmony. PFar'52. Syn. of Early Pennock											
Harnish. D	Pa	rob	m	r	etj		msa	g		m	
Harper. Dap. Syn. Harper's Seedling	Tenn.?	obe	ml	wyrs	tj	w	psa			ml	
Harper Seedling. L. Syn. Harper's Seedling											Do.
Harper's Seedling. NWC. Syn. of Harper											
Harper's Seedling. A'95. Syn. of Harper Seedling											
Harper Sweet. W. Syn. Harper's Sweet	Ill	ob	ml	rs			s	g		m	
Harper's Sweet. NWFG'52. Syn. of Harper Sweet											
Harpole. TennBX-I. Syn. Sweet Limbertwig	Tenn.?	obe	ml	ydr	fj	gy	s	vg	dm	ml	
Harrah. P'95. Syn. Billie's Favorite	Va	obe	l	yse	ftj	yw	sa	vg		ml	
Harriet. R. Syn. Harriet's Favorite											Do.
Harriet's Favorite. MoH'73. Syn. of Harriet											
Harrigan. E. Syn. of Milam											
Harris. D. Syn. Ben Harris	N. C	rob	l	pyb	e	w	psa	g	km	m	Probably same as Ben Harris of Warder.
Harris Greening. F&L			l	gy				g	k	e	
Harrison. DomEnc. Syns. Harrison Cider, Long Stem	N. J	orob	ms	y	t	vy	rsa	g	ke	ml	
Harrison Cider. BBL. Syn. of Harrison											
Harrison Sweet. R. Syn. Harrison's Sweet											Not described.
Harrison's Sweet. MagofH'53. Syn. of Harrison Sweet											
Harris Whitehall. Dap. Syn. of Dyer											
Harris Winter. A'75											Do.
Harry. L. Syn. Harry Sweet	Pa	re	m	gyb	cj	w	sa	g		vl	
Harry Kaump. Cat. [Probably same as Kaump.]											Do.
Harry Kaump. IaH'80. Syn. of Kaump											
Harry Sweet. D. Syn. of Harry											
Harte. ColExR'89											Do.
Hart Early. R. Syn. Hart's Early Sweet											Do.
Hart's Early Sweet. NEF'32. Syn. of Hart Early											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Hartford. L. Syns. Champ Sweet, Champ Sweeting, Hartford Sweet, Hartford Sweeting, Keney's Sweet, Spencer's Sweeting.	Conn	rob	ml	ygrs	vjt	y	rs	g	m	vl	
Hartford. D. Syn. of Hollow Crown											
Hartford Rose. NYB15	Conn	oblc	ml	yr	ftj	w	sa	g	k	me	
Hartford Sweet. Lin. Syn. of Hartford											
Hartford Sweeting. K. Syn. of Hartford											
Hartland. R. Syn. Hartland Beauty	Iowa	robc	ml	gyrs	tj	w	rs	vg		m	
Hartland Beauty. A'77. Syn. of Hartland											
Hart's Orange Sweeting. MagofH'47. Syn. of Hart Sweet											
Hart's Pippin. IllB45											Not described.
Hart Seedling. MinnExR'90											Do.
Hart's Seedling. AmGar'94. Syn. of Brett											
Hartshorn. WisB45											Do.
Hart Sweet. R. Syn. Hart's Orange Sweeting	Ohio?			dy			s				
Harty. L. Harty Sweeting			s	y					c	m	
Harty Sweeting. Th. Syn. of Harty											
Harvest. C		obl	s	y		w	psa	g		e	
Harvest. NEF'27. Syn. of Early Harvest											
Harvest Apple. MagofH'51. Syn. of Primate											
Harvest Early. Lin. Syn. of Early Harvest											
Harvest Queen. ColExR'91											Do.
Harvest Redstreak. D. Syns. Early Red Pippin, Early Redstreak, Striped Harvest.	Pa	ob	m	wrs	ctj	w	sa	g	k	me	
Harvest Red Streak. IaH'71. Syn. of Redstripe											
Harvest Sweet. AmF'28											
Harvey. D. Syn. Dr. Harvey	Eng	ro	l	gyru	f	w	bsa	g	k	ml	From Lindley.
Harvey Pippin. L. Syns. Dredge's Beauty of Wilts, Harvey's Pippin	Eng	r	m	yrc	fcj		r			l	
Harvey's Pippin. D. Syn. of Harvey Pippin											
Harvey Stripe. IndH'72											Not described.
Harvey's Wiltshire Defiance. D. Syn. of Wiltshire											
Harwell. TennBI-IX. Syn. Ball's Choice	Tenn	ob	l	ygrs	fcj	gyw	sa	g		l	
Harwood. MoH'67											Do.
Hasenkopp (Saitchia golova). Gb. Syn. of Hare Head											
Haskall Sweet Hort'72. Syn. of Haskell											
Haskell. L. Syns. Haskall Sweet, Haskell's Pear Sweet, Haskell Sweet, Sassafras Sweet.	Mass	ob	ml	gyb	tj	y	rvs	vg-b	dk	me	
Haskell's Pear Sweet. A'69. Syn. of Haskell											
Haskell Sweet. Lin. Syn. of Haskell											
Hastings. S&W	Mich	r	l	yc	c	w	sa	vg		l	
Hatch. BBL											Do.

Hatcher. Dap. Syn. Hatcher's Seedling	Tenn	re	m	drpu	fcj	y	msa	vg		l	
Hatcher's Seedling. Dap. Syn. of Hatcher											
Hatley. P'90	Ark	obe	m	yrs	ftj	y	sa	vg-b	d	ml	
Haupe. R. Syn. Haupe Stripe											Do.
Haupe Stripe. FDNCo. Syn. of Haupe											
Haute Bonte. C. Syns. Blandilalie, Reinette grise haute bonte	Fr	r	m	yb	tj	gw	bsa	g	d	l	
Have. IllB45											'Do.
Haven. A'73	For	obe	ml	y	fvtj	wy	sa			l	
Haven Pippin. Dap. Syn. of Ledge											
Haverstraw Pippin. D. Syn. of Champlain											
Haverstraw Pippin. D. Syn. of Summer Pippin. [S. P. and Champlain probably identical.]											
Havre. L. Syns. Belle Douce du Havre, Belle du Havre	Fr	robe	vl	yr			sa	vg		m	
Hawberry Pippin. D. Syn. of Hollandbury											
Hawf. L. Syn. Hawf's Seedling	N. B										Do.
Hawf's Seedling. Cat. Syn. of Hawf											
Hawke. R. Syn. Hawke's Rustycoat											Do.
Hawke's Rustycoat. IllH'97. Syn. of Hawke											
Hawkins. L. Syn. Hawkins's Chief	Minn	obe	m	py	c		ba	g		m	From Western Pomologist.
Hawkins' Chief. Hort'72. Syn. of Hawkins											
Hawkins Pippin. IllH'77											Not described.
Hawley. MagofH'47. Syns. Douse, Dows, Dowse	N. Y	robe	l	y	vtj	w	rsa	vg		m	
Hawthorndean. M. Syn. of Hawthornden											
Hawthornden. NEF'32. Syns. Hawthorndean, Maiden's Blush (erroneously of some American collections), Red Hawthornden, White Hawthornden.	Scot	rob	ml	pyb	j	w	sa	g	km	m	
Hawthornden. D. [Similar to above, but a winter variety.]										l	Do.
Hawthornden of the English. K. Syn. of Maiden Blush											
Hayasche Gold Reinette. Dap. Syn. of Hoya											
Hayboys. MagofH'37	Ohio	ob	l	py		y	bs	g-vg	dk	me	
Haycock. BBL											Do.
Hayes. L. Syn. Mrs. Hayes											Do.
Hayes' Fall. JVL. Syn. of Wine											
Hay Fall. R. Syn. Hay's Fall. [This is probably Wine.]		rob	l	gyrs	c	gy		vg		me	
Hay's Fall. GLA. Syn. of Hay Fall. [Probably syn. of Wine.]											
Hayford. R. Syn. Hayford Sweet	Me									l	
Hayford Sweet. MeExR'93. Syn. of Hayford											
Haymaker. E. Syn. of Cat Pippin											
Haymaker. D. Syn. of Cut											
Hay's. B. Syn. of Wine											
Hayne Pippin. IndH'78											Do.
Haynes. R. Syn. Haynes' Sweet	Me	obl	l	yr	c	y	s	g	dk	ml	
Haynes' Sweet. MeExR'96. Syn. of Haynes											
Hays' Apple. Lin. Syn. of Wine											
Hays Fall. L. Syn. Hays' Fall											Do.
Hays' Fall. Cat. Syn. of Hays' Fall											
Hays' Winter. DomEnc. Syn. of Wine											
Hays' Winter Wine. E. Syn. of Wine											
Haywood. PJB. Syn. Queen of Haywood	N. C	ob	l	ysc		w	bsa	g	m	ml	
Hazel. MagofH'38. Syn. Hessel. [Possibly a pear.]											Do.
Hazeldeen. Dap. Syn. of Princely											
Headley. CanExR'01											Do.
Headlight. IllH'97											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Heart. L. Syns. Heart's Pippin, Heartt's Pippin		r	ml	y			sa		k	m	
Heart's Pippin. MagofH'47. Syn. of Heart											
Heartt's Pippin. Hort'66. Syn. of Heart											
Heaster. D. Syn. of Hiester											
Heath. GenF'34. Syn. Heath's Early Nonsuch											Not described.
Heath's Early Nonsuch. MagofH'39. Syn. of Heath											
Heatherbell. CanExR'01		rob	m	gyrs	cj	w	sa			l	
Heath Favorite. R. Syn. Heath's Favorite											Do.
Heath's Favorite. MichB31. Syn. of Heath Favorite											
Hebble. R. Syn. Hebble White		ob	m	g	c	gw				l	
Hebble White. CanExR'01. Syn. of Hebble											
Hebron. MinnHort'94											
Heckenwelder. MagofH'53											Do.
Hector. MagofH'53	Pa	rc	l	yrs		y	bpsa	g		l	
Hedrick. R. Syn. Hedrick Sweet	W. Va	obc	m	gyb	ftj	y	s	vg		l	
Hedrick Sweet. P'95. Syn. of Hedrick											
Heicke's Summer Queen. H. Syn. of Early Pennock											
Heicke's Winter Sweet. E. Syn. of London Sweet											
Heidelocher. GenF'33. Syn. of Hoskreiger											
Heidemeyer. P'95	Ger	rc	s	ysc	fcj	y	sa	vg-b		m	
Heidorn. MHSC'86. Syns. Gov. list No. 164, Heidorn's Streaked, Polosatoe Heidorna, Polosatka Heidorna, Polosatoe Heidorns, Shro. to Ia. No. 116.	Rus	robc	m	y				g			
Heidorn Streaked. R. Syn. Heidorn's Streaked	Rus		l	yrs			s				
Heidorn's Streaked. ACT. Syn. of Heidorn Streaked											
Heidorn's Streaked. Gb. Syn. of Heidorn											
Heilige Julian's Appel. D. Syn. of Saint Julien											
Heiges. ArkB49. Syn. Red Limbertwig	Ark	rob	m	yrsc	ftj	y	sa	vg-b		ml	
Heike. R. Syn. Heike's Sweet. [Probably Heikes.]			l	w			s	vg	kd		
Heike's Sweet. NAPC'49. Syn. of Heike											
Heikes Crab. A'75. [Possibly a Crab.]											Do.
Heine. OL	Tex	obl	l-vl	yb	f	w		vg		ml	
Heisler. WmCh. Syn. Stone's Eureka. [May be Missouri.]				rs						l	
Heister. W. Syn. of Hiester											
Helen. L. Syn. Helen's Favorite	Ohio	r	m	drs	tj	ws	sa			l	
Helen (Can). MHSC'86	Can			dr			s		k	vl	
Helen's Favorite. MagofH'46. Syn. of Helen											
Helper. A'54. Syn. Zeiber	Pa										Do.
Helsham. L. Syn. Doctor Helsham's Pippin	Eng	rc	m	ygb		w	s			m	From Lindley.
Hemmenger. BBL											Not described.
Hemmingberger. R. Syn. Hemmingberger's Greening											Do.

Hemmingberger's Greening. MichB31. Syn. of Hemmingberger											
Hemphill. W	N. C	obc	ml	wyb	cm	yw	sa	g		vl	
Hempstead. D. Syn. of Streaked Pippin											
Henderson. MoH'73			l	y				vg		me	
Hendrick. R. Syns. Hendrick Sweet, Sweet Winesap		rob	ml	rs	cjf	w	s		dm	l	
Hendrick Sweet. A'89. Syn. of Hendrick											
Henhouse. NEF'30				y	t		p	g		e	
Henley. W	South	c		y			s				
Hennepin. IllH'87	Ill		l					g		vl	
Henniker. L. Syn. Lady Henniker	Eng	rc	vl	yrsc	vt		sa	g	dk	ml	From Journal of Horticulture.
Henning. SCExR'98											Not described.
Henning Stripe. R. Syn. Henning's Striped Sweet											Do.
Henning's Striped Sweet. MoH'86. Syn. of Henning Stripe											
Henrick. L. Syn. Henrick Sweet		ob	m				s	g		l	
Henrick Sweet. Hort'60. Syn. of Henrick											
Henrick Sweet. T. Syn. of Sweet Pearmain. [Mr. Lyon thought this doubtful.]											
Henrick Sweet. D. Syn. of Sweet Winesap											
Henry. W. Syn. Henry Apple	Vt	oblc	l	yb	t	y	sa	g		ml	
Henry Apple. D. Syn. of Henry											
Henry Clay. BBL											Do.
Henry Sweet. D. Syn. of Sweet Winesap											
Henry Sweeting. IllH'69. [This may be Sweet Winesap.]											Do.
Henry Weeping. R. Syn. Henry's Weeping Pippin											Do.
Henry's Weeping Pippin. Hort'49. Syn. of Henry Weeping											
Henshaw. D. Syn. of Buckingham											
Henwood. MoH'63. Syn. Henwood Seedling	Ind	oblc	l	y	ctj	yw	a	vg		l	A seedling of Ortley.
Henwood Bellflower. IllB45. [Probably a syn. of Henwood.]											Not described.
Henwood Seedling. A'60. Syn. of Henwood											
Hepler. Hort'53	Pa	rob	m	pyb	j	w	psa	g		vl	
Hepper. E	Am	r		y			sa	g			May be same as Hepler.
Herbstealville. R. Syn. Rother Herbstealville											Not described.
Herbst Strefling. Gb. Syn. of Autumn Streaked											
Herbst Streifling. Gb. Syn. of Autumn Streaked											
Herbststrich Apfel. D. Syn. of Early Autumn											
Hereford Pearmain. Wg. Syn. of Herefordshire											
Herefordshire. L. Syns. English Pearmain, Hereford Pearmain, Herefordshire Pearmain, Herfordshire, Hertfordshire Pearmain, Old Pearmain, Parmin, Parmin Royal, Royale d'Angleterre, Royal Pearmain (of some), (Winter Pearmain, erroneously).	Eng	rc	m	yrs	cj	y	rsa	vg	d	ml	
Herefordshire Beefing. UCExR'92											Do.
Herefordshire Golden Pippin. D. Syn. of Golden Pippin (Eng.)											
Herefordshire Pearmain. GenF'33. Syn. of Herefordshire											
Herefordshire Queening. D. Syn. of Crimson Queen											
Herefordshire Red Streak. D. Syn. of Redstreak											
Herfordshire. F. Syn. of Herefordshire											
Herman. A'52	Pa	oblc	m	yrs	tj	g	sa	g		l	
Herman. MoH'88. Syn. of Hermann											
Hermann. RNY'70. Syn. Herman	Mo	c	m	r	j	w	sa	g		vl	
Herndon. BBL. [This may be Sangamon. See IllH'71, 273.]											Do.
Herndon's Seedling. IllH'71. Syn. of Sangamon											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Hernodler. NCExR'89. [This may be Kernodle.]											Not described.
Herr. R. Syn. Herr's Winter											Do.
Herren. MHSC'86. Syns. Gov. list No. 315, Herrenapfel, Lord's Apple, Shro. to Ia. No 87.	Rus.	obobl c		y						ve	
Herrenapfel. Gb. Syn. of Herren											
Herr's June. MagofH'53. Syn. of Margaret											
Herr's Striped June. Hort'60. Syn. of Margaret											
Herr's Winter. IllB15. Syn. of Herr											
Herschal. R. Syn. Herschal Cox	Tenn		m	rs				g		l	
Herschal Cox. OL. Syn. of Herschal											
Hersey. L. Syn. Hersey Keeper		r		rs			sa			l	
Hersey Keeper. W. Syn. of Hersey											
Hersey Sweet. MontB24							s				Do.
Hertfordshire Pearmain. C. Syn. of Herefordshire											
Hertfordshire Underleaf. DomEne. Syn. of Underleaf											
Heslep. A'97	Ga	rc	ms	yr				g	mk	l	
Hesper. R. Syn. Hesper Rose											Do.
Hesper Rose. MichB31. Syn. of Hesper											
Hess. MagofH'53	Pa	rc	m	rs	t	gw	sa	g		ml	
Hessel. MagofH'38. Syn. of Hazel. [Possibly a pear.]											
Heteric. H. Syn. of Hetterich											
Heterich. A'52. Syn. of Hetterich											
Hetterich. E. Syns. Heteric, Heterich	Pa	rob	ml	y	t	w	a	g		ml	
Hewes. L. Syns. Hewes' Crab, Hewe's Virginia Crab, Hughe's Virginia Crab, Virginia Crab.	Va	rob	vs	grs	(*)	w	va	g	c	ml	Fit only for cider.
Hewes' Crab. Hort'56. Syn. of Hewes											
Hewe's Virginia Crab. C. Syn. of Hewes											
Hewitt. L. Syn. Hewitt's Sweet		ob	l	yrs	t	w	ps	g		m	
Hewitt's Sweet. D. Syn. of Hewitt											
Hex's White. Dap. Syn. of Settle											
Hey Boy. MagofH'43											Not described.
Hiawatha. A'71	Wis.	r	m	yb				g			
Hibernal. Gb. Syns. Gov. list No. 378, Orsimui, Osimui	Rus.	ob	l	rs			sa		k		
Hicks. Hort'66. Syns. Buckram, Hick's	N. Y.	r	ml	gye	tmj	w	s	vg		ml	
Hick's. D. Syn. of Hicks											
Hick's Fancy. GenF'33. Syn. of Early Nonpareil (Eng.)											
Hicks Sweet. DelExR'95											Do.
Hicks White. L. Syns. Hick's White, Hix's White	Va	c		w				vg?		m	
Hick's White. F. Syn. of Hicks White											
Hick's White. Dap. Syn. of Settle											

Hicus. R. **Syn.** Hicus Hinkle											Do.
Hicus Hinkle. IndH'73. Syn. of Hicus											
Hiester. D. Syns. Baer, Heaster, Heister, Miller, Stehly	Pa	rob	m	yrs	ej	w	psa	g		l	
Higbee. MagofH'53. Syn. of Higby											
Higby. L. Syns. Fenton Sweet, Higbee, Higby Sweet, Higby's Sweet, Lady Blush, Ladies' Blush, Lady Cheek Sweet, Trumbull Sweet.	Ohio	re	m	pyb	vtj	w	s	vg-b	dkm	ml	
Higby Sweet. W. Syn. of Higby											
Higby's Sweet. T. Syn. of Higby											
Higer. MagofH'53											Do.
Higgins. R. Syn. Higgins' Red Winter	Utah		l	r				vg		vl	
Higgins' Red Winter. A'75. Syn. of Higgins											
High Canons. BBL											Do.
Highfill. ArkB49	Ark	re		yrs	t	w	sa	g		l	
Highland. L. Syn. Highland Beauty	N. Y	obc	ms	wyb	fetj	w	sa	vg	d	l	
Highland Beauty. Dap. Syn. of Highland											
Highlander. D	Vt	obc	m	grs	jt	w	psa	g		m	
Highland Pippin. Dap. Syn. of Primate											
High Lo Jack (of some). Syn. of Bostick											
Highton. R. Syn. Highton Sweet											Do.
Highton Sweet. WVaB75. Syn. of Highton											
Hightop. W. Syn. Lewis Jones	Ind	rob	l	rs	ftj	yw	sa	g	dkm	ml	
Hightop Sweet. Cole. Syns. Early Sweet, Hightop Sweeting, Summer Sweet, Summer Sweeting, Spence's Early, Sweet June, Sweet June of Ill.	Mass	r	ms	py		y	vs	vg	dk	ve	
High Top Sweet (incorrectly). Dap. Syn. of King Sweet											
Hightop Sweet (incorrectly). Dap. Syn. of Amsterdam											
Hightop Sweeting. Th. Syn. of Hightop Sweet											
Hightop Winter. R. Syn. Hightop Winter Sweet			s	gy			s	p		ml	
Hightop Winter Sweet. IllB45. Syn. of Hightop Winter											
Hilaire. L. Syns. Cabane du Chien, Fameuse Baldwin (of some), St. Hilaire.	Que	robc	ms	wrsp	tj	vw	sa			ml	
Hillars. R. Syn. Hillars Grande	Fr	c		yrb	fr		s				A seedless variety.
Hillars Grande. AJofHVI. Syn. of Hillars											
Hiley. L. Syn. Hiley's Eureka	Ga	rob	m	yrs	fc		a	vg		l	
Hiley's Eureka. A'79. Syn. of Hiley											
Hill Favorite. L. Syn. Hill's Favorite	Mass	robc	m	yrs	ftj	y	sa	g-vg		m	
Hill's Favorite. D. Syn. of Hill Favorite											
Hill Longstem. R. Syn. Hill's Long Stem		r	ms	gy			msa			e	
Hill's Long Stem. IllB45. Syn. of Hill Longstem											
Hill Red. R. Syn. Hill's Red											Not described.
Hill's No. 2. IaH'85. Syn. of Windsor											
Hill's Red. IllH'83. Syn. of Hill Red											
Hills. A'91	Ill	robl	ml	crs		w	a		m	ml	
Hillsboro. AHortA'69	Ill	c	ml	gy	j	y	ba	g	dk	ml	
Hill Seedling. R. Syn. Hill's Seedling											Do.
Hill's Seedling. WVaB75. Syn. of Hill Seedling											
Hill Sweet. L. Syn. Hill's Sweet		rob	m	yr	tj	yw	rs	g-vg		l	
Hill's Sweet. D. Syn. of Hill Sweet											
Hilltop. MagofH'43											Do.
Hilpot. MichB31											Do.
Hilton. D	N. Y	r	l	yg	tj		sa	g	k	m	
Himbeer. BBL											Do.
Himbeerapfel Livlander. Gb. Syn. of Livland Raspberry											

* Texture, tough.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Hinckley. R. Syns. Hinckley's Sweet, Hinkley Sweet			l				s	g			
Hinckley's Sweet. IllB45. Syn. of Hinckley											
Hinckman. C. Syn. of Newark King											
Hindlip. R. Syn. Lord Hindlip											Not described
Hinesley. W	Ind	ob	l	rs			s	g		l	
Hinkley Sweet. MagofH'36. Syn. of Hinckley											
Hinnersley. D	Pa	roble	ms	g	tmj	gw	sa	g		l	
Hiram. IndH'72	Ill	rob	ml	rs			sa	vg	m	vl	
Hiram Sweet. BBL											Do.
Hislop. R. Syn. Hislop Seedling. [Perhaps intended for Hyslop.]											Do.
Hislop Seedling. MinnExR'90. Syn. of Hislop											
Hixon. Hort'75. Syn. of Magnolia											
Hix White. A'95	South										Do.
Hix's White. A'73. Syn. of Hicks White											
Hoadley (Ohio). MagofH'53. Syn. Big Rambo	Ohio	r	l					g			
Hoadley (Wis.). A'99	Wis	rob	l	wyrs				g	km	me	Said to be a seedling of Oldenburg.
Hoary Morning. D. Syns. Dainty Apple, Downy, Sam Rawlings	Eng	obc	l	yrs	f	w	bsa	g	k	m	
Hobart. R. Syn. Hobart Seedling											Not described
Hobart Seedling. IndH'98. Syn. of Hobart											
Hobbs. L. Syns. Hobbs' Late Sweet, Hobbs' Sweet	Pa	rob	l	gy	t		s			m	From Hobbs' manuscript
Hobbs' Late Sweet. IllB45. Syn. of Hobbs											
Hobbs' Sweet. D. Syn. of Hobbs											
Hockett. L. Syns. Hockett Sweet, Hockett's Sweet	N. C	rob	m	yrs	cj	yw	rs	g	km	l	
Hockett Sweet. W. Syn. of Hockett											
Hockett's Sweet. D. Syn. of Hockett											
Hocking. W. Syn. Townsend		rob	ml	yrc	j	y	bsa	g	km	m	Very similar to Townsend, if not identical
Hocking. D. Syn. of Townsend											
Hocking Seedling. MagofH'47. [This may be Hocking or Townsend.]											Not described.
Hocott. ASB&S		ob	l	r						l	
Hodge. L. Syn. Hodge's Limbertwig		r	s	wrs	jf	w	sa	vg		m	
Hodge's Limbertwig. W. Syn. of Hodge											
Hoen. IllH'00											Do.
Hoffman. R. Syn. Hoffman Golden											Do.
Hoffman Golden. BBL. Syn. of Hoffman											
Hogan. D. Syn. of Domine											
Hogan. E. Syn. of Wells											
Hogg. L. Syn. Hogg (incomparable)											Do.
Hogg (incomparable). Cat. Syn. of Hogg											

Hog Island. L. Syns. Canada Sweet, English Sweet (erroneously), Hog Island Sweet, Sweet Pippin, Van Kleek's Sweet.	N. Y.	ob	m	yrsc	jet	y	vs	g-vg		m	
Hog Island Sweet. D. Syn. of Hog Island											
Hog Island Winter. L. Syn. Winter Hog Island Sweet	N. Y.	obe	ms	pyrs	tvj	y	rs	g		l	
Hogpen. Cole. Syn. of Fall Orange											
Hog Pen. Dap. Syn. of Southern Porter											
Hog Snout	N. C.	r	ml	rs			sa	g			The name rather indelicate.
Holaday's Seedling. Hort'56. Syn. of Hollady											
Holbert. L. Syn. Holbert's Victoria	Eng.	o	s	yru	j	y	visa			vl	From Hogg.
Holbert's Victoria. D. Syn. of Holbert											
Holcomb. D		ob	m	yrs	ftmj	w	msa	g		l	
Holdeman. MichB31											Not described.
Holden. D. Syn. of Fall Orange											
Holden Pippin. Cole. Syn. of Fall Orange											
Holdfast. Gb. Syn. of Shepherd											
Hollady. D. Syns. Holaday's Seedling, Hollady's Seedling	Va.	ob	m	yb	ct	y	sa	g		l	
Hollady's Seedling. A'52. Syn. of Hollady											
Holland. L. Syns. Belvidere Pippin, French Pippin (of some), Holland Pippin, Pie Apple, Reinette de Hollande, Summer Pippin.		oble	vl	gyb			sa	g	k	me	Resembles Fall Pippin.
Holland Beauty. OreB22											Not described.
Hollandburgh. E. Syn. of Hollandbury											
Hollandbury. E. Syns. Beau Rouge, Bonne Rouge, Hawberry Pippin, Hollandburgh, Hollingbury, Horsley Pippin, Howberry Pippin, Kirke's Scarlet Admirable.	Eng.	rob	vl	yb	tj	w	bsa		k	m	
Holland Pippin. DomEnc. Syn. of Holland											
Holland Pippin (erroneously). C. Syn. of Fall Pippin											
Holland Red. L. Syn. Holland's Red Winter	Ohio									l	Do.
Holland's Red Winter. W. Syn. of Holland Red											
Holland's Red Winter. Dap. Syn. of Winesap											
Holland Rose. L. Syns. Pomme de Codillac, Rose de Hollande, Rose de la Benauge, Rose Tendre.	Hol. ?	obe	ml	dy	t	yw	a			l	From Annals of Pomology.
Holland Sweet. D. Syn. Holland's Sweet		c	m	grs	f		s	g	k	vl	
Holland's Sweet. W. Syn. of Holland Sweet											
Holley. A'81	N. S.		vl							l	
Hollingbury. D. Syn. of Hollandbury											
Hollis Red. IllB45. Syn. of Holly											
Hollister. R. Syn. Hollister Sweet											Not described.
Hollister Sweet. ColExR'88. Syn. of Hollister											
Hollman. IllH'68											Do.
Hollman. T. Syn. of Nickajack											
Hollman Sweet. BBL											Do.
Hollow Core (N. J.). D	N. J.	robl	m	yrb	tj	w	sa	g		ml	
Hollow Core (Eng.). D	Eng.	c	m	gb	t	w	bpsa			m	From Hogg.
Hollow Cored Pippin. D. Syn. of Ortley											
Hollow Crown. D. Syns. Hartford, Kelsey, Tyler	N. E.	re	l	yrs	etj	y	psa	g	km	m	
Hollow Crown Pearmain. D. Syn. of Long Island Pearmain											
Hollow Crown Pearmain. E. Syn. of Wine											
Hollow Crown Pippin. D. Syn. of Hollow Eye											
Hollow Eye. L. Syns. Hollow Crown Pippin, Hollow Eyed Pippin	Eng.	rob	m	yb	fj		sa		k	m	
Hollow Eyed Pippin. D. Syn. of Hollow Eye											
Hollow Rock. MagofH'53											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Holly (Ga.). GenF'46. Syns. Hardskin, Hollis Red, Northern Hardskin, Persimmon, Simmon.	Ga	rob	m	yrs	fj	y	s	g		l	
Holly. JWA. Syn. Wine			l	rs				g		me	Distinct from preceding.
Holly Crown. NYAg'48. Syn. of Dyer											
Holman. MoH'87	Mo		m	rs	c	y	bsa	g		l	
Holman. P'94. Syn. of Holman Russet											
Holman. W. Syn. of Nickajack											
Holman Russet. P'94. Syn. Holman	Me	obc	s	cru	ftj	y	msa	vg-b	d	l	Resembles Pomme Gris.
Holmes. Th. Syn. Holmes Apple	Mass	rob	m	yb	tfj	y	sa		dc	ml	
Holmes Apple. Hort'46. Syn. of Holmes											
Holmes Sweet. L. Syn. Holmes' Sweet	N. Y.	rc	m	yb	tj	y	rs	vg		l	
Holmes' Sweet. D. Syn. of Holmes Sweet											
Holsten Sweet. D. Syn. of Holston											
Holston. L. Syns. Holsten Sweet, Holstone Sweeting, Holston Sweet		r	ml	gyb	ftj	wy	vs	vg	dk	ml	
Holstone Sweeting. IndH'72. Syn. of Holston											
Holston Sweet. RNY'61. Syn. of Holston											
Holt. IndH'80. Syn. Holt's Seedling	Ark	ob	l	gywrs	cmj	gy	sa	g		l	
Holt (Minn.). IaH'98	Minn	r	s	ygb	tj	y	sa	g		me	
Holten. L. Syn. Holten Sweeting							s	g	dc	m	
Holten Sweeting. Th. Syn. of Holten											
Holton. R. Syn. Holton's Sweeting. [Probably same as Holten.]											Not described.
Holton's Sweeting. MagofH'50. Syn. of Holton											
Holt's Seedling. ArkB49. Syn. of Holt											
Home. ColB17											Do.
Homestead. Cat											Do.
Home Vandevere. Cat. Syn. Southern Home											Do.
Home Wine. (LC)											Do.
Home Winter. R. Syn. Home's Winter Wine											Do.
Home's Winter Wine. IllH'88. Syn. of Home Winter											
Hominy. SCExR'98. [May be Hommony.]											Do.
Hominy. D. Syn. of Sops-of-Wine											
Hommacher. W. [Probably identical with Cat Pippin.]	Pa		l	y			sa	g		l	
Hommacher Apfel. D. Syn. of Cut											
Hommacher Apfel. E. Syn. of Cat Pippin											
Hommony. W. Syn. Homony Apple	South	oblc	l	rs			sa	g		e	Probably Early Pennock.
Homony Apple. Hort'56. Syn. of Hommony											
Honemaker Pippin. D. Syn. of Cut											
Honest John. P'95	Va	obc	ml	ywrsc	fcj	yw	msa	g-vg	d	vl	
Honey. W. Syn. Honey Sweet	{Pa.? Ohio?}	robc	m	pybc	mjc	w	vs	g	k	me	

Honey Creek. R. Syn. Honey Creek Pippin											Not described.
Honey Creek Pippin. IndH'67. Syn. of Honey Creek											
Honey Greening. MagofH'53. Syns. Honey Sweet (incorrectly), Poppy Greening.	West	rob	ml	gyb	fctj	w	vs	vg		ml	
Honey Greening. D. Syn. of Green Sweet											
Honey Pink. A'81											Do.
Honey Pippin. W		c		rs			s				
Honey Sweet. Hort'54. [Probably same as Honey.]	Ohio?										Do.
Honey Sweet. D. Syn. of Honey											
Honey Sweet (incorrectly). D. Syn. of Honey Greening											
Honey Sweet (of some). D. Syn. of Wetherill											
Honey Sweet (of some). E. Syn. of Winter Paradise											
Hongrie. L. Syn. Reinette de Hongrie	Eng.?	rob	m	ru	fc	gw				vl	From Lindley.
Honiker. W	Pa										Not described.
Hood. D. Syn. Hood's Seedling		oble	s	yrs	f	w	ps			m	
Hood's Seedling. D. Syn. of Hood											
Hooker. MagofH'47	Conn	c	m	gyrs	t	g	psa	g		ml	
Hoop. CGen'66. Syn. of Greyhouse. [Hoops.]											
Hoopbole. W	Ohio	rob	s				sa	g		l	
Hooper. MagofH'39. L. Syn. Hooper's Redstreak	Ohio?	r					sa		dc	m	
Hooper's Redstreak. H. Syn. of Hooper											
Hoopes. D. Syn. of Greyhouse. [Hoops.]											
Hoopes. W. Syn of Greyhouse. [May Seek no further.]											
Hoopes' Pearmain. Dap. Syn. of Greyhouse. [May Seek no further.]											
Hoops. IndF'40. Syn. of Greyhouse. [May Seek no further.]											
Hoops. IllH'73. [Said to be similar to but not Greyhouse.]											Do.
Hoosier. W	Ind	obl	m	rs			sa	g		l	
Hoosier June. R. Syn. Hoosier Red June. [Named by Dr. Stayman of Kans.]											Do.
Hoosier Red. Hort'60	Ind	r	m	y			sa	g		l	
Hoosier Red June. Hort'65. Syn. of Hoosier June											
Hoosier's Red. MoH'68. Syn. of Ashmore											
Hoover. MagofH'57. Syns. Black Coal, Hoover Pippin, Wattagah, Wattaugah.	S. C.	rob	m	yrs	ftj	y	rsa	vg		ml	
Hoover. Dap. Syn. of Black Coal											
Hoover. Hort'75. Syn. of French Pippin											
Hoover June. Dap. Syn of Yellow June											
Hoover Pippin. GarM'74. Syn. of Hoover											
Hop. MagofH'42. Syn. Hop Apple											Do.
Hop Apple. Hort'54. Syn. of Hop											
Hopbole. FDNCo. [Perhaps same as Hoopbole]											Do.
Hope. A'75											Do.
Hopewell. P'95. Syn. Patterson	Pa	obc	s	yru	j	y	bmsa	vg		vl	The name of Hopewell of Mo. changed to Monsees.
Hopewell. MoH'93. Syn. of Monsees.											
Hopkins. AmF'50	Md	rob	ms	yrs	cj	w	psa	g-vg		m	
Hopkins Porter. A'73	Vt	robl	m	yr			sa			l	
Hopkins Red Cheek. W. Syn. of Monmouth											
Hopper. W	S. C.	rob	l	yru			sa	g			
Hopsey. D. Syn. of Greyhouse. [Hoops, May Seek no further.]											
Hopson. Dap. Syn. of Greyhouse. [May Seek no further, Hoops.]											
Hord. MagofH'53											Not described.
Horen. MinnExR'90											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Hormead. L. Syns. Arundel Pearmain, Hormead Pearmain, Hormead Pippin.	Eng	re	m	py	etj	w	bsa	g-vg		m	
Hormead Pearmain. GenF'33. Syn. of Hormead											
Hormead Pippin. GenF'33. Syn. of Hormead											
Horn. W. Syns. Leech's Red Winter, North Carolina Vandevere	Ga.?	ob	ms	wyrs	mj	yw	sa	g		l	
Horne. R. Syn. Horne's Winter Wine. [Probably same as Horn.]											Not described
Horne's Winter Wine. IaH'88. Syn. of Horne											
Hornet. W	Pa		l	y				g			
Hornet Sweeting. Th(?). Syn. of Flat Sweet (Eastern)											
Horrex's Pearmain. D. Syn. of Fouldon											
Horse. Hort'52. Syns. Haas, Horse Apple, Large Yellow Horse, Oldfield Apple, Summer Horse, Trippe's Horse, Yellow Horse, Yellow Hoss.	N. C.?	robl	l	yb	fet	y	sa	g	km	me	
Horse (of Petticolas). H	Ohio							g			Of doubtful identity.
Horse Apple. E. Syn. of Fall Queen. [Buckingham.?]											
Horse Apple. IndF'40. Syn. of Horse											
Horse Bud. A'89. Syn. of Shockley											
Horse (erroneously) D. Syn. of Finley											
Horse (of some). Hort'70. Syn. of Haas											
Horse Block. MagofH'48. Syn. of Manomet											
Horse Improved. BBL											Not described
Horseshoe. R. Syn. Horse Shoe Red											Do.
Horse Shoe Red. WVaB75. Syn. of Horseshoe											
Horsham. L. Syn. Horsham Russet	Eng	r	s	yru	fe	w	bsa			m	
Horsham Russet. D. Syn. of Horsham											
Horsley Pippin. D. Syn. of Hollandbury											
Horton. L. Syn. Horton Sweet	Ohio										Do.
Horton Sweet. W. Syn. of Horton											
Hosfeld. MagofH'53											Do.
Hoskreiger. GenF'33. Syn. Heidelocher	Eng.?	ob	l	ygrs	t	w	bsa			l	From Hogg
Hoss. Dap. Syn. of Haas											
Hotchkiss. SDB76. Syn. Hotchkiss Seedling	Minn	ob	l	gb	fj		psa	g		vl	Originated by Mrs. Kimball, Winnebago City, Minn
Hotchkiss Seedling. MinnExR'90. Syn. of Hotchkiss											
Hottenstien. Dap. Syns. Libert, Lippart	Pa	rob	l	gyrs	ftj	w	sa			m	
Houblon. AmGar'02											
Houghtalling. BBL											Not described
House. D. Syn. of Fall Wine											
Housome. BBL. Syn. Housome's Choice	Ill	obl	l	gyrs						vl	May be Housum Red of Pa.
Housome's Choice. BOC. Syn. of Housome											
Houst. R. Syn. Red Houst			l					g	m	e	

Houston. A'87											Not described.
Housum Red. R. Syn. Housum's Red	Pa	rob	m	yrs	ctj	w	sa	vg	d	l	Possibly identical with Housome.
Housum's Red. MagofH'53. Syn. of Housum Red											
Hovey. W		ob		rs			s				
Howard. A'52. [Regarded as very good.]								vg			Not described.
Howard. Hort'56. Syn. of Nickajack											
Howard Aport. R. Syn. Howard's Aport											Do.
Howard's Aport. DelExR'95. Syn. of Howard Aport											
Howard Best. R. Syn. Howard's Best Russian											Do.
Howard's Best Russian. MichB31. Syn. of Howard Best											
Howard's Edgemont. D. Syn. of Edgemont											
Howard Russet. E. Syn. of Cheeseboro											
Howard Sweet. ArkB60	Ark	oble	l	r			s		m	ml	
Howard's Sweet. D. Syn. of Bailey Sweet											
Howberry Pippin. D. Syn. of Hollandbury											
Howe Apple. Cole. Syn. of Winthrop Greening											
Howell. MagofH'53	Mo		l	yrs				g		l	
Hower. D. Syn. of Fall Wine											
Hower. Dap. Syn. of French Pippin											
Howe's Russet. D. Syn. of Roxbury											
Howsley. R. Syn. Howsley's Lady Finger	Kans	obe	ml	yrs	tj	w	sa	vg		m	
Howsley's Lady Finger. MoH'83. Syn. of Howsley											
Howsley Winesap. R. Syn. Howsley's Winesap											Do.
Howsley's Winesap. JWK. Syn. of Howsley Winesap											
Howson. L. Syn. Capt. Howson											Do.
Hoy. R. Syn. Hoy's Seedling	Ill	ob	ml	yb		gy	bpsa	vg	d	ml	
Hoya. L. Syns. Hayasche Gold Reinette, Hoya Golden Reinette, Hoyasche Gold Reinette, Reinette de Hoya.	Ger	ob	m	yrs	jt	y	sa	g		l	
Hoya Golden Reinette. Dap. Syn. of Hoya											
Hoyasche Gold Reinette. Dap. Syn. of Hoya											
Hoyle. L. Syn. Hoyle's Nonpareil	South	ob		rs			sa				
Hoyle's Nonpareil. W. Syn. of Hoyle											
Hoy's Seedling. AHortA'71. Syn. of Hoy											
Hoyt. R. Syn. Hoyt Sweet											Do.
Hoyt Sweet. A'77. Syn. of Hoyt											
Hubbard. D		roble	l	y	tj	y	psa	g		m	
Hubbard. Hort'58. Syn. of Nickajack											
Hubbard Pearmain. L. Syns. Golden Vining, Hubbard's Pearmain, Hubbard's Russet Pearmain.	Eng	rc	s	yru	f	y	rs	g	d	l	From Lindley.
Hubbard's Pearmain. GenF'33. Syn. of Hubbard Pearmain											
Hubbard's Russet Pearmain. D. Syn. of Hubbard Pearmain											
Hubbard Sugar. L. Syn. Hubbard's Sugar	N.C	ob	m	gyrs	jf		rsa?			m	
Hubbard's Sugar. D. Syn. of Hubbard Sugar											
Hubbardson. Wg. Syn. of Hubbardston											
Hubbardson Nonsuch. Wg. Syn. of Hubbardston											
Hubbardston. W. Syns. Farmer's Profit, Hubbardson, Hubbardson Nonsuch, Hubbardston Nonesuch, Hubbardston Nonsuch, John May, Nonsuch (Hubbardston), Old Town Pippin, Red Winter Nonsuch, Sutton.	Mass	robl	l	yrs	jt	y	sa	vg	dk	ml	
Hubbardston Nonesuch. F. Syn. of Hubbardston											
Hubbardston Nonsuch. GenF'38. Syn. of Hubbardston											
Hubbardston Nonsuch. E. Syn. of Sutton											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks
Hubbardston Nonsuch (erroneously). Dap. Syn. of McAfee											
Hubbardston Pippin. D	N. H.?	rc	l-vl	yrs	tcj	y	psa	vg		l	
Hubbell (erroneously). IllH'70. Syn. of Baltimore											
Hudson Red Streak. Hort'75. Syn. of Long Red											
Huff. R. Syn. Huff's Seedling											Not described.
Huff's Seedling. WVaB75. Syn. of Huff											
Huguenot. BBL											Do.
Hughes. W. Syns. Hughes Apple, Hughe's Blush	Pa	r	l	gyb	ftj		msa	vg-b	d	vl	
Hughes American. R. Syn. Hughes' American Golden Pippin	Am	r	l	y			sa	vg		l	
Hughes American Golden Pippin. W. Syn. of Franklin Golden											
Hughes' American Golden Pippin. W. Syn. of Hughes American											
Hughes Apple. A'56. Syn. of Hughes											
Hughe's Blush. K. Syn. of Hughes											
Hughes Golden. L. Syns. Hughes' Golden Pippin, Hughes' New Golden Pippin.	Eng	rob	ms	yru	f	yw	rb		d	ml	From Ronalds.
Hughes' Golden Pippin. Syn. of Hughes Golden											
Hughes' New Golden Pippin. GenF'33. Syn. of Hughes Golden											
Hughe's Virginia Crab. DomEnc. Syn. of Hewes											
Hugo. L. Syn. Victor Hugo											Not described.
Hull Blossom. W		rc	m	pyrs	tj	w	ps	g	dk	m	
Hulls. Hort'72	Wis.?										Do.
Hull Sweet. D		rob	m	rs	tj	w	ps	g-vg		m	
Hulse. R. Syn. Hulse's Sweet		ob	s	y			s	g			
Hulse's Sweet. IllB45. Syn. of Hulse											
Hultenstein. Hort'72											Do.
Humboldt. JNCo	Iowa		m				sa	vg		l	One of Thompson's seedlings.
Humiston. Dap	Conn	robe	m	ygrs	tmj	w	sa	g	k	l	
Humphrey. M	N. Y		l	rs				vg		l	A seedling of Northern Spy.
Humphrey Red. R. Syn. Humphrey's Red											Not described
Humphrey's Red. IndF'40. Syn. of Humphrey Red											
Hundred. L. Syn. Old Hundred	Mass.?	robe	m	yrs	ctj	w	sa	g		ml	
Hungarian. (LC)											Do.
Hunge. A'58. Syn. Hunger	N. C.?	r	l	gb			sa	g	k	m	
Hunger. D. Syn. of Hunge											
Hunt. W	Ind	rob	m	rs	fj	y	sa	vg	dm	ml	
Hunt. GBB. Syn. of Striped Sweet Pippin. [S. S. P. is given by G. B. Brackett in Cat. as Hunt of Warder.]											
Hunt's Connecticut. D. Syn. of Connecticut Hunt											
Hunt's Deux Ans. D. Syn. of Deux Ans											

Hunt Duke. L. Syns. Hunt's Duke of Gloucester, Hunt's Nonpareil (?)	Eng.?	r	ms	gru	cj	w	sa			ml	From Hogg and Lindley.
Hunter. E	Pa	r	ml	rs			sa	vg		m	
Hunterdon. MichB31											Not described
Hunter Pippin. Dap. Syn. Hunter's Pippin	N. Y	re	m	wy	tj	w	bsa			me	
Hunter's Pippin. MassH'70. Syn. of Hunter Pippin											
Hunter Sweet. L. Syn. Hunter's Sweet	Ohio										Do.
Hunter's Sweet. W. Syn. of Hunter Sweet											
Hunt's Fine Green Pippin. D. Syn. of Green Newtown											
Hunt's Green Newtown Pippin. D. Syn. of Green Newtown											
Hunthouse. D	Eng	robe	m	ybe	fe	w	a			ml	From Hogg.
Hunt's Nonpareil(?). D. Syn. of Hunt Duke											
Hunt's Nonpareil. GenF'33. Syn. of Nonpareil											
Hunt Pearmain. R. Syn. Hunt's Pearmain											Not described
Hunt's Pearmain. MagofH'51. Syn. of Hunt Pearmain											
Hunt Russet. NEF'53. Syns. American Golden Russet of N. E., American Golden Russet (of some incorrectly), Bullock's Pippin or Sheepnose (incorrectly), Fay's Russet, Golden Russet, Golden Russet (not of N. Y.), Golden Russet of Mass., Golden Russet of N. E., Hunt's Russet, Mass. Golden Russet, New Eng. Golden Russet, New England Russet, Russet Pearmain.	Mass	robe	ms	yru	tj	yw	rsa	vg-b	d	vl	
Hunt's Duke of Gloucester. D. Syn. of Hunt Duke											
Hunt's Russet. Cole. Syn. of Bullock											
Hunt's Russet. W. Syn. of Hunt Russet											
Huntsman. L. Syn. Huntsman's Favorite	Mo	obe	l	pyb	etj	y	sa	vg		l	
Huntsman's Favorite. Hort'67. Syn. of Huntsman											
Huntsman Russet. W		c		ru			sa				
Hunt Winter. R. Syn. Hunt's Winter Pearmain	Ohio?		m	r				g			
Hunt's Winter Pearmain. MagofH'44. Syn. of Hunt Winter											
Hurlbut. NEF'48. Syns. Hurlbut Stripe, Hurlbutt	Conn	obe	m	yrs	etjm	w	sa	g-vg	d	m	
Hurlbut Stripe. D. Syn. of Hurlbut											
Hurlbut Sweet(?). D. Syn. of English Sweet											
Hurlbutt. W. Syn. of Hurlbut											
Hurne. P'95	Ark	r	m	ywrse	fcj	y	sa	vg		m	
Huse. R. Syn. Huse Seedling											Do.
Huse Seedling. MagofH'39. Syn. of Huse											
Hutcheson. D. Syn. Hutchison	Ky	rc	m	yr	fmj	w	msa	g-vg		vl	
Hutchins. SDB76	Minn		l	rs						m	A seedling of Oldenburg. Origin, Lake City, Minn.
Hutching's Seedling. W. Syn. of Sugarloaf Pippin											
Hutchinson's Pippin. Dap. Syn. of Ben Davis											
Hutchinson Spotted. R. Syn. Hutchinson's Spotted											
Hutchinson's Spotted. GenF'33. Syn. of Hutchinson Spotted											
Hutchins Sweet. IaH'91											
Hutchison. T. Syn. of Hutcheson											
Hutton. L. Syn. Hutton Square	Eng	r	l	yb	c	w	bs	g	k	m	
Hutton Square. D. Syn. of Hutton											
Huzzer. Cat											Not described.
Hyari. R. Syn. Hyari Piros											Do.
Hyari Piros. AlaB98. Syn. of Hyari											
Hyatt. L. Syn. Hyatt's Wonderful, Hyatt's Seedling	South	ob		y			sa				
Hyatt's Seedling. GenF'45. Syn. of Hyatt											
Hyatt's Wonderful. W. Syn. of Hyatt											
Hybrid Russet. MinnExR'90											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Hybrid Seedling. WisB45											Not described.
Hyde. Dap. Syn. of Columbia											
Hyde Keeper. (LC). Syn. Hyde's Keeper											Do.
Hyde's Keeper. Cat. Syn. of Hyde Keeper											
Hyde King. (LC). Syns. Hyde's King, Hyde's King of the West			vl	yg				g		vl	
Hyde's King. MJG. Syn. of Hyde King											
Hyde's King. AmGar'01. Syn. of Wealthy. [S. A. Beach in American Gardening.]											
Hyde's King of the West. IllH'96. Syn. of Hyde King											
Hyde's Sweet. D. Syn. of Wood Sweet											
Hyder. TennBX-I	Tenn	obc	l	r	ct	y	sa	vg		m	
Hyder Sweet. P'95	Tenn	rc	ml	ywrsc	fcj	y	s	vg		m	May be distinct from Hyder.
Hyblll. SBro											Not described.
Hygine. ColB17											Do.
Hyler. R. Syn. Hyler's Eureka											Do.
Hyler's Eureka. SCExR'98. Syn. of Hyler											
Ice Cream. W	Ky	ob	ml	y			sa	g		m	
Ice Cream (Alex.). L. Syn. Alexander's Ice Cream	{Ill.? / N. C.?}		m	yrs				vg		ve	
Ida. P'94	Wis	rc	m	yrs	fcj	y	sa	vg	d	l	
Ideal. BBL											Do.
Idura. P'95. Syn. Hall's No. 5	Ill	rc	m	yws	ftj	y	s	g-vg		m	
Ildrod. R. Syn. Ildrod Pigeon											Do.
Ildrod Pigeon. BBL. Syn. of Ildrod											
Illinois Beauty. IllH'80											Do.
Illinois Greening. W	Ill	roblc	ml	yg		y	sa	vg	dm	l	Doubtless same as Curtis Greening.
Illinois Imperial. MoH'86	Ill		ml	yrs	f	w	bsa	vg		e	
Illinois Imperial. NYExR'94. Syn. of Everbearing											
Illinois Pippin. W	Ill	r	ml				sa	g		vl	This is probably the Wythe
Illinois Pippin. Dap. Syn. of Wythe											
Illinois Pumpkin Sweet. W. Syn. of Illinois Sweet											
Illinois Red. IllB45			m					g		m	
Illinois Sweet. L. Syns. Lane's Sweet, Ill. Pumpkin Sweet	Ill	oblc	ml	rs			s	vg	dk	vl	
Imperative. ColExR'88			m							m	
Imperator. MHSC'86. Syns. Imperatorskoe, Shro. to Ia. No. 153	Rus										Not described.
Imperatorskoe. Gb. Syn. of Imperator											
Imperial (Iowa). Cat	Iowa										Do.
Imperial (Rus.). Gb. Syn. Gov. list No. 295	Rus										Do.
Imperial (France). D. Syns. Magnifique, Maltranche	Fr	obc	m	yrs	ctj	w	rsa	g		m	

Imperial Citron. Gb. Syns. Gov. list No. 393, Tsitrownoe Tsarskoe, Zitsonnoe Zarskoe.	Rus										Do.
Imperial Gestreister. BBL											Do.
Imperial Magnifique. IllB45			l	rs				vg		l	
Imperial Pearmain. IllB45											Do.
Imperial Purple. MichB31											Do.
Imperial Rambo. A'77	Pa	ob	m	wyrs	vtjm	w	sa	vg		ml	
Imperial Russet. W. Syn. of Spice Russet											
Imperial Vandervere. E. Syn. of Vandervere											
Imperial Vandevere. A'52	Pa										From Pa. Pom. Report.
Imperial Vandevere. D. Syn. of Vandervere Pippin											
Imperial White. Dap. Syn. of Parry White											
Improved Ashmead. BBL											Not described.
Improved Ben Davis. IllH'99. [Probably a sport of B. D.]											Do.
Improved Bess Pool. BBL											Do.
Improved Hoope. Cat											Do.
Improved Janet. Cat											Do.
Improved Red Spitzenburgh. Dap. Syn. of Blue											
Improved Shannon. IllH'97											Do.
Improved Winesap. BBL											Do.
Indeed Good. D. Syn. of Gewiss											
Indian. A&H	Ind	robl	l	yrs		y	sa	vg	dm	l	
Indian. Dap. Syn. of McAfee											
Indiana. MichB177		rob		rurs			sa			l	
Indiana Beauty. W	Ind	robl	l	rs	j	y	sa	g		m	
Indiana Favorite. RNY'61	Ind	rob	ml	rs	tj	w	msa	g-vg	dm	l	
Indiana Jannetting. D. Syn. of Ralls											
Indian Apple. E. Syn. of Gray Vandervere											
Indiana Vandevere. D. Syn. of Vandervere Pippin											
Indiana Winter. IllB45											Do.
Indian Coin. MassB41											Do.
Indian Prince. MagofH'41		r	m	r	fj	y	psa	g		m	
Indian Queen. E. Syn. of Early Pennock											
Indian Rareripe. PFar'48											Do.
Indian Winter. W	South	c		y			sa			vl	
Ingraham. A'69. Syn. of Ingram											
Ingraham Winter. R. Syn. Ingraham's Winter	N. C	rc	m	yr	fj	w		vg		ml	
Ingraham's Winter. Hort'69. Syn. of Ingraham Winter											
Ingram. AHortA'69. Syns. Ingraham, Ingram's Seedling	Mo	rob	ms	yrs	mje	yw	msa	vg		vl	A seedling of Ralls.
Ingram's Seedling. Hort'68. Syn. of Ingram											
Inkerman. R. Syn. Inkerman Greening											Not described.
Inkerman Greening. CanExR'01. Syn. of Inkerman											
Inman. E. Syn of Ortley											
Innes. W		ob	rs				sa				
Iola. W. Syn. of Buckingham											
Iola. W. Syn. of Equinetelee. [Perhaps same as Buckingham.]											
Iola. W. Syn of Equinetely. [Perhaps same as Buckingham.]											
Iowa. Dap. Syn. of De Long											
Iowa. Hort'70. Syn. Iowa Russet	Iowa	rob	m	yru	ftmj	y	sa	g-vg		l	
Iowa Beauty. JVC		rob	l	wrs			msa	vg		me	Originated with G. C. Patten, Charles City, Iowa.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Iowa Blush. A'75	Iowa? Ohio?	rc	l	rs			sa	g	k	ml	
Iowa Flat. WRH											Not described.
Iowa Keeper. (LC)	Iowa	rob	ml	y						vl	
Iowa Russet. Dap. Syn. of Iowa											
Iowa Seedling. BBL											Do.
Ipswich. MagofH'35	Mass.?		l	yrs	tj		r	vg		l	
Irish Apple. C. Syn. of Irish Reinette											
Irish Codlin. GenF'33. Syn. of Manks											
Irish Peach. W. Syns. Early Crofton, Irish Peach Apple, Peach, Peach Apple.	Eur	rob	m	ygb	tj	w	sa			me	
Irish Peach Apple. GenF'33. Syn. of Irish Peach											
Irish Peach of N. Z. BBL. [Probably not distinct.]											Do.
Irish Pippin. Dap. A'95	Pa	robc	ml	wrs	tj	w	sa	vg		m	
Irish Pitcher. GenF'33. Syn. of Manks											
Irish Reinette. D. Syn. Irish Apple	Eng	rob	m	gbru	cj	yw	ba	g	k	ml	
Irish Russet. GenF'33. Syn. of Young											
Iron. (South.) W	South	r		y			sa				
Iron. (Nova Scotia.) R. Syn. Iron Apple	N.S.?	ob	l	gyb	fj	yw	sa	g-vg		l	
Iron Apple. E. Syn. of Brabant											
Iron Apple. A'77. Syn. of Iron (Nova Scotia)											
Ironclad. A'77	Pa	rob	m	gywrc	fj	gy	sa	g-vg	d	vl	
Iron Mountain. W	Mo	r	ml	y			sa	g		l	
Iron Pippin. W	Ky	r	ml	rs			sa	g		l	
Ironstone. H. Syn. Eastern Pippin		r	ml	y				g	k	vl	
Ironstone Pippin. E. Syn. of Easter											
Irwin Beauty. BBL											Do.
Irwin Red. R. Syn. Irwin's Red											Do.
Irwin's Red. MagofH'53. Syn. of Irwin Red											
Isaac. F											Do.
Isham. (LC). Syn. Isham Sweet	Wis	robl	l	r			s	g	km	ml	
Isham Sweet. IllH'83. Syn. of Isham											
Isherwood. JVC. Syn. Ishewood	Iowa		l	gy			msa	g		l	Ishewood may be correct.
Ishewood. CLW. Syn. of Isherwood											
Ishmaelite. A'97	Mo	obc	ml	gyb				g		l	
Island. L. Syns. Chicago (?), Island Beauty		r	l	pyb	tj	w	bsa	g		m	
Island Beauty. D. Syn. of Island											
Islem. IllH'70											Not described.
Isle of Wight. L. Syns. Isle of Wight Orange, Isle of Wight Pippin, Orange Pippin, Pomme d'Orange.	Eng.?	r	s	dyb	fj		ra	g	d	ml	From Ronalds

Isle of Wight Orange. GenF'33. Syn. of Isle of Wight											
Isle of Wight Orange. K. Syn. of Orange Pippin (France)											
Isle of Wight Pippin. GenF'33. Syn. of Isle of Wight											
Isleworth. L. Syns. Brentford Crab, Isleworth Crab		rc	m	yb	ej	w	sa	p		m	
Isleworth Crab. D. Syn. of Isleworth											
Isom. W		ob		y			sa				
Italian. L. Italian Rose, Weisse Italianische Rosmarinapfel	Italy	roble	m	yrs	tj	w	sa		d	ml	From Diel.
Italian Rose. D. Syn. of Italian											
Iva. BBL											Not described.
Ivanhoe. FDNCo	Va		m	yb						l	
Ivins. R. Syn. Ivins' Pippin											
Ivins' Pippin. IaH'03. Syn. of Ivins											
Ivory. Gb. Syns. Simmnibiel, VRS to Ia. No.7	Rus										Do.
I. X. L. BBL											Do.
Ize. R. Syn. Ize Sweet											Do.
Ize Sweet. BBL. Syn. of Ize											
Izzard. D. Syn. of Mason Stranger											
Jabe. D	Mass	ob	s	pyb	ftj	yw	sa			m	
Jabez. W. Syn. Jabez Sweet	Conn	rc	m	y	tj	w	rs	g-vg		ml	
Jabez Sweet. MagofH'43. Syn. of Jabez											
Jack. H. Syn. Early Jack				g	vj		msa			e	
Jack Apple. D. Syn. of Oskaloosa											
Jackman. L. Syn. Jackman's Sweet	Pa	r		y			s			ml	
Jackman's Sweet. W. Syn. of Jackman											
Jack Murphy. E. Syn. of Murphy											
Jackson (Ga?Va?). W	{Ga. ? Va. ?}	ob		y			sa				
Jackson (Pa.). A'56. Syns. Jackson Seedling, Rittner	Pa	rob	m	gyrs	ftj	g	sa	g-vg		ml	
Jackson (Del.). A'91	Del		ml	r				vg	dm	vl	May be same as preceding.
Jackson. IllB45. Syn. of Amos											
Jackson Apple. D. Syn. of Chenango											
Jackson Apple. D. Syn. of Congress											
Jackson Beauty. R. Syn. Jackson's Beauty			l					vg	dm	l	
Jackson's Beauty. TCF. Syn. of Jackson Beauty											
Jacksonian. Hort'54	Ohio	r		rs			sa			l	
Jackson Red. A'60. Syn. of Buckingham											
Jackson Red. Hort'56. Syn. of Nickajack											
Jackson's Red. D. Syn. of Buncombe											
Jackson's Roman Stem. Dap. Syn. of Clermont											
Jackson Seedling. R. Syn. Jackson's Seedling	Ga	ob	m	yr	tj	w				ml	From seed of Limbertwig.
Jackson Seedling. Hort'56. Syn. of Jackson											
Jackson's Seedling. A'81. Syn. of Jackson Seedling											
Jackson Winesap. IndH'72. Syn. of Smith											
Jacob. HSR&S. Syn. Jacob Apple		robl	ml	yrs	fj		sa			ml	
Jacob. (LC). Syn. of Jacobs Sweet											
Jacob Apple. IllB45. Syn. of Jacob											
Jacobs Favorite. R. Syn. Jacobs' Favorite of Ohio											Not described.
Jacobs' Favorite of Ohio. MichB31. Syn. of Jacobs Favorite											
Jacobs Sweet. MassH'80. Syns. Jacob, Jacob's Sweet, Jacobs Winter Sweet	Mass	rob	l	yr			s	vg	dm	l	
Jacob's Sweet. A'85. Syn. of Jacobs Sweet											
Jacobs Winter Sweet. NYB15. Syn. of Jacobs Sweet											
Jacques. L. Syn. Jacques Lebel	Eng	rob	l	pyb	t	w	msa	vg		ml	From Album de Pomologie.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Jacques Lebel. D. Syn. of Jacques											
Jagd. MagofH'53. Syn. of Yacht											
James. H. Syn. of Buchanan											
James Coal. IllB45		r	m	rs			s			m	
James River. IllB45. [Probably Limbertwig or Willow]				prs			msa			l	
James River. MagofH'53. Syn. of Limbertwig											
James River. D. Syn. of Willow											
James Sweet. MontB12											Not described.
Jane. Hort'56	Pa	r	m	yb	cj	y	msa	g		l	
Janet (of Muir). IllB45. Syn. of Wright Janet											
Janeton. MoH'70. Syn. of Ralls											
Janet Seedling. L. Syn. Seedling Janet	Ind	c	ml	rs			sa	g		l	
Janette. T. Syn. of Ralls											
Janetting. W. Syn. of Ralls											
Jansen. R. Syn. Jansen's Seedling											
Jansen's Seedling. MinnHort'97. Syn. of Jansen											
Januarea. GenF'33. Syn. of Canada Reinette											
January. MichB31			m	r			s	g		l	May be Canada Reinette.
Jarmine Ballard. IllB45		ob	m	gyrs			msa	g			
Jarminite. W. Syn. Germanite	Ohio	rob	ml	grs	f		bmsa			l	
Jeannette. L. Syns. Dame Jeannette, Joannetten's Reinette	Fr	rc	ms	yb		wy	msa			ml	From The Verger.
Jeartts. R. Syn. Jeartts Fine Red											Not described.
Jeartts Fine Red. OreB22. Syn. of Jeartts											
Jeff Davis. S&W											Do.
Jefferis. E. Syns. Everbearing, Illinois Imperial, Grantham, Jeffries	Pa	obc	m	yrcs	tj	w	rmsa	vg-b	dm	me	
Jefferis Everbearing. Cat. [Probably same as Jefferis.]											Do.
Jeffers. (LC)											Do.
Jefferson. E	Ky	rc	ml	rs			sa	vg		vl	
Jefferson County. Hort'55	N. Y.	robc	m	yr	jt	wy	psa	g-vg	d	m	
Jefferson Pippin. D. Syn. of Ralls											
Jeffery's No. 1. JVC. Syn. of Hamilton Blush											
Jeffery's No. 2. JVC											
Jeffery's No. 3. JVC											
Jeffery's No. 4. JVC. Syn. of Lemon Pippin (Wis.)											
Jeffries. H. Syn. of Jefferis											
Jellyflower. Dap. Syn. of Scollop Gilliflower											
Jeltoe biel (Fischer). Gb											
Jeltoe biel (Rgl.). Gb											
Jeltoe Sladkoe. Gb. Syn. of Yellow Sweet											
Jeltui arkad. Gb. Syn. of Yellow Arcad											

Jeltui Naliv. Gb. Syn. of Yellow Naliv											
Jeniton. B. Syn. of Ralls											
Jenkins. Hort'53	Pa	ro	s	yr	tj	w	ps	g		l	
Jenkins' Summer Pippin. Dap. Syn. of Primate											
Jenks. MagofH'37											Do.
Jennett. E. Syn. of Ralls											
Jennetting. C. Syn. of White Juneating											
Jenney. (LC)	Wis.	obl	l	wrs			msa		dm	l	
Jennings. GLT. Syn. Jennings' Florida	Fla. ?	ob	l	g		w	sa	g	dk	e	
Jennings. Hort'75. Syn. of Porter											
Jennings' Florida. GLT. Syn. of Jennings											
Jennings Sweet. R. Syn. Jennings' Sweet	Ohio	rob	l	yrs		w	s	g	k	m	
Jennings' Sweet. K. Syn. of Jennings Sweet											
Jenny Lind. Cat											Do.
Jenny Seedling. D. Syn. of Hall											
Jenny's Seedling. T. Syn. of Hall											
Jerico. MagofH'41											Do.
Jersey Beauty. SDB76		rob	l	gyrs		vy	psa	g		me	
Jersey Black. W. Syn. Black Apple of Coxe	N. J. ?	r	m	drpu	fj	y	rsa	g	dkm	ml	Probably same as Black.
Jersey Black. E. Syn. of Black											
Jersey Greening. W	N. J	r	l	g			sa	g		l	
Jersey Greening. DomEnc. Syn. of Ortley											
Jersey Greening. C. Syn. of Rhode Island											
Jersey King. W	Ohio	c	ml	rs			sa	g		l	
Jersey Pearmain. Hort'75. Syn. of Autumn Pearmain											
Jersey Pippin. E	Eur.	roble	m	ygrs	j	gy	sa	g		ml	
Jersey Redstreak (of Springer). H								p			Not described.
Jersey Sweet. Wg. Syns. American, Jersey Sweeting, July Branch	N. J. ?	roc	m	gyrs	fjt	w	s	g-vg	dk	me	
Jersey Sweeting. GenF'36. Syn. of Jersey Sweet											
Jerusalem. TJG&S											Do.
Jerusalem. K. Syn. of Pigeon											
Jesse. P'95	Ga	rob	ms	y	f	y	msa	g-vg		ml	
Jessup. R. Syn. Jessup Seedling											Do.
Jessup Seedling. IndH'66. Syn. of Jessup											
Jewett. R. Syns. Jewett's Best, Jewett's Striped	Vt	rob	l	ygr	j	yw	psa	vg		ml	
Jewett Red. NEF'49. Syns. Jewett's Fine Red, Jewett's Red, Nodhead	N.	rob	m	gwrse	tj		pmsa	g-vg		ml	
Jewett's Best. D. Syn. of Jewett											
Jewett's Fine Red. MagofH'42. Syn. of Jewett Red											
Jewett's Red. Cole. Syn. of Jewett Red											
Jewett's Striped. Hort'75. Syn of Jewett											
J. F. Winter. Cat	Mo										Do.
Jholns. MagofH'43											Do.
Jiles. A'77. [Probably same as Giles.]	Va.		m							l	
Joannetten's Reinette. D. Syn. of Jeannette											
Joannetting. D. Syn. of White Juneating											
Job. R. Syn. Deacon Job											Do.
Joe Allen. D. Syn. of Ben Davis											
Joe Berry. H. Syn. of Flushing (?)											
Joe Berry. E. Syn. of Newtown Spitzenburg											
Jo Daviess. R. Syn. Joe Davis											Do.
Joe Davis. IndH'63. Syn. of Jo Daviess											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Joel. MagofH'53	Pa	ob	ms	gyb		gy		g			
John. L. Syn. John's Sweet	N. H	rc	m	wyrs	jt		s	g		vl	
John Apple. DomEnc. Syn. of Deux Annee											
John Apple. GenF'33. Syn. of Cowarne Queen											
Johnan. R. Syn. Johnan Sweeting											Not described.
Johnan Sweeting. Hort'48. Syn. of Johnan											
John Carter. D	Conn. ?	rc	l	yrc	tj	w	sa	g		m	
John Garretson's Early. E. Syn. of Garrettson											
John Garretson's Early Apple. MagofH'44. Syn. of Garrettson											
John Hunt. A'60											Do.
John May. D. Syn. of Hubbardston											
John Richardson. MHSC'79	Eng	robl	l-vl	gyrs	tj	y	sa	g	dk	m	
John's Early Winter. MichB31. Syn. of John Winter											
John Snepps'. W. Syn. of Snepp											
Johnson (Conn.). D	Conn	rc	ml	yrs	tcj		s	g		mc	
Johnson (Ill.). D	Ill	ob	ml	pyrc	fmj	y	sa	vg		l	
Johnson (Wis.). CH	Wis		m	rs						l	
Johnson. D. Syn. of Redstreak											
Johnson County. R. Syn. Johnson County Red. [May be J. of Ill.]											Do.
Johnson County Red. IllH'88. Syn. of Johnson County											
Johnson Favorite. BBL											Do.
Johnson's Favorite. D. Syn. of Mangum											
Johnson's Fine Winter. MagofH'53. Syn. of York Imperial											
Johnson Green. IndH'87	Ind. ?									vl	
Johnson Keeper. R. Syn. Johnson's Keeper											Do.
Johnson's Keeper. IllH'87. Syn. of Johnson Keeper											
Johnson of Ill. BBL. [May be J. Ill.]											Do.
Johnson Red. R. Syns. Brazil Crab, Johnson's Red			s		vj			vg	dc	l	
Johnson's Red. JVL. Syn. of Johnson Red											
Johnson Red Winter. R. Syn. Johnson's Red Winter	Miss. ?	r	ms	gr				vg		m	
Johnson's Red Winter. A'85. Syn. of Johnson Red Winter											
Johnson Russet. D		oblrc	m	yru	t	w		p		ml	
Johnson Seedling. R. Syn. Johnson's Seedling			l	yru	c			g		m	
Johnson's Seedling. IllH'00. Syn. of Johnson Seedling											
Johnson Sweet. L. Syn. Johnson's Sweet	Ohio	obl	ml	y			s	g		l	
Johnson's Sweet. H. Syn. of Johnson Sweet											
John's Sweet. W. Syn. of John											
John Winter. R. Syn. John's Early Winter											Do.
Jolly. L. Syn. Jolly Beggar	Eng	r	ml	y			s		k	me	
Jolly Beggar. D. Syn. of Jolly											

Jonathan. NEF'28. Syns. King Philip, New Spitzenburgh, Philip Rick, Wine (erroneously), Winesap (erroneously).	N. Y	roble	m	yrsb	vjt	ws	msa	vg-b	dkm	l	
Jonathan (of Buler). IllB45. Syn. of Buler											
Jonathan of the North. InB31. Syn. of Anisim											
Jonathan Seedling. IllH'01											Do.
Joncret. L. Syn. Tardine de Joncret	Belg	re	ml	gyb	t	w	msa			me	From Annals of Pomology
Jones. L. Syn. Lewis Jones' Seedling	Ind	ob	l	rs			sa	g		l	
Jones. IndH'80. Syn. Jones Apple	N. C	rob	l	yrs	tfj	y	msa	g	dkm	l	
Jones. Dap. Syn. of Southern Porter											
Jones Apple. IndH'80. Syn. of Jones											
Jones Cider. JVL	N. C								c		Not described.
Jones' Early Harvest. Dap. Syn. of Red June											
Jones Favorite. L. Syn. Jones' Favorite	Tex	obl	ml	g				g		e	
Jones' Favorite. A'81. Syn. of Jones Favorite											
Jones's Green. R. Syn. Jones' Green Winter											Do.
Jones's Green Winter. MagofH'53. Syn. of Jones Green											
Jones's Pippin. Cole. Syn. of Fall Orange											
Jones's Seedling. JVL	Tenn	re	ml	yrs			ma	g		l	
Jones's Seedling. P'95. Syn. of Allison											
Jones's Seedling of N. Z. BBL											Do.
Jordon. CanExR'95	Ont	robl	m	gy	fj	gy	bmsa	g		vl	
Jordon Seedling. IllH'02. Syn. Jordon's Seedling			m	r				vg		ml	
Jordon's Seedling. IllH'89. Syn. of Jordon Seedling											
Jose Moore's Sweeting. NEF'29. Syn. of Moore Sweet											Do.
Joseph. R. Syn. Joseph Sweeting											
Josephine. AmGar'85	Mich			wy			s	g		l	
Josephine. A'77. Syn. of Gloria Mundi											
Joseph Sweeting. MagofH'37. Syn. of Joseph											
Josey. R. Syn. Josey Green	Ind			y						vl	
Josey Green. IndH'75. Syn. of Josey											
Josie Moore. JTL. Syn. of Moore Sweet											
Journalaskia. D. Syn. of Junaluskee											
Jubilee. L. Syn. Jubilee Pippin	Eng	r	m	y	e	w	msa			m	From Lindley.
Jubilee Pippin. D. Syn. of Jubilee											
Judge Andrews. D. Syn. of Andrews											
Judson. JNCo. Syns. Thompson 29, Thompson's Seedling No. 29	Iowa?	re	l	grs		w	sa	p	km	ml	One of Thompson's seedlings?
Juicy Bite. D	Pa	re	m	pyrs	et	w	sa	g		m	
Juicy Bite. E. Syn. of Better than Good											
Juicy Burr Apple. Gb. Syn. of Lapouchoe Naliv											
Juicy Krimtarter. Gb. Syn. of Crimean Naliv											
Juicy Red. MHSC'86	Rus	obe	m	yrs		w	sa		d	e	
Juicy Ribbed. MHSC'86. Syns. Rubets rebristui nalivnoi, Shro. to Ia. No. 96.	Rus										Not described.
Juicy Streaked. Gb. Syn. of Streaked Naliv											
Juicy Stripe. MHSC'86	Rus	obe	m	rs	tj		sa		d	me	
Juicy Transparent. SDB65											Do.
Juicy White. Gb. Syn. of White Naliv											
Juicy Yellow. MHSC'86	Rus	obe	ml	y	j	w	a		dk	e	
Julian. Hort'58. Syns. Julien, Julienne, Julin, Juling, Thurmond	N. C.? Va.?	re	ml	wrs	tj	yw	psa	g-vg		e	
Julian Summerour. F. [Probably Nickajack.]	Ga										Do.

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Julien. MagofH'57. Syn. of Julian											
Julienne. IllH'72. Syn. of Julian											
Julin. T. Syn. of Julian											
Juling. MagofH'57. Syn. of Julian											
July. RNY'61. Syns. August Apple, Fourth of July, McAdow's June, Siberian August, Stewart's Nonpareil, Tetofsky (erroneously).	Ger	robc	ms	wyrs	j	w	bsa	g	km	e	Closely resembles Tetofski.
July (Ohio). RNY'61	Ohio	c	m	rs			sa	g		vl	
July Apple. Magof'H'50. Syn. of Primate											
July Bough. JMO. Syn. of Bough											
July Bower. BBL											Not described.
July Branch. Dap. Syn. of Jersey Sweet											
July Cluster. JVL	Va		m	wy	j			vg		e	
July Flower. K. Syn. of Cornish Gilliflower											
July Pippin. D. Syn. of Early Harvest											
July Queen. Dap	Ga	rc	m	ygrs	tjm	w	sa	vg		me	
July Sweet. WVaB75											Do.
Jumbo. BBL. [Possibly a Crab.]											Do.
Junaliska. W. Syn. of Junaluskee											
Junaluska. T. Syn. of Junaluskee											
Junaluskee. MagofH'57. Syns. Journalaskia, Junaliska, Junaluska	N. C	rob	ml	yb	mj	y	rsa	g-vg	dk	l	
June. W	Va	c	ml	y			s			e	
June Apple. IllB45. Syn. of Red June											
Juneating. Wg. [Probably same as White Juneating.]		rob	s	y				g		ve	
Juneating (?) H. Syn. of Bracken											
Juneating. DomEnc. Syn. of White Juneating											
Juneating White. H. Syn. of White Juneating											
June Market. BBL											Do.
June of some in Ohio. E. Syn. of Margaret											
June Sweet. L. Syns. Early Red Sweet, June Sweeting, Red June Sweet, Striped Red Harvest, Striped Sweet Harvest.	Pa.?	rob	m	gyrs	tj	w	srp	g		ve	
June Sweeting. D. Syn. of June Sweet											
Juneting. C. Syn. of White Juneating											
Juniata. Dap. Syn. of Washington Strawberry											
Juniting. D. Syn. of White Juneating											
Jussow's Winterapfel. Cb											
Justice. IllH'01											Do.
Justice King. WVaB75											Do.
Kafvelas. MHSC'86	Swed		l	rs				vg	dk	m	

Kaighn. L. Syns. Cane Spitzenburgh, Kaighn's Spitzemberg, Kaighn's Spitzenberg, Kaighn's Spitzenburgh, Kain's Spitzenburg, Lady Finger, Ohio Wine, Red Pearmain, Red Spitzenburgh, Spitzenburg Kaighn's.	N. J.	oble	l	wyrs	cj	y	psa	g	km	ml	
Kaighn's Spitzemberg. C. Syn of Kaighn											
Kaighn's Spitzenberg. Cole. Syn. of Kaighn											
Kaighn's Spitzenburgh. D. Syn. of Kaighn											
Kaighn's Spitzenburg (incorrectly). Dap. Syn of Long Red											
Kain's Spitzenburg. Cat. Syn. of Kaighn											
Kaiser. T. Syn. of Keisèr											
Kaiser Wilhelm. IllH'00. [Doubtless same as Keiser William.]	Ger		l					vg			
Kajabowka. Gb. Syn. of Karabovka											
Kalamas. MHSC'86	Rus		ml	dr		gw					
Kalkidon. Gb. Syns. Khalkidouskoe, Rgl. to Ia. No. 540, Shro. to Ia. No. 94.	Rus										Do.
Kalkidouskoe. MHSC'86	Rus	e	ml	gyr	fj	y	msa	vg		me	
Kalvil jeltui. Gb. Syn. of Yellow Calville											
Kalvil krasnui. Gb. Syn. of Blushed Calville											
Kalvil krasnui lietnui. Gb. Syn. of Red Summer Calville											
Kalvil Niemetskui. Gb. Syn. of German Calville											
Kalvil polosatui. Gb. Syn. of Striped Calville											
Kalvil Ruskui. Gb. Syn. of Russian Calville											
Kalvil weisser sommer. Gb. Syn. of White Summer Calville											
Kalville krasnuiletneg. Gb. Syn. of Red Summer Calville											
Kalville Scholti. Gb. Syn. of Yellow Calville											
Kandle. R. Syn. Kandie Sinap											Do.
Kandie Sinap. IndH'87. Syn. of Kandie											
Kane. E. Syns. Cain, Cane	Del	obe	s	wyre	jc	w	psa	g	d	m	
Kansas Beauty. AmGar'90	Kans	obe	l	yb	tj	y	sa	vg		m	
Kansas Bellflower. AHortA'71	Kans	robe	ml	yrb	tj	y	msa	b		l	An Ortley seedling. Origin, Leavenworth, Kans.
Kansas Greening. NYB90	Kans		ml	gb		y	sa			l	
Kansas Keeper. IllH'69. [Dr. Warder said "K. K." was Stark. See IllH'69, 315.]	Kans.?	robe	ml	gyrs	tcj	y	sa	g		l	Is this Keeper? The descriptions are similar.
Kansas Pippin. A'71											Not described.
Kansas Queen. AHortA'70	Kans	re	m	dr	fj	w	bsa	g		me	
Kansas Spitzenburg. A'77	Kans	re	ml	yrs	f(j	y	msa			l	
Kansas Sweet. Dap	Kans	obe	l	gyrs	fjc	yw	bvs	vg		ml	
Kansas Traveler. DrHS	Kans							vg		l	
Kantz. P'91	Wis	rob	l			yw	sa	vg		m	
Karaboff. Gb. Syn. of Karabovka											
Karabovka. IaH'85. Syns. Gov. list No. 205, Kajabowka, Karaboff, Shro. to Ia. No. 21.	Rus										Do.
Kara Sinap. IndH'87											Do.
Kardinal. Gb. Syn. of Cardinal											
Kardinal Celine (?). IaB3. Syn. of Cellini											
Kartaes (Hun.). BBL											Do.
Karthaus. Cat											Do.
Kasota. Cat											Do.
Kasseler. R. Syn. Grosse Kasseler Reinette											Do.
Kaump. IaH'92. Syn. Harry Kaump	Wis	r	l	y				g	km	l	
Kavelos. SDB76	Swed	obe	vl	ygrs	j	w	psa	g	k	e	Received from horticultural department of Sweden.
Kay. SL&Co											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Kean. R. Syn. Kean's Seedling	Ont.?	ob	ml	grs	cj		sa	g	k	m	
Kean's Seedling. A'99. Syn. of Kean											
Kearosee. Hort'59. [Reported from Lebanon Co., Pa.]											Not described
Keasbey's Favorite. Dap. Syn. of Lambert											
Keaton. R. Syn. Keaton Neverfail											Do.
Keaton Neverfail. IndH'98. Syn. of Keaton											
K's Seedling. TennBI-IX. Syn. of Milburn											
Keckskemet. AlaB98											Do.
Keddleston. L. Syn. Keddleston Pippin	Eng	c	s	pyru	j	y	s		d	ml	From Ronalds.
Keddleston Pippin. D. Syn. of Keddleston											
Keene. L. Syns. Keene's Sweet, Keen's Sweet											Not described.
Keene's Sweet. Cat. Syn. of Keene											
Keen's Sweet. MagofH'44, Syn. of Keene											
Keeper. P'95	Kans	robl	m	gy	fj	y	bmsa	vg		vl	Can this be Kansas Keeper?
Keeping. R. Syn. Keeping Redstreak	Eng	rob	m	yrs	f	gy	bsa		k	ml	From Hogg.
Keeping Redstreak. D. Syn. of Keeping											
Keeping Russet. D	Eng	r	m	pyrb	fj	y	rsa		d	ml	Do.
Keepwell. W	Ohio	r	s	rs			s	g		vl	
Keeskemet. (LC)	Eur.										Not described.
Keespomet. BBL											Do.
Kelcher. P'95. Syn. Pleasant Garden	Tenn	rc	s	gyrs	f	y	msa	g		m	
Keige. R. Syn. Keige's Early Winter											Do.
Keige's Early Winter. A'75. Syn. of Keige											
Keim. Hort'53	Pa	ob	ms	py	tcf	w	bsa	vg		l	
Keiser. MagofH'49. Syns. Kaiser, Red Seeknofurther, Seek-no-further	Ohio	rob	m	pyrs	jm	y	sa	g	dk	ml	
Keiser Fall. R. Syn. Keiser Fall Spice											Do.
Keiser Fall Spice. BBL. Syn. of Keiser Fall											
Keiser William. BBL. [Probably same as Kaiser Wilhelm.]											Do.
Keister. T	Pa	rc	s	rs			sa	vg		m	
Keiv Reinettie. Gb. Syn of Kief Reinette											
Keller. R. Syn. Keller's Seedling	Ohio		s	dr				g		vl	
Keller's Seedling. MagofH'46. Syn. of Keller											
Kelley's Sweet. T. Syn. of Moore Sweet											
Kelley White. E. Syn. of Belmont											
Kellogg. R. Syn. Kellogg Russet. [Resembles Golden Russet (N. Y.).]				ru							Do.
Kellogg Russet. A'85. Syn. of Kellogg											
Kelsey. A'56	Pa	robc	m	gyb	ft	gw	sa	g		l	
Kelsey. D. Syn. of Hollow Crown											
Kelsey Sweet. D	Conn	r	m	gyb	tj	gw	s	g		m	
Kelter. W. Syn. Boas	Pa	ob		y			sa				

Keller. Hort'53. Syn. of Bons											
Kemp. R. Syn. Kemp Favorite											Do.
Kemp Favorite. BBL. Syn. of Kemp											
Kempster's Pippin. D. Syn. of Blenheim											
Keney's Sweet. D. Syn. of Hartford											
Kennard's Choice. MoH'88. Syn. of Kinnard											
Kennebee. L. Syn. Kennebee Russet	Me	re	m	yru	tj		bsa	g		m	
Kennebee Russet. D. Syn. of Kennebee											
Kennebee Seedling. Dap. Syn. of Winthrop Greening											
Kennebee Sweeting. A'81											Do.
Kennedy. W	Ga	r	l	rs			sa	g		m	
Kennedy Red. L. Syn. Kennedy's Red Winter	Pa	re	l	yrs	mjc	w	sa	g		ml	
Kennedy's Red Winter. D. Syn. of Kennedy Red											
Kenney. D	Conn	rob	ms	gyrs	tj	w	sa	g		l	
Kenozi. WashB26											Do.
Kenrick. Syns. Kenrick's Autumn, Kenrick's Red Autumn	Mass	r	l	pygrs	tj	ws	sa	g		m	
Kenrick's Autumn. Lin. Syn. of Kenrick											
Kenrick's Red Autumn. D. Syn. of Kenrick											
Kent. D	Mich	r	l	pgyb	tj	w	sa	g-vg	dm	m	
Kent Beauty. L. Syns. Beauty of Kent, Kentish Pippin	Eng	robe	vl	gyrps	jct		sa	g	km	m	
Kent Flower. L. Syn. Flower of Kent	Eng	re	l	yrs	j	gy	sa	g	k	ml	
Kentish Broading. D. Syn. of Broadend											
Kentish Broading. D. Syn. of Broading											
Kentish Codlin. CanExR'01		oble	l	gy	emj	w	a			me	
Kentish Fillbasket. Lin. Syn. of Fillbasket											
Kentish Pippin. DomEnc	Eng	rob	m	gyb	ctj	yw	rsa	g	k	vl	
Kentish Pippin. GenF'33. Syn. of Kent Beauty											
Kent Island. R. Syn. Kent Island Pine			l	gyb	j	w	sa	g			
Kent Island Pine. AP. Syn. of Kent Island											
Kent Pippin. IndH'72. [May be same as Kent Beauty.]											Do.
Kentuck. R. Syn. Choice Kentuck		obl	l	yrs		y	sa			l	Wm. Hy. Smith gives this as a syn. of Smith.
Kentucky. D. Syn. Summer Pippin	Ky.?	re	l	yrs	jt		sa	g		m	Grown and recommended by T. McWhorter of Ill.
Kentucky Bellflower. Dap. Syn. of Long Red											
Kentucky Choice. Cat. [Probably same as Kentuck.]	Ky.?										Not described.
Kentucky Cream. RNY'61	Ky	robl	ml	yrb	j	y	brsa	g-vg		l	
Kentucky Cream. IllB21. Syn. of Ned											
Kentucky Gilliflower. Dap. Syn. of Long Red											
Kentucky King. W	Ky	ob	ml	yrsc	fj	y	bsa	g-vg	dk	ml	
Kentucky Long Keeper. IllB45. Syn. of Krauser											
Kentucky Long Stem. RNY'61											Do.
Kentucky Pippin. Hort'56. Syn. of Ben Davis											
Kentucky Queen. W. Syn. of Winter Queen. [Probably Buckingham.]											
Kentucky Queen. D. Syn. of Buckingham											
Kentucky Red. HG&Co. Syns. Kentucky Red Cider, Kentucky Red Crab, Red Cider Crab, Red Crab.	Ky.?	obc	s	ydrs	vj	w	a	g	c	ml	A celebrated cider apple of the Hewes type.
Kentucky Red. A'95. [This is probably Ben Davis.]											Not described.
Kentucky Red. Hort'56. Syn. of Ben Davis											
Kentucky Red Cider. IndH'88. Syn. of Kentucky Red											
Kentucky Red Crab. JBW&B. Syn. of Kentucky Red											
Kentucky Redstreak. D. Syn. of Ben Davis											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Kentucky Red Streak. D. Syn. of Bradford											
Kentucky Streak. A'60. Syn. of Ben Davis											
Kentucky Streak. W. Syn. of Bradford											
Kentucky Summer Queen. P'93	N. C.?	rob	l	gwrs	fj	wy	msa	vg	dm	e	It is suggested that this is Summer King.
Kentucky Sweet. W	Ky.?	c	m	drs	tfj	y	s	vg	km	ml	
Kentucky Wonder. K&S		ob	ml	yrs				g		e	
Kenworthy. A'97	N. C.?		ml	drs	t	y	s	vg		ml	
Kera. R. Syn. Kera's Greening											Not described.
Kera's Greening. HH'97. Syn. of Kera											
Kern. L. Syn. Kern's Choice	Kans.?		l	dr							
Kern's Choice. DrHS. Syn. of Kern											
Kernodle. L. Syns. Kernodle's Seedling, Kernoodle's Winter	N. C	robl	l	yrs				vg	dm	vl	
Kernodle's Seedling. A'85. Syn. of Kernodle											
Kernoodle's Winter. JVL. Syn. of Kernodle											
Kerr. P'91. Syn. Kerr Greening	Md	ob	m	gwr	f	yw	bsa	g	km	vl	
Kerr Greening. P'91. Syn. of Kerr											
Kerry. L. Syns. Edmonton's Aromatic, Edmonton's Aromatic Pippin, Kerry Pippin.	Ire	o	m	py	tc	y	s	g	d	m	
Kerry Pippin. NEF'32. Syn. of Kerry											
Kestner. Dap	Ky	ob	m	wyrs	tj	y	rsa	vg		ml	
Keswick. (LC.) Syns. Codlin, Keswick Codlin, Keswick Codling	Eng	roble	ml	gyb	j	yw	n	g	k	me	
Keswick Codlin. GenF'33. Syn. of Keswick											
Keswick Codling. W. Syn. of Keswick											
Ketchum. L. Syn. Ketchum's Favorite	Vt	rob	m	pyb	mtj	w	sa	g		ml	
Ketchum's Favorite. D. Syn. of Ketchum											
Kettageskie. LaB36. Syn. of Kittageskee											
Kettegeskee. Hort'58. Syn. of Kittageskee											
Key. L. Syn. Key's Red, Key's Red Winter, Key's Winter	Tenn	robe	m	gydr	cj	w	sa			ml	
Key Early. R. Syn. Key's Early White	Tenn			w						e	
Keyes Red. BBL. [Probably same as Key.]											Do.
Key Fall. R. Syn. Key's Fall											Do.
Key's Early White. A'75. Syn. of Key Early											
Key's Fall. A'75. Syn. of Key Fall											
Key's Red. Dap. Syn. of Key											Do.
Key's Red Winter. TCF. Syn. of Key											
Keystone. Dap. Syn. of Greyhouse. [May Seek-no-further.]											
Key's Winter. TexB16. Syn. of Key Winter											
Key's Winter. Cat. Syn. of Key											
Key Winter. R. Syn. Key's Winter											Do.

Khalkidonskoe. Gb. Syn. of Kalkidon											
Kickapoo. BBL											Do.
Kidd. Dap. Syn. of Southern Porter											
Kiddleston. R. Syn. Kiddleston Pippin		obl	ms	yru			a	vg		ml	This is probably Keddleston.
Kiddleston Pippin. IllB45. Syn. of Kiddleston											
Kief Reinette. R. Syns. Gov. list No. 447, Keiv Reinette, Kiev Reinette, Queen of Kiew, Ranette Kilinski, Renet Kievskni.	Rus.										Not described.
Kiev Reinette. IaB90. Syn. of Kief Reinette											
Kievskoe. SDB76	Rus.	rc	l	gb	j	w	psa	g		l	Possibly same as Yellow Kief.
Kievskoe jeltoe. Gb. Syn. of Yellow Kief											
Kikita. D		rob	m	gyb	tj	w	s	g		m	
Kilham. L. Syn. Kilham Hill	Mass.	r	ml	yrs	dm		sa	g		m	
Kilham Hill. NEF'34. Syn. of Kilham											
Kilkenny. R. Syn. Kilkenny Codlin	Ire.	r		y				vg	k	me	
Kilkenny Codlin. GenF'33. Syn. of Kilkenny											
Kimball. P'95. Syn. Dr. Dunn's Sweeting	Va.	rob	m	gywrs	fcj	w	s	vg		l	
Kincald. A'81											Not described.
Kinellan. D	Scot	rc	m	ygb	fj	w		g		ml	
King (Ind.). E	Ind	ob	l	y			sa	g		me	
King (Ky.). MagofH'46	Ky	oblob		y			sa			l	
King (R.). R. Syn. King Apple			vl	r				vg		ml	
King. GenF'33. Syn. of Borsdorffer											
King. D. Syn. of Buckingham											
King. Dap. Syn. of Summer King											
King. MagofH'48. Syn. of Tompkins King											
King Apple. Hort'58. Syn. of Batchelor. [Possibly Buckingham.]											
King Apple. DomEnc. Syn. of King (R.)											
King Apple. MagofH'48. Syn. of Tompkins King											
King Genet. R. Syn. King's Jenneting. [Probably Ralls.]											Do.
King George the Third. E. Syn. of Borsdorffer											
King-Newark. W. Syn. of Newark King											
King of all the World. FDNCo. Syn. of World King											
King of Ohio. Cat											Do.
King of Pippins. K. Syns. Hampshire Yellow, King of the Pippins	Eng	rob	m	yrs	f		a	g		me	
King of some. D. Syn. of Lady Fancy											
King of Sweets. Dap. Syn. of King Sweet											
King of the Pippins. NEF'32. Syn. of King of Pippins											
King of the Rambos. Dap. Syn. of Maggie											
King of Tompkins. Hort'56. Syn. of Tompkins King											
King of Tompkins County. Hort'56. Syn. of Tompkins King											
King Philip. Lin. Syn. of Jonathan											
King Pocket. R. Syn. Kings Pocket		rob	ml	yrs				g-vg			
King Russet. IllB45											Do.
Kings. D. Syn. of Cubashea											
Kingsbury Russet. E. Syn. of Cheeseboro											
Kingsbury Russet. Hort'75. Syn. of Pumpkin Russet											
Kings Jenneting. MoH'73. Syn. of King Genet											
Kingsley. NAPC'19	N. Y.	r	m	yrs	fjm		sa	vg		ml	
Kings Pocket. MagofH'39. Syn. of King Pocket											
King Solomon. W. Syn. of Solomon											
Kingston. L. Syn. Kingston Black	Eng	r	s	pyrs	tj	ws	s		e	m	
Kingston Black. D. Syn. of Kingston											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Kingston Seedling. OntExR'82											Not described.
King's Stripe. MHSC'86. Syn. of King Stripe											
King Stripe. L. Syns. King's Stripe, Rotstrahliger Konig, Shro. to Ia. No. 79.	Rus										Do.
King Sweet. D. Syns. Hightop Sweet (incorrectly), King of Sweets, King Sweeting, Sidney Sweet, Summer Sweet, Thomas Sweet.	Me	roble	ms	gyb	tj	w	rs			m	
King Sweeting. A'77. Syn. of King Sweet											
King's Winter. W. Syn. of Winter King											
King Tom. W	Mo.? N. C.?	r	m	y		y	sa	g		me	
Kinkead. A'77	Ohio	rob	l	wrs	tj	w	sa	vg		m	
Kinnaird. (LC.) Syn. of Kinnard											
Kinnaird's Choice. Dap. Syn. of Kinnard											
Kinnard. Bul8. Syns. Kennard's Choice, Kinnaird, Kinnaird's Choice, Kinnard's Choice.	Tenn	obc	m	yr	ctj	y	rsa	vg		ml	
Kinnard's Choice. IllH'02. Syn. of Kinnard											
Kinney. D. Syn. Kinney Winter	South	rc	m	gyru	fj	y	sa	g		m	
Kinney Winter. A'95. Syn. of Kinney											
Kinsey. L. Syn. Kinsey's Sweet							s				Do.
Kinsey's Sweet. MagofH'53. Syn. of Kinsey											
Kinsy. MichB31. Syn. Nott County Seedling. [May be same as Kinsey.]											Do.
Kinzy. MoH'86. Syn. Kinzy Sweet. [Origin Holt Co., Mo.]	Mo										Do.
Kinzy Sweet. NWFG'55. Syn. of Kinzy											
Kirby's Red. D. Syn. of Buncombe											
Kircher. R. Syn. Kircher's Kitchen											Do.
Kircher's Kitchen. WBKJ. Syn. of Kircher											
Kirefskol. MoH'67	Rus.?		vl								Do.
Kirkbridge. L. Syns. Conic June, Kirkbridge White, White or Yellow June (of some), Yellow Flat, Yellow June.		oble	ms	yw	tj	w	sa	g	dk	me	
Kirkbridge White. IndF'40. Syn. of Kirkbridge											
Kirke. L. Syn. Kirke's Lord Nelson	Eng	r	l	pyrs	fj		sa	g		m	
Kirke's Golden Reinette. K. Syn. of Golden Reinette											
Kirke's Lemon Pippin. D. Syn. of Lemon Pippin											
Kirke's Lord Nelson. GenF'33. Syn. of Kirke											
Kirke's Scarlet Admirable. D. Syn. of Hollandbury											
Kirk Fame. BBL											Do.
Kirkland. D	N. Y	robl	ml	pyb	ctj	wy	sa		km	vl	
Kirtland. D. Syn. Kirtland's Seedling	Ohio?	obl	l	dy y	t	y	sa			me l	
Kirtland Keeper. CAG											
Kirtland's Seedling. AHortA'68. Syn. of Kirtland											

Kirtly. R. Syn. Kirtly's Hangon											Do.
Kirtly's Hangon. IllH'01. Syn. of Kirtly											
Kitchen. W	Ohio	ob	ml	y			sa	g		l	
Kitchmor. L. Syn. Kitchmor's Favorite	Ohio	c	ml	y			sa	g		l	
Kitchmor's Favorite. W. Syn. of Kitchmor											
Kithagerkee. A'67. [Perhaps Kittageskee.]											Do.
Kitita. IllB45											Do.
Kittageskee. Hort'58. Syns. Kettageskie, Kettegeskee	South	ob	ms	yb	ct	y	bsa	g-vg		l	
Kitzinger. BBL											Do.
K. J. Greening. Cat	Ala										Do.
Klaproth. A'64	Pa	ob	m	gyrs	cjt	w	psa	vg	dkm	me	
Klein. R. Syn. Klein Seedling											Do.
Klein Seedling. MinnExR'90. Syn. of Klein											
Kleine Casseler Reinette. GenF'33. Syn. of Barcelona											Do.
Kleine Graue Reinette. D. Syn. of Carpentin											
Kleneskol. ColExR'88											Do.
Klickitat. OreB40	Wash	r	l	yb	ctj	y	msa	vg		l	May be Baldwin. See A. 99, 210.
Klineff's apple. Gb. Syn. of Kluevskoe											
Klinewskoe. Gb. Syn. of Kluevskoe											
Kluevskoe. MHSC'86. Syns. Gov. list No. 457, Klineff's apple, Klinewskoe, Shro. to Ia. No. 28.	Rus										Not described.
Knapp. L. Syn. Knapp's Harvey	Mass	robe	l-vl	pyb	m	wy	prsa	g		m	
Knapp's Harvey Dap. Syn. of Knapp											
Kneisley. R. Syn. Kneisley Bellflower											Do.
Kneisley Bellflower. BBL. Syn. of Kneisley											
Knevskoe. CanExR'01		r	m	gwb	jc	w	sa			me	
Knickerbocker. W		rob	ml	gy	jc	w	bsa	g-vg	dk	m	
Knight. P'93	S.C	roblob	s	yrs		w	rmsa	g		vl	
Knight's Codlin. GenF'33. Syn. of Wormsley											
Knight's Codling. E. Syn. of Wormsley											
Knight's Golden Pippin. GenF'33. Syn. of Downton											
Knight June. R. Syn. Knight's Red June	Ky		ml					g		e	
Knight's Pippin. GenF'33. Syn. of Downton											
Knight's Red June. W. Syn. of Knight June											
Knight's Red June. D. Syn. of Red June											
Knightswick Pippin. GenF'33. Syn. of Wick											
Knobbed Russet. D. Syn. of Knobby Russet											
Knobby Russet. D. Syns. Knobbed Russet, Old Maid's, Winter Russet	Eng	ro	m	yru	c	y	s	g	d	l	
Knowles. L. Syns. Knowles' Early, Oat Harvest, Potter's Early	Pa.?	rob	s	pgyrs	tj	w	sa	g-vg	dk	e	
Knowles' Early. D. Syn. of Knowles											
Knowles Pippin. SDB76		obe	m	py		w	sa	g	k	m	
Knox. BBL. Syns. Knox Russet, Knox's Russet	Pa	re	ms	ygbru	f	y	sa	g-vg	d	ml	
Knox County Rambo. IllH'74. Syn. of Knox Rambo											
Knox Rambo. R. Syn. Knox County Rambo	Ill	rob	ml	gyrs				vg	dm	ml	A seedling of Rambo.
Knox Russet. RNY'61. Syn. of Knox											
Knox's Russet. W. Syn. of Knox											
Kochers. P'91. Syn. Kochers' Apple	Pa	r	l	yrs	fj	y	sa	vg	mk	l	
Kochers' Apple. WBKJ. Syn. of Kochers											
Koeniglicher. R. Syn. Koeniglicher Kurzstiel											Not described.
Koeniglicher Kurzstiel. MoH'87. Syn. of Koeniglicher											
Koening's Pippelin. D. Syn. of Golden Pippin (Eng.)											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Koffman June. A'99. Syn. of Coffman											
Kohl. A'54	Ger	r	s		cj			g		vl	
Kohl Early. R. Syn. Kohl's Early											Not described.
Kohl's Early. CanExR'01. Syn. of Kohl Early											
Kolb. L. Syn. Kolb's Winter	South									l	Do.
Kolb's Winter. W. Syn. of Kolb											
Kolomenshoe. MHSC'86. Syn. Shro. to Ia. No. 63	Rus										Do.
Konig. L. Syns. French Golden Reinette, Konig's Reinette, Reinette Doree, Reinette du Roi, Royale, Winter Citronenapfel.	Ger	rob	ml	pyb	vfj	yw	rsa		d	l	From Diel.
Konigin Louise. Gb. Syn. of Queen Louise											
Konig's Reinette. D. Syn. of Konig											
Konitschenewoe Rannoe. Gb. Syn. of Early Cinnamon											
Kool Appel. D. Syn. of Rambour Rose											
Koritchneroe. Gb. Syn. of Cinnamon											
Koritchneroe ananasnoe. Gb. Syn. of Cinnamon Pine											
Koritchneroe Polskoe. Gb. Syn. of Polish Cinnamon											
Koritchneroe rannee. Gb. Syn. of Early Cinnamon											
Koritschewoe Ananasnoe. MHSC'81. Syn. of Cinnamon Pine											
Koritschnovvie-Polasatoe. A'83. [May be Polish Cinnamon.]											
Korolevskoe. MHSC'86. Syn. of Royal											
Korolewskoe. Gb. Syn. of Royal											
Koshkonong. IllH'83											Not described.
Koss. R. Syn. Koss Early											Do.
Koss Early. BBL. Syn. of Koss											
Kossuth. IllH'89	Ark	ob	ms	gr	tc	w	sa	vg		l	
Kountz. E. Syn. of Newtown Spitzenburg											
Koursk Reinette. IaB90. Syn. of Kursk Reinette											
Koursk's (a name of a place) *Anisette.* Gb. Syn. of Kursk Anis											
Kovitschneoe. Gb. Syn. of Cinnamon											
Kraam. K. Syn. of Cram											
Kram. D. Syn. of Cram											
Krasnabakoe. Gb. Syn. of Red Sided											
Krasnobakoe. Gb. Syn. of Red Sided											
Krass Sladkaja. Gb. Syn. of Red Sweeting											
Kras Sladkaya. Gb. Syn. of Red Sweeting											
Kratz. W	Pa										Do.
Krauser. D. Syns. Kentucky Long Keeper, Krauser Pippin, Krouser, Krowser.	Pa	rc	m	wyrs	tm	w	sa	g-vg	m	l	
Krauser Pippin. IllB45. Syn. of Krauser											
Krauter. L. Syn. Krauter Reinette	Ger	rob	m	gy	fj	w				l	

Krauter Reinette. D. Syn. of Krauter											
Kremer. Gb. Syns. Gov. list No. 286, Kremer's (Seedling), Kremerskoe	Rus.										Do.
Kremer Glass. L. Syns. Gov. list No. 284, Kremer's Glass, Kremer's Glassy, Steklianka Kremera, Steeklianka Kremer's.	Rus.										Do.
Kremer's Glass. Gb. Syn. of Kremer Glass											
Kremer's Glassy. Gb. Syn. of Kremer Glass											
Kremer's (Seedling). Gb. Syn. of Kremer											
Kremerskoe. Gb. Syn. of Kremer											
Kremls. ColExR'88											Do.
Kremlin. H			l							e	
Krenton. R. Syn. Krenton Pippin											Do.
Krenton Pippin. HMHS. Syn. of Krenton											
Krimskaja beel. Gb. Syn. of White Crimean											
Krimskaja selonka. Gb. Syn. of Green Crimean											
Krimskaya biel. Gb. Syn. of White Crimean											
Krimskaya zelenka. Gb. Syn. of Green Crimean											
Krimski Jabloki. MoH'67. [Probably a type rather than a variety.]	Rus.										Do.
Krimskoe nalivnoe. Gb. Syn. of Crimean Naliv											
Krimskoe vochina. Gb. Syn. of Crimean (vochin)											
Krimskoe vosduchnoe. Gb											
Krimskoe wochina. Gb. Syn. of Crimean (vochin)											
Krimskoo Naliwnoe. Gb. Syn. of Crimean Naliv											
Krivospitsa. Gb. Syn. of Crooked Spike											
Krivospitsæ. Gb. Syn. of Crooked Spike											
Krivospitsæ Aromatnoe. Gb. Syn. of Aromatic Spike											
Kriwospizæ. Gb. Syn. of Crooked Spike											
Kriwospizæ Aromatnoe. Gb. Syn. of Aromatic Spike											
Kronesh. R. Syn. Kronesh Rosy											Do.
Kronesh Rosy. WashB6. Syn. of Kronesh											
Krouser. MagofH'53. Syn. of Krauser											
Krowser. MagofH'53. Syn. of Krauser											
Kruder. Gb. Syns. Kruder oder blauer, Shro. to Ia. No. 17	Rus.										Do.
Kruder oder blauer. MHSC'86. Syn. of Kruder											
Krudner. R. Syn. Reinette Krudner's											Do.
Krupneena. A'83. Syn. of Enormous											
Krupnui skvosnoi nalir. Gb. Syn. of Large Transparent											
Krupnui skwormnaliw. Gb. Syn. of Large Transparent											
Kryger. MagofH'42											Do.
Kurak. R. Syn. Kurak Reinette											Do.
Kurak Reinette. ColExR'88. Syn. of Kurak											
Kurr. A'54	Pa										Do.
Kursk Anis. Gb. Syns. Anis Kurski, Anis Kurskui, Gov. list No. 984, Koursk's (a name of a place) Anisette.	Rus.										Do.
Kursk Reinette. MHSC'86. Syns. Koursk Reinette, Reinette Kurski, Renet Kurski, Shro. to Ia. No. 20.	Rus.										Do.
Kustoe. Gb. Syns. Bushy, Gov. list No. 215	Rus.										Hansen says, identical with Garden.
Kyle. R. Syn. Kyle's Winter											Not described.
Kyle's Winter. IIIB45. Syn. of Kyle											
Laak. R. Syn. Reinette de Laak				y				g		l	From Gardener's Journal.
La Belle. IIIH'72. [A Wisconsin seedling of Tolman.]											Not described.
Labute. D	Fr	rc	l	yrs	efj	w	sa	g		m	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
La Canelle. D. Syn. of Gestreifter											
La Chine. R. Syn. Reinette de la Chine			m				a	g		l	
Lacker. E. Syns. Lacquire, Laquier, Lecker	Pa	ob	m	rsc	tcj	w	psa	g	dm	ml	
Lacon. P'89	Ill	ob	ml	ygb	fj	y	sa	g		ml	
Lacquire. Hort'47. Syn. of Lacker											
Lacy's Nonpareil. D. Syn. of Early Nonpareil (Eng.)											
Ladies'. NEF'31. Syn. of Williams											
Ladies' Blush. E. Syn. of Gabriel											
Ladies' Blush. D. Syn. of Higby											
Ladies' Blush. Hort'69. Syn. of Lady Blush											
Ladies' Choice. BBL. Syn. of Lady Choice											
Ladies' Choicest. IllH'69. Syn. of Lady Choice											
Ladies' Ear Drop. W. Syn. of Eardrop											
Ladies' Favorite. W. Syn. of Fall Queen. [Which is Buckingham.]											
Ladies' Favorite, of some. Syn. of McAfee											
Ladies' Favorite, of Tennessee. A'60. Syn. of Buckingham											
Ladies' Sweet. D. Syn. of Lady Sweet											
Ladies' Sweet, of some. D. Syn. of Sweet Winesap											
Ladies' Sweeting. Lin. Syn. of Lady Sweet											
Ladies' Winter Sweet. A'54. Syn. of Lady Sweet											
Lading. L. Syn. Winter Lady	Eng	rc	m	gru	jt	gw	s		k	m	From Hogg.
Lady. GenF'33. Syns. Api, Api Petite, Gros Api Rouge, Lady Apple, Longbois or Longwood, Petit Api, Petite Api, Petite Api Rouge, Pomme d'Api, Pomme d'Api Rouge, Pomme d'Apis, Pomme d'Apple, Pomme Roso, Pomone d'Apis.	Fr	ob	vs	pyb	ctj	w	sa	vg	d	l	
Lady Alice. R. Syn. Lady Alice Eyre											Not described.
Lady Alice Eyre. BBL. Syn. of Lady Alice											
Lady Apple. DomEnc. Syn. of Lady											
Lady Blush (Pa.?). D. Syn. Ladies' Blush	Pa.?	r	ml	wyb	mj	y	psa	g		m	
Lady Blush (Elliott). D. Syn. Lady's Blush			ml	y							
Lady Blush (South). W	South	c		y			sa				
Lady Blush. W. Syn. of Higby											
Lady Cheek Sweet. D. Syn. of Higby											
Lady Choice. L. Syns. Ladies' Choice, Ladies' Choicest, Lady's Choice											Do.
Lady de Gray's. E. Syn. of Fill Basket											
Lady Delight. L. Syn. Lady's Delight	Eng	rob	m	gyb	cj	w	bsa		k	m	From Hogg.
Lady Dufferin. Cat. Syn. of Dufferin											
Lady Elgin. BBL		rob	m	gb	cj	w				l	
Lady Fancy. L. Syns. King of some, Lady's Fancy		oble	ml	wyrs	ctj	w	sa	g		l	
Lady Finger (Eng.). Dap	Eng	rc	ms	gy	tj	y	pa			l	Do.

Lady Finger (Coxe). DomEnc. Syns. Lady's Finger, Long Pippin, White Paradise.		oble		gy						ml	
Lady Finger (Elliott). E. Syn. Sheep Nose		obl	m	pyb	f			g		m	
Lady Finger (Md.). D	Md.?	re	m	yb	tmj	w	psa	g-vg		me	
Lady Finger. H. Syn. of Kaighn											
Lady Finger (incorrectly). E. Syn. of Long Red											
Lady Finger Pippin. W. Syn. of Buncombe											
Lady Fitzpatrick. D. Syn. of Carter Blue											
Lady Healy. MagofH'47. Syn. Lady Healy's Nonsuch	Eng	rob	m	pyb	f		psa	g	k	m	
Lady Healy's Nonsuch. NEF'31. Syn of Lady Healy											
Lady Henniker. Dap. Syn. of Henniker											
Lady Lyons. FDNCo											Not described.
Lady of the Wemyss. D. Syn. of Wemyss											
Lady Pippin. ArkB19. Syn. of Beach											
Lady Sandwich. S&W											Do.
Lady Seedling. L. Syn. Lady's Seedling	Pa	ob	m	gyb	j	w	psa			m	
Lady Spitzenburg. Cat											Do.
Lady Sudley. AmGar'99. Syn. of Sudley											
Lady Sweet. L. Syns. Ladies' Sweet, Ladies' Sweeting, Ladies' Winter Sweet, Lady's Sweet, Lady's Sweeting, Pommeroy, Roa Yon.	N. Y	re	l	ygrs	tje	gw	s	g-vg	dk	vl	
Lady Trusling. IndH'75. Syn. of Trusling											
Lady Waldron. BBL. [Probably same as Waldon.]											Do.
Lady Washington. W		r	l	y			sa	g		l	May be same as Cooper.
Lady Washington. E. Syn. of Cooper											
Lady Washington. W. Syn. of Loudoun											
Lady Washington. E. Syn. of Yellow Bellflower											
Lady Washington (Ohio). R. Syn. Lady Washington of Ohio											Not described.
Lady Washington of Ohio. BBL. Syn. of Lady Washington (Ohio)											
Lady White. L. Syn. Lady's White	Ohio	r	ms		tj	w	sa			l	
Lady's Blush. Dap. Syn. of Ewalt											
Lady's Blush. WHR'53. Syn. of Lady Blush (Elliott)											
Lady's Choice. Cat. Syn. of Lady Choice											
Lady's Delight. D. Syn. of Lady Delight											
Lady's Fancy. D. Syn. of Lady Fancy											
Lady's Finger. Lin. Syn. of Lady Finger											
Lady's Finger. D. Syn. of White Paradise											
Lady's Seedling. D. Syn. of Lady Seedling											
Lady's Sweet. D. Syn. of Lady Sweet											
Lady's Sweeting. Lin. Syn. of Lady Sweet											
Lady's White. D. Syn. of Lady White											
Lafayette. R. Syns. La Fayette, La Fayette's Favorite	N. H	r	m	wyrs	jt	w	psa	g-vg		ml	
La Fayette. D. Syn. of Lafayette											
La Fayette's Favorite. MagofH'42. Syn. of Lafayette											
La Haute boute. DomEnc											Do.
Labellia. Hort'73. [From H. S. Williams, Glenwood, Iowa.]											Do.
Laird. BBL											Do.
Lake. W	Ohio	robe	m	yrs	tj	y	rpsa	vg		m	}Apparently distinct.
Lake. W	Ohio	oble	s	rs			sa	vg		m	
Lakin. R. Syn. Lakin's Choice											Not described.
Lakin's Choice. FDNCo. Syn. of Lakin											
Lalle. IllB45. Syn. of Golden Sweet											
Lallier. L. Syn. Lallier's Prolific Red	Kans	obe	m	gyrs	etj	y	psa	vg	dm	ml	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Lallier's Prolific Red. A'77. Syn. of Lallier											
Lamb Abbey. L. Syns. Lamb Abbey Pearmain, Laneb Abbey Pearmain.	Eng	r	m	yrs	cj	w	sa	g		m	
Lamb Abbey Pearmain. GenF'33. Syn. of Lamb Abbey											
Lamber. IndH'93											Not described.
Lambert. DomEnc. Syn. Keasbey's Favorite	N. J	roble	l	wyrs	fj	w	psa	vg		ml	
La Mere des Pommes. D. Syn. of Rambour Rose											
Lanark. JVC											Do.
Lancashire Crab. D. Syn. of Minchall											
Lancaster. W		r		y			s				
Lancaster (Va.). W	Va	obl		y			sa				
Lancaster. MagofH'44			ml	gyb	cj	w		g		l	
Lancaster. E. Syn. of Lancaster Greening											
Lancaster Crab. D. Syn. of Minchall											
Lancaster Greening. A'52. Syns. Lancaster, Lancaster Pippin, Lancaster (of Indiana).	Pa	robe	m	gyb	cj	y	psa	vg		vl	
Lancaster (of Indiana). IllB45. Syn. of Lancaster Greening											
Lancaster (of Jones). IllB45							sa			m	Said to differ from Lancaster Greening.
Lancaster Pippin. D. Syn. of Lancaster Greening											
Lancaster Queen. A'52. Syn. of Summer Queen											
Lancaster Sweet (Ind.?). W	Ind.?	ob	ml	y			s	g	k	m	
Lancaster Sweet (Pa.?). D	Pa.?	re	m	wrs	j	w	s	g		m	
Lancaster Witch. H. Syn. of Witch											
Landis. MagofH'53											Not described.
Land Jewell. CH	Wis	e	l	rs				g		ml	
Landon. V	Vt	re	m	yrse	fcj	y	sa	vg		vl	
Landrum. W	Ga	e	m	y			s	g		m	
Landsberg. L. Syns. Landsberger Reinette, Reinette de Landsberg	Ger	ob	ml	yb	fctj	y	sa	g-vg		ml	
Landsberger Reinette. Dap. Syn. of Landsberg											
Landsburg. Gb. Syns. Landsburger Reinette, V. R. S. to Ia. No. 40		obe	ml	rs			sa	g	d	l	Perhaps same as Landsberg.
Landsburger Reinette. MHSC'81. Syn. of Landsburg											
Lane. WHyS		e	l	yr	t		r	vg	dm	vl	This may be Sops-of-Wine.
Laneb Abbey Pearmain. D. Syn. of Lamb Abbey											
Lane Albert. R. Syn. Lane Prince Albert											Not described.
Lane Prince Albert. BBL. Syn. of Lane Albert											
Lane Red. L. Syn. Lane's Red Streak	Ill	re	l	yrs	ft	w	psa	g		m	
Lane's Red Streak. D. Syn. of Lane Red											
Lane Sweet. L. Syn. Lane's Sweet	Mass	re	m	yrs	ctj	w	ps	g-vg		m	
Lane Sweet. L. Syn. Lane's Sweet	Mass	obe	m	yb	j	y	s			l	Differs from preceding.
Lane's Sweet. IllH'69. Syn. of Illinois Sweet											

Lane's Sweet. W. Syn. of Lane Sweet											
Langdon. P'95. Syn. Morgan	Tenn	rob	l	y	fjt	y	sa	g		mi	
Langendorffer. W	Eur	r		y			sa				
Langerfeldskoe. Gb. Syn. of Longfield											
Langer gruner gulderling. Gb											
Langford. CW. Syns. Langford Seedling, Lankford's Seedling	Del	r	ml	yrs	fj		msa			l	Lankford probably correct.
Langford Seedling. Syn. of Langford. [Perhaps Lankford.]											
Langton. R. Syn. Langton's		r	m	grs	c	w	sa	g		me	
Langton's. CanExR'01. Syn. of Langton											
Lanier. A'73. Syn. Lannier	S. C.	r	l	yrs	c		s	vg		ml	
Lankford. P'91. Syn. Vickers, Lankford's Seedling	Md / Del	robl	ml	pyb	etj	wy	sa			vl	Langford probably a synonym.
Lankford's Seedling. AFM. Syn. of Langford											
Lankford's Seedling. AFM. Syn. of Lankford											
Lannier. JWK. Syn. of Lanier											
Lansburg. ColExR'88. [May be Lansingburg, or Landsberg.]											Not described.
Lansingburg. II. Syns. Lansingburgh, Lansingburg Pippin, Rock Apple	N. Y	rob	m	yb	f		msa	g		vl	
Lansingburgh. W. Syn. of Lansingburg											
Lansingburg Pippin. MoH'86. Syn. of Lansingburg											
Lapland. BBL											Do.
Lapouch. Gb. Syn. of Lapouchoe											
Lapouchoe. Gb. Syns. Burr, Gov. list No. 350, Gov. list No. 470, Lapouch	Rus										Do.
Lapouchoe Naliv. Gb. Syns. Gov. list No. 544, Juicy Burr Apple, Lapouchoe Nalivnoe, Lapouchoe Naliw.	Rus										Do.
Lapouchoe Nalivnoe. Gb. Syn. of Lapouchoe Naliv											
Lapouchoe Naliw. Gb. Syn. of Lapouchoe Naliv											
Laqua. MinnHort'94											Do.
Laquier. GenF'46. Syn. of Lacker											
La Reinette Grise. DomEnc											Do.
Large Anis. IaB31	Rus			gy						m	Said to be same as Cross. See Ia. B. 31.
Large Anis. MHSC'86. Syns. Anis Krupnui, Shro. to Ia. No. 27	Rus										Probably differs from preceding.
Large Black. D. Syn. of Red Detroit											
Large Bosdorfer. IaB31	Rus		m	rs				vg	dm	l	
Large Bough. W. Syn. of Bough											
Large Cockpit. S&W											Not described.
Large Codlin. R. Syn. Large English Codling											Do.
Large Early Bough. GenF'32. Syn. of Bough											
Large Early Harvest. DomEnc. Syn. of Early Harvest											
Large Early Red. D. Syn. of Red and Green											
Large English Codling. IndH'72. Syn. of Large Codlin											
Large Ey. Ripe. Cat. [Perhaps a syn. of Early Ripe]											Do.
Large Fall Pippin. NEF'26. Syn. of Fall Pippin											
Large Fall Pippin. GenF'33. Syn. of White Spanish											
Large Golden (N. E.). R. Syn. Large Golden Pippin	Pa	r	vl	gy	tje	y	sa	vg-b		l	Described by Dr. Stayman in MoH'83, 75.
Large Golden Pippin. D. Syn. of Champlain											
Large Golden Pippin. D. Syn. of Golden Pippin (N. E.)											
Large Golden Pippin. D. Syn. of Large Golden											
Large Golden Pippin. D. Syn. of Summer Pippin											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Large Golden Pippin. E. Syn. of Walworth											
Large Green. Dap. Syn. of Gros Vert											
Large Green and Red Sweet. BBL. Syn. of Red and Green											
Large Greening. C	Pa	ob	l	g	jt	w				ml	
Large Green Pippin. MichB31											Not described.
Large June. A'95	Tex										Do.
Large Lady. L. Syns. Api Gros, Large Lady Apple	Fr	rob	s	yb			sa	g	d	vl	
Large Lady Apple. D. Syn. of Large Lady											
Large Long White. Gb. Syns. Beel Krupnaja Prodolgonataja, Biel Krupnaya Prodolgovatnaya, Gov. list No. 979.	Rus										Do.
Large May. FDNCo											
Large Newtown Pippin. GenF'33. Syn. of Green Newtown											
Large Pipin. DomEnc											Do.
Large Prolific. MHSC'86. Syns. Plodovitka Krupnaya, Shro. to Ia. No. 146.	Rus										Do.
Large Rambo. A'77. Syn. of Grosh											
Large Rambo (?). D. Syn. of Rambo											
Large Red (N. S.). Syn. Large Red from Nova Scotia											Do.
Large Red from Nova Scotia. MichB31. Syn. of Large Red (N. S.)											
Large Red (Ohio). Cat											Do.
Large Red and Green Sweeting. DomEnc. Syn. of Red and Green											
Large Red Romanite. Cat. [A synonym of Pennock.]											Do.
Large Red Sweeting. E. Syn. of Red and Green											
Large Romanite. Syn. of Pennock											
Large Russet. WisB45											Do.
Largeseed. R. Syn. Gentle's Large Seed		ob	ml	rs			a	vg		ml	
Large Striped June. JAY		r	l	rs	tj		s		d	e	Appears to be sweet hence not Red June.
Large Striped Pearmain. Dap. Syn. of McAfee											
Large Striped Pearmain. E. Syn. of McAfee. [Striped Winter of Mr. Lyon.]											
Large Striped Winter Pearmain. Hort'56. Syn. of McAfee											
Large Striped Winter Pearmain. D. Syn. of McAfee. [Striped Winter of Mr. Lyon.]											
Large Subacid. Gb. Syn. of Large Transparent											
Large Summer. L. Syn. Large Summer Queen	N. C.?	rob	l-vl	gyrs	ftj	w	r-sa	vg		me	
Large Summer Pearmain. Dap. Syn. of Buckingham											
Large Summer Queen. IndH'72. Syn. of Large Summer											
Large Summer Queen. F. Syn. of Summer Queen											
Large Summer Rambo. A'77. Syn. of Grosh											
Large Summer Russet. NEF'29. Syn. of Catshead											

Large Sweet Bough. H. Syn. of Bough											
Large Transparent. Gb. Syns. Gov. list No. 566, Krupnui Skvosnoi Naliv, Krupnui Skworminaliw, Large Subacid.	Rus										Not described.
Large Vandervere. W. Syn. of Vandervere Pippin											
Large Vine. F											Do.
Large White Incomparable Crab. D. Syn. of White Incomparable											
Large White Juneating. D. Syn. of Early Harvest											
Large White Sweeting. DomEnc			l				s			m	
Large Winter. R. Syn. Large Winter Greening											Do.
Large Winter Greening. FDNCo. Syn. of Large Winter											
Large Winter Queen. IndF'40. Syn. of Buckingham											
Large Winter Red. IndF'40. Syn. of Pottinger											
Large Yellow. A'73											Do.
Large Yellow Bough. Syn. of Bough											
Large Yellow Harvest. Lin. Syn. of Early Harvest											
Large Yellow Horse. IndF'40. Syn. of Horse											
Large Yellow Newark Pippin. Th. Syn. of Newark Pippin											
Large Yellow Newtown Pippin. C. Syn. of Yellow Newtown											
Large Yellow Summer. K. Syn. of Lyman Large											
Larimore. MoH'86	Mo		l	dr				g		e	
Larue. L. Syn. Larue's Big Green	Ky		vl	y			sa	g	k	l	From Ky. Hort. Society.
La Rue. CanExR'01. [This is probably Baxter of Stone and Wellington.]											Not described.
Larue. S&W. Syn. of Baxter											
Larue's Big Green. D. Syn. of Larue											
La Salle. CanH'01	Ont	oble	l	gyrs							
Lasting Vandevere. D. Syn. of Vandevere											
Latah. BBL											Do.
Late Ammidon. R. Syn. Ammidon's Late											Do.
Late Baldwin. NEF'49. Syn. of Baldwin											
Late Baldwin. A'77. [Not certainly distinct.]											Do.
Late Bough. D. Syn. of Autumn Bough											
Late Carse of Gowrie. D. Syn. of Glammis											
Late Chandler. H		re	ml	rs			sa	g		l	
Late Chandler. D. Syn. of Chandler											
Late Duchess. NYB15											Do.
Late Golden. L. Syn. Late Golden Sweet		r	ml	y			s	vg		m	
Late Golden Pippin. GarCal											Do.
Late Golden Sweet. D. Syn. of Baker Sweet											
Late Golden Sweet. W. Syn. of Late Golden											
Late Harvest. A'69. Syn. Long Stem											Do.
Late Keeping Pie. MagofH'53. Syn. of Late Pie											
Late Pennock. IndH'76		c	ml		f					vl	
Late Pie. R. Syn. Late Keeping Pie		obc	m	gy						l	
Late Pippin. IllB45											Do.
Late Pound. L. Syn. Late Pound Sweet	Vt	ob	l	y			s			ml	
Late Pound Sweet. K. Syn. of Late Pound											
Late Queen. E. Syn. Brown's Late Queen. [Possibly Buckingham.]	Ohio?	re	l	y			sa	g		m	
Late Queen. Hort'47. Syn. of Buckingham											
Late Redstreak. A'77. Syn. of Fall Redstreak											
Late Reinette. L. Syns. New Late Reinette, Reinette Tardive Nouvelle		rob	m	yrs	ftj	y	sa			vl	From Album de Pomologie.
Late Russian. GJC. Syn. Summer Red					tj			vg	d	l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Late Strawberry. Cole. Syns. Autumn Strawberry, Fall Strawberry, Forsythe's Seedling, Strawberry.	N. Y.	rc	m	wrs	tj	yw	psa	vg	d	m	
Late Strawberry (erroneously). W. Syn. of Chenango											
Late Sweet. D.	Conn.?	r	m	yrs	c	w	s	g	k	vl	
Late Wine. D.		rc	ms	rep	vtj	w	sa	vg		m	
Late Winter. Cat.											Not described.
Latham. D.	N. Y.	obc	m	yb	tj	w	psa	g		m	
Latham Pippin. Hort'48. [Reported from Me. as a very late keeper.]										vl	Do.
Lathrop. L.											Do.
Latier. AHortA'71	Kans	rc	m	rs	fj	y	sa	g		m	
Laurence. W.	Ohio		l					g		l	
Laurens. R. Syns. Laurens' Greening, Lawrens' Greening	Ga. / South	ob	m	gy		w	a			l	
Laurens' Greening. LaB32. Syn. of Laurens											
Laurre. MoH'83											Do.
La Victoire. VtB83		obc	l	crs	f	w	rsa	g		l	
La Violette. K. Syn. of Violette											
Lawler. Cat. [Probably Lawver.]											Do.
Lawrens' Greening. W. Syn. of Laurens											
Lawson. GarM'73											Do.
Lawver. PFar'68. Syn. Delaware Red Winter	Kans.? / Mo.? / Ill.?	robe	l	dr	fc	w	sa	g		vl	
Lawver's Seedling No. 1. IllB45											
Lawyer. Cat. [Is probably Lawver.]											Do.
Layman. R. Syn. Layman's Sweet											Do.
Layman's Sweet. OntExR'82. Syn. of Layman											
Leach. SDB76. Syn. Leach No. 5	Minn	robl	m	pyb	f	w	psa	g		ml	Originated by H. B. Leach, Richmond, Minn.
Leach No. 5. SDB76. Syn. of Leach											
Lead. MHSC'81. Syns. Gov. list No. 362, Rgl. to Ia. No. 277, Shro. to Ia. No. 3, Svinsovka, Svintsovka, Swinzoffka.	Rus.	obc	l	y			sa	g	k	vl	Hansen regards Nos. 3 and 362 as distinct
Leadington. L. Syns. Grey Leadington, Grey Leadington Pippin, Leadington's Grauer Pippin.	Scot	roblc	m	gyru	ftvj	w	sa			m	From Lindley.
Leadington. GenF'33. Syn. of Green Codlin											
Leadington's Grauer Pippin. D. Syn. of Leadington											
Leanham. D. Syn. of Nickajack											
Leanto. R. Syn. Leanto Sweet											Not described
Leanto Sweet. MagofH'53. Syn. of Leanto											
Leath. BBL											Do.

Leather Apple of Taric. D. Syn of Pomme Gris											
Leather Coat. GarCal. Syn. of Royal Russet											
Leather Coat Russet. D. Syn. of Old Russet											
Leathercoat Russet. C. Syn. of Royal Russet											
Leaver. D	S. C	rc	m	yrs	fcj	y	rsa	g-vg		l	
Le Beau. A'75											Do.
Lebedka. Gb. Syn. of Swan											
Lecher. A'54. Syn. of Manck											
Lecker. MagofH'53. Syn. of Lacker											
Ledenets. MHSC'86. Syn. Shro. to Ia. No. 30	Rus.	ob	l	y			sa	vg		l	
Ledenets Niemetskui. Gb. Syn. of German Ledenets											
Ledge. Syns. Haven Pippin, Ledge Sweet, Portsmouth Sweet, Seedling from A. H. Haven.	N. H	ob	m	wyrs	tjm	y	s	g-vg	k	l	
Ledge Sweet. MagofH'53. Syn. of Ledge											
Leech's Red Winter. D. Syn. of Horn											
Leeds Beauty. AmGar'99. Syn. of Scarlet Pippin											
Lee Frost Proof. R. Syn. Lee's Frost Proof											Do.
Lee's Frost Proof. JVL. Syn. of Lee Frost Proof											
Leeks. MHSC'77											Do.
Leeper. R. Syn. Leeper's Beauty	Ky.?										Do.
Leeper's Beauty. IHH'89. Syn. of Leeper											
Legal. R. Syn. Legal Tender			l					g		l	
Legal Tender. SBro. Syn. of Legal											
Le Grand Bohemian Borsdorffer. D. Syn. of Borsdorffer											
Lehigh. R. Syn. Lehigh Greening	Pa	rob	vl	yg	cj	gy	sa	g	dk	vl	
Lehigh Greening. P'91. Syn. of Lehigh											
Lehmapfel (Serianka). Gb. Syn. of Serinkia											
Leibg. G&S. [Probably same as Leiby.]											Do.
Leibling. KN	Ill		l		j					m	
Leiby. EH. [Probably same as Leibg.]											Do.
Leicester. L. Syns. Leicester Sweet, Leicester Sweeting, Lester Sweet, Leicester Winter Sweet, Potter Sweet.	Mass.	ob	ml	gyr	t		rs	vg	dk	l	
Leicester Sweet. MagofH'46. Syn. of Leicester											
Leicester Sweeting. Cole. Syn. of Leicester											
Leicester Winter Sweet. A'75. Syn. of Leicester											
Leipprandt No 1. MichB31											Do.
Leipprandt No. 2. MichB31											Do.
Leipprandt No. 3. MichB31											Do.
Leipsic. L. Syns. Borsdorfer Leipziger, Gov. list No. 578, Leipsic Borsdorf, Leipzig Borsdorf, Leipziger Boresdorfer.	Rus.										Do.
Leipsic Borsdorf. Gb. Syn. of Leipsic											
Leipzig Borsdorf. Gb. Syn. of Leipsic											
Leipziger Boresdorfer. Gb. Syn. of Leipsic											
Leithemer. L. Syn. Leithemer Streifling	Ger	rc	l	pyrs	f	ws	s			ml	
Leithemer Streifling. D. Syn. of Leithemer											
Lejanka. Gb. Syns. Gov. list No. 240, Lieby, Shro. to Ia. No. 41, Teschanka.	Rus.										Do.
Leland. L. Syns. Leland Pippin, Leland Spice, New York Spice	Mass.	r	l	yb	tj	y	rsa	vg	dk	m	
Leland Pippin. Hort'16. Syn. of Leland											
Leland Spice. Cole. Syn. of Leland											
Lelleur. Dap	Eur.	rob	ml	yrs	ftj	w	sa	g-vg		l	
Leming. L. Syn. Leming Sweet	Ohio	ob	l	y			s	g		e	
Leming Sweet. W. Syn. of Leming											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Lemon. MHSC'86. Syns. Gov. list No. 159, Limonoe, Limonnoe, Shro. to Ia. No. 128.	Rus										Not described.
Lemon. W. Syn. of Rock Pippin											
Lemon Pippin (Eng.). GarCal. Syns. Kirke's Lemon Pippin, Pepin Limon de Galles.	Eng	o	m	py	f		bsa	g		m	
Lemon Pippin (Wis.). Syn. Jeffery's No. 4	Wis. ?										Do.
Leon. R. Syn. Leon Red Streak											Do.
Leona. SDB76	Minn	rob	ms	yrsc	mj	w	psa	g		vl	Originated by S. A. Alling, Homer, Minn.
Leon Red Streak. MoH'73. Syn. of Leon											
Lesber. MagofH'53. [May be same as Lesher.]											Not described.
Lesher. MagofH'53. D	Pa	ob	ml	wpcb	ct	w	psa	g		l	
Lessoff. BBL											Do.
Lester. R. Syn. Lester's Beauty											Do.
Lester's Beauty. IllH'83. Syn. of Lester											
Lester Sweet. W. Syn. of Leicester											
Lestre. L. Syn. Pomme de Lestre	Fr							g		vl	
Leterey. BBL. Syn. of Letorey											
Letorey. Tenn.BI-X. Syn. Leterey	Tenn	ob	ml	yr	fj	y	sa	vg	m	vl	
Levantine. R. Syn. Curtes Levantine											Do.
Lever. A'67	S. C.	c		rs			sa				
Levett. L. Syn. Levett's	Ky.										Do.
Levett's. W. Syn. of Levett											
Levi. MoH'88											Do.
Lewis. MagofH'38											Do.
Lewis (Ind.). WHR'52	Ind	rc	ml	yrs	tc	y	ra	vg-b		me	Western Hort. Review, 1852.
Lewis (of Ragan). A'56. Syn. Lewis of Ragan	Ind	obc	m	yru	tfj	y	sa	vg		ml	
Lewis. Dap. Syn. of Clark											
Lewis Early. R. Syn. Lewis' Early											Do.
Lewis' Early. MagofH'36. Syn. of Lewis Early											
Lewis Green. A'77		obc	l	gyb	tj	gw	sa	vg		m	
Lewis Imperial. R. Syn. Lewis' Imperial Spice. [Resembles Baldwin.]	Conn										Do.
Lewis' Imperial Spice. A'58. Syn. of Lewis Imperial											
Lewis Incomparable. L. Syn. Lewis' Incomparable	Eng	rob	ml	yrs	fc	y	bsa		k	ml	
Lewis' Incomparable. D. Syn. of Lewis Incomparable											
Lewis Jones. W. Syn. of Hightop											
Lewis Jones' Seedling. W. Syn. of Jones											
Lewis of Ragan. W. Syn. of Lewis (of Ragan)											
Lexington (Warder). W		obl		rs			sa				
Lexington (H&G.). HG&Co		oblc	l-vl	yb	tmj		sa	vg		vl	

Lexington. (H.) HFH			m					g		e	
Lexington Queen. D. Syn. of Buckingham											
Leyden. R. Syn. Leyden Pippin											Do.
Leyden Pippin. GenF'33. Syn. of Leyden											
Libert. Dap. Syn. of Hottenstien											
Liberty. Hort'56	Ohio	roblob	m	yrs	f	y	sa	g	dkm	vl	
Libhart. D. Syn. of Ned											
Lichtenwalder. CanExR'01		r	m	gyb	fc	gy	msa			l	
Lieb. R. Syn. Lieb Sweet											Do.
Lieb Sweet. BBL. Syn. of Lieb											
Lieby. Gb. Syn. of Lejanka											
Lieby. MinnB32. Syn. of Recumbent											
Liege. L. Syns. Ananas de Liége, Calville Ananas de Liége, Lutticher Ananas de Liége.	Belg	oble	l	gru	f	w	sa		k	l	From the Verger.
Livlander Himbeerapfel. Gb. Syn. of Livland Raspberry											
Lievland Raspberry. IaB90. Syn. of Livland Raspberry											
Lightly. SDB76. Syn. Lightly (No. 16)	Minn	robobl	ms	yb	f	ws	sa	g-vg		l	
Lightly (No. 16). SDB76. Syn. of Lightly											
Light Red. IllH'95. Syn. Light Red Seedling	Ill.?		ml					vg	dk	ml	
Light Red Seedling. IllH'89. Syn. of Light Red											
Ligoz. D		r	l	yrs	cj	w	psa	g		ml	
Lijanka. ColExR'91											Not described.
Likely. MichB31											Do.
Lillian. Cat											Do.
Lillie of Kent. PE. Syn. of Lilly											
Lilly. Buls. Syn. Lillie of Kent, Lilly of Kent, Lily of Kent	Del	roble	ml	gy				g	dm	vl	
Lilly of Kent. P'91. Syn. of Lilly											
Lily Buckland. D. Syn. of Devonshire											
Lily of Kent. DelB38. Syn. of Lilly											
Lima. D. Syn. of Twenty Ounce											
Limberlimb. R. Syns. Limber Limb, Limber Limb Pippin	Ohio	r	l	y			sa	g		l	
Limber Limb. W. Syn. of Limberlimb											
Limber Limb Pippin. BBL. Syn. of Limberlimb											
Limbertwig. NEF'30. Syns. American Limbertwig, Green Limbertwig, James River, Red Limber Twig.	N.C.?	robe	ml	gyrc	tj	w	a	g	dk	vl	
Limbertwig (of N.C.). L. Syn. North Carolina Limbertwig											Do.
Limber Twig Russet. D. Syn. of Golden Russet (N. Y.)											
Limbertwig-Summer. W	South	ob	ml	rs			sa	vg		e	
Limburger. AndN			vl							l	
Limonnoe. Gb. Syn. of Lemon											
Limonnoe jeltoe. Gb. Syn. of Yellow Lemon											
Limonnoe Scholtoe. Gb. Syn. of Yellow Lemon											
Limonoe. Gb. Syn. of Lemon											
Limtwiler. IndH'75											Do.
Lincoln (Me.). MagofH'16	Me	rob		yb				vg		m	
Lincoln (Ky.? Tex.?). MoH'89	{Ky.? Tex.?}	ob	m	gb			sa	g	km	me	
Lincoln Pippin. A'51	Conn.?	robe	ml	gy	tj	wy	sa	vg		m	
Lincoln Pippin. Cole. Syn. of Winthrop Greening											
Lincolnshire. L. Syns. Lincolnshire Holland Pippin, Striped Holland Pippin.	Eng.?	rob	ml	yrs		w	sa		k	ml	
Lincolnshire Holland Pippin. D. Syn. of Lincolnshire											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Lincolnshire Red. R. Syn. Lincolnshire Red Coat		c	l	gyrb	cj	w	s	g		l	
Lincolnshire Red Coat. BBL. Syn. of Lincolnshire Red											
Lincoln Wonder. L. Syn. Lincoln's Wonder	Ala.? Ky.?										Not described
Lincoln's Wonder. A'79. Syn. of Lincoln Wonder											
Lind. CH. Syn. Lind Center	Wis		l	r			a			l	
Lind Center. WisHort'98. Syn. of Lind											
Linden. Gb. Syn. of Lipka											
Lindenwald. D	N. Y	rob	m	gb	cj	y	psa	g-vg		m	
Lindfield. A'99											Do.
Lindley. L. Syn. Lindley's Nonpareil	N. C	ob	s	yb	c	y	rmsa	g-vg	d	me	
Lindley's Nonpareil. IndF'40. Syn. of Lindley											
Lindsey. BBL											Do.
Ling. L. Syn. Ling Sweet											Do.
Ling Sweet. MagofH'53. Syn. of Ling											
Linn. P'95	Kans	rc	ml	gywrc	fcj	y	sa	g		vl	
Linsley. L. Syn. Linsley's Favorite	Ohio	ob		y			sa				
Linsley's Favorite. W. Syn. of Linsley											
Linsley Sweet. L. Syn. Linsley's Sweet	Ohio	ob		rs			s			m	
Linsley's Sweet. W. Syn. of Linsley Sweet											
Linton. MagofH'53											Do.
Lipin. Gb. Syns. Lipinskoe, Shro. to Ia. No. 44	Rus										Do.
Lipinskoe. MHSC'86. Syn. of Lipin											
Lipka. Gb. Syns. Gov. list No. 976, Linden, Tipka	Rus										Do.
Lipkins. L. Syn. Lipkins Sweet	Pa.?	obc	m	wyb	fcj	w	s			l	
Lipkins Sweet. Dap. Syn. of Lipkins											
Lippart. Dap. Syn. of Hottenstien											
Lippincott. L. Syn. Lippincott Sweet	N. J	rc	m	ycb	tj	w	ps	g		l	
Lippincott. Lin. Syn. of Summer Rose											
Lippincott's Early. W. Syn. of Summer Rose											
Lippincott Sweet. A'64. Syn. of Lippincott											
Lipsey. L. Syn. Lipsey's Russet	Ohio	obl	ml	ru			sa	vg		l	
Lipsey's Russet. W. Syn. of Lipsey											
Lissof. R. Syn. Lissof Seedling											Do.
Lissof Seedling. ColExR'96. Syn. of Lissof											
Litch. Hort'72. [Cultivated by J. C. Plumb, of Wis.]											Do.
Litchfield. L. Syn. Litchfield Pippin	Me	o	ml	yb		w	sa				Maine Pomological Report
Litchfield Pippin. D. Syn. of Litchfield											
Litsey. Dap. Syn. of Doctor Walker											
Litiz. GarM'80	Pa		m	wy				vg		me	

Little. A'95	Rus										Not described.
Little Beauty. D	Eng.?	rob	s	yb		y				ml	From Ronalds.
Little Hat. Gb. Syns. Gov. list No. 272, Schapotchka, Schapotschka	Rus										Not described.
Little Pearmain. W	Ohio	r	ml	ru			sa	vg		l	
Little Pearmain. E. Syn. of Bullock											
Little Pipka. Gb. Syns. Gov. list No. 174, Malnja Pipka, Pipka (———)	Rus										Do.
Little Rachel. BBL											Do.
Little Red. L. Syn. Little Red Winter. [May be Gilpin.]											Do.
Little Red Romanite. Wg. Syn. of Gilpin											
Little Red Winter. Cat. Syn. of Little Red											
Little Repka. Gb. Syns. Gov. list No. 410, Little Seedling, Reipka Malenkaya, Repka Malenka.	Rus		m	rs						l	
Little Rock. MagofH'53											Do.
Little Romanite. D. Syn. of Gilpin											
Little Russet. BBL											Do.
Little Seedling. A'81. [Probably Little Repka.]											Do.
Little Seedling. Gb. Syn. of Little Repka											
Little Seedling. A'83. Syn. of Repka Malenka											
Little Vandevere. D. Syn. of Vandevere											
Livlandischer Sommer. Gb. Syn. of Summer Livland											
(Livlandischer Winter.) Gb. Syn. of Winter Livland											
Livland Muscatel. Gb. Syns. Gov. list No. 963, Lowland Muscatel, Muscateller Livlandischer, Muscatapfel Livlander, Muscateller Lievlander, V. R. S. to Ia. No. 25.	Rus	obe	l	rs							
Livland Raspberry. Gb. Syns. Gov. list No. 340, Himbeerapfel Livlander, Lievlander Himbeerapfel, Lievland Raspberry, Lowland Raspberry.	Rus										Do.
Loan. L. Syns. Loan's English Pearmain, Loan's Pearmain		robl	s	grs	fjc			g		m	
Loan's English Pearmain. C. Syn. of Loan											
Loan's Pearmain. DomEnc. Syn. of Loan											
Lobb. C		ob	ms	rsru	f	y	sa			ml	
Locart. L. Syn. Gros Locart	Fr.?		vl	yb				vg			
Lochran. IaH'89											Do.
Locust. R. Syn. Locust Grove											Do.
Locust Grove. IllB45. Syn. of Locust											
Locy. D		robc		grs	etj	g	psa	g		ml	
Loddington. BBL											Do.
Lodge's Early. Hort'54. Syn. of Summer Rose											
Lodgemore. L. Syns. Clissold's Seedling, Lodgemore Nonpareil	Eng	r	m	yb	fej	y	sa?		d	l	From Hogg.
Lodgemore Nonpareil. D. Syn. of Lodgemore											
Loeds. ColExR'88											Not described.
Logan. ArkB60	{Mo.? / Ark.?}	rob	m	ry	t	y	sa	g	m	l	Possibly two varieties.
Logan Berry. Hort'58	N. C.	ob	l	y			s	g		m	
Logan Late. R. Syn. Logan's Late	Mo		ml						m	l	May be same as Logan, Mo.
Logan's Late. MoH'85. Syn. of Logan Late											
Logan's Northern Pippin. IllH'69. Syn. of Minkler											
Logan Sweet. CH	Wis	c	!	yb	cj		s	vg		l	
Log Cabin. WVaB75											Not described.
London. IllB45		r	l	gy			sa	g-vg		l	
Londonderry. D. Syn. of Derry											
London Golden Pippin. D. Syn. of Golden Pippin (Eng.)											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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London Pippin. GenF'33. Syns. Five Crowned Pippin, London Sweet (erroneously), New London Pippin, Royal Somerset.	Eng	re	l	yb	f	w	sa	g	k	ml	
London Sweet. E. Syns. Clark's Seedling, Heicke's Winter Sweet, London Winter Sweet, Mrs. Weaver's Sweet, Sweet London Winter, Winter Sweet.	Ohio?	rob	ml	pyru	jtf	w	s	g-vg	k	ml	
London Sweet (erroneously). H. Syn. of London Pippin											
London Winter Sweet. D. Syn. of London Sweet											
Long. A'54									m	me	
Long (Rus.). Gb. Syns. Dlimoe, Dlinnoe, Gov. list No. 600, Long Apple.	Rus										Not described.
Long. Dap. Syn. of Southern Porter											
Long Apple. Gb. Syn. of Long (Rus.)											
Long Arcad. MHSC'86. Syns. Arkad Dlinnui, Gov. list No. 592, Long Arcade, Shro. to Ia. No. 99.	Rus										Do.
Long Arcade. Gb. Syn. of Long Arcad											
Longbois or *Longwood.* C. Syn. of Lady											
Longevity. CanH'96	Ont.?	re	m	yr	fjm	y	sa	g		vl	
Longfellow. OreB22											Do.
Longfield. A'83. Syns. English Pippin, Good Peasant, Langerfeldskoe, Longfield Apple, Shro. to Ia. No. 56.	Rus	robl	ml	y			sa	g	km	m	
Longfield. MinnBl. Syn. of English Pippin											
Longfield Apple. Gb. Syn. of Longfield											
Long Green. MoH'65											Do.
Long Homer. SDB76. Syn. Long John	Minn	obobl	ml	dr	j	ws		g		m	Originated by S. A. Alling, Homer, Minn.
Long Island. D. Syn. of Fall Orange											
Long Island Graft. Dap. Syn. of Fall Orange											
Long Island Pearmain. C. Syns. Autumn Pearmain, Hollow Crown Pearmain, Winter Pearmain.		robl	l	yrs	ct		sa	g	dm	ml	
Long Island Pippin. D		rob	l	yg	fj	gy	sa	vg	d	ml	
Long Island Russet. C	N. Y	r	ms	yru		y	msa	g	c	ml	
Long Island Seek-no-further. W	N. Y	obc	l	rs			sa	vg	dk	m	
Long Island Seeknofurther. T. Syn. of Ferris											
Long John. D		c	l	gy		yw	sa			vl	
Long John. E. Syn. of Long Red (Pa.)											
Long John. SDB76. Syn. of Long Homer											
Long Keeper. R. Syn. Long's Keeper											Not described.
Long's Keeper. IllH'96. Syn. of Long Keeper											
Long Keeping. GarCal. Syn. of Mauck											
Longlimb. W	Ohio	r	l	rs			sa	g		l	
Long-limbed Russet. IllH'86. Syn. of English Russet											

Longlimb Sweet. R. Syn. Long-limbed Sweet											Do.
Long-limbed Sweet. Hort'55. Syn. of Longlimb Sweet											
Long May. D. Syn. of White Paradise											
Longmont. UCExR'91											Do.
Long Pearmain. MagofH'47. Syn. of Long Red (Pa.)											
Long Pippin. C. Syn. of Lady Finger											
Long Red (Pa.?). L. Syns. English Pearmain (incorrectly), Hudson Red Streak, Kaighn's Spitzenburg (incorrectly), Kentucky Bellflower, Kentucky Gilliflower, Lady Finger (incorrectly), Long John, Long Pearmain, Long Red Pearmain, Mudhole, Park (not of Kansas), Pearmain, Pound Royal (incorrectly), Red Bellflower (incorrectly), Red Gilliflower (of some), Red Pearmain, Red Pippin, Red Phoenix, Red Spitzenburg, Red Winter Pearmain, Russian, Scarlet Pearmain (incorrectly), Sheepnose (of some), Striped Pearmain, Wabash Bellflower, Winter Pearmain.	Pa.?	oble	ml	rs			sa	g		ml	
Long Red (Va.) L. Syn. Long's Red Winter	Va	rob	ml	yrs	tje	y	sa	g-vg		ml	
Long Red Pearmain. Dap. Syn. of Long Red (Pa.?)											
Long's Red Winter. D. Syn. of Long Red (Va.)											
Long Russet. R. Syn. Long's Russet	Ky	ob	ml	gru	mtj	wg	sa	g		vl	
Long's Russet. Dap. Syn. of Long Russet											
Longstart. D. Syn. Westmoreland Longstart	Eng	r	m	yrs	etj	w	psa		k	m	
Longstem (Ky.? Va.? O.?). W	Ky.? Va.? Ohio?	rob	m	grs		gw	msa	g-vg		l	
Longstem (Lewis Jones). W	Ind	ob	ml	rs			sa	g		m	
Longstem (Mass.). Cole	Mass	rob	m	yb	tj	y	sa	g		ml	
Longstem (Pa.). MagofH'53	Pa	robl	ms	yrs	etm	w	sa	g-vg		ml	
Longstem (Ct.). D	Conn	rob	m	yru	f	y	s	g		ml	
Long Stem. DomEnc. Syn. of Harrison											
Long Stem. A'69. Syn. of Late Harvest											
Lon Stem Sweet. D. Syn. of Baker Sweet											
Long Striped Pearmain. Cat. [Probably Syn. of Long Red (Pa.?).]											Do.
Long Tom. C. Syn. of Bullock											
Longville. L. Syns. Longville's Kernel, Sam's Crab	Eng	oble	ms	gyrs	f	y	sa	g		me	
Longville's Kernel. GenF'33. Syn. of Longville											
Long White. SDB65											Do.
Longworth. L. Syn. Longworth's Red Winter	Iowa	robc	m	wyrs	tj	ws	sa	vg		ml	
Longworth's Red Winter. Dap. Syn. of Longworth											
Longworth Sweet. L. Syn. Longworth's Sweet	Ohio	rc	ml	yru			s	vg	d	l	
Longworth's Sweet H. Syn. of Longworth Sweet											
Looker. L	Mo.?										Do.
Loomhouse. IndH'72											Do.
Loose. MagofH'53											Do.
Lopside. W	Ohio	ob	ml	rs			sa	g		l	
Lopside. H. Syn. of Greyhouse. [May Seek-no-further.]											
Lopsided Pearmain. Dap. Syn. of Greyhouse. [May Seek-no-further.]											
Lorain. R. Syn. Lorain Sweet											Do.
Lorain Sweet. CAG. Syn. of Lorain											
Lord. SDB76. Syns. Lord's Longfield, Lord's Seedling	Minn	rc	m	gre	f	ws	psa	vg		ml	Originated from seed of Wealthy, Minnesota City, Minn.
Lord's Apple. Gb. Syn. of Herren											
Lord Beaconfield. BBL											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Lord Botetourt. DOM. Syn. of Botetourt											
Lord Bottcourt. Cat. Syn. of Bottcourt. [Probably Botetourt.]											
Lord Burghley. D. Syn. of Burleigh											
Lord Burleigh. D. Syn. of Burleigh											
Lord Derby. BBL											Not described
Lord Grosvenor BBL. Syn. of Grosvenor											
Lord Gwydr's Newtown Pippin. D. Syn. of Alfriston											
Lord Hindlip. BBL. Syn. of Hindlip											
Lord's Longfield. SDB76. Syn. of Lord											
Lord Nelson. CAG. Syns. Blenheim Orange, Blenheim Pippin	Eng	r	l-vl	drs		y		g	k	l	
Lord Nelson (Kirke's). Mag of H'50											Do.
Lord Ragland. Hort'58	Eng.?								k		Do.
Lord's Seedling. MinnHort'99. Syn. of Lord											
Lord Sheffield. Cat. Syn. of Sheffield											
Lord Suffield. D. Syn. of Suffield											
Lord Wolseley. SBro. Syn. of Wolseley											
Lore. DelB95											Do.
Lorick. L. Syns. Lorick Cluster, Lorick's Cluster	{Ga.? Va.?}	re	s	wgb		gw	psa	g		vl	
Lorick Cluster. D. Syn. of Lorick											
Lorick's Cluster. W. Syn. of Lorick											
Loring. L. Syns. Loring's Sweet, Loring Sweeting	Mass.	ob	m	gyb	tj		s	g		vl	
Loring's Sweet. E. Syn. of Loring											
Loring Sweeting. Th. Syn. of Loring											
Lorne. L. Syn. Marquis of Lorne	N. S.	rob	l-vl	wyrs	ctj	w	bsa	g-vg		m	
Losey. NAPC'49	N. Y	robl	l						m		From N. Amer. Pom. Convention, 1849.
Loskrieg. K. Syn. Prince's Table Apple	Eur.?	obl	ml	wrs				vg	d	m	
Losovka. IaB31. Syn. Orel list No. 4	Rus.		m	yrs				g			
(Lost.) Gb. Syn. Shro. to Ia. Nos. 117, 118, 119. [True name not given.]	Rus.										Not described.
Lothringer Rambour. A'77, Syn. of Grosh											
Lothrop No. 1. MassH'76											
Lothrop No. 2. MassH'76											
Lothrop No. 3. MassH'76											
Lothrop No. 4. MassH'76											
Lothrop No. 5. MassH'76											
Lou. A'85	Minn	rob	ml	yrs	jc	yw	sa	g	km	e	
Loudon. W. Syn. of Loudoun											
Loudon Co. Sweet. WVaB75. Syn. of Loudoun County											
Loudon Pippin. D. Syn. of Loudoun											

Loudon's Pippin. A'71. Syn. of Loudoun											
Loudon Sweet. MagofH'53. [Perhaps Loudoun.]											Do.
Loudon White. MagofH'53. [Perhaps Loudoun.]											Do.
Loudoun. Bul. 6. Syns. Lady Washington, Loudon, Loudon Pippin, Loudon's Pippin, White's Loudon Pippin.	Va	obe	l	pyb	ctj	y	sa	g-vg	d	ml	
Loudoun County. R. Syn. London Co. Sweet	Va.?						s				Do.
Lough. JVL											Do.
Louise. Bul8. Syn. Princess Louise	Ont	re	ml	rb	tj	w	sa	g	d	ml	
Louise Renard. D. Syn. of Renard											
Louis Favorite. R. Syn. Louis' Favorite											Do.
Louis' Favorite. ColExR'88. Syn. of Louis Favorite											
Lounger. PFar'53. Syn. of Pie											
Loure Queen. E. Syn. of Lowre											
Loux. R. Syn. Loux Roseau											Do.
Loux Roseau. A'77. Syn. of Loux											
Love. BBL											Do.
Loveden's Pippin. Syn. of Nonpareil											
Lovett. L. Syn. Lovett's Sweet	Mass.	robe	m	y	mj	y	s	g		ml	
Lovett's Sweet. M. Syn. of Lovett											
Lowe. Bul8	Am	r	vl	y			msa	g	km	e	
Lowell. Cole. Syns. Golden Pippin (of some), Greasy Pippin, Lowell Pippin, Michigan Golden, Orange, Pound Royal (erroneously), Queen Anne, Rissley, Tallow Apple, Tallow Pippin.	Am	robe	l	y		yw	ba	g-vg	dkm	me	
Lowell Green. R. Syn. Lowell Greening											Do.
Lowell Greening. NEF'49. Syn. of Lowell Green											
Lowell Pippin. Syn. of Lowell											
Lowland. Bul8. Syn. of Livland Raspberry. [An error in Bulletin 8.]											
Lowland Muscatel. Gb. Syn. of Livland Muscatel											
Lowland Raspberry. Bul8. Syn. of Livland Raspberry. [Error of Bul. 8.]											
Lowre. L. Syns. Loure Queen, Lowre Queen	Ohio?	rob	m	yrs	tj	yw	sa	vg		ml	
Lowre Queen. E. Syn. of Lowre											
Lowrie. IllB45											Do.
Loy. MoH'85, Syn. Loy's Seedling	Mo	ob	l	yrs			sa	g	m	l	
Loy's Seedling. MoH'84. Syn of Loy											
Lubsk Queen. N. Syn. of Lubsk Reinette											
Lubsk Reinette. Gb. Syns. Gov. list No. 444, Lubsk Queen, Renet Liubskui, Reinette Liubski.	Rus.		l							me	
Luce. L. Syn. Luce's Early Joe		rob	ml	y			sa	g		me	
Luce's Early Joe. PFar'53. Syn. of Luce											
Lucinda. P'95	Ore	robl	l	gy	ftj	w	sa	g		vl	
Lucker. RNY'54	N. Y	ob	m	r	t			g		l	
Lucombe. R. Syn. Lucombe's Seedling	Eng	r	l	wrs	fj		sa	g	k	m	
Lucombe's Seedling. GenF'33. Syn. of Lucombe											
Lucombe Pine. L. Syns. Lucombe's Pine Apple, Pine Apple, Pine Apple Pippin.	Eng	obe	ms	pyb	tj	yw	sa	g		m	
Lucombe's Pine Apple. D. Syn. of Lucombe Pine											
Lucy. Hort'72. Syns. Lucy Sweet, Twin Apple	Vt	rob	m	pgyb	mj	w	s			m	
Lucy Pew. MoH'85. Syn. of Pew											
Lucy Red. L. Syn. Lucy's Red Cheek	Cal	rob	ml	rs						me	
Lucy's Red Cheek. Wn. Syn. of Lucy Red											
Lucy Sweet. Dap. Syn. of Lucy											
Ludwig. D. Syn. Haas	Pa	re	l	wrs	jm	ws	sa	g-vg		l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Ludwig. CBCo. Syn. of Haas											
Luiken. Gb. Syns. Luiken apfel, Gov. list No. 4	Rus										Not described.
Luiken apfel. Gb. Syn. of Luiken											
Luke. R. Syn. Luke's Silver	Mo							g		vl	
Luke's Silver. MoH'85. Syn. of Luke											
Luster. R. Syn. Early Luster											Do.
Lutticher Ananas de Liege. D. Syn. of Liege											
Lux. JLB	Nebr		l	gyb						me	
Luxemburg. L. Syn. Reinette de Luxemburg											Do.
Luyken. PFar'60	Ger	rob	m	wyrs	j	ws		vg	dk	m	
Lyman. R. Syn. Lyman's Seedling		c	ml	ygr	j	w	msa	p		me	
Lyman Large. L. Syns. Large Yellow Summer, Lyman's Large Summer	Conn.?	rob	l	y	t	y	sa	g	dk	me	
Lyman's Large Summer. Cole. Syn. of Lyman Large											
Lyman's Large Yellow. Lin. Syn. of Pumpkin Sweet											
Lyman's Pumpkin Sweet. K. Syn. of Pumpkin Sweet											
Lyman's Seedling. CanExR'01. Syn. of Lyman											
Lyman Sweet. SDB76	Minn	robl	l	gyrb		w	s	g		m	Originated in 1876, from seed of Wealthy.
Lynn. W	Ky	ob	ml	rs			sa	g		l	
Lyon. L. Syn. General Lyon	Mo	rc	ms	yrb	femj	y	sa	g-vg	m	l	
Lyon Pippin. R. Syn. Lyon's Pippin											Not described.
Lyon's Pippin. IllB45. Syn. of Lyon Pippin											
Lyon Sweet. L. Syn. Lyon's Sweet	Conn	rc	m	yrs	ejt	w	s	g		ml	
Lyon's Sweet. D. Syn. of Lyon Sweet											
Lyscom. NEF'30. Syns. Matthew Stripe, Osgood's Favorite	Mass	r	l	gyrs	f		sa	g-vg	dk	m	
Mabbott. R. Syn. Mabbott Pearmain											Do.
Mabbott Pearmain. BBL. Syn. of Mabbott											
Mabie. R. Syn. Mabie Sweet											Do.
Mabie Sweet. BBL. Syn. of Mabie											
Mabel. A'97	Ill	ob	l	yg	j		s	vg		e	
Mabile. MagofH'46											Do.
McAdow's June. D. Syn. of July											
McAfee. Dap. Syns. Gray Apple, Gray's Keeper, Hubbardston Nonsuch (erroneously), Indian, Ladies' Favorite (of some), Large Striped Pearmain, Large Striped Winter Pearmain, McAfee's Nonsuch, McAfee's Red, McAffee, Missourian, Missouri Keeper, Missouri Superior, New Missouri, Nonsuch, Park, Park Keeper, Russian, Snorter, Storr's Wine, Striped Pearmain, Striped Sweet Pippin, Striped Winter Pearmain, Stephenson, Uncle Zeeke, Valandigham Wine, White Crow, White Pearmain, Wyandotte, Zeeke.	Ky	robe	l	ygrsc	tc	yw	msa	g-vg	dm	ml	

McAfee's Nonsuch. D. Syn. of McAfee											
McAfee's Red. Dap. Syn. of McAfee											
McAffee. W. Syn. of McAfee											
McBride. L. Syn. McBride's Waxen		c		y			s				
McBride's Waxen. W. Syn. of McBride											
Maccabee. AmGar'01. Syns. Mississippi Superior, Park Keeper, Stevenson Pippin.											Doubtless an error; should be McAfee.?
McCall. AB&Co		obl	l	y				vg		l	
MacCartney. MagofH'52. Syn. McCarty	Mass			r			a			vl	
McCarty. MagofH'42. Syn. of MacCartney											
McClellan. NWFG'52			l	r				g	m	ml	Appears distinct from McLellan.
McClellan. MagofH'54. Syn. of McLellan											
McCloud's Family. W. Syn. of Family											
McCord. TennBX-I. Syn. Arlington Queen	Tenn	ob	l	gwrs	ftj		sa	vg	dk	m	
McCormack. L. Syn. McCormack's	Ohio	c	l	y			sa	g		l	
McCormack's. W. Syn. of McCormack											
McCoy. L. Syn. McCoy's Pippin	Pa	ob	l	gwb	ctj	w	sa	g		m	
McCoy's Pippin. D. Syn. of McCoy											
McCroskey. TennBI-IX	Tenn	r	m	yr	cvj	y	sa	g		vl	
McCuller. L. Syn. McCuller's Winter	N. C							vg			Not described.
McCuller's Winter. A'85. Syn. of McCuller											
McDaniel. W	Ohio	rob	m	yres	j	y	rsa	vg	dk	m	
McDonald. WMP&S			ml	rs				g		l	
McDonald Red. R. Syn. McDonald's Red. [May be McDonald.]											Do.
McDonald's Red. IllB45. Syn. of McDonald Red											
McDowell. R. Syn. McDowell's Fall											Do.
McDowell's Fall. MoH'73. Syn. of McDowell											
McDowell Red. L. Syn. McDowell's Red	Va.?										Do.
McDowell's Red. W. Syn. of McDowell Red											
McDowell Sweet. L. Syn. McDowell's Sweet	N. C	rob	ml	yrs	tj	w	s	g-vg		m	
McDowell's Sweet. W. Syn. of McDowell Sweet											
McEwan. R. Syn. McEwen's Sweet		obl	sm	y	cj	w	s	g		l	
McEwen's Sweet. CanExR'01. Syn. of McEwen											
McFee. R. Syn. McFee's											Do.
McFee's. NMB4. Syn. of McFee											
McGregor. R. Syn. McGregor's Baking	Can	ob	m	gy	cj	w	a		km	me	
McGregor's Baking. MHSC'76. Syn. of McGregor											
McHenry. D	Ohio	ob	ml	rs			sa	vg	d	m	
McHenry Pippin. A'77. Syn. of Gloria Mundi											
McHenry White. L. Syn. McHenry's White	Ohio	ob	ml	y			sa	g		ml	
McHenry's White. W. Syn. of McHenry White											
MacIndoe. R. Syn. MacIndoe Russet											Do.
MacIndoe Russet. BBL. Syn. of MacIndoe											
MacIntire's Sweeting. D. Syn. of Marble											
McIntosh. L. Syn. McIntosh Red	Ont	rob	ml	wyrc	fvtj	w	sa			ml	
McIntosh Red. Dap. Syn. of McIntosh											
McIntyre. A'75											Do.
Mack. P'95. Syn. Uncle Jack	Ga	obc	l	gyrsc	fjc	gy	s	vg		ml	
MacKay. L. Syns. Mackay Sweet, McKay's Sweeting	Mass	robc	m	yb	tjm	w	s	g		l	
Mackay Sweet. MagofH'43. Syn. of MacKay											
McKay's Sweeting. K. Syn. of MacKay											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Mackie's. H. Syn. of Clyde											
Mackie's Clyde Beauty. GenF'49. Syn. of Clyde											
McKim. L. Syn. McKim's Vandevere	Pa	rob	m	yrs	t	w	a	g		m	
McKim's Vandevere. D. Syn. of McKim											
MacKinlay. A'62. Syn. of McKinley											
McKinley. W. Syn. Mackinlay	Ind	robe	m	gyrs	fj		sa	g	dm	ml	
McKinley. WHyS. Syn. of McMillin											
McKinley's Green. P'95. Syn. of McMillin											
McKinney. A'73	N. Y	ob	ml	yb	fjm	wy	sa			vl	
McKinney Yellow. R. Syn. McKinney's Yellow	Ill							g		l	
McKinney's Yellow. IllH'90. Syn. of McKinney Yellow											
McLaughlin. R. Syn. McLaughlin's Keeper											Not described.
McLaughlin's Keeper. IndH'89. Syn. of McLaughlin											
MacLean. W. Syns. McLean's Favorite, MacLean's Favorite	Eng	r	m	yru	c		a	g		ml	Possibly two distinct varieties.
McLean's Favorite. H. Syn. of MacLean											
MacLean's Favorite. D. Syn. of MacLean											
McLean Winter. R. Syn. McLean's Winter Pippin		r	s	r				g		l	
McLean's Winter Pippin. IllB45. Syn. of McLean Winter											
McLee. R. Syn. McLee's Mammoth											Not described.
McLee's Mammoth. MichB31. Syn. of McLee											
McLelan. H	Pa	rob	ml	rs			s	g		l	
McLellan. Cole. Syns. McClellan, Martin	Conn	robe	ml	yrs	vtj	w	msa	vg		l	
McMahan. BBL. Syn. of McMahon. [A possible doubt as to correct spelling.]											
McMahon. A'85. Syns. McMahan, McMahon's White	Wis	robl	l	yw			sa	g	km	m	Origin, Richland Co., Wis. in about 1860.
McMahon's Bloom. MoH'93. Syn. of McMahon Red											
McMahon Red. R. Syns. McMahon's Bloom, McMahon's Red											Not described.
McMahon's Red. MoH'93. Syn. of McMahon Red											
McMahon's White. A'91. Syn. of McMahon											
McMillin. P'95. Syns. McKinley, McKinley's Green	Tenn	r	l	gyb	tj	gy	sa	g		l	
McMurry. TennBX-1	Tenn	rob	m	yrs	fj	w	sa	g		e	
McNash. JWK	Md		m	gyb				vg		vl	
Macomber. W. Syn. of Rolfe											
Madam Lewis. HG&Co	Ohio	rob	l	rs			sa	vg	k	em	
Madeleine. D. Syn. of Summer Calville											
Madere. R. Syn. Reinette de Madere			l	y			sa	vg-b		l	
Madge. DelExR'95											Do.
Madison. L. Syn. Madison Red		ob		rs			sa				

Madison Red. MagofH'53. Syn. of Madison											
Mage's Johnny. D. Syn. of Green Tifling											
Maggie. L. Syns. King of the Rambos, Maggie's Favorite	Pa	rob	ml	pyrs	ftj	w	sa	vg		m	
Maggie's Favorite. Dap. Syn. of Maggie											
Magnet. MinnExR'90											Do.
Magnifique. D. Syn. of Imperial (France)											
Magnolia (Mass.). Cole. Syn. Hixon	Mass.	robe	m	yrsc	tj	w	bsa	g-vg		m	
Magnolia (Tenn.). D	Tenn.?	robe	l	yrs	tj	y	psa	vg		ml	
Magnum Bonum. D. Syn. of Bonum											
Magnum Bonum. IllB45. Syn. of Mangum											
Magog. LC. Syn. Magog Red Streak	Vt	robl	m	yrs	cjm	y	sa			l	
Magog Red Streak. MHSC'77. Syn. of Magog											
Magoon Sweet. A'81. Syn. of Calef											
Magoun Apple. D. Syn. of Calef											
Magyar. AlaB98											Do.
Mahaska. A'71. Syn. Miller Apple	Iowa?	rob	l	wyrs	tj	w	sa	vg		l	Appears to be distinct from Baltimore.
Mahaska. A'75. Syn. of Baldwin. [A mistake. Is corrected A'75, p. 36. Should be Baltimore.]											
Mahaska. A. Syn. of Baltimore											
Mahaska. A'73. Syn. of Cogswell. [Probably an error.]											
Mahoning. R. Syn. Mahoning Valley											Not described.
Mahoning Valley. BBL. Syn. of Mahoning											
Maid. R. Syn. Maid's Legs											Do.
Maid's Legs. MagofH'58. Syn. of Maid											
Maiden's Apple. D. Syn. of Maiden Favorite											
Maiden Blush. MagofH'38. Syns. Blush, Hawthornden (of the English), Maiden's Blush, Red Cheek, Vestal.	N. J	rob	m	pyb	t	w	sa	g	dkm	m	
Maiden's Blush. C. Syn. of Maiden Blush											
Maiden's Blush. DelB38. Syn. of Maryland Maid											
Maiden's Blush (erroneously) of some American collections. MagofH'57 Syn. of Hawthornden.											
Maiden's Bosom. D. Syn. of Nantahala											
Maiden Fair. R. Syn. Maiden's Fair											
Maiden's Fair. MichB31. Syn. of Maiden Fair											
Malakoff. RNY'70											Do.
Maiden Favorite. L. Syns. Maiden's Apple, Maiden's Favorite	N. Y	roble	ms	pycb	tc	w	sa	g-vg	d	ml	
Maiden's Favorite. W. Syn of Maiden Favorite											
Maiden's Favorite. IllB45. Syn. of Mangum											
Main. R. Syn. Main Pippin											Do.
Main Pippin. IllH'96. Syn. of Main											
Majetan. MagofH'51. Syn. of Majettin											
Majettin. L. Syn. Majetan, Winter Majettin	Eng	re	m	gru	tj	gw	sa		k	m	From Hogg.
Major. MagofH'53	Pa	robe	l	grs	cj	y	rsa	vg	dm	vl	
Major Sweet. Dap. Syn. of Andrew Sweet											
Makefield. AmGar'01	Pa		l	dr						l	Much like Smith but darker red.
Mala Carle. D. Syns. Charles Apple, Malcarle, Male Carle, Mela Carla, Mela de Carlo, Pomme de Charles, Pome Finale.	Italy	obc	m	pyb	jt	w	sa	g	d	ml	
Malaja Pipka. Gb. Syn. of Little Pipka											
Malakoff. Cat											Not described.
Malamuskeet. W. Syn. of Mattamuskeet											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Malcarle. K. Syn. of Mala Carle											
Male Carle. GenF'33. Syn. of Mala Carle											
Malenka. Cat											Not described.
Malinda. P'91 Syn. Melinda	Vt	rc	ml	yr	f	w	sa	g	dkm	vl	
Malingre. L. Syns. Calville Malingre, Pomme de Malingre		obl	vl	yrs		w	a		k	vl	From Hogg
Malinorka. Gb. Syn. of Raspberry											
Malinorka krasnaya. Gb. Syn. of Red Raspberry											
Malinovskoe. Gb. Syn. of Raspberry											
Malinowskoe. Gb. Syn of Raspberry											
Mallet. WisB77. Syn. of Mallett											
Mallett. A'69. Syn. Mallet	Rus	rob	l	gysc	cj	w	sa	g		ml	Prof. Budd thinks White Pelikanoff should be Mallett.
Maloney. P'95. Syn. Rosedale Pippin	Tenn	rc	l	ygrn	ftj	y	s	vg		ml	
Maltranche. D. Syn. of Imperial											
Mamma. D. Syn. Mammy Apple	South	ob	ml	rc		y	rsa			m	
Mamma Beam. Cole. Syn. of Belmont											
Mammoth. D. Syn. of Golden Pippin (N. E.? N. Y.?)											
Mammoth Black Twig. JBW&B. Syn. of Arkansas											
Mammoth Black Twig. TennBIX-1. Syn. of Paragon											
Mammoth Greening. A'77		robc	vl	gy	tj	w	sa	vg		ml	
Mammoth June. W	Ky	robc	m	wyrs	t	vw	sa	g	d	me	
Mammoth Pippin. W. Syn. of Gloria Mundi											
Mammoth Pippin. SBro. Syn. Arkansas Pippin. [Not Gloria Mundi.]											
Mammoth Pippin of Arkansas. SBro. Syn. Arkansas Pippin. [Distinct from Gloria Mundi.]											
Mammoth Rambo. A'77. Syn. of Grosh											
Mammy Apple. A'77. Syn. of Mamma											
Manaen. D	Pa	robc	m	wyb	tjm	yw	s	vg		me	From Rural New Yorker
Manchester. BBL											Not described.
Mangum. W. Syns. Alabama Pearmain, Blakely, Carter, Carter of Ala., Carter's Winter, Cheese, Fall Cheese, Gloucester Cheese, Gully, Johnson's Favorite, Magnum Bonum, Maiden's Favorite, Maxfield, Patton, Sam Wingard, Seago, Summer Cheese.	Ala	obc	m	yrs	vtjm	y	sa	vg-b	d	m	
Mangum. T. Syn. of Carter											
Mangum. W. Syn. of Patton. [Probably same as Mangum.]											
Manks. L. Syns. Eve of Scotland, Frith Pitcher, Frith Pippin, Irish Codlin, Irish Pitcher, Mank's Codlin.	Eng	roblc	m	pyb	fc	yw	bsa	g	k	m	
Mank's Codlin. GenF'33. Syn. of Manks											
Mank's Codling. CanB37. Syn. of Winter St. Lawrence											

Mann. Dap. Syn. Diltz	N. Y	rob	ml	gy	tjm	y	sa	g-vg	km	vl	
Manning. A'87. Syn. Manning's Blush	Wis		l	wb				vg	d	me	
Manning's Blush. CH. Syn. of Manning											
Manning Red. R. Syn. Manning's Red	Wis	obl	l	r					m	l	
Manning's Red. WisB15. Syn. of Manning Red											
Mannington. L. Syn. Mannington's Pearmain	Eng	rc	m s	yru	ct	y	bsa	vg	d	m	
Mannington. IllB45. Syn. of Red Astrachan											
Mannington's Pearmain. D. Syn. of Mannington											
Manomet. MagofH'48. Syns. Horse Block, Manomet Sweet, Manomet Sweeting.	Mass	rob	m	yb	tj		s	vg	dk	me	
Manomet Sweet. MagofH'48. Syn. of Manomet											
Manomet Sweeting. Cole. Syn. of Manomet											
Manor. P'94	Pa	rc	m	gyr	fmj	yg	sa	vg		ml	
Mansfield. L. Syn. Mansfield Russet	Mass	roble	s	ru			s	g-vg	dk	vl	
Mansfield Russet. W. Syn. of Mansfield											
Manwaring. A'83											Do.
Manx. R. Syn. Manx Codlin											Do.
Manx Codlin. GenF'33. Syn. of Manx											
Maple. JNCo	Iowa	ob	m	y			s	vg		e	One of Thompson's seedlings.
Maralandica. Hort'52. Syn. of Early Harvest											
Marble (Elliott). L. Mac Intire's Sweeting, Marble Sweet, Marble Sweeting, Virginia Sweet.		ro	ml	yr			s			ml	
Marble (Gb.). MHSC'86. Syns. Marble Apple, Mramornoe, Shro. to Ia. No. 97.	Rus										Not described.
Marble Apple. IaB'90. Syn. of Marble (Gb)											
Marble Sweet. D. Syn. of Marble (Elliott)											
Marble Sweeting. E. Syn. of Marble (Elliott)											
March. L. Syns. March's Red Seedling, March's Red Winter	Ohio	r	ms	yb	tj	y	psa	g		ml	
March's Red Seedling. D. Syn. of March											
March's Red Winter. D. Syn. of March											
Margaret. DomEnc Syns. Duverson's June, Early June, Early Margaret, Early Red Juneating, Early Red Margaret, Early Striped Juneating, Eve Apple of the Irish, Herr's June, Herr's Striped June, June of some in Ohio, Margaretha Apfel of Germans, Marguerite, Red June, Red Juneating, Red Margaret, Southern Striped June, Strawberry Apple, Striped June, Striped Juneating, Striped Quarrendon, Summer Traveler, Virginia June.	Eng	roc	ms	gyrs		w	sa	g		e	
Margaretha Apfel of the Germans. E. Syn. of Margaret											
Margil. GenF'33. Syns. Munche's Pippin, Neverfail, White Margil	Eng	rob	s	yrs		y	sa	g	d	m	
Marguerite. GenF'33. Syn. of Margaret											
Maria Bush. W	Pa	rob	l	yrs	tj	w	rsa	g	d	m	
Marias. R. Syn. Marias des Cygnes											Do.
Marias des Cygnes. BBL. Syn. of Marias.											
Marie Pinel de la Toule. Cat. Syn. of Toule											
Marietta. R. Syn. Marietta Seek-no-further		ob	m	rs			sa	vg		m	Possibly Westfield. See Mag. of H.'49, 26.
Marietta Russet. D. Syn. of Roxbury											
Marietta Seek-no-further. IllB45. Syn. of Marietta											
Marietta Seek-no-further. MagofH'49. Syn. of Westfield											
Marigold. L. Syn. Creed's Marigold	Eng	r	m	yrs	tj	y	s			m	From Hogg.
Marigold. Lin. Syn. of Orange Pippin (Fr.)											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Marigold Pippin. K. Syn. of Orange Pippin (Fr.)											
Marion. L. Syn. General Marion	S. C	robc	ms	pyrs	cmj	w	sa	g-vg		l	
Marion Red. A'95. Syn. Marion County Red											Not described.
Marion County Red. WashB26. Syn. of Marion Red											
Mark. R. Syns. Mark's, Mark Sweet							s				Do.
Mark's. Hort'53. Syn. of Mark											
Mark Sweet. MagofH'53. Syn. of Mark											
Market. W	Va	r		rs			sa				
Markley. R. Syn. Markley's Red	Cal										Do.
Markley's Red. A'95. Syn. of Markley											
Markovka. MHSC'86. Syn. Shro. to Ia. No. 162	Rus.										Do.
Marks. MagofH'53	Pa	rc	m	yw	t	w	bsa	g		l	
Marl. R. Syn. Marl Bank											Do.
Marl Bank. FDNCo. Syn. of Marl											
Marlboro. R. Syns. Marlboro Sweet, Marlborough Sweet	Mass.		l	drs			s	vg			
Marlboro Sweet. JWA&C. Syn. of Marlboro											
Marlborough Sweet. Hort'46. Syn. of Marlboro											
Marmalade (Rus.). MHSC'86. Syns. Marmeladnoe, Shro. to Ia. No. 144	Rus.	rob	m	rs			s	g	dk	m	
Marmalade (Eng.). VanD. Syns. Althorp Pippin, Marmalade Pippin, Welsh Pippin.	Eng	robl	ml	yb	fj	yw	s			ml	
Marmalade Pippin. MagofH'50				rs						me	
Marmalade Pippin. D. Syn. of Marmalade (Eng.)											
Marmeladnoe. Gb. Syn. of Marmalade (Rus.)											
Marquis. MagofH'44	Mass.	r	ml	y					d	vl	
Marquis. Cat. [Possibly a syn. of Lorne.]											Do.
Marquis of Lorne. Dap. Syn. of Lorne											
Marrow. L. Syn. Early Marrow	Scot	rc	l	ywb	t			g	k	m	
Marrowfat. JRJ			l	r					k	me	
Marrow Pippin. D. Syn. of Ortley											
Marsh. P'93	Tenn	r	m	g	tj	gw	sa	g		l	
Marshall. D	N. H. ?	rob	ml	gb					m	vl	From Maine Hort. Report
Marshall Red. L. Syns. Marshall's Red, Marshall's Red of California, Marshall's Seedling, Red Bellflower.	Cal	r	l	r			a	vg		m	
Marshall's Red. Wn. Syn. of Marshall Red											
Marshall's Red of California. BBL. Syn. of Marshall Red											
Marshall Seedling. R. Syn. Marshall's Seedling		c	ml	ywb	fcj	w	sa			l	May be Marshall Red
Marshall's Seedling. CanExR'01. Syn. of Marshall Seedling											
Marshall's Seedling. Wn. Syn. of Marshall Red											
Marshall Sweet. L. Syn. Marshall's Sweet, Marshall's Sweet Favorite	Ohio	robc	ms	yrs	tmj	ws	s	g	k	ml	
Marshall's Sweet. D. Syn. of Marshall Sweet											

Marshall's Sweet Favorite. W. Syn. of Marshall Sweet											
Marston. L. Syn. Marston's Red Winter	N. H	rc	ml	wyrse	vjt	wy	sa	g-vg	d	l	
Marston's Red Winter. K. Syn. of Marston											
Martha. A'87,	Wis		m	r				g	dm	ml	
Martha Washington. ColExR'96	Ark		l	yrs			sa			l	
Martin. D. Syn. Martin Apple	Ohio	rob	ml	yrs	tj	y	msa	g	km	me	
Martin. E. Syn. of McLellan											
Martin Apple. A'67. Syn. of Martin											
Martin Nonpareil. K	Eng	rob	s	yru	ctj	y	bsa	vg	d	l	
Martin's Red. ArkB49. Syn. of Ozone											
Mary. D		r	ms	yrsc	emj	w	msa	g-vg		l	
Mary (Wis.) CH	Wis		l	r					d	l	Originated by Wm. Springer, Waupaca Co., Wis.
Mary Chester. W	South	ob		rs			sa				
Mary Coffin. BBL											Not described.
Marygold. MagofH'37. Syn. American Marygold	Am	ob		y			sa			m	Differs from Marigold, the English variety.
Maryland. H. Syns. Maryland Beauty, Maryland Red Streak		ob	m	wrs	tj	w	sa	g		m	
Maryland. Bul8. Syn. of Maryland Maid											
Maryland Beauty. D. Syn. of Maryland											
Maryland Cheese. D. Syn. of Summer Cheese											
Maryland Maid. R. Syns. Maiden's Blush, Maryland, Maryland Maiden Blush.	Md	rc	m	yr	ft	w		vg	mk	ml	
Maryland Maiden Blush. JWK. Syn. of Maryland Maid											
Maryland Queen. Dap. Syn. of Haas											
Maryland Red Streak. MoH'63. Syn. of Maryland											
Maryland Spice. JWK			m	r				vg		me	
Mary Moyer. W	South	ob		rs			sa				
Mary Womack. W. Syn. of Womack											
Mason. A'77. [Possibly a syn. of Mason Stranger. See A'77,123.]	W. Va										Not described.
Mason Orange. (LC). Syns. Bellflower Improved, Mason's Orange	Kans	robl	l	y				g	dm	l	Almost certainly originated in Kansas.
Mason Pippin. AHortA'69. Syn. of Mason Stranger											
Mason's Orange. MoH'83. Syn. of Mason Orange											
Mason's Pippin D. Syn. of Mason Stranger											
Mason Stranger. L. Syns. Izzard, Mason Pippin, Mason's Pippin, Old Field.	Va	ob	m	yb	cj	w	rmsa	vg		l	
Mason Sweet. S&H			m	yr			s				
Mass. Golden Russet. Dap. Syn. of Hunt Russet											
Massay Seedling. R. Syn. Massay's Seedling. [Perhaps same as Massey.]											Not described.
Massay's Seedling. IllB45. Syn. of Massay Seedling											
Massey. L. Syn. Massey's Winter	South									l	Do.
Massey's Winter. W. Syn. of Massey											
Masten. D. Syn. Masten's Seedling	N. Y	rc	ms	yb	ftj	w	psa	g		l	
Masten's Seedling. Hort'66. Syn. of Masten											
Master. L. Syns. Master's, Master's Seedling	Eng	r	m	ygb		w	pa			ml	
Master's. D. Syn. of Master											
Master's Seedling. D. Syn. of Master											
Masters. MagofH'42. [Originated with Mr. Masters, Greenland, N. H.]	N. H										Do.
Mastodon. A'75											Do.
Matamuskeet. F. Syn. of Mattamuskeet											
Matapfel. D. Syn. of Rostocker											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Matchless. D. Syn. of Adams Pearmain											
Matchless. GenF'33. Syn. of Newtown Spitzenburg											
Mathew Fall. L. Syn. Mathew's Fall											Not described.
Mathew's Fall. Cat. Syn. of Mathew Fall											
Mathews. Dap	Va	rob	m	wb	ftjm	w	sa			ml	
Mathews. IllH'00. Syn. of Wisconsin Russet											
Matilda. A'71	Va							g			Do.
Matimuskite. F. Syn. of Mattamuskeet											
Matlock. L. Syn. of Matlock's Summer	Ky	ob	l	rs			sa	g		me	
Matlock's Summer. Hort'56. Syn. of Matlock											
Matson. A'54			l	rs			a	g	km		
Mattamuskeet. D. Syns. Malamuskeet, Matamuskeet, Matimuskite	N. C	robc	m	yrs	c	wy	bsa	g		l	
Matteaux's Seedling. D. Syn. of Beachemwell											
Matthew Russet. IllH'86. Syn. of Wisconsin Russet											
Matthew Stripe. D. Syn. of Lyscom											
Mattock. R. Syn. Mattock's Summer											Do.
Mattock's Summer. IllB45. Syn. of Mattock											
Mauck. MagofH'53. Syns. Giant, Lecher, Long Keeping	Pa	c	l	gyb	t		p	g		m	
Maverack. L. Syns. Maverack's Sweet, Maverick Sweet	S. C	rob	l	yb	t	y	brs	g-vg	k	ml	
Maverack's Sweet. D. Syn. of Maverack											
Maverick Sweet. W. Syn. of Maverack											
Mawhinney. CH	Wis		l	r			a			l	
Maxey. AHortA'70. Syn. Maxey Red, Maxley	Ky	rc	ml	grs		w	sa	g	dm	vl	
Maxey Red. RNY'69. Syn. of Maxey											
Maxfield. D. Syn. of Mangum											
Maxley. A'75. Syn. of Maxey											
May. W. Syns. May Apple, May (of Meyers), May Seeknofurther, Myers Apple, Pillkin, Plymouth Greening, Rhenish May, Rhenish May (of Illinois), Winter May.	Va	rc	m	gyb	fc	w	msa	g	km	vl	
May. Cat. Syn. of Myers (?) [Probably May]											
May. D. Syn. of White Paradise											
May Apple. D. Syn. of May											
May Apple. F. Syn. of White Juneating											
May Apple Pippin. WVaB75. Syn. of White Juneating											
Mayberry. L. Syn. Mayberry Seedling	Va.?										Do.
Mayberry Seedling. W. Syn. of Mayberry											
May (erroneously). D. Syn. of Greyhouse. [May Seeknofurther.]											
Mayflower. NEF'52	Mass		m							vl	
May Flower. IllH'70. Syn. of Baltimore (Elliott)											
May Large Yellow. A'73. [Catalogued by the Society.]											Do.

Mayling. MagofH'53											Do.
Maynard. L. Syn. Maynard No. 1	Ky										Do.
Maynard No. 1. W. Syn. of Maynard											
Mayne. R. Syn. Mayne Island											Do.
Mayne Island. BBL. Syn. of Mayne											
May (of Adair). IllB45			m					p		me	
May (of Meyers). H. Syn. of May											
May (of Virginia). D. Syn. of White Juneating											
May Pippin. LaB3			s	y				g		ve	Probably same as White Juneating.
May Pippin. D. Syn. of White Juneating											
May Queen. W	Ohio	ob	s	y			sa	g		e	
May's Seedling. P'94. Syn. of Almota											
May Seek-no-further. E. Syn. of Greyhouse											
May Seek-no-further (of some). D. Syn. of May											
May Yellow. JVL. Syn. of White Juneating											
Mazensks. ColExR'88											Not described.
Meach. D	Vt	re	l	yrs	jm	y	sa	g		m	
Meacham Sweet. D. Syn. of Munson											
Mead. L. Syn. Mead's Keeper										l	Do.
Meader. R. Syn. Meader's Winter	Minn									l	
Meader's Winter. MinnHort'96. Syn. of Meader											
Mead's Keeper. W. Syn. of Mead											
Meadow. L. Syns. Borovinka lugovaya, Borowinka lugouaja, Gov. list No. 548, Meadow Borovinka, Meadow's Mushroom.	Rus										Do.
Meadow Borovinka. Gb. Syn. of Meadow											
Meadow's Mushroom. Gb. Syn. of Meadow											
Meadow Sweet. D		rob	m	py	tj	w	s	g		ml	
Mear. L. Syns. Mear's Seedling, Mear's Sweet	Ohio	rob	ms	gyb	jtm	w	s	g		l	
Mear's Seedling. W. Syn. of Mear											
Mear's Sweet. D. Syn. of Mear											
Mecklenburg. JVL	N. C		m	rs		y	sa	vg		l	
Medbery. MagofH'53											Do.
Medfield. NEF'50	Mass	ob	m	yr				g		l	
Medium. R. Syn. Medium Red Long keeper											Do.
Medium Red Long keeper. IllB45. Syn. of Medium											Do.
Meek. L. Syn. Meek's Seedling											
Meek's Seedling. Cat. Syn. of Meek											
Megginch Favorite. .GenF'33. Syn. of Golden Reinette (Eur.)											
Meigs. A'60. Syn. of Buckingham											
Meigs. D. Syn. of Buncombe											
Meister. MagofH'57	Pa	re	ms	gyrs	t		psa	g		m	
Mela Carla. M. Syn. of Mala Carle											
Mela de Rosmarino. K. Syn. of Red Romarin											
Mela di Carlo. GenF'33. Syn. of Mala Carle											
Mela di Rosmarino rossa. D. Syn. of Red Romarin											
Mela Januera. K. Syn. of Canada Reinette											
Melinda. IllH'94. Syn. of Malinda											
Melling. IllH'96. [May be same as Mellinger.]											Do.
Mellinger. A'77. Dap	Pa	re	ml	rs			sa			m	
Mellott. BBL											Do.
Mellow. R. Syn. Fall Mellow	For	robl	l	wy	tmj	w	sa				

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Melon. MagofH'47. Syns. Norton's Melon, Watermelon	N. Y	robc	ml	pyrs	vt	w	rsa	vg-b	dkm	ml	
Melon. Gb. Syn. of Bell (Melonen). [Doubtless same as Melonen.]											
Melon. A'77. Syn. of Gloria Mundi											
Melon. Gb. Syn. of Melonen											
Melonen. Gb. Syns, Gov. list No. 568, Melon, Melonenapfel	Rus		l	rs			sa	vg	d	e	
Melonen. Gb. Syns. Melonen oder nonnen, Nun, Shro. to Ia. No. 29	Rus										Not described; probably identical.
Melonen. Gb. Syns. Bell, Shro. to Ia. No. 61, Svonkoeili dinnoe	Rus										
Melonenapfel. Gb. Syn. of Melonen											
Melonen oder nonnen. Gb. Syn. of Melonen											
Melon Sweet. OreB22											Not described.
Melrose. D. Syn. White Melrose	Scot	robc	l	py	f	yw	msa			m	
Melting. E. Syns. Melting Mouth, Melt-in-the-Mouth	Pa	rc	ms	yrs	tj	yw	rpsa	vg	d	m	
Melting Mouth. E. Syn. of Melting											
Melting Pippin. D. Syn. of Ortley											
Melting Sweet. A'83											Do.
Melt-in-the-Mouth. D. Syn. of Melting											
Melt-in-the-Mouth (of some). D. Syn. of Choice											
Melville Sweet. MagofH'47. Syn. of Melvin											
Melvin. L. Syns. Melville Sweet, Melvin Sweet	Mass	r	m	ygrs	r		s	g		ml	
Melvin Sweet. MagofH'47. Syn. of Melvin											
Memel. BBL											Do.
Menage. L. Syn. Mere de Menage		c	vl	yrs	frj		sa		km	m	
Menagen. OntExR'82											Do.
Menagere. AmF'63. Syn. Menagerie	Eur	ob	vl	pyb	mj		sa	g	k	ml	
Menagerie. E. Syn. of Menagere											
Menary. IaH'84. Syn. Meneray											Do.
Meneray. MinnExR'90. Syn. of Menary											
Menoher. R. Syns. Menoher's No Core, Menscher's No Core											Do.
Menoher's No Core. BBL. Syn. of Menoher											
Menonisten. L. Syns. Menonisten Reinette, Reinette des Menonistes	Ger	rob	m	yrub	fj		sa	g	d	ml	
Menonisten Reinette. D. Syn. of Menonisten											
Menscher's No Core. GarM'74. Syn. of Menoher											
Mensfeld. L. Syns. Calville d'Hivre de Mensfeld, Mensfeld Calville, Mensfelder Gulderling, Mensfelder Winter Calville.	Eur	robl	l	yg	ft		sa	g	dk	ml	From the Verger.
Mensfeld Calville. D. Syn. of Mensfeld											
Mensfelder Gulderling. D. Syn. of Mensfeld											
Mensfelder Winter Calville. D. Syn. of Mensfeld											
Mensk. Gb. Syns. Gov. list No. 481, Mtsenkoe, Mzensk, Mzenskoe	Rus										Not described; perhaps identical.
Mensk. Gb. Syns. Mtenskoe, Shro. to Ia. No. 81	Rus										

Meraine. ColExR'88									k	l	
Mercer. D		rob	m	py	tje	w	sa	g		m	Quite probably distinct.
Mercer. (Miss.?) A'75	Miss.?	ob	m	wrs	ftj	w	sa	vg		me	
Mere'de Menage. GenF'33. Syn. of Menage											
Merienwerder. R. Syn. Golden Merienwerder		obl	ml	gy	jc	w	sa			me	
Merit. NWC		rob	l	rs	tj	y	sa	vg		ml	Possibly Buckingham.
Merit. D. Syn. of Buckingham											
Merkeley. L. Syn. Merkeley's Red	Cal		l	rs			sa		m		
Merkeley's Red. Wn. Syn. of Merkeley											
Merrill. L. Syns. Merrill's, Merrill's Apple	N. Y	r	m	lyb		y	rsa	g		l	
Merrill's. D. Syn. of Merrill											
Merrill's Apple. D. Syn. of Merrill											
Merrit Pearmain. R. Syns. Merrit's Pearmain, Merritt's Pearmain, Royal Pearmain.	Va.?	rob	l	rru	fr	y	sa	vg	dc	ml	
Merrit's Pearmain. DomEnc. Syn. of Merrit Pearmain											
Merritt. L. Syn. Merritt's Sweet		ob	m	yb	c		vs	g	k	me	
Merritt's Pearmain. D. Syn. of Merrit Pearmain											
Merritt's Sweet. W. Syn. of Merritt											
Merwin. D		rob	ml	pyrs	mjc	y	sa	g		ml	
Metalybl. AlaB98											Not described.
Metell. AlaB98											Not described; perhaps identical.
Metett. BBL											
Methodist. D	Conn	oblo	m	grs	t	w	sa	g		m	
Metoiree. D. Syns. French Crab, Metoisee		obl	m	yb	j			g	k		
Metoisee. C. Syn. of Metoiree											
Metott. (LC)	Eur										Not described.
Mexico. MagofH'40	Conn	rob	m	yrsc	tj	ws	psa	g-vg	d	m	
Michael Henry. DomEnc. Syns. Michael Henry Pippin, Rariton Sweet, White Pearmain, White Winter Pearmain.	N. J	roblo	m	yg	tj	gw	rmsa	g-vg	dk	ml	
Michael Henry Pippin. C. Syn. of Michael Henry											
Michael Sweet. R. Syn. Michael's Sweet											Do.
Michael's Sweet. IllB45. Syn. of Michael Sweet											
Michell. L. Syn. Michell's Seedling											Do.
Michell's Seedling. Cat. Syn. of Michell											
Michenor. L. Syn. Michenor's Red Sweet	Ohio	r	ml	rs			s	g		l	
Michenor's Red Sweet. W. Syn. of Michenor											
Michigan Beauty. D. Syn. of Shiawassee											
Michigan Golden. W. Syn. of Michigan Golden Pippin	Mich	re	l	y			sa	vg	dk	m	
Michigan Golden. D. Syn. of Lowell											
Michigan Golden Pippin. A'60. Syn. of Michigan Golden											
Michigan Winter. L. Syn. Michigan Winter Pippin	Mich.?	ob	l	y			sa	g		l	
Michigan Winter Pippin. W. Syn. of Michigan Winter											
Mickel. R. Syn. Mickel No. 1	Wis	ob	l	gws	ftj	w	sa	g		m	
Mickel No. 1. P'92. Syn. of Mickel											
Mickleham. R. Syn. Mickleham Pearmain											Do.
Mickleham Pearmain. BBL. Syn. of Mickleham											
Micoud. L. Syn. Calville Rouge de Micoud	Fr	rob	m	yrb		yw	s			me	From Lindley.
Middle. MagofH'49. Syn. Mittel	N. Y	roble	ms	gy	t	w	bsa	g		ml	
Middlebourg. L. Syns. Middlebourg Reinette, Reinette de Middlebourg.	Hol	robl	m	gy	fr	yw	sa			l	From the Verger.
Middlebourg Reinette. D. Syn. of Middlebourg											
Middleton. IllH'85	Ill			gr				vg			
Middleton Greening. BBL											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Midwinter. A'03	Iowa									l	
Mifflin. L. Syn. Mifflin King	Pa	ob	s	wb	ctj	w	sa	g		m	
Mifflin King. A'52. Syn. of Mifflin											
Mignonne. L. Syn. Mignonne d'Hiver	Fr.?	obc	ms	gyb	fmj	w	s			ml	
Mignonne d'Hiver. D. Syn. of Mignonne											
Mihalyfe. BBL											Not described.
Milam. MB&Co			m	r						l	Perhaps is Milam.
Milam. Hort'50. Syns. Blair, Harrigan, Red Winter Pearmain, Rusty Coat Milam, Thomas, Winter Pearmain (of some).	South	rc	ms	grs	f		psa	g	dmk	l	
Milam Vert. WVaB75											Not described.
Milburn. TennBI-IX. Syn. K's Seedling	Tenn	obobl	l	y	ftj	w	sa	vg		vl	
Milch. D. Syns. Brauschweiger Milch, Milch Apfel	Ger	r	ml	wcs	tc	w	sa			me	
Milch Apfel. D. Syn. of Milch											
Milden. A'73. Syn. Milding	N. H	obc	l	rs			sa	g	dkm	ml	
Milding. Dap. Syn. of Milden											
Mill. R. Syn. Mill's Sort											Do.
Millboy. P'95	W. Va	rob	ml	yrsc	ftj	y	s	g	d	me	
Millbrook. P'95. Syn. Mill-brook	Del	rob	m	wrs	fc	yw	sa	g-vg		ml	
Mill-brook. PE. Syn. of Millbrook											
Mill Creek. Hort'49. Syn. of Smokehouse											
Mill Creek. E. Syn. of Vandevere											
Mill Creek Vandevere. Hort'49. Syn. of Smokehouse											
Mill Creek Vandervere. E. Syn. of Vandevere											
Miller (N. Y.) D. Syns. Miller's Apple, Miller's Seedling	N. Y	robc	ml	yrs	tc	y	psa	g-vg		m	}Possibly identical.
Miller (Pa.) D	Pa	rob	ms	wyrs	jt	ws	sa	g		m	
Miller (Wis.) CH	Wis		l	r				g	dk	l	
Miller. D. Syn. of Hiester											
Miller Apple. A'71. Syn. of Mahaska											
Miller's Apple. W. Syn. of Miller											
Miller's Apple. W. Syn. of Powers (Ohio)											
Miller's Best Sort. T. Syn. of Progress											
Miller Cherokee. R. Syn. Miller's Cherokee	Utah		l	r						vl	
Miller's Cherokee. A'77. Syn. of Miller Cherokee											
Miller's Seedling. D. Syn. of Ellsworth											
Miller's Seedling. Hort'58. Syn. of Miller											
Milligen. NYB15											Not described.
Milliken. L. Syns. Milliken's Sweet, Milliken's Winter Sweet	Ohio?	r	l	y			s	g		l	
Milliken's Sweet. W. Syn. of Milliken											
Milliken's Winter Sweet. IndH'67. Syn. of Milliken											
Mills. R. Syn. Mills Seedling. [Probably a crab. See SDB76, 74.]											Do.

Mills Seedling. MinnExR'90. Syn. of Mills											
Millisburg. R. Syn. Millisburgh Pippin											Do.
Millisburgh Pippin. IllH'68. Syn. of Millisburg											
Mill's Sort. IndH'72. Syn. of Mill											
Millwood. L. Syn. Millwood Green											Do.
Millwood Green. W. Syn. of Millwood											
Milo. AJofHVII	N. Y		m	wrs	etj	w	sa	vg		m	
Milton. A'87											Do.
Milton Golden Pippin. D. Syn. of Golden Pippin (Eng.)											
Milwads. L. Syn. Winter Sweet Milwads										l	Do.
Milwaukee. JVC	Wis	robl	l	yrs			sa	g	km	l	Originated with Geo. Jeffery, Milwaukee, Wis.
Mims. A'83	S. C	ob	ml	yrs	fj	w	s	vg		m	
Minch. BBL											Not described.
Minchall. L. Syns. Lancashire Crab, Lancaster Crab, Minchall Crab, Mincham's Crab, Minshul Crab.	Eng	rob	ml	yrub	cj	w	ba		k	ml	From Ronalds.
Minchall Crab. D. Syn. of Minchall											
Mincham's Crab. D. Syn. of Minchall											
Mingo. AHortA'71	Ohio	rob	l	yrs	j	y	bsa	g-vg	km	vl	
Minier. L. Syn. Minier's Dumpling	Eng	r	l	gb	fj		sa			ml	From Lindley.
Minier's Dumpling. D. Syn. of Minier											
Minister. M	Mass	oblc	l	gyrs	vt	yw	a	g-vg	dk	ml	
Minkler. Syns. Brandywine, Logan's Northern Pippin, Mumper Vandevere	Pa	robc	m	gyrs	emj	y	sa	g	mk	l	This is Mumper Vandevere of Downing's appendix.
Minkler Molasses. L. Syn. Minkler's Molasses	Ill	ob	m	y			s	g		l	
Minkler's Molasses. W. Syn. of Minkler Molasses											
Minnesota. FDNCo. [May be Minnesota Crab.]											Not described.
Minnesota. R. Syn. Minnesota Gilbert	Minn?	ob	l	ygrse	j	w	sa	g	k	me	First noticed at E. B. Jordan's, Rochester, Minn.
Minnesota Gilbert. SDB76. Syn. of Minnesota											
Minot. MagofH'37											Not described.
Minshul Crab. D. Syn. of Minchall											
Miron. BBL											Do.
Mirone Sacharni. Gb. Syn. of Sugar Miron											
Miron krasnui. Gb. Syn. of Red Miron											
Miron ploskui. Gb. Syn. of Flat Miron											
Miron rshevski. MHSC'86. Syn. of Rschev Miron											
Miron Sacharuni. Gb. Syn. of Sugar Miron											
Mirror. (LC)	Eur.										Do.
Mishler. L. Syn. Mishler's Sweet	Pa.?	roblo	l	gy	tjm	w	s	g		m	
Mishler's Sweet. D. Syn. of Mishler											
Miskimmin. R. Syn. Miskimmin Sweet											Do.
Miskimmin Sweet. MagofH'53. Syn. of Miskimmin											
Missing Link. IllH'97	Ohio?	obobl	l	gr	tj	y		g		vl	Probably same as Willow.
Mississippi (?). D. Syn. of Gloria Mundi											
Mississippi Superior (?). AmGar'01. Syn. of Maccabee. [Evidently McAfee.]											
Missouri. L. Syns. Missouri Keeper, Missouri Orange, Missouri Pippin	Mo	rob	ml	wyrs	e	w	bsa	g	km	l	
Missourian. D. Syn. of McAfee. [Striped Winter of Mr. Lyon.]											
Missouri Janet. D. Syn. of Ralls											
Missouri Keeper. D. Syn. of McAfee. [Striped Winter of Mr. Lyon.]											
Missouri Keeper. W. Syn. of Missouri											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Missouri Orange. A'81. Syn. of Missouri											
Missouri Pearmain. IllB45											Not described.
Missouri Pippin. AHortA'71. Syn. of Missouri											
Missouri Pippin. D. Syn. of Nickajack											
Missouri Queen. AHortA'71	Mo.?	rc	vl	yrsc	fj	y	bmsa	g-vg	dk	ml	May be Buckingham.
Missouri Red. MoH'70	Mo		l					g		l	
Missouri Red. D. Syn. of Nickajack											
Missouri Red Winter. Cat. Syn. of Missouri Winter											
Missouri Spy. Cat											Not described.
Missouri Superior. IllB45. [Probably McAfee.]											Do.
Missouri Superior. AHortA'70. Syn. of McAfee											
Missouri Winter. L. Syn. Missouri Red Winter											Do.
Mr. Gladstone. BBL. [Probably a syn. of Gladstone.]											Do.
Mrs. Bryan. BBL. [Doubtless same as Bryan.]	Ga										Do.
Mrs. De Caradeuc. W. Syn. of Caradeuc											
Mrs. Dallas. P'95. Syn. of Dallas											
Mrs. Hayes. Cat. Syn. of Hayes											
Mrs. Ryan. OklB2. [Probably intended for Bryan.]											Do.
Mrs. Weaver's Sweet. D. Syn. of London Sweet.]											
Mitchell. R. Syn. Mitchell's Iowa Seedling											Do.
Mitchell's Iowa Seedling. MinnExR'90. Syn. of Mitchell											
Mitchell of Dorchester. Cat. Syn. of Dorchester											
Mitchell Red. R. Syns. Mitchell's Red Warrior, Red Warrior											Do.
Mitchell's Red Warrior. SDB65. Syn. of Mitchell Red											
Mitchelson. L. Syn. Mitchelson's Seedling	Eng	rc	ml	yrub	fc	y	bsa		dk	ml	From Hogg.
Mitchelson's Seedling. D. Syn. of Mitchelson											
Mittel. Hort'55. Syn. of Middle											
Mitter. R. Syn. Mitter's Red											Not described.
Mitter's Red. IllH'88. Syn. of Mitter											
Mittinger. MichB31											Do.
Mobbs. D. Syn. of Nickajack											
Mock. P'95. Syn. Mock's Winter	Ark	r	l	yr	fcj	y	rsa	g		l	
Mock's Winter. ArkB49. Syn. of Mock											
Modoc. BBL											Do.
Mohawk. MagofH'53. L. Syn. Striped Mohawk		r	ml	yrs				p		m	
Mohler. MoH'87	Mo.?		m	rs			sa	g		l	
Molasses. H. Syn. of Apple Butter											
Molasses (Ohio). W	Ohio	c	s	y			s	g		l	
Molasses (N. C.). E	N. C	ob	ml	rs			s	g		l	
Molasses (Am.). E. Syn. Butter	Am	r	s	y			s				

Molasses Apple. C. Syn. of New England Sweet											
Molasses Sweet. D. Syn. of Priest											
Mollie. RNY'70. Syn. Molly	Minn	ob	m	yg	t		sa			ml	A seedling of Oldenburg.
Molly. IllH'68. Syn. of Mollie											
Molly Whopper. D. Syn. of Fallawater											
Monarch. NWFG'52. Syn. Monarch Sweet		rob	m	rs	j		sa	g		m	
Monarch Sweet. NWFG'52. Syn. of Monarch											
Monday. L. Syns. Golden Monday, Monstow's Pepping	Eng	rob	s	yrn	c	yw	s	b	d	m	From Hogg.
Monks. R. Syn. Monk's Favorite	Ind	r	l	yrs	tj	yw	sa	g	dkm	m	
Monk's Favorite. W. Syn. of Monks											
Monkland. L. Syn. Monkland Pippin		r	s	gy		gw		p		m	
Monkland Pippin. D. Syn. of Monkland											
Monkton. D	Eng	ob	ms	rse	j	y	ba		e		Do.
Monmouth. A'51. Syns. Hopkin's Red Cheek, Monmouth Pippin, Red Cheek, Red Cheek Pippin.	N.J	obc	l	pyb	jf		bsa	vg-b	dk	ml	
Monmouth Pippin. K. Syn. of Monmouth											
Monmouthshire. R. Syn. Monmouthshire Beauty											Not described.
Monmouthshire Beauty. BBL. Syn. of Monmouthshire											
Mononk. IllH'72											Do.
Monroe. W	Ohio										Do.
Monroe Sweet. MeExR'93											Do.
Mons de Nikitor. IllH'99. Syn. of Nikitor											
Monsees. P. Syn. Hopewell	Mo	obl	l	rse				vg	km	l	Name changed from Hopewell.
Monstow's Pepping. D. Syn. of Monday											
Monstreuse de Nitika BBL. Syn. of Nitika											
Monstrous. GenF'33. Syn. of Green Codlin											
Monstrous Bellflower. C		robl	l	yb	j	w	bsa	g		m	Almost certainly Ortley, R.
Monstrous Pippin. DomEnc. Syn. of Gloria Mundi											
Monstrous Rambo. A'77. Syn. of Grosh											
Monstrous Red. L. Syns. Monstrous Red Reinette, Monstrous Rennet		r	l	rs				vg	dk	ml	
Monstrous Red Reinette. Lin. Syn. of Monstrous Red											
Monstrous Rennet. DomEnc. Syn. of Monstrous Red											
Montalivet. D	Fr	r	ms	y	fj	y	psa	g		l	
Monte Bello. IllH'69	Ill	ob	ml	pyrs	vtj	ws	sa	vg		m	
Montgomery Sweet. Hort'46. Syn. of Autumn Bough											
Montreal. E. Syn. of St. Lawrence											
Montreal Peach. L. Syn. Peach of Montreal	Que	oble	ml	y			sa	vg	dm	m	
Montreal Peach. N. Syn. of Peach (Montreal)											
Montreal Strawberry. CanB37											Not described.
Moody. NEF'32. Syn. Moody's Seedling or Grandfather											Do.
Moody's Seedling or Grandfather. MagofH'38. Syn. of Moody											
Mook. AmGar'01. [Mentioned by Professor Waugh.]	Pa										Do.
Moon. A'77	Ga	oble	ml	yc	c	w	bsa	g		e	
Moore. D. Syn. Moore's Seedling	Eng.?	robe	l	gyrs	t	y	ps	vg	k	m	From Hogg.
Moore Extra. L. Syn. Moore's Extra	Ohio	re	ml	yrs	tjm	y	sa	vg		l	
Moore's Extra. Hort'68. Syn. of Moore Extra											
Moore Favorite. L. Syn. Moore's Favorite											Not described.
Moore's Favorite. BBL. Syn. of Moore Favorite											
Moore Greening. L. Syn. Moore's Greening	Conn	roble	m	gy	jt	w	bsa	g		l	
Moore's Greening. NEF'32. Syn. of Moore Greening											
Moore's Late Sweet. Cole. Syn. of Moore Sweet											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Moore Ruby. BBL											Not described.
Moore Seedling (Ohio). RNY'61	Ohio	r	l	rs			sa	vg		l	
Moore Seedling (Ont.). R. Syn. Moore's Seedling	Ont										Do.
Moore's Seedling. D. Syn of Moore											
Moore's Seedling. A'97. Syn. of Moore Seedling (Ont.)											
Moore's Shanty. IndH'70. Syn. of Moore Sweet											
Moore Sweet. L. Syns. Black Sweet, Kelley's Sweet, Polhemus (Long Island), Pound Sweet (of some), Moore's Late Sweet, Moore's Shanty, Moore's Sweet, Moore's Sweeting, Red Sweet Pippin, Sweet Pippin, Red Winter Sweet (of some), Josie Moore.		rob	m	dr		y	rpvs	g	dkm	vl	
Moore's Sweet. D. Syn. of Moore Sweet.											
Moore's Sweeting. NEF'29. Syn. of Moore Sweet											
Moorhen. L. Syn. Moorhen Pippin	Eng	rob	ms	grub	f		rp		d	vl	From Ronalds.
Moorhen Pippin. D. Syn. of Moorhen											
Moose. D. Syn. of Mouse											
Moregi. IndH'88	Rus		l			y		g	dk	l	Not identified by Mr. Gibb in his catalogue.
Moregi. Gb											
Moreland. D	Pa		m	yb			pa	g	k	m	
More Ruby. L. Syn. More's Ruby											Not described.
More's Ruby. Cat. Syn. of More Ruby											
Morey. R. Syn. Morey's Melon		rob	s	gy			sa	vg		me	
Morey's Melon. Hort'48. Syn. of Morey											
Morgan. C. Syns. Morgan Apple, Morgan White	N. J	rob	l	grb	tj	gw	ba	g		ml	
Morgan. TennBI-IX. Syn. of Langdon											
Morgan Apple. DomEnc. Syn. of Morgan											
Morgan Christmas. R. Syn. Morgan's Christmas	N. C	ob	ml	rb				vg		l	
Morgan's Christmas. WTH&Co. Syn. of Morgan Christmas											
Morgan Favorite. L. Syn. Morgan's Favorite		r	l	rs				vg	d	ml	
Morgan's Favorite. K. Syn. of Morgan Favorite											
Morgan's Favorite. D. Syn. of Twenty Ounce											
Morgan Sweet. H											Do.
Morganton. L. Syn. Beauty of the World	N. C	ob	m	yrsc	f	w	rsa	vg		l	
Morgan White. W	Ill	rob	ml	yrs	tj	gw	ba	g		ml	Probably same as Morgan.
Morgan White. W. Syn. of Morgan. [Of doubtful identity.]											
Mormon. L. Syn. Red Mormon	Pa	ob	m	yrs	tj	y	sa	g-vg		l	
Morris. W	Ill	obl	l	ru			sa	g		l	
Morris' Court of Wick. D. Syn. of Morris Wick											
Morris' Nonpareil Russet. GenF'33. Syn. of Morris Russet											
Morrison. R. Syn. Morrison's Red	Mass			r						l	

Morrison Red. W. Syn. Morrison's Red	Mass	rc	m	yrs	tc		sa	vg		l	
Morrison's Red. A'69. Syn. of Morrison											
Morrison's Red. NEF'55. Syn. of Morrison Red											
Morrison Sweet. D	N. Y.	rob	m	gb		w	s	p		m	
Morris Red. MichH'80. Syn. Steel's Red (erroneously)	Ohio?	oc	ml	rs	jt	yw	sa	vg		vl	Possibly same as Sutton.
Morris Russet. L. Syns. Morris' Nonpareil Russet, Morris' Russet	Eng	r	ms	ru	ftj		bsa			ml	From Hogg.
Morris' Russet. D. Syn. of Morris Russet											
Morris Sack and Sugar. D. Syn. of Sack and Sugar											
Morris Seedling. R. Syn. Morris' Seedling	Iowa									ml	Not described.
Morris' Seedling. A'75. Syn. of Morris Seedling											
Morris Sweet. R. Syn. Morris' Sweet	Pa	r	vl	yrs			s	vg		l	
Morris' Sweet. MagofH'53. Syn. of Morris Sweet											
Morris Wick. L. Syn. Morris' Court of Wick	Eng	ob	s	gb	ftj		sa			ml	Perhaps identical with Wick.
Morris Winter. R. Syn. Morris' Winter	Va										Not described.
Morris' Winter. F. Syn. of Morris Winter											
Morrow. L. Syn. Gov. Morrow	Ohio	ob	ml	rs			sa	g		l	
Morse. R. Syn. Morse's Seedling	Ont	r	l	y	tmj	w	a	vg	dm	e	
Morse's Seedling. MagofH'42. Syn. of Morse											
Morton (Ohio). W. Syn. Morton's Seedling	Ohio	rob	l	gyb	tj	w	msa	g		m	
Morton (Nev.). A'87	Nev		l	r		w	msa	vg		l	
Morton Pearmain. BBL											Do.
Morton Red. L. Syn. Morton's Red	N. S.	robe	m	wrs	ftj	w	sa			ml	
Morton's Red. Dap. Syn. of Morton Red											
Morton's Seedling. D. Syn. of Morton (Ohio)											
Morven. A'91	Del		s	pysc	fj	w	sa	vg	d	l	
Moscow. WyB34											Do.
Moscow of Wis. BBL	Wis.?										Do.
Moscow Pear. Gb. Syns. Gov. list No. 380, Gruscheffka Moskoloskaja, Gruschevka Woskovskaya.	Rus.	rob		yrs	vj	w	sa	vg	dk	me	Hansen calls this Moscow. See S. D. B. 76, 75.
Moseley. L. Moseley Sweet		ob		rs			s				
Moseley Sweet. W. Syn. of Moseley											
Moser. L. Syns. Moser's Sweet, Mosier Sweet	Ind	ob	ml	yg			s		dkm	l	
Moser's Sweet. IndH'73. Syn. of Moser											
Moses. L. Syn. Moses Wood	Me	r	m	yrs	tj	w	psa	g		m	
Moses Wood. MagofH'46. Syn. of Moses											
Mosher. L. Syn. Mosher Sweet	N. Y	obe	ml	y			s		dk	m	
Mosher Sweet. Dap. Syn. of Mosher											
Mosier Sweet. IndH'88. Syn. of Moser											
Moss. L. Syn. Moss' Incomparable	Eng	rc	l	yb	t	yw	sa			l	
Moss' Incomparable. D. Syn. of Moss											
Motchetchnoe. Gb. Syn. of Pickle											
Mote. L. Syns. Mote's Red Seedling, Mote Sweet, Mote's Sweet	Ohio	robe	l	pyb	tmj	y	rs	vg	dk	m	
Mote's Red Seedling. IllB45. Syn. of Mote											
Mote Seedling. R. Syn. Mote's Seedling	Ohio	r		y	tj	y	sa	vg		m	Distinct from Mote. See IllH'72, 227.
Mote's Seedling. IllH'72. Syn. of Mote Seedling											
Mote Sweet. W. Syn. of Mote											
Mote's Sweet. A'67. Syn. of Mote											
Mother. MagofH'44. Syns. Gardener's Apple, Queen Anne	Mass	rc	m	yrs	tj	y	rsa	b	d	ml	
Mother Beam. Hort'56. Syn. of Belmont											
Mother Davies. E. Syn. of Mother Davis											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Mother Davis. D. Syn. Mother Davies	Pa	rc	m	wyrs	tj	y	sa	g-vg		m	
Mother Favorite. L. Syns. Big Tree, Mother's Favorite, Smith's Favorite.	Ohio	rob	l-vl	yb	fj	yw	sa	vg	k	me	
Mother's Favorite. Dap. Syn. of Mother Favorite											
Motschetschnoe. Gb. Syn. of Pickle											
Mott. L. Syn. Mott's Sweet. [Possibly may be Mote.]											Not described.
Motteaux's Seedling. GenF'33. Syn. of Beachamwell											
Mott's Sweet. Cat. Syn. of Mott											
Mottled Anis. A'83. Syns. Anis Pestrui, Shro. to Ia. No. 13	Rus										Do.
Moulton. R. Syn. Moulton's Winter											Do.
Moulton's Winter. IllB45. Syn. of Moulton											
Moultree. R. Syns. Moultree's Winter, Moultrie	South	ob	l	grs	jc		sa			l	Moultree and Moultrie are doubtless the same.
Moultree's Winter. GHM&S. Syn. of Moultree											
Moultrie. PJB. Syn. of Moultree											
Mount. R. Syn. Mount's Sweet Bough											Not described.
Mount's Sweet Bough. IndH'69. Syn. of Mount											
Mountain Beauty. Dap	Va	ob	ms	wrs	tj	w	sa	vg		ml	
Mountain Beet. MHSC'77	Can.?	robobl	m	ydrs	fj	ws	sa	g		m	
Mountain Belle. W	Ga	obc	ml		j	w	sa	g		vl	From White's manuscript.
Mountain Chief. A'69			m	yg				vg		m	
Mountaineer. JVL		rob	ml	gyr		y		vg		l	
Mountaineer. W. Syn. of Mount Pleasant											
Mountaineer. W. Syn. of Weaver Sweet											
Mountaineer. D. Syn. of Mountain Sweet											
Mountain Flora. Dap. Syn. of Gloria Mundi											
Mountain Green. Dap. Syn. of Fallawater											
Mountain Greening. Cat											Not described.
Mountain Pearmain. CBH			l	yrs	cf	y	a	g		m	
Mountain Pippin. E. Syn. of Fallawater											
Mountain Pippin. Hort'56. Syn. of Yellow Newtown											
Mountain Sprout. MagofH'53	N. C	c	l	y			sa	g		m	
Mountain Sweet (Pa.). W. Syn. Mountaineer. [Also a number of doubtful synonyms.]	Pa	ob	l	y	tf	w	rs	g-vg	dk	ml	
Mountain Sweet. L. Syn. Blue Mountain Sweet		rob	m	gy	f		s	vg			From Country Gentleman.
Mt. Tender Skin. JAY		rob	l	wrs				vg		me	
Mountain Tulip. MHSC'77											
Mountain Valley. BBL											Not described.
Mountain Vandevere. D. Syn. of Vandervere Pippin											
Mount Boomer. VaB2											Do.

Mount Gilead. R. Syn. Mount Gilead Beauty	Ohio		m	yr			sa			l	Said to have been planted by Johnny Appleseed.
Mount Gilead Beauty. A'71. Syn. of Mount Gilead											
Mt. Joy. Cat											Not described.
Mount Lookout. R. Syn. Mount Lookout Sweet											Do.
Mount Lookout Sweet. WVaB75. Syn. of Mount Lookout											
Mount Penn. A'97	Pa	rc	l	rsc				g		l	
Mount Pleasant. L. Syns. Mountaineer, Mount Pleasant Sweet	Ohio	ob	l	y			s	g		m	
Mount Pleasant Sweet. MagofH'53. Syn. of Mount Pleasant											
Mount Swaager. W. Syn. of Swaager											
Mourning. R. Syn. Mourning Pippin											Do.
Mourning Pippin. BBL. Syn. of Mourning											
Mouse. D. Syn. Moose	N. Y	rc	l	gyb	fmj	vw	sa	g		m	
Mowell. MagofH'53											Do.
Moxey. Cat											Do.
Moyer. (LC.) Syn. Moyer's Prize		robl		yb	cf	w		vg	dm	l	
Moyer's Prize. GNM. Syn. of Moyer											
Moyle. L. Syn. Gennet Moyle	Eng	r	l	y	fj		sa	g	c	m	
Mozley. R. Syn. Mozley Sweet	Ohio	ob	ml	yrs	cjt		s			l	Probably intended for Moseley.
Mozley Sweet. JRJ. Syn. of Mozley											
Mramornoe. Gb. Syn. of Marble											
Mtenskoe. Gb. Syn. of Mensk											
Mtsenkoe. Gb. Syn. of Mensk											
Mtsenskoe sladkoe. Gb. Syn. of Sweet Mensk											
Mudd. L. Syn. Mudd's No. 1	Ill	r	l	y			sa	g		m	
Mudd's No. 1. W. Syn. of Mudd											
Mudd Market. L. Syn. Mudd's Market		c		y			sa				
Mudd's Market. W. Syn. of Mudd Market											
Mudhole. Hort'75. Syn. of Long Red											
Mueller Spitz. L. Syns. Mueller's Spitz, Mueller's Spitz apfel, V. R. S. to Ia. No. 33.	Rus										Not described.
Mueller's Spitz. Gb. Syn. of Mueller Spitz											
Mueller's Spitz apfel. Gb. Syn. of Mueller Spitz											
Mullen. BBL											Do.
Mullett. L. Syn. Seedling from A. A. Mullett	Ohio	rob	ml	rs				vg	dk		
Multicolor. Gb. Syns. Pestruchka, Shro. to Ia. No. 102	Rus										Do.
Mumper Vandevere. A'75. Syn. of Minkler											
Munche's Pippin. GenF'33. Syn. of Margil											
Mundy's. H. Syn. of Fall Queen. [This is probably Buckingham.]											
Munroe Favorite. BBL											Do.
Munson. (LC). Syns. Meacham Sweet, Munson Sweet, Munson Sweeting, Orange, Orange Sweet, Ray Apple.	Mass.?	ob	m	pyb	j	y	s	g	k	ml	
Munson Sweet. MagofH'53. Syn. of Munson											
Munson Sweeting. GenF'49. Syn. of Munson											
Murphy. NEF'34. Syns. Barnes' Stripe, Dark Red Streak, Jack Murphy, Murphy Red.	Mass	r	ml	drs	t	w	a	g		ml	
Murphy Blush. FHC			m	gb					dk	l	
Murphy Greening. R. Syn. Murphy's Greening											Do.
Murphy's Greening. WisB45. Syn. of Murphy Greening											
Murphy Red. Syn. of Murphy											
Murray. T	South	oble	ml	y			sa			l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Murray Seedling. R. Syn. Murray's Seedling											Not described.
Murray's Seedling. WisB45. Syn. of Murray Seedling											
Muscat. L. Syn. Muscat Reinette	Ger	rc	m	yrs	j	yw	rsa			ml	From Hogg.
Muscat. Gb. Syn. of Muscatel											
Muscatapfel Livlander. Gb. Syn. of Livland Muscatel											
Muscatapfel (Livlander Rgl.). Gb. Syn. of Muscatel											
Muscatel. Gb. Syns. Gov. list No. 313, Muscat, Muscatapfel (Livlander Rgl.), Persian.	Rus										Not described; possibly identical.
Muscatel. Gb. Syn. Gov. list No. 234, Muscatelnoe	Rus										
Muscateller Livlandischer. Gb. Syn. of Livland Muscatel											
Muscatelnoe. Gb. Syn. of Muscatel											
Muscatel Reinette. Gb. Syns. Gov. list No. 962, Queen Muscatel, Reinette Muscateller.	Rus										Not described.
Muscat Persian. (LC)	Rus.?										Do.
Muscat Reinette. D. Syn. of Muscat											
Muscovia. MagofH'50											Do.
Museau de Levre. D. Syn. of Pigeonette											
Musgrove's Cooper. W. Syn. of Grosh											
Musgrove's Cooper. D. Syn. of Western Beauty											
Mushroom. L. Syn. Red Mushroom											Do.
Mushroom. Gb. Syn. of Borovinka											
Musgrove. R. Syn. Musgrove Rambo. [Probably Grosh.]											Do.
Musgrove Rambo. BBL. Syn. of Musgrove											
Muskingum. L. Syn. Muskingum Keeper	Ohio	ob	ml	rs			sa	g		vl	
Muskingum Keeper. W. Syn. of Muskingum											
Muskingum Red. R. Syn. Muskingum Red Streak											Do.
Muskingum Red Streak. IndH'72. Syn. of Muskingum Red											
Muskmelon. A'77		obc	l	gyb	tj	gy	msa	vg		m	
Muskmelon. D. Syn. of Toccoa											
Musk Spice. E		rob	s	y			sa	vg		m	Seems not to be **Fall Wine.**
Musk Spice. T. Syn. of Fall Wine											
Must. L. Syn. Red Muster	Eng	rob	l	y			r			m	
Muster. W		ob	l	yrsc	ftj	y	sa	b	d	m	
Mutton. R. Syn. Davidson's Mutton											Not described.
Myers. Cat. Syns. May, Renish May. [Undoubtedly same as May.]											Do.
Myers Apple. H. Syn. of May											
Myers' Nonpareil. E. Syn. of Ohio Nonpareil											
Mygatt's Bergamot. E. Syn. of Dyer											
Myo. BBL											Do.
Mysalt. A'58. [May be Pomme Royal.]	Conn?										Do.

Mystic. Dap	Conn	rob	m	pyrs	ftj	w	sa			m	
My Sweetheart. FDNCo											Do.
Mzensk. Gb. Syn. of Mensk											
Mzenskoe. Gb. Syn. of Mensk											
Mzenskoe Sladkoe. Gb. Syn. of Sweet Mensk											
Mzensk Sweet. Gb. Syn. of Sweet Mensk											
Naig. R. Syn. Naig's August											Do.
Naig's August. IllB15. Syn. of Naig											
Naigle. L. Syn. Naigle's Winter	Mo	rob	m	pyb	etj	w	sa	vg		ml	
Naigle's Winter. Hort'68. Syn. of Naigle											
Naleiv Woskowoi. Gb. Syn. of Waxen Naliv											
Naliv Voskovoi. Gb. Syn. of Waxen Naliv											
Nalivnoe bielui. Gb. Syn. of White Naliv											
Nalivnoe jeltui. Gb. Syn. of White Naliv											
Nalivnoe jeltui. Gb. Syn. of Yellow Naliv											
Nalivnoe krasnoe. Gb. Syn. of Red Naliv											
Nalivnoe Zelenui Schirokui. Gb. Syn. of Broad Green											
Nan. R. Syn. Nan Beauty											Do.
Nan Beauty. IllH'96. Syn. of Nan. [Possibly Nansemond Beauty.]											
Nancy. R. Syn. Nancy Jackson											Do.
Nancy Jackson. BBL. Syn. of Nancy											
Nanny. D	Eng	r	m	yrs	j	y	sa			m	From Hogg.
Nan Seedling. BBL											Not described.
Nansemond (LC). Syn. Nansemond Beauty	Va.?	robe	m	yrb	etj	w	sa			vl	
Nansemond Beauty. F. Syn. of Nansemond											
Nanson. R. Syn. Nanson Beauty. [Probably Nansemond.]											Do.
Nanson Beauty. WVaB75. Syn. of Nanson											
Nansyman. R. Syn. Nansyman Beauty. [Probably Nansemond.]											Do.
Nansyman Beauty. TJG&S. Syn. of Nansyman											
Nantahala. R. Syns. Maiden's Bosom, Nantahalee, Nantehalee	Ala	obe	m	yg	tj	w	a	g		me	
Nantahalee. D. Syn. of Nantahala											
Nantahwee. LaB3. [Probably Nantahala.]											Do.
Nantehalee, GarM'59. Syn. of Nantahala											
Narcissus. MagofH'53											Do.
Nash. P'95. Syn. Nash's Seedling	Tenn	ob	l	gywrs	f	yg	sa	g		m	
Nashes. Cat											Do.
Nash's Seedling. TennBI-IX. Syn. of Nash											
Nashville. L. Syn. Nashville Mammoth	Tenn		vl	y	cj		msa		m	l	
Nashville Mammoth. CN. Syn. of Nashville											
Nasledka. MHSC'86. Syn. Shro. to Ia. No. 67	Rus										Do.
Naslicdnik Nicolai Aleksandrovitch. Gb. Syn. of Nicolai											
Nathusius. IllH'94	Eur									ml	
Natural (Seedling). IndH'72											Do.
Naylor Rambo. A'77. Syn. of Grosh											
Neal. L. Syn. Neal's Keeper. [Probably Neil.]											Do.
Neal's Keeper. Cat. Syn. of Neal											
Neasley Bellflower. D. Syn. of Neisley											
Neat. L. Syn. Neat Russet		c	s	ru			sa	g		l	
Neat Russet. W. Syn. of Neat											
Nebo. ArkB49	Ark	oble	l	gyrse	fmj	w	sa	vg-b		ml	
Nebraskan. AjofHVI											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Nectar. GarM'60	N. C	ob	m	g	j	y	rs			me	From Gardener's Monthly.
Ned. W. Syns. Cream, Creek, Custard, Kentucky Cream, Libhart, Saylor.	Pa	robc	m	yrs	tj	w	sa	g-vg		l	
Needle. D.	Eng.?	rob	ms	y	j	w	psa	g		ml	
Needles. D. Syn. of Flat Pippin											
Neelovskoe. Gt. Syns. Gov. list No. 180, Negoloff's Apple, Nejolowskoe	Rus.										Not described.
Neemezki Kalville. Gb. Syn. of German Calville											
Neff. MagofH'53											Do.
Negoloff's Apple. Gb. Syn. of Neelovskoe											
Neil. L. Syn. Neil's Keeper	Ill		ml	yrs			sa		m	l	
Neil's Keeper. W&Co. Syn. of Neil											
Neill Summer. R. Syn. Neill's Summer											Do.
Neill's Summer. S&W. Syn. of Neill Summer											
Neisley. L. Syns. Neasley Bellflower, Neisley Bellflower	Ohio	rob	ml	wyrs	mj	y	sa	g		l	
Neisley Bellflower. D. Syn. of Neisley											
Neisley's Winter Penick. D. Syn. of Pennock											
Neisley's Winter. E. Syn. of Pennock											
Nejolowskoe. Gb. Syn. of Neelovskoe											
Nelken Apfel. D. Syn. of Cornish Gilliflower											
Nelson (Ill.). AJofHII	Ill	rob	ml	gyb	fj	gy	s	g		vl	From Amer. Journal of Horticulture.
Nelson (Mo.). MoH'83	Mo	rob	l	gyrs	tj	yw	sa	vg		l	Probably distinct from preceding.
Nelson Codlin. L. Syns. Backhouse's Lord Nelson, Nelson's Codlin	Eng	rob	l	py	t	yw	ba	g	k	m	
Nelson's Codlin. D. Syn. of Nelson Codlin											
Nelson Rock. Dap. Syn. Rock Apple	Va	obc	ml	gwrs	ftj	wy	sa			ml	
Nelson Seedling. R. Syn. Nelson's Seedling											Not described.
Nelson's Seeding. IllH'99. Syn. of Nelson Seedling											
Nelson Sweet. IllH'79			l							l	Probably same as Nelson (Ill.).
Nelson Victory. R. Syn. Nelson's Victory		ob	l	rs			sa	g		ml	
Nelson's Victory. IllB45. Syn. of Nelson Victory											
Ne Plus Ultra. W	Ga	ob	l	y			sa	g		m	May be Buckingham.
Ne Plus Ultra. D. Syn. of Buckingham											
Neppy. IaB6											Not described.
Nequassa. D. Syn. Nequassa Sweet	N. C	ob	l	yrs		w	vs	g		ml	
Nequassa Sweet. D. Syn. of Nequassa											
Nero. IllH'89	N. J.?	robl	m	yr	jfc	w	sa	g	km	l	
Ness. SDB65	Iowa	rob	m	yrsc			sa	g		e	Originated by J. B. Mitchell, Cresco, Iowa.

Neumeister. MHSC'81. Syn. V. R. S. to Ia. No. 22	Rus.	obe	ms	rs			sa			e	
Neusia. BBL											Not described.
Never Bloom. JVL											Do.
Neverfail (of Tenn.). W	Tenn	c		rs			sa				Probably Buckingham. See A. 1873, p. 40.
Neverfail. A'73. Syn. of Buckingham											
Neverfail. D. Syn. of Fail Never											
Neverfail. D. Syn. of Margil											
Neverfail. Cole. Syn. of Ralls											
Neverfail. A'89. Syn. of Shockley											
Neverfail Seedling. L. Syn. Seedling Neverfail	Ind	ob	ml	y			sa	g		l	
Neversick. A'51. Syn. of Neversink											
Neversink. MagofH'53. Syn. Neversick	Pa	rc	l	yb	tj	y	sa	g		l	
Newark Gate. DomEnc	N. Y						a		ke		
Newark King. C. Syns. Hinckman, King Newark	N. J	rc	m	yrg	t		rsa	g		ml	
Newark Pippin. DomEnc. Syns. French Pippin, French Pippin of Newark, Large Yellow Newark Pippin, New Ark Pippin, Yellow Pippin.	N. J	robl	ml	y	tj	y	vrsa	vg	dk	ml	
New Ark Pippin. Lin. Syn. of Newark Pippin											
Newark Sweeting. C. Syn. of Campfield											
Newbank. R. Syn. Newbank's Seedling	Ind.?		m					vg	dm	l	
Newbank's Seedling. IndH'70. Syn. of Newbank											
New Bedford. IndH'90											Not described.
Newbold. MagofH'53											Do.
Newbold's Admiral Duncan. D. Syn. of Rymer											
Newbold's Duke of York. D. Syn. of Rymer											
New Brunswick. RNY'71	N. B.?		ml	ywrs	f			g	km	me	This may be Oldenburg.
New Brunswick. D. Syn. of Oldenburg											
New Brunswicker. A'81	N. B.		m	rs			a			me	Probably Oldenburg.
New Brunswick Greening. McExR'93											Not described.
Newbury. D. Syn. Cat's Head		oble	l	gb	c	g		p		ml	
Newby. IndH'94. Syn. of Doctor											
Newcomer. W	Va	ob		y			sa				
Newell. A'95. Syns. Newell's Winter, Orange Winter	Wis	robl	l	yrs				g	km	l	
Newell. Cat. Syn. of Fall Orange											
Newell's Winter. WisB45. Syn. of Newell											
New England. L. Syn. New England Red	Ky	r	l	rs			sa	g		m	
New England Golden Russet. Dap. Syn. of Hunt Russet											
New England Red. W. Syn. of New England											
New England Russet. Dap. Syn. of Hunt Russet											
New England Seek-no-further. T. Syn. of Westfield											
New England Sweet. R. Syns. Molasses Apple, New England Sweeting		obl		y			s			l	
New England Sweeting. C. Syn. of New England Sweet											
New Greening. L. Syns. Curtis Greening, New Rhode Island Greening, Sweet Rhode Island Greening.	Ohio?	ob	l-vl	gyb	tj	y	s	vg	km	ml	Identical with Curtis Greening.
New Hampshire. IllH'93. Syn. New Hampshire Sweet	Ill	r	l	y			s	vg		me	
New Hampshire Sweet. IllB45. Syn. of New Hampshire											
New Hawthornden. OntExR'82											Not described.
New Jersey. R. Syn. New Jersey Orange Pippin								g	m	me	
New Jersey Orange Pippin. PHF. Syn. of New Jersey											
New Jersey Redstreak. E. Syn. of Early Pennock											
Newland. R. Syn. Newland Sack											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Newland Sack. BBL. Syn. of Newland											
New Late Reinette. D. Syn. of Late Reinette											
New Leathercoat. IllH'69											Not described.
New Lemon. L. Syn. New Small Lemon Pippin	Eng	robl	s	y	fj	w	psa	g		m	From Ronalds.
New London Pippin. GenF'33. Syn. of London Pippin											
Newman. BBL. Syn. Newman Seedling	Ohio	oblc	ml	gyr	fcj		sa	g		l	
Newman Apple. MoH'95. Syn. of Ben Davis											
Newman Seedling. NYExR'96. Syn. of Newman											
New Missouri. Dap. Syn. of McAfee											
New Nonpareil. GenF'33. Syn. of Early Nonpareil (Eng.)											
Newport (Vt.). P'94. Syns. Newport Sweet, Newport Winter Sweet, Winter Sweet.	Vt	rc	m	gr	f	w	s	g		l	
Newport (Iowa). IllH'83. [Said to have originated in Iowa.]	Iowa										Not described.
Newport Sweet. ColExR'88. Syn. of Newport, (Vt.)											
Newport Winter Sweet. A'95. Syn. of Newport, (Vt.)											
New Rhode Island Greening. Dap. Syn. of New Greening. [Probably Illinois Greening.]											
New River. L. Syn. New River Boat Apple	Va	ob	m	yb	tmj	w	sa			m	
New River Boat Apple. RNY'71 Syn. of New River											
New Rock. L. Syn. New Rock Pippin	Eng		ms	gbru	fr	y	s	g		ml	
New Rock Pippin. D. Syn. of New Rock											
New Scarlet Nonpareil. GenF'33 Syn. of Scarlet Nonpareil											
New Small Lemon Pippin. D. Syn. of New Lemon											
New Spitzenburgh. GenF'32. Syn. of Jonathan											
Newton. Hort'72	Wis.									l	
Newton. Th. Syn. of Newtown Spitzenburg											
Newton Early. CGen'59		r	vl	yg	c		sa	g		s	
Newton Pippin. FEY. [Probably Yellow Newtown.]											Do.
Newton Pippin. G. Syn. of Green Newtown											
Newton Spitzenberg. C. Syn. of Newtown Spitzenburg											
Newton Wonder. FEY			l	yrc	fj	w	sa	vg	km	vl	
Newtown Greening. D. Syn. of Golding											
Newtown Pippin. GenF'33. Syn. of Green Newtown											
Newtown Pippin. DomEne. Syn. of Yellow Newtown											
Newtown Pippin Green. Lin. Syn. of Green Newtown											
Newtown Pippin (of Lewis Sanders, Ky.). E		rc	l	rs			sa				Possibly identical with Yellow Newtown.
Newtown Pippin Yellow. H. Syn. of Yellow Newtown											
Newtown Spitzenberg. Cole. Syn. of Newtown Spitzenburg											

Newtown Spitzenburg. H. Syns. Barrett's Spitzenburgh, Burlington, Burlington Spitzenberg, E opus Vandervere, Fall Vandevere, Flushing, Joe Berry, Kountz, Matchless, Newton, Newton Spitzenberg, Newtown Spitzenberg, Newtown Spitzenburgh, New York Vandevere, Ox Apple, Ox Eye, Queen of the Dessert, Spiced Ox Eye, Spitzenburgh, Vandervere, Vandevere of N. Y., Wine (erroneously).	N. Y.	robc	ml	yrs	ct	y	rmsa	vg-b	dk	ml	
Newtown Spitzenburg. H. Syn. of Flushing											
Newtown Spitzenburgh. M. Syn. of Newtown Spitzenburg											
Newville. RNY'70. Syns. Sharp's Apple, Sharp's Mountain, Sharp's Seedling.	Pa							vg		ml	
New Water. BBL											Not described.
New Wonder. IllH'99. [May be same as Newton Wonder.]											Do.
New York Bellflower. Dap. Syn. of Fall Orange											
New York Early. IndH'81											Do.
New York Gloria Mundi. C. Syn. of Gloria Mundi											
New York Greening. T. Syn. of Golden Pippin (N. E.)											
New York Greening. D. Syn. of Golding											
New York Greening. A'54. Syn. of Yellow Newtown											
New York No. 1. PaB18											
New York No. 2. PaB18											
New York Pippin. PFar '53. Syn. of Ben Davis											
New York Pippin. NEF'29. Syn. of Yellow Newtown											
New York Spice. D. Syn. of Leland											
New York Somerset. MichB169. Syn. of Somerset											
New York Summer. R. Syn. New York Summer Bellflower											Do.
New York Summer Bellflower. BBL. Syn. of New York Summer											
New York Sweet. R. Syn. New York Sweet Russet				ru			s				Do.
New York Sweet Russet. NHB48. Syn, of New York Sweet											
New York Vandevere. T. Syn. of Newtown Spitzenburg											
Niack Pippin. E. Syn. of Bough. [Should be Nyack.]											
Niack Pippin. K. Syn. of Nyack. [Should be Nyack Pippin.]											
Nichner Strawberry. IaB31. Syn. of Nitchner Strawberry											
Nichols. L. Syns. Nichols Sweet, Nichols Sweet Spice		rc	m	yrs	cj	w	s	g	k	ml	
Nichols Sweet. Mag of H'38. Syn. of Nichols											
Nichols Sweet Spice. Mag of H'40. Syn. of Nichols											
Nickajack. Hort'56. Syns. Aberdeen, Accident, Alleghany, Berry, Big Hill, Carolina, Carolina Spice, Caroline, Chaltram Pippin, Chatham Pippin, Cheatan Pippin, Cheataw, Dahlonega, Edwards, Edward Shantee, Forsythe's Seedling, Gowden, Graham's Red Warrior, Hollman, Holman, Howard, Hubbard, Jackson Red, Leanham, Missouri Pippin, Missouri Red, Mobbs, Pound, Red Hazel, Red Pippin, Red Warrior (erroneously), Rickman's Red, Ruckman, Ruckman's Red, Summerour, Teanham, Trenham, Walb, Wall, Wander, Winter Horse, Winter Rose, World's Wonder.	N. C	rob	l	yrs	cmtj	y	sa	g	mk	vl	
Nick's Green (?). Cat. Syn. of Nix											
Nicnac. MichB31											Do.
Nicolai. Gb. Syns. Nasliednik Nicolai Aleksandrovitch, Rgl. to Ia. No 243.	Rus										Do.
Nida. BBL											Do.
Niedwetzkiana. BBL											Do.
Niel. BBL. Syn. Niel's Keeper	Ill		ml	rs	f			vg		l	
Niel's Keeper. JVC. Syn. of Niel											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Nieman. L. Syns. Nieman's Red Reinette, Nieman's Rothe Reinette, Reinette Rouge de Nieman.	Ger	re	m	yrs	tj	w	sa			ml	From the Verger.
Nieman's Red Reinette. D. Syn. of Nieman											
Nieman's Rothe Reinette. D. Syn. of Nieman											
Niemetskui Kalvil. Gb. Syn. of German Calville											
Niger. E. Syn. of White Calville											
Nikitor. R. Syn. Mons de Nikitor. [Probably same as Nitika.]											Not described.
Nine Ounce. Dap. Syn. of Dean											
Nine Partners Little Russet. GenF'53. Syn. of Partners											
Niswander. R. Syn. Niswander Red Streak											Do.
Niswander Red Streak. TJG&S. Syn. of Niswander											
Nitchner's erdbeerapfel. Gb. Syn. of Nitchner Strawberry											
Nitchner Strawberry. L. Syns. Nichner Strawberry, Nitchner's erdbeerapfel, Nitchner's Strawberry, V. R. S. to Ia. No. 45.	Rus		l	y				vg		ve	
Nitchner's Strawberry. Gb. Syn. of Nitchner Strawberry											
Nitika. R. Syn. Monstreuse de Nitika											Do.
Nix. L. Syns. Carolina Winter, Carolina Winter Queen, Nick's Green, Nix's Apple, Nix Green, Nix Green Winter, Queen Apple (erroneously).	Ga	rob	m	gy	ft	w	psa	g		ml	
Nix's Apple. H. Syn. of Nix											
Nix Green. D. Syn. of Nix											
Nix Green Winter. W. Syn. of Nix											
Nixon. IllH'97			l	y	f		sa	vg		l	Possibly identical with Nixonite.
Nixonite. MoH'99. Syn. Bain	Mo	re	l	yb		y	sa		km	l	
Noble. W. Syn. Noble Pippin	Ohio	oble		rs			sa		d	vl	
Noble Pippin. K. Syn. of Noble											
Noble Redstreak. Gb. Syns. Edler rosenstreifling, Gov. list No. 61, Streifling Edler Winter, V. R. S. to Ia. No. 28.	Rus										Not described.
Noble Savar. AlaB98											Do.
Noble Savaria. WashB26											Do.
Noble Scovari. BBL											Do.
Noble Sovari. (LC)											Do.
Noblesse. L. Syn. Noblesse de Grand	Eng	re	l	py	f		bsa			ml	From Ronalds.
Noblesse de Grand. D. Syn. of Noblesse											
Noble Winter. R. Syn. Noble's Winter											Not described.
Noble's Winter. WisB45. Syn. of Noble Winter											
No-blow. MoH'90. [Perhaps identical with Bloomless.]											Do.
No Core. AJofHVI. Syn. of Hillars											
No. 4 Babcock's. BBL											
No. 5 Babcock's. BBL											

No. 13 Babcock's. BBL
No. 14 Babcock's. BBL
No. 1 Brett. BBL
No. 1 Coote. BBL
No. 2 Coote. BBL
No. 3 Coote. BBL
No. 4 Coote. BBL
No. 5 Coote. BBL
No. 3 Gideon. BBL
No. 20 Gideon. BBL
No. 1 Gray. BBL
No. 2 Gray. BBL
No. 1 Herren's. BBL
No. 2 Herren's. BBL
No. 3 Herren's. BBL
No. 4 Herren's. Cat
No. 92 Miller. BBL
No. 1 New. MichB169
No. 2 New. MichB169
No. 1 Ogden. BBL
No. 12 Orel. N. Syn. of Aport Voronesh
No. 20 Parry. Cat. Syn. of Parry 20
No. 17 Peffer. BBL
No. 1 Randall. BBL
No. 2 Randall. BBL
No. 3 Randall. BBL
No. 5 Randall. BBL
No. 6 Randall. BBL
No. 24 Ream. BBL
No. 1 Red Winter. A'85
No. 1 Riffe. BBL
No. 1 Roberts. BBL
No. 2 Roberts. BBL
No. 3 Robey Seedling. MagofH'52. [May be Robey, of Downing]
No. 1 Ross. BBL
No. 2 Ross. BBL
No. 1 Stayman. BBL
No. 2 Stayman. BBL
No. 10 Thompson. BBL
No. 29 Thompson. BBL
No. 38 Thompson. BBL
No. 44 Thompson. BBL
No. 46 Thompson. BBL
No. 59 Thompson. BBL
No. 451. P'91. Syn. of Worszt
No. 973. P'91. Syn. of Shining Aromatic
No. 4 Voronesh. N. Syn. of Aport Voronesh
No. 56 Vor. (?) N. Syn. of Gipsey
No. 1 Watkins. BBL
No. 2 Watkins. BBL
No. 1 Wilson. BBL
No. 2 Wilson. BBL

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Nodhead. NEF'49. Syn. of Jewett Red											
Noeaqual. SBro. Syn. of Ohio Nonpareil											
Noll's No 1. MagofH'53. Syn. of Adams											
Noneantum Wonder. GenF'33. Syn. of Dumelow											
Nonesuch. Cat											Not described.
Nonesuch Beauty. IllH'96											Do.
Nonnettit. S&W			l	rs	vj			vg		l	
Nonpareil (Eng.). DomEnc. Syns. Duc d'Arsel, English Nonpareil, Grune Reinette, Hunt's Nonpareil, Loveden's Pippin, Nonpareil d'Angleterre, Nonpareille, Old Nonpareil, Original Nonpareil, Reinette Nonpareil.	Eng	rc	m	ygru	cj		rmsa	g		l	
Nonpareil (Ill.?). W	Ill.?	rc	ml	rs			a	vg	d	m	
Nonpareil. DomEnc. Syn. of Lady											
Nonpareil. SBro. Syn. of Ohio Nonpareil											
Nonpareil. H. Syn. of Ross Nonpareil											
Nonpareil d'Angleterre. GenF'33. Syn. of Nonpareil											
Nonpareille. E. Syn. of Nonpareil											
Nonpareil, Old. W	Eng	robc	s	ru			sa	g		vl	Apparently identical with Nonpareil Russet.
Nonpareil Russet. GenF'33. Syn. Russet-Coated Nonpareil	Eng	robc	s	yru	cj	w	sa	g		vl	
Nonpareil, Scarlet. W		r	ms	rs			sa	g		l	
Nonpareil. Cat											Not described.
Nonsuch. GarCal. Syn. English Nonsuch	Eng	ob	m	gyrs	fj	w	sa	g	k	m	
Nonsuch. Dap. Syn. of McAfee											
Nonsuch. Th. Syn. of Red Canada											
Nonsuch (Hubbardston). Wn. Syn. of Hubbardston											
Nonsuch, Old. H. Syn. of Red Canada											
Nordhaussan. R. Syn. Beauty of Nordhaussan											Do.
Nord Star. BBL. [Perhaps intended for North Star]											Do.
Noregon. SDB76	Iowa	robc	ml	wyrsc	jfc		sa	vg		m	Originated with J. B. Mitchell, Cresco, Iowa.
Norfolk. Cole	Mass	ob	s	y	fc		sa	g		me	
Norfolk. D											Not described.
Norfolk Beaufin. GenF'33. Syn. of Beaufin											
Norfolk Beaufing. BBL. Syn. of Beaufin											
Norfolk Beauty. AmGar'01											Do.
Norfolk Beefing. D. Syn. of Beaufin											
Norfolk Colman. D. Syn. of Winter Colman											
Norfolk Keeper. L	Mass	ob	s	y			sa				Probably same as Norfolk.
Norfolk Paradise. D	Eng	obl	m	yrs	j	w	rsa			ml	From Lindley.
Norfolk Pippin. GenF'33. Syn. of Adams Pearmain											

Norfolk Stone. L. Syns. Norfolk Stone Pippin, Stone Pippin, White Pippin, White Stone Pippin.		r	ms	ygb	f	w	brs		k	l	
Norfolk Stone Pippin. D. Syn. of Norfolk Stone											
Norfolk Storing. D. Syn. of Storing											
Norfolk Storing. D. Syn. of Winter Colman											
Norman. MagofH'53											Not described.
Normanton Wonder. Dap. Syn. of Dumelow											
Norris. MagofH'53											Do.
Norse. IaH'98											Do.
North. R. Syn. Queen of the North	Iowa	obe	ml	yrb	tj	yw	sa	vg		e	
North American Best. D. Syn. of Primate											
Northampton. D	Pa	ob	m	wyrs	ftj	w	sa	vg	dm	ml	
North Carolina. A'95											Do.
North Carolina Baldwin. A'58	N. C.?									l	Do.
North Carolina Greening. D. Syn. of Bullett											
North Carolina Greening. D. Syn. of Green Abram											
North Carolina Keeper. A'89	N. C		m	yrs	cj		sa			l	
North Carolina Keeper. Cat. Syn. of either Horn, Bullett, or Green Abram											
North Carolina Limbertwig. JBW&B. Syn. of Limbertwig (of N. C.)											
North Carolina Red. IllB45		ob	m	dr			msa	g		l	
North Carolina Red June. F. Syn. of Red June											
North Carolina Vandevere. Dap. Syn. of Horn											
Northern Blush. RNY'70	Wis		m	yb				g		l	
Northern Dumpling. S&W											Do.
Northern Golden Sweet. GenF'48. Syn. of Northern Sweet											
Northern Greening. IllH'82	Wis			g						l	
Northern Greening. GenF'33. Syn. of Cowarne											
Northern Hardskin. D. Syn. of Holly											
Northern Pippin. IllH'99											Do.
Northern Queening. Syn. of Cowarne Queen											
Northern Spitzenburg. A'71. [May be misprint for Newtown Spitzenburg.]											Do.
Northern Spy. MagofH'44. Syn. Spy	N. Y	robe	l	gyrs	ft	w	sa	vg-b	dkm	l	
Northern Sweet. MagofH'49. Syns. Golden Sweet, Northern Golden Sweet, Northern Sweeting.	Vt	rob	m	yb	tj	w	s	vg	k	m	
Northern Sweeting. GenF'49. Syn. of Northern Sweet											
Northfield. MichB169. Syn. Northfield Beauty	Vt	robl	ml	yrs	jc		bsa	vg	dkm	ml	
Northfield Beauty. A'81. Syn. of Northfield											
North Star. CanExR'96. Syns. Dudley's Winter, Winter Duchess	Me	rob	l	yr	c	y	sa	g		ml	Same as Dudley, which is probably correct.
North Star. IaH'94	Iowa	rob	ms	yb	j	y	a	g		m	Originated with C. G. Patten, Charles City, Iowa.
North Virginia. L. Syn. North Virginia Mammoth											Not described.
North Virginia Mammoth. Cat. Syn. of North Virginia											
Northwestern Greening. A'85. Syn. North West Greening	Wis	r	l	yg			sa	vg	m	ml	Originated in Waupaca County, Wis.
North West Greening. CanH'94. Syn. of Northwestern Greening											
Northwick Pippin. GenF'33. Syn. of Blenheim											
Norton. L. Syn. Norton Pippin	Ky	rob	ml	yrs	tj	w	sa	vg		m	
Norton's Melon. Cole. Syn. of Melon											
Norton Pippin. Dap. Syn. of Norton											
Norway. L. Syn. Winter Norway											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Norwich Pippin. GenF'33. Syn. of Blenheim											Not described.
Norwood. R. Syn. Norwood Pippin											
Norwood Pippin. MoH'73. Syn. of Norwood											
Notley. FDNCo											Do.
Nott County Seedling. MichB31. Syn. of Kinsey											
Nottingham. L. Syn. Nottingham Pippin	Eng.?	rob	m	yru		w	sa				From Hogg.
Nottingham Brown. A'91. Syn. of Brown. [Erroneously published in Bul 8 as Nottingham.]											
Nottingham Pippin. D. Syn. of Nottingham											
Nova Scotian. A'77	N. S.	robe	l	yrs	tj	yw	sa	vg-b		l	
Novelty. CanB37	Ont		s	r	fcj	y	psa	g	k	me	
Novgorod Streaked. Gb. Syns. Gov. list No. 266, Polosatoe Novgorodskoe, Polosatoe Nowgorodskoe.	Rus										Not described.
Noyes. A'71. Syn. Doctor Noyes	Me	robobl	m	yr	tj		msa	vg	dkm	ml	
Nuba. A'97	Ky.?	ob	s	yrse			sa	vg		e	
Null. TennBX-1	Tenn	rob	vl	gyr	fj	y	sa	g	dkm	e	
Nun. Gb. Syn. of Melonen											
Nursery. DomEnc		rc	ms	gyb	cmj	y	sa	g		l	
Nut Large. IndH'84. Syn. of Nutt											
Nutmeg. W	Ind	rc	s	rs			s	vg		m	
Nutmeg Cockle. GenF'33. Syn. of Cockle											
Nutmeg Pippin. D. Syn. of Cockle											
Nutt. R. Syns. Nut Large, Nutt's Large Early. [Cultivated by Silas Whorton in 1824.]			l				a			e	Do.
Nutt's Large Early. CGen'59. Syn. of Nutt											
Nyack. (LC.) Syns. Niack Pippin, Nyack Pippin	N. Y	ob	ml	rs			a	vg	dm	m	Probably Champlain of Bulletin 8.
Nyack Pippin. D. Syn. of Champlain											
Nyack Pippin. W. Syn. of Nyack											
Nyack Pippin. D. Syn. of Summer Pippin											
N. Y. Early Red. Cat. Syn. of Early Red (N. Y.)											
Oakbena. A'87. Syn. of Okabena											
Oaken. R. Syn. Oaken Pippin											
Oaken Pippin. DomEnc. Syn. of Oaken											
Oakes (Mass.). NEF'50	Mass	rob	m	gyb	jt	y	psa	g-vg		ml	
Oakes (Eng.). D	Eng	r	m	grs		gw	msa		k	m	From Lindley.
Oakland. A'83. Syn. Oakland Co. Seek-no-further		ob	ml	rs			sa	vg	dm	l	
Oakland Co. Seek-no-further. MichB118. Syn. of Oakland											
Oakland No. 6. MinnHort'97											
Oakland No. 9. MinnHort'97											

Oakland No. 11. MinnHort'97											
Oakland No. 14. MinnHort'97											
Oakland No. 16. MinnHort'97											
Oakland No. 20. MinnHort'97											
Oakland No. 23. MinnHort'97											
Oakland No. 29. MinnHort'97											
Oakland No. 30. MinnHort'97											
Oakland No. 41. MinnHort'97											
Oakley. R. Syn. Oakley Grove Pippin											Not described.
Oakley Grove Pippin. BBL. Syn. of Oakley											
Oakton. SDB76	Iowa?	rob	m	gyrs	fj	w	sa	g		l	
Oat Harvest. D. Syn. of Knowles											
Oats Harvest. W	Ohio	r	s	y			sa	g		me	
Oats (incorrectly). Dap. Syn. of Early Harvest											
Obadiah. MagofH'53											Do.
Ober. BBL											Do.
Oberrie. R. Syn. Oberrie der Glanzreinette											Do.
Oberrie der Glanzreinette. MoH'87. Syn. of Oberrie											
O'Brian. L. Syn. O'Brian's Orange											Do.
O'Brian's Orange. NCExR'89. Syn. of O'Brian											
Occident. JBW&B. Syn. California											Do.
Oclesma. MichB31											Do.
Oconee. L. Syn. Oconee Greening	Ga	rob	l	ybru	fcj	y	sa	g-vg		m	
Oconee Greening. D. Syn. of Oconee											
O'Conner. R. Syn. O'Conner's Green											Do.
O'Conner's Green. BBL. Syn. of O'Conner											
October. JTL			l	r			a	k		m	
Odd-Year. R. Syn. Odd-Year Baldwin	Mass.?	c		grs						l	Probably not distinct; only a sport.
Odd-Year Baldwin. JWA&Co. Syn. of Odd-Year											
Oderslebene. R. Syn. Oderslebene Calville											Not described.
Oderslebene Calville. BBL. Syn. of Oderslebene											
Oel. P'94	N. Y	re	s	yre	fj	yw	sa	g		ml	
Ofine. D	Eng	robe	l	pyb	ft	w	msa			m	From Annals of Pomology.
Ogden. R. Syn. Ogden's No. 1											Not described.
Ogden's No. 1. Cat. Syn. of Ogden											
Ogdensburg. R. Syn. Ogdensburgh	N. Y	robe	m	wyb	jt	w	msa	vg		m	From Elliott's Notes.
Ogdensburgh. D. Syn. of Ogdensburg											
Ogilby. Hort'56. Syn. of Ogleby											
Ogle. P'95. Syn. Winter Snow	Ill	ob	m	yr	cj	w	ma	vg	dkm	vl	
Ogleby. W. Syns. Ogilby, Oglesby	Va	rob	ms	yb	cj	y	sa	g		m	
Oglesby. A'52. Syn. of Ogleby											
Oglevie. MagofH'53. [May be same as Ogleby.]											Not described.
Ohio Beauty. IndH'61. [This is probably Grosh.]											Do.
Ohio Beauty. W. Syn. of Grosh. [Western Beauty and Grosh probably identical.]											
Ohio Beauty. D. Syn. of Western Beauty											
Ohio Favorite. D. Syn. of Ortley											
Ohio Greening. MagofH'53											Do.
Ohio Harvest. WVaB75											Do.
Ohio Ladyfinger. R. Syn. Ohio Lady Finger											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Ohio Lady Finger. WBKJ. Syn. of Ohio Ladyfinger											
Ohio Limbertwig. IllH'80											Not described.
Ohio Nonpareil. MagofH'48. Syns. Cattell Apple, Myer's Nonpareil, Noeaqual, Nonpareil, Rusty Core, Western Beauty (erroneously).	Ohio	rob	ml	yrs	tj	yw	rsa	vg	dkm	m	
Ohio Nonpareil. F. Syn. of Cogswell											
Ohio Nonpareil. E. Syn. of Gravenstein											
Ohio Nonpareil. H. Syn. of Western Beauty											
Ohio Pippin. D. Syns. Buchanan, Ernst's Apple, Ernst's Pippin, Shannon.	Ohio?	rob	l	yb	mj	y	pa	g	km	ml	
Ohio Red. L. Syn. Ohio Redstreak	Ohio	ob	m	yrs	cj		rsa	g		vl	
Ohio Redcheek. R. Syn. Ohio Red Cheek			l	yb				g		l	
Ohio Red Cheek. IllB45. Syn. of Ohio Redcheek											
Ohio Redstreak. W. Syn. of Ohio Red											
Ohio Wine. D. Syn. of Fall Wine											
Ohio Wine. E. Syn. of Kaighn											
Ohio Winter. W	Ill	r	m	rs			sa	g		vl	
Ohlinger. MagofH'53	Pa		ms	yb	t	yw	sa	g		m	
Okabena. N. Syn. Oakbena	Minn	rob	m	rs			sa	g		ml	
Okabena Seedling. MinnExR'90											Do.
Okanaba. IllH'01											Do.
Okera. BBL. [Perhaps same as the following.]											Do.
Okeroe. SDB76	Swed	rc	ms	yrsc	f	w	psa	vg		m	Supposed to have originated in Sweden.
Okolona. P'95	Tenn	ob	l	gywrs	ft	w	msa	vg		me	
Oldaker's New. D. Syn. of Alfriston											
Old Bettie. Dap. Syn. of Annette											
Old Codlin. L. Syns, Codlin, Codling, English Codlin, Old English Codlin, Old English Codling, Trenton Early.	Eng	oblc	ml	pyb	t	w	psa	g	k	me	
Old Colony. R. Syn. Old Colony Pearmain											Not described.
Old Colony Pearmain. MagofH'39. Syn. of Old Colony											
Old Dapple. W. Syn. of Dapple											
Oldenburg. A'83. Syns. Borovitski, Borovinka of J. L. Budd, Borovitsky, Brunswicker, Charlamowski, Duchess of Oldenburg, Duchess of Oldenburgh, Dutchess, New Brunswick, Oldenburgh, Smith's Beauty of Newark.	Rus	rob	m	yrs	j		sa	g	km	me	
Oldenburgh. Wg. Syn. of Oldenburg											
Old English Codlin. D. Syn. of Old Codlin											
Old English Codling. W. Syn. of Old Codlin											
Old English Codling. W. Syn. of English Codlin											
Old Field. D	Conn	obc	m	yb	t	y	psa	g		l	
Oldfield. E. Syn. of Fall Queen. [Probably Buckingham.]											

Old Field. D. Syn. of Mason Stranger											
Oldfield Apple. Hort'52. Syn. of Horse											
Old Golden Pippin. Lin. Syn. of Golden Pippin (Eng.)											
Old House. A'56	Pa	obc	m	yb	tfj		sa	g		ml	
Old Hundred. D. Syn. of Hundred											
Old Maid's. D. Syn. of Knobby Russet											
Old Nonpareil. BBL. [May be Nonpareil.]											Do.
Old Nonpareil. GenF'33. Syn. of Nonpareil											
Old Nonsuch, of Mass. D. Syn. of Red Canada											
Old Pearmain. NEF'26. Syn. of Herefordshire											
Old Pearmain. D. Syn. of Winter Pearmain											
Old Pippin. L. Syn. Old Town Pippin		rob	ml	pyrs	fmj	y	sa	g	k	l	
Old Pomeroy. GenF'33		ob		ryb				g	d	ml	
Old Royal Russet. D. Syn. of Old Russet											
Old Royal Russet. D. Syn. of Royal Russet											
Old Russet. L. Syns. Leather Coat Russet, Old Royal Russet		r	m	gru		gw	a			ml	
Old Town. L. Syns. Old Town Crab, Spice Apple (of some)	Va		s	gy	cj		s			l	
Old Town Crab. D. Syn. of Old Town											
Old Town Pippin. Hort'54. Syn. of Hubbardston											
Old Town Pippin. D. Syn. of Old Pippin											
Old Vandervere. IndF'40. Syn. of Vandevere											
Old Winter Pearmain (called here Hoops). IllH'68. [This is doubtless Greyhouse.]											Do.
Oley. L. Syn. Speckled Oley	Pa	r	m	gyrs	mj	w	sa	g			
Olga. R. Syn. Olga Nicolajewna											Do.
Olga Nicolajewna. IndH'87. Syn. of Olga											
Olighar No. 2. SDB65											
Olighar No. 6. SDB65											
Olighar No. 8. SDB65											
Olighar No. 10. SDB65											
Olighar No. 14. SDB65. Syn. of Oligher											
Oligher (?). R. Syns. Ohligee, Olighar No. 14, Oligher No. 14, Superb	Minn	ob	l	y	tj	w	pa	g		l	Variously spelled by same author. Which is correct?
Oligher No. 14. SDB76. Syn. of Oligher (?)											
Oline. D		r	vl	yb	tf		sa	vg		m	From report of Society of Van Mons.
Oliphant. MagofH'50											Not described.
Olive (N. C.). JVL	N. C	c	m	c	cj		sa	vg		m	
Olive (Vt.). GarM'60	Vt	obc	m	yrs	tj	w	sa			ml	From Gardener's Monthly.
Olive (Eng.). C	Eng			yru			sa			m	
Oliver. MagofH'53											Not described.
Oliver (Ark.). ArkB49. Syns. Oliver's Red, Senator	Ark	rob	l	rse	fj	yw	rsa	vg	m	ml	
Oliver's Red. ArkB49. Syn. of Oliver (Ark.)											
Omar Pasha. D	Eng	rob	ml	yru	fcj	w	a		k		
Omensk (name of a place). Gb. Syn. of Romenskoe										l	
(Omitted.) Gb. Syns. Christapfel, Gov. list No. 310	Rus										Do.
(Omitted.) Gb. Syns. Gov. list No. 451, Vorschtapel	Rus										Do.
(Omitted.) Gb. Syns. Gov. list No. 463, Pipka postilnaya	Rus										Do.
(Omitted.) Gb. Syns. Gov. list No. 798, Stekliannoe duchistoe	Rus										Do.
(Omitted.) Gb. Syns. Gov. list No. 979, Tchutilotchnoe	Rus										Do.
(Omitted.) Gb. Syns. Rgl. to Ia. No. 10, Rigaer herbst Streifling	Rus										Do.
(Omitted.) Gb. Syns. Shro. to Ia. No. 31. [Label lost.]	Rus										Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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(Omitted.) Gb. Syns. Gvosditchoe, Shro. to Ia. No. 58	Rus										Not described.
(Omitted.) Gb. Syns. Krimskoe Vosduchnoe, Shro. to Ia. No. 65	Rus										Do.
(Omitted.) Gb. Syns. Scharik kremera, V. R. S. to Ia. No. 6	Rus										Do.
(Omitted.) Gb. Syn. Jeltoe biel (Fischer), V. R. S. to Ia. No. 13	Rus										Do.
(Omitted.) Gb. Syns. Jeltoe biel, V. R. S. to Ia. No. 14	Rus										Do.
(Omitted.) Gb. Syns. Reinette Scharlock, V. R. S. to Ia. No. 23	Rus										Do.
(Omitted.) Gb. Syns. Moregi, V. R. S. to Ia. No. 30	Rus										Do.
(Omitted.) Gb. Syns. Lauger gruner gulderling, V. R. S. to Ia. No. 37	Rus										Do.
(Omitted.) Gb. Syns. V. R. S. to Ia. No. 42, Weisser Winter tafel apfel	Rus										Do.
Onarga. RNY'70	Ill	rob	m	rs				vg			
O'Neal. L. Syn. O'Neal's Seedling										l	Do.
O'Neal's Seedling. Cat. Syn. of O'Neal											
Oneida. L. Syn. Oneida Chief	N. Y										Do.
Oneida Chief. W. Syn. of Oneida											
Onstine. L. Syn. Onstine Greening	Ohio?	robc	m	gy	fj	wy	sa		km		
Onstine. D. Syn. of Wood Greening											
Onstine Greening. Dap. Syn. of Onstine											
Ontario. D	Ont	obc	l	wyrs	ftj	wy	sa			vl	Described in Hort'74, 312, previous to being named.
Ontz. L. Syn. Reinette Ontz	Belg	obc	m	py	mj	y	sa			l	
Ooltewah. P'95	Tenn	rob	l	gy	ctj	y	sa	g		e	
Oostanaula. P'95. Syn. White Sweet	Tenn	rob	ml	gyb	ft	y	s	g-vg	dk	e	
Opalescent. IllH'01. [Possibly same as Hastings.]											Not described.
Open Ridge. L. Syn. Open Ridge Favorite											Do.
Open Ridge Favorite. Cat. Syn. of Open Ridge											
Oporto. IllH'96. [Probably same as Aport.]											Do.
O'Porto. IaB31. Syn. of Aport											
O'Porto Rosy. Gb. Syn. of Rosy Aport											
O'Porto Turnip Seedling. Gb. Syn. of Repka Aport											
Orange (N. J.). DomEnc. Syn. Fall Orange	N. J	rob	m	yru	j	y	sa	vg		m	
Orange (Pa.). MagofH'53	Pa	rob		y		y	sa	g			
Orange (Ct.). W	Conn	r	l	y			sa	g		l	
Orange (Fr.). D	Fr	r	m	yb	tj	w	sa	g		m	
Orange (Turner). R. Syn. Orange Apple. [Described by Prof. J. B. Turner, of Illinois. May be Trenton Early.]		rc	l	yg	tjc		sa	vg	dm	me	
Orange. C. Syn. of Fall Orange											
Orange. Cole. Syn. of Lowell											
Orange. Cat. Syn. of Munson											
Orange. Cole. Syn. of Spring Orange											

Orange. D. Syn. of Summer Pound											
Orange Apple. A'52. Syn. of Orange (Turner)											
Orange Apple. IndH'69. Syn. of Summer Queen											
Orange Pippin (N. J.). K	N. J	rob	ml	y			sa		m	m	
Orange Pippin (Fr.)	Fr	r	ml	y			a		e	ml	
Orange Pippin. GenF'33. Syn. of Isle of Wight											
Orange Red. IllB15. Syn. of Limbertwig											
Orange Russet. Hort'55. [So named by P. Barry, about 1845.]											Do.
Orange Russet. W. Syn. of Orange Sweet											
Orange Sweet (Ohio). D	Ohio	r	l	gy	tj	w	ps	g	k	m	
Orange Sweet (Mass.). D	Mass	ob	m	gy	c	yw	rs	g	k	me	
Orange Sweet (Me.). D	Me	ro	m	yb	t	y	rs			m	
Orange Sweet (East). D. Syns. Orange Russet, Orange Sweeting	East	r	l	gyrn	fj	g	s	g	k	m	
Orange Sweet. Cole. Syn. of Golden Sweet											
Orange Sweet. D. Syn. of Munson											
Orange Sweet (erroneously). E. Syn. of Sweet Romanite											
Orange Sweeting. K. Syn. Golden Sweet	Conn.?	ob	ml	y			vs	vg		m	May be identical with one of the Orange Sweets.
Orange Sweeting. D. Syn. of Golden Sweet											
Orange Sweeting. W. Syn. of Orange Sweet (East)											
Orange Winter. A'89. Syn. of Newell. [Name recently changed to Newell.]											
Oranie. MHSC'86	Swed		m	g				vg	dk	e	
Orchard. R. Syn. Queen of the Orchard	Mass	robe	ml	yrs	tj	yw		vg		me	
Orchard Red. OklEx'98											Not described.
Ord. D. Syns. Ord's, Ord's Apple, Simpson's Pippin, Simpson's Seedling	Eng	obe	m	grs	te	gw	bsa			vl	Raised from seed of Yellow Newtown.
Ord's. AHortA'69. Syn. of Ord											
Ord's Apple. AJofHIV. Syn. of Ord											
Ord Beni. MassB41			ml								Not described.
Ordway. MagofH'53											Do.
Oregon. L. Syn. Oregon Baldwin											Do.
Oregon Baldwin. Cat. Syn. of Oregon											
Oregon Queen. IndH'93											Do
Oregon Sweet. P'95	Ore.?	rob	l	gy			s	vg		e	
Orel List No. 4. IaB31. Syn. of Losovka											
Orel List No. 6. IaB90. Syn. of Striped Winter											
Original Nonpareil. D. Syn. of Nonpareil											
Orlon. ColExR'89											Do.
Orisimi. L. Syn. Orisimi Hibernal											Do.
Orisimi Hibernal. Cat. Syn. of Orisimi											
Orleans. MagofH'37. Syns. Orleans Reinette, Reinette d'Orleans		robl	l	yrs	fj	y	ba			ml	
Orleans Reinette. D. Syn. of Orleans											
Orloff. Gb. Syns. Gov. list No. 133, Orlovskoe, Orlowskoe	Rus										Do.
Orlovskoe. Gb. Syn. of Orloff											
Orlowskoe. Gb. Syn. of Orloff											
Ornament. L. Syn. Ornament de Table		rob	m	r			psa	vg		ml	
Ornament de Table. DelExR'95. Syn. of Ornament											
Orndorf. D. Syn. Orndorff	Ohio	rob	m	yrs	t	w	sa	g		m	
Orndorff. MagofH'53. Syn. of Orndorf											
Orne. MagofH'45. Syn. Orne's Early	Eur.?	r	m	w	tfj	w	sa	g		me	
Orne's Early. D. Syn. of Orne											

Catalogue of the known varieties af apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Oro. P'91	N. J	ob	m	yrs	fj	y	sa	vg		ml	
Orrick. BBL											Not described.
Orsimui. Gb. Syn. of Hibernal											
Ortley. GenF'33. Syns. Bellflower White, Crane's Pippin, Cumberland Spice, Davis, Davis White Bellflower, Detroit, Detroit of the West, Golden Pippin, Greasy Pippin, Green Bellflower, Hollow Cored Pippin, Inman, Jersey Greening, Marrow Pippin, Melting Pippin, Monstrous Bellflower, Ohio Favorite, Ortley Pippin, Spice Pippin, Tod's Golden Pippin, Tom Woodward Pippin, Van Dyne, Warren Pippin, White Bellefleur, White Bellflower, White Detroit, White Pippin, White Seek-no-further, Willow Leaf Pippin, Woodward's Pippin, Woolman's Long, Yellow Pippin.	N. J	roble	ml	gy	ftj	w	sa	g-vg	dk	ml	
Ortley Pippin. M. Syn. of Ortley											
Orton. R. Syn. Orton's Red Winter	Utah		m	l	f					l	
Orton's Red Winter. A'77. Syn. of Orton											
Osage. L. Syn. Osage Sweet											Do.
Osage Sweet. Cat. Syn. of Osage											
Osawatomie. A'77	Kans	robe	m	yrs	tj	yw	sa	g		l	
Osborn. L. Syn. Osborn's Rambo	Ind	r	ml	rs			sa	vg		m	
Osborn Cheese. R. Syn. Osborn's Cheese											Do.
Osborn's Cheese. IllB45. Syn. of Osborn Cheese											
Osborn's Fall Sweet. E. Syn. of Osburn Sweet											
Osborn Pippin. R. Syn. Osborn's Pippin				y			a	vg		l	
Osborn's Pippin. IllB45. Syn. of Osborn Pippin											
Osborn's Rambo. W. Syn. of Osborn											
Osborn Sweet (Ind.). R. Syn. Osborn's Sweet	Ind	obl	m	y			s	g		l	
Osborn's Sweet. IndH'88. Syn. of Osborn Sweet (Ind.)											
Osborn's Sweet. MagofH'5. Syn. of Osburn Sweet											
Osburn Sweet. W. Syns. Osborn's Fall Sweet, Osborn's Sweet		r	l	y			s			m	Osborn Sweet (Ind.) distinct from this.
Osceola. MagofH'43	Ind	robe	ml	yrs	fj	w	psa	g-vg	dm	l	
Osenni Aport. Gb. Syn. of Autumn Aport											
Osgood's Favorite. K. Syn. of Lyscom											
Osimoe. Gb. Syn. Shro. to Ia. No. 7	Rus										Not described.
Osimui. Gb. Syn. of Hibernal											
Oskaloosa. GarM'59. Syn. Jack Apple	Iowa	rob	m	y	j		sa			m	From Gardener's Monthly.
Oslin. NEF'32. Syns. Arbroath Pippin, Oslin Pippin, White Oslin	Scot	ob	ms	py	fcj	y	sa	g		m	
Oslin Pippin. MagofH'51. Syn. of Oslin											
Osnabruck. L. Syns. Grau Osnabrucker Reinette, Osnabrucker Reinette, Reinette d'Osnabruck.	Eur	r	s	ybru	fj	w		vg		ml	From the Verger.

Osnabrucker Reinette. D. Syn. of Osnabruck											
Ossippee. R. Syn. Ossippee cream											
Ossippee Cream. NEF'42. Syn. of Ossippee											
Osterley. D. Syn. Osterley Pippin	Eng	rob	ms	grub	fcj	gy	ba			ml	From Ronalds.
Osterley Pippin. D. Syn. of Osterley											
Ostogate. D	Fr.?	rob	m	yru	f	wy	msa			m	From Annals of Pomology.
Ostogate. D. Syn. of Doux											
Ostrakavis. SDB76. Syn. Ostrakoff X Ben Davis	Iowa	c	ms	yb		w	s			ml	Origin Iowa Ex. Station. Seed of Ostrakoff × Ben Davis.
Ostrakoff X Ben Davis. SDB76. Syn. of Ostrakavis											
Ostrakoff. N. Syn. of Ostrokoff											
Ostrakoff. MinnB83. Syn. of Hibernal											
Ostrekoff's Glass. Gb. Syn. of Ostrokoff											
Ostrokovskaya Steklianka. Gb. Syn. of Ostrokoff											
Ostrekowskaja Steklianka. Gb. Syn. of Ostrokoff											
Ostrokoff. Gb. Syns. Gov. list No. 472, Ostrakoff, Ostrekoff's Glass, Ostrekowskaja Steklianka, Ostrokovskaya Steklianka, Shro. to Ia. No. 4, Steklianka Ostrokovskaya.	Rus		ml	y			sa			vl	
Oszl. R. Syn. Oszi-Vaj											Not described.
Oszi-Vaj. AlaB98. Syn. of Oszi											
Otoe. A'71. Syn. Otoe Red Streak	Nebr	rob	m	wyrs	etj	ws	sa	g-vg		vl	
Otoe Red Streak. RNY'70. Syn. of Otoe											
Overflowing. Gb. Syns. Gov. list No. 972, (Tchereztetchuni), Treehtrshromnoe.	Rus										Do.
Overman. L. Syns. Overman's Sweet, Overman's Sweeting	Ill	robe	m	yrs	mj	w	s	g		l	
Overman's Sweet. NWFG'52. Syn. of Overman											
Overman's Sweeting. W. Syn. of Overman											
Overton. IllH'99											Do.
Ovlatt. D	Ohio	robe	l	gyb	t	w	psa	g		me	
Owen's Golden Beauty. GenF'33. Syn. of White Juneating											
Owen Jones. CanExR'01		roble	ml	grs	fmj	y		g		ml	
Owens. IaH'97											
Ox. D	Pa	re	l	wb	etj	w		g		ml	
Ox Apple. AmF'63. Syn. of Gloria Mundi											
Ox Apple. H. Syn. of Newtown Spitzenburg											
Ox Eye. H. Syn. of Flushing. [Probably an error.]											
Ox Eye. D. Syn. of Newtown Spitzenburg											
Ox Eye of *O.* Cole. Syn. of Vandevere											
Ox Eye (of some in Ky.). D. Syn. of Buckingham											
Oxford. MagofH'53											Do.
Oxford (Ind.). Dap	Ind	robe	m	pyb	fj	wy	sa			l	
Oxford Orange. (LC)	Minn	ro	m	yb	f	w	psa	vg		l	Originated by Wm. Oxford, Freeburg, Minn.
Oxford Peach. D. Syn. of Scarlet Pearmain											
Oxnead. L. Syns. Earl of Yarmouth's Pearmain, Oxnead Pearmain	Eng	c	s	gru	fe	gw	ra			ml	
Oxnead Pearmain. D. Syn. of Oxnead											
Ox Noble. GB	Mich	re	vl	yrs				g		l	
Ox Sweet. D	Mass	rob	ml	gb	jt	yw	s	g		m	
Ox Sweet. RNY'57. Syn. of Yankee Spy											
Ozark. ArkB60	Ark	r	l	y			sa	g		ml	
Ozark Pippin. TennBI-IX. Syn. of Deaderick											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Ozone. ArkB49. Syn. Martin's Red	Ark	rob	ml	ywrsc	ftj	y	sa	vg-b		ml	
Pack Horse. MagofH'51			l					g		l	
Padley. L. Syns. Compote, Padley's Pippin, Padley's Royal George, Padley's Royal George Pippin.	Eng	rob	ms	gyru	j	y	rba		d	ml	From Henry Corse, of Montreal.
Padley's Pippin. GenF'33. Syn. of Padley											
Padley's Royal George. K. Syn. of Padley											
Padley's Royal George Pippin. K. Syn. of Padley											
Paine. L. Syn. Capt. Paine's											Not described.
Painted. Gb. Syns. Gov. list No. 438, Pointed, Rospisnoe	Rus										Do.
Painted Anis. Gb. Syns. Anis rospisni, Anis rospisnoe, Pointed Aniselle	Rus										Do.
Painted Arcad. Gb. Syns. Arkad rospisnui, Shro. to Ia. No. 143	Rus										Do.
Painted Lady. JVL				py					d	ml	
Painted White. Gb. Syns. Beel raspisnaja, Biel raspisnaya, Gov. list No. 468, Pointed White.	Rus										Do.
Palmer (Ga.). L. Syns. Palmer Apple, Pear Apple	Ga.?	robc	ml	pyrs	fj	wy	psa		km	ve	
Palmer (Wis.). WisExR'96	Wis	rob	m	rs	fj	w	sa		k	l	
Palmer. Cat. Syn. of Pear											
Pal...er Apple. A'79. Syn. of Palmer											
Palmer Greening. D. Syn. of Washington Royal											
Palmer of N. Z. BBL											Do.
Palo. Cat											Do.
Palouse. P'91	Wash	oblc	ml	yrs	c	y		vg		ml	
Panden. L. Syn. Panden Sweet		ob	m	yb	c	w	s	g	k	m	
Panden Sweet. D. Syn. of Panden											
Panther. D. Syn. of Santanchee											
Pantneyite. H. Syn. of Putneyite											
Paoli. RNY'70											
Papa. ColExR'88											Do.
Paper. W. Syn. of Champlain											
Paper Apple. D. Syn. of Summer Pippin											
Paper Skin. Dap. Syn. of Champlain											
Papoff. R. Syn. Papoff's Streaked	Rus		l	yrs						e	
Papoff's Streaked. JVL. Syn. of Papoff											
Paradise. C			ms	y			s			mc	
Paradise Pippin. D. Syn. White Paradise											
Paradise Strie. R. Syn. Paradise Strie d'Hiver		ob	ml	rs			sa	vg		m	
Paradise Strie d'Hiver. IllB45. Syn. of Paradise Strie											
Paradise Summer. W. Syn. of Summer Paradise											
Paradise Sweet. WBKJ			l		cvj	w	sa		dc	mc	
Paradise Winter. W. Syn. of Winter Paradise											

Paradise Winter Sweet. Cat. Syn. of Winter Paradise										
Paragon. ArkB49. Syns. Black Twig, Mammoth Black Twig, Twitty's Paragon.	Tenn	rc	vl	yrs	fj	y	bmsa	vg	dm	l	Doubtful if distinct from Arkansas.
Paragon. E		rob	m	pyb	cj	y	sa	vg		ml	Named prior to preceding. Doubtless extinct.
Paris. MoH'86	Mo		l					g		l	
Pariser. R. Syn. Pariser Rambour											Not described.
Pariser Rambour. MoH'87. Syn. of Pariser											
Paris Pippin. NEF'31											Do.
Park. A'67. Syns. Park Apple, Park Spice	N. Y	rc	m	wyrs	fmj	y	sa	vg		l	
Park Apple. D. Syn. of Park											
Parke's Keeper. AHortA'69. Syn. of McAfee											
Parker. IllB45											Do.
Park Keeper. AmGar'01. Syn.of Maccabee. [Evidently a misprint for McAfee.]											
Park Keeper. Dap. Syn. of McAfee											
Park (not of Kansas). Dap. Syn. of Long Red											
Parks. MagofH'39											Do.
Park Spice. D. Syn. of Park											
Park Sweeting. A'73	Ohio						s			m	
Parlin. P'94. Syn. Parlin's Beauty	Me	rc	l	pyb	fj	y	sa	g		ml	
Parlin's Beauty. IllH'99. Syn. of Parlin											
Parmain d'Ete. E. Syn. of Summer Pearmain											
Parmain d'Hiver. D. Syn. of Winter Pearmain											
Parmelee. PFar'51											
Parmentier. L. Syn. Parmentier Reinette	Fr	r	l	yrs	f	yw	a			vl	From the Society Van Mons.
Parmentier Reinette. D. Syn. of Parmentier											
Parmetta. WisHort'01. Syn. Rushford	Wis	r	l	gr			sa	vg		l	
Parmin. D. Syn. of Herefordshire											
Parmin Royal. D. Syn. of Herefordshire											
Parrot. L. Syn. Parrot Reinette	Eur	rob	ml	yrs	tj	w	bsa	g	mk	l	
Parrot Reinette. D. Syn. of Parrot											
Parry. L. Syn. Parry's Pearmain	Eng	robl	s	gyrs	fj		rs	g-vg	d	l	
Parry 20. L. Syn. No. 20 Parry											Not described.
Parry's Pearmain. GenF'33. Syn. of Parry											
Parry White. L. Syns. Imperial White, Parry's White, Superior White, White Apple.	Pa.?	robe	ms	wb	fct	w	sa	g	dkm	me	
Parry's White. Dap. Syn. of Parry White											
Parson. CanExR'96. Syn. Parson's Sweet	Mass	rc	l	yr	tj	w	s	vg		ml	
Parson Early. R. Syn. Parson's Early											Do.
Parson's Early. E. Syn. of Parson Early											
Parson Sweet. L. Syn. Parson's Sweet. [Possiby same as Parson.]											Do.
Parson's Sweet. CanExR'96. Syn. of Parson											
Parson's Sweet. Cat. Syn. of Parson Sweet											
Partners. R. Syn. Nine Partners		robl	s	gru					d	l	
Partnership. IllB45											Do.
Pasman. AlaB98											Do.
Pason. L. Syn. Pason Sweet. [May be same as Parson.]											Do.
Pason Sweet. Cat. Syn. of Pason											
Pasquatank. Cat											Do.
Pasque Apple. K. Syn. of Easter											
Passe. R. Syn. Passe Lettres											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Passe Lettres. IllB45. Syn. of Passe											
Passe Pomme. D. Syn. of Pigeon											
Passe Pomme Cotellee. D. Syn. of Early Autumn											
Passe Pomme d'Automne. D. Syn. of Early Autumn											
Passe Pomme de Canada. GenF'33. Syn. of Royal Russet											
Passe Pomme Rouge. D. Syn. of August Red											
Passe Pomme Rouge d'Automne. D. Syn. of Early Autumn											
Pasteana. R. Syn. Pomme de Pasteana											Not described.
Pastichorka. Gb. Syn. of Shepherd											
Patch. L. Patch's Russet	Eng	rob	ms	gyru	c	yw	bsa	g		m	
Patch's Russet. D. Syn. of Patch											
Paternoster Apfel. D. Syn. of Dutch Mignonne											
Paterson's Sweet. D. Syn. of Bailey Sweet											
Paterson's Sweet. D. Syn. of Victoria Sweet											
Patsbury. (LC)											Do.
Patten. L. Syns. Patten's Duchess No. 3, Patten's Greening	Iowa		ml	y			sa	vg	dk	l	
Patten's Duchess No. 2. JVC											
Patten's Duchess No. 3. JVC. Syn. of Patten											
Patten's Fameuse No. 1. JVC											
Patten's Greening. A'89. Syn. of Patten											
Patten No. 20. IllH'02	Iowa		l	rs	c			g		me	Supposed to be a seedling of Oldenburg.
Patterson. JBW&B. Syn. of Bailey Sweet											
Patterson. P'95. Syn. of Hopewell											
Patterson Early. R. Syn. Patterson's Early											Not described.
Patterson's Early. MagofH'53. Syn. of Patterson Early											
Patterson Sweet. E. Syn. of Bailey Sweet											
Pattle Grimes. WMP&S	Md			pr	j	w		vg		l	
Patton. W. Syns. Alabama Pearmain (of Peters), Carter (Ala.), Mangum	Ala	rob	ml	rs			a	g		ml	Probably distinct from Mangum.
Patton. Syn. of Carter Blue											
Patton. D. Syn. of Mangum											
Patton Russet. R. Syn. Patton's Hybrid Russet. [Probably Patten is correct.]											Not described.
Patton's Hybrid Russet. MinnExR'90. Syn. of Patton Russet											
Patton Sweet. R. Syn. Patton's Winter Sweet	Ohio	oble	ml	gb	tj	w	s			l	Described by R. Seevers in Mag. of H. '46, 444.
Patton's Winter Sweet. MagofH'46. Syn. of Patton Sweet											
Paul. L. Syn. Seedling Paul	Pa.?	ob		rs			sa	vg		ml	
Paulet. R. Syn. Paulet Russet			s	yru			sa			e	

Paulet Russet. IllB45. Syn. of Paulet											
Paul Imperial. R. Syn. Paul's Imperial											Not described.
Paul's Imperial. NYB15. Syn. of Paul Imperial											
Pawpaw. Hort'58. Syns. Ball Apple, Pawpaw Seedling, Rubicon, Western Baldwin.	Mich	robl	m	yrs	jfr	y	bsa	vg	d	vl	Probably same as Rubicon.
Pawpaw Seedling. Hort'58. Syn. of Pawpaw											
Pawsan. D	Eng	r	m	gru	fj		a		c	m	
Payne. L. Syns. Payne's Keeper, Payne's Late Keeper	Mo								m	l	
Payne's Keeper. BBL. Syn. of Payne											
Payne's Late Keeper. MoH'01. Syn. of Payne											
Payton. MoH'94. Syn. of Gano											
Peabody. R. Syn. Peabody Greening											Do.
Peabody Greening. A'81. Syn. of Peabody											
Peach. D. Syn. Peach of Kentucky		obc	ms	pyb	ctj	w	sa	g-vg		vl	
Peach. SP&L. Syn. of Irish Peach											
Peach. N. Syn. of Peach (Montreal)											
Peach Apple. CAG. Syn. of Irish Peach											
Peach Apple Seedling from Minn. MinnExR'90											
Peachblow. Dap	Me	robc	l	yb	tmj	wy	sa	g	km	m	
Peach (Montreal). A'83. Syns. Canada Peach, Montreal Peach, Peach	Fr	rc	ml	rs			sa	vg	dm	m	
Peach of Kentucky. IllB45. Syn. of Peach											
Peach of Montreal. T. Syn. of Montreal Peach											
Peach Pond. A'71. Syns. Peach Pond Sweet, Peach Pound Sweet	N. Y	robc	m	rs	tmj		s	vg	dk	m	
Peach Pond Sweet. D. Syn. of Peach Pond											
Peach Pound Sweet. IllB45. Syn. of Peach Pond											
Peach Ridge. MichB31											Do.
Peak. R. Syns. Peak's Red, Peak's Red Winter			l	r			sa	g		l	
Peaked. R. Syn. Peaked Sweeting							s				Do.
Peaked Sweeting. A'73. Syn. of Peaked											
Peak Fall. R. Syns. Hard's Limbertwig, Peak's Fall	N. C	c	m	wyrs			ma			ml	
Peaknose. NEF'50	Mass		m					g			
Peak's Fall. IllH'72. Syn. of Peak Fall											
Peak's Red. IllB45. Syn. of Peak											
Peak's Red Winter. IllB45. Syn. of Peak											
Pear (Pa.). D. Syn. Pear Apple	Pa	robl	ms	pyb	c	w	psa	g		ml	
Pear (Rus.). MHSC'86. Syns. Gov. list No. 267, Gruscheffka, Gruschevka, Shro. to Ia. No. 83.	Rus										Do.
Pear. NYB90. Syn. Palmer. [Probably same as Palmer.]		robl	m	rs				g			
Pear Apple. D. Syn. of Pear (Pa.)											
Pear Apple. Dap. Syn. of Palmer											
Pear Apple. D. Syn. of Quince (of Coxe)											
Pear Flavor. IllH'81	Eur										Do.
Pear Lot. D. Syn. of Willis Sweet											
Pearl of England. Dap. Syn. of Perle											
Pearmain. Dap. Syn. of Long Red											
Pearmain. D. Syn. of Winter Pearmain											
Pearmain Herefordshire. F. Syn. of Winter Pearmain											
Pearmain Rouge. R. Syn. Pearmain Rouge d'Hiver		rc	s	yrb			sa	vg		vl	
Pearmain Rouge d'Hiver. IllB45. Syn. of Pearmain Rouge											
Pearmain Russet. W		r	s	ru			sa	vg		l	
Pear (of Illinois). MichB31											Do.
Pear Pippin. Dap	N. J.?	roble	l	py	tj	w	sa	g	dkm	ml	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Pear Rennet. K. Syn. Reinette Poire	Eng			y			sa		c	ml	
Pearsall. L. Syn. Pearsall's Sweet	N. Y.?	r	ml	yrs	cmj	y	s	g	k	l	
Pearsall's Sweet. D. Syn. of Pearsall											
Pearson. R. Syn. Pearson's Plate	Eng	ob	s	gyb	ct	w	sa	g		l	
Pearson's Plate. GenF'33. Syn. of Pearson											
Pearson Early. L. Syn. Pearson's Early		r	ml	py		yw	a			me	
Pearson's Early. D. Syn. of Pearson Early											
Pearson Pippin. L. Syn. Pearson's Pippin	Eng		s	ru		y	r		k		
Pearson's Pippin. C. Syn. of Pearson Pippin											
Pearson Winter. IaH'85											Not described.
Pear Sweet. R. Syn. Pear Sweeting											
Pear Sweeting. RIB37. Syn. of Pear Sweet											
Pear Tree Lot. MagofH'41. Syn. of Willis Sweet											
Pease. Bul8. Syn. Walter Pease	Conn	r	vl	rysc	ftj	w	sa	vg	dk	me	
Peasgood. L. Syn. Peasgood's Nonsuch	Eng	rob	l	yrse	tvj	y	a		dk	m	
Peasgood's Nonsuch. Dap. Syn. of Peasgood											
Peck. (LC). Syns. Peck's Pleasant, Waltz Apple, Watts'	R. I.	rob	ml	gyb	jct	y	sa	vg-b	dkm	ml	
Pecker. Th. Syn. of Baldwin											
Peck's Pleasant. K. Syn. of Peck											
Peck Spice. L. Syn. Peck's Spice	N. Y		l	gy			a	g	dkm	me	
Peck's Spice. BBCo. Syn. of Peck Spice											
Pedimont. L. Syn. Pedimont Pippin											Do.
Pedimont Pippin. Cat. Syn. of Pedimont											
Pedrick. R. Syn. Pedrick's Mulberry, Pedrick's Spitzenburg			ml					vg		l	
Pedrick's Mulberry. IllB45. Syn. of Pedrick											
Pedrick's Spitzenburg. IndH'72. Syn. of Pedrick											
Peebles. P'95	Ky	robobl	ml	gyb	fj	y	bsa	gv-g		ml	
Peerless. A'77	Minn	rob	l	grs	fj		psa	vg	dk	m	Originated at Richland, Minn., in 1864.
Peers. MichB31											Not described.
Peffer. P'89	Wis	r	ml	yrs	ftj	w	sa	g		ml	A seedling of Pewaukee.
Peffer Duchess. R. Syn. Peffer's Duchess X Ralls Genet	Wis	ob	m	yrs	jf	w	sa	vg		l	Originated by Geo. P. Peffer, Pewaukee, Wis.
Peffer's Duchess X Ralls Genet. SDB76. Syn. of Peffer Duchess											
Peffer Golden. R. Syn. Peffer's Golden	Wis	robe	ml	yrb	fj	y	sa	vg-b	d	l	
Peffer's Golden. A'77. Syn. of Peffer Golden											
Peffer's No. 1. OntExR'82											
Peffer's No. 10. MinnExR'90											
Peffer's No. 20. IllH'89											
Peffer's No. 25. Hort'72											

Peffer's No. 29. JVC											
Peffer Russet. R. Syn. Peffer's Russet	Wis			ru							Not described.
Peffer's Russet. Hort'72. Syn. of Peffer Russet											
Peffer Sweet. R. Syn. Peffer's Sweet	Wis	ob	m	gy			s				
Peffer's Sweet. IllH'91. Syn. of Peffer Sweet											
Peffer Winter. R. Syn. Peffer's Winter	Wis	robl	ml	gyrs	tj	yw	bsa	g		l	May possibly be Pewaukee.
Peffer's Winter. A'77. Syn. of Peffer Winter											
Pekin. R. Syn. Pekin (of Indiana)		obl	m	rb			sa	vg		l	
Pekin (of Indiana). IllB45. Syn. of Pekin											
Pelham. L. Syns. Green Sweet, Pelham Sweet	Mass	robc	ms	gbru	t	y	s	g		l	
Pelham Sweet. D. Syn. of Pelham											
Pelican. K. Syn. of Pennock											
Pembina. Cat											Not described.
Pen. A'71	Pa	robc	l	yr	tj	y	sa	vg		l	Named for Hop Pen, near which it originated.
Penakin. JGH&S. [Probably a perversion of Pennock.]											Not described.
Pendant Ear. Gb. Syns. Gov. list No. 374, Vislouchoe, Wislowehoe	Rus										Do.
Pendula. BBL											Do.
Penenger. MoH'65											Do.
Penn. PFar'97											
Penn Black. F&L	Tenn							vg		vl	
Pennington. W. Syn. Pennington's Seedling	Eng	ob	m	yru	fe	y	ba	p		l	
Pennington's Seedling. GenF'33. Syn. of Pennington											
Pennock. C. Syns. Big Romanite, Broad Apple, Foster'sBest, Gay's Romanite, Large Romanite, Neisley's Winter, Neisley's Winter Penick, Pelican, Pennocks, Pennock's Large Red, Pennock's Red, Pennock's Red Winter, Phoenix, Pomme Roye, Prolific Beauty, Red Ox, Red Pennock, Romanite, Roman Knight, Winter Pennock.	Pa	robc	vl	yrs	tj	y	pmsa	g		l	
Pennocks. M. Syn. of Pennock											
Pennock's Large Red. IndF'40, Syn. of Pennock											
Pennock's Red. IndF'40. Syn. of Pennock											
Pennock's Red Winter. DomEnc. Syn. of Pennock											
Penn Russet. Cat											Do.
Pennsylvania Cider. D. Syn. of Smith											
Pennsylvania Redstreak. W. Syn. of Wine											
Pennsylvania Russet. IndH'74											Do.
Pennsylvania Sweet. D. Syn. Pennsylvania Sweeting	Pa.?	obl	l	gy	tf		vs	g	k	ml	
Pennsylvania Sweeting. W. Syn. of Pennsylvania Sweet											
Pennsylvania Vandervere. E. Syn. of Vandevere.											
Pennsylvania Winesap. W	Pa.?	obe	l	yrs	tj	yw	sa	g	d	ml	
Penn. Winter. R. Syn. Penn. Winter Sweet							s			l	Do.
Penn. Winter Sweet. FF&S. Syn. of Penn. Winter											
Penro. IllH'71											Do.
People's Choice. D. Syn. of Choice											
Pepin d'Or. D. Syn. of Golden Pippin (Eng.)											
Pepin d'Or Allemand. D. Syn. of Allemand											
Pepin Limon de Galles. D. Syn. of Lemon Pippin											
Pepin Parmain d'Angleterre. D. Syn. of Winter Pearmain											
Pepin Parmain d'Hiver. D. Syn. of Winter Pearmain											
Pepin Russe. D		rob	m	yb	f	yw	sa			ml	From transactions of Society Van Mons.
Pepper. ColExR'89											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Pepping Englischer. Gb. Syn. of English Pippin											
Pere de Grande. BBL											Not described.
Peremenes. D. Syn. of Winter Pearmain											
Perfection. JVC	Minn	r	vl	yrs			sa	g	km	m	
Perkins. W	South	r	s	y			sa	g		l	
Perkins. Dap. Syn. of Forney											
Perkin's Long. MagofH'41. Syn. of Endicott											
Perkins No. 32. SDB76											
Perkins No. 46. SDB76											
Perkins No. 78. SDB76											
Perkins Sweet. BBL											Do.
Perkins Winter. IllB45											Do.
Perle. L. Syns. Pearl of England, Perle d'Angleterre	Eur		ms	yrs	j	w	bsa	g-vg		m	
Perle d'Angleterre. Dap. Syn. of Perle											
Perpetual. R. Syn. Perpetuelle		c	m	yb			sa			l	
Perpetuelle. IllB45. Syn. of Perpetual											
Perry. P'92	Ohio	ob	m	yrs	ftj	y	sa	vg	dm	vl	
Perry Red. L. Syn. Perry Red Streak	N. Y	ob	m	pyrs	ctj	w	sa			m	
Perry Red Streak. Hort'69. Syn. of Perry Red											
Perry Russet. W. Syn. Golden Russet		rc	m	yru	fj	y	bsa	g-vg	dkm	ml	
Persian. Gb. Syns. Sary Synap, Synap, V. R. S. to Ia. No. 20	Rus	robl	m	y				vg	dm	l	
Persian. Gb. Syn. of Muscatel											
Persimmon. D. Syn. of Holly											
Pervis. R. Syn. Pervis Winter	N. C		ml	r				vg		vl	
Pervis Winter. JAY. Syn. of Pervis											
Pesolschnaja Steklianka. Gb. Syn. of Sandy Glass											
Pesotchnoe Steklianovoe. Gb. Syn. of Sandy Glass											
Pestruchka. MHSC'86. Syn. of Multicolor											
Peter (Mass.). W	Mass	obl	ml	y			sa	g		e	
Peter (Minn.). IaH'86. Syn. Gideon's Best of All, Peter Gideon's Best	Minn	rob	l	gywrs	tj	y	sa	g		m	
Peter Gideon. MichB169	Minn	obc	l	y			sa	g	km	m	Possibly identical with Peter (Minn.).
Peter Gideon's Best. MoB10. Syn. of Peter (Minn.)											
Peter Good. JVC											Not described.
Peterhoff. Gb. Syns. Peterhovskoe, Rgl. to Ia. No. 328	Rus										Do.
Peterhovskoe. Gb. Syn. of Peterhoff											
Peterkin. IaH'72											
Peter Porter. BBL											Do.
Petersburgh Pippin. GenF'33. Syn. of Green Newtown											
Petersburgskoe krasnoe. Gb. Syn. of Red Petersburg											

Peterson. R. Syn. Peterson Seedling	Minn	robe	l	rs	jt	ws	psa	g		m	Originated by F. J. Peterson, Waconia, Minn.
Peterson Charlamoff. SDB76. Syn. of Charlamoff											
Peterson Seedling. SDB76. Syn. of Peterson											
Peter (the Great). Cat											Not described.
Petit Api. Lin. Syn. of Lady											
Petit Api Noir. W	Eur	r	s	rs			sa	g		l	Probably identical with Black Lady.
Petite Api. E. Syn. of Lady											
Petite Api Rouge. D. Syn. of Lady											
Petite Reinette Grise. Dap. Syn. of Carpentin											
Petit Jean. D	Eng	roob	s	yrs	t	w		g		ml	
Petrovskoe. Gb. Syns. Gov. list No. 372, Petrowskoe, St. Peter's, Shro. to Ia. No. 80.	Rus										Not described.
Petrowskoe. A'83. Syn. of Petrovskoe											
Petworth. L. Syns. Green Nonpareil, Petworth Nonpareil	Eng			g	cj					l	
Petworth Nonpareil. K. Syn. of Petworth											
Pew. R. Syn. Lucy Pew	Mo	r	ml	gyrs		w	sa	vg		m	
Pewaukee. Hort'70	Wis	rob	ml	yrs	cj	w	bsa	g		l	
Pfarrer Walter. D. Syn. of Fallawater											
Pfeiffer. MagofH'53. Syns. Pifer, Pfeifer	Pa	r	ms	yrs	t	w	sa	g		vl	Perhaps not identical. W. and D. differ in description.
Pfeifer. D. Syn. of Pfeiffer											
Pfuffer. A'54. Syn. of Alsace											
Pharr. R. Syn. Pharr's Seedling		re	l	y	tj	wy	sa	vg		ml	
Pharr's Seedling. A'77. Syn. of Pharr											
Philadelphia Green. IllB45. Syn. of Harvest Redstreak											
Philadelphia Pippin. E. Syn. of Fall Pippin											
Philadelphia Queen. IndH'64. Syn. of Early Red											
Philadelphia Sweet. D. Syn. of Autumn Bough											
Philip's Reinette. GenE'33. Syn. of Wick											
Philip Rick. GenF'32. Syn. of Jonathan											
Philips Seedling. MinnHort'97. Syn. of Eureka											
Philip Sweet. Cat											Not described.
Phillippi. A'56	Pa	obe	m	gyb	tfj		sa	g-vg		ml	
Phillips' Seedling. H. Syn. of Phillips Sweet											
Phillips Sweet. A'77. Syns. Phillips' Seedling, Phillip's Sweet, Phillips' Sweeting.	Ohio	robe	ml	wyrs	ctj	w	s	g-vg	k	l	
Phillip's Sweet. W. Syn. of Phillips Sweet											
Phillips' Sweeting. E. Syn. of Phillips Sweet											
Phineas. R. Syns. Phineas Red, Phinehas			m	dr		w			k	l	
Phineas Red. MagofH'40. Syn. of Phineas											
Phinehas. MagofH'42. Syn. of Phineas											
Phoebe. JNCo	Iowa		l	grs	cj		a			l	One of Thompson's seedlings.
Phoenix. NWFG'52	Ill.?	rob	m	yrs	cj	y	sa	g		l	
Phoenix. H. Syn. of Pennock											
Phoenix. AmGar'01. Syn. of Rome											
Phoenix No. 50. IllH'00. [Described but not named.]	Ill	ob	ml	grs	f	w	sa	g		l	
Pian. R. Syn. Pian Sweeting				yr			s	vg		m	
Pian Sweeting. AmF'57. Syn. of Pian											
Picardo. IllH'86											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Pickard. MoH'63. Syn. Pickard's Reserve	Ind	robc	ml	yb	ctj	y	msa	g-vg	dk	ml	
Pickard Bros. Cat.											Not described.
Pickard Choice. R. Syn. Pickard's Choice. [Probably same as Pickard.]											Do.
Pickard's Choice. UtahB18. Syn. of Pickard Choice											
Pickard's Reserve. W. Syn. of Pickard											
Pickaway Rambo. A'77. Syn. of Grosh											
Pickering. R. Syn. Pickering Seedling											Do.
Pickering Seedling. BBL. Syn. of Pickering											
Picket. Dap. Syns. Picket's Late, Pickett	Ky	rob	ml	yrs	ftj	wy	rsa	vg		l	
Picket's Late. IllH'86. Syn. of Picket											
Pickett. IllH'86. Syn. of Picket											
Pickle. Gb. Syns. Gov. list No. 359, Motchetchnoe, Motschetschnoe, Wetting	Rus										Do.
Pickman. K. Syn. Pickman Pippin	Mass	rob	m	yru	c	yw	psa	g-vg		vl	
Pickman Pippin. M. Syn. of Pickman											
Picquett. IllH'87		rc	l					g		l	Possibly identical with Picket.
Pie. PFar'53. Syn. Lounger	Ohio	obl	l	rs			sa	g		m	
Pie Apple. IndF'40. Syn. of Holland											
Piedmont. L. Syns. Dollins Pippin, Piedmont Pippin	Va	robc	l	gyru	ctj	y	sa			l	
Piedmont Pippin. Dap. Syn. of Piedmont											
Pifer. IllB45		ob	m	gyrs			sa	g		vl	Seems to be distinct from Pfeiffer.
Pifer. D. Syn. of Pfeiffer											
Pigeon. C. Syns. Arabian Apple, Coeur de Pigeon, Duif Apfel, Gros Coeur de Pigeon, Jerusalem, Passe Pomme, Pigeon Blanc, Pigeon Rouge, Pomme Pigeon, Rather Taubenapfel.	Eur	oblc	m	pyb	c	w	psa	g		ml	From Ronalds.
Pigeon Blanc. IllB45. Syn of Pigeon											
Pigeon de Rouen. K. Syn. of Rouen Pigeon											
Pigeonet Blanc. D. Syn. of Pigeonette											
Pigeonette. MagofH'53. Syns. American Peach, Museau de Levre, Pigeonet Blanc, Pigeonette Blanc d'Ete, Pigeonette de Rouen, Pigeonette Gros de Rouen, Pigeonette Jerusalem, Taubenfarbige Apfel.	Eur	rob	ms	yrs		w	a			me	From Hogg.
Pigeonette Blanc d'Ete. D. Syn. of Pigeonette											
Pigeonette de Rouen. D	Eur	oblc	l	pyb	t	w	sa	g		l	
Pigeonette de Rouen. D. Syn. of Pigeonette											
Pigeonette Gros de Rouen. D. Syn. of Pigeonette											
Pigeonette Jerusalem. IllB45. Syn. of Pigeonette											
Pigeon Hill. W	Eur	r		rs			sa				Possibly same as Pigeonette.
Pigeon Rouge. W	Eur	c	s	rs			sa	g		m	May be identical with Pigeon.

Pigeon Rouge. D. Syn. of Pigeon											
Pignose. R. Syn. Pig Nose											Not described.
Pig Nose. MagofH'36. Syn. of Pignose											
Piketon. L. Syn. Piketon Russet	Ohio	c	l	rgru						vl	From transactions Ohio Pomological Society.
Piketon Russet. D. Syn. of Piketon											
Piles. L. Syns. Piles Russet, Pyles Russet	Eng	rob	m	gru		g	bsa			vl	From Lindley.
Piles Russet. D. Syn. of Piles											
Pilliken. D. Syn. of Greyhouse. [May Seek-no-further.]											
Pillkin. D. Syn. of May											
Pilot (Va.). A'69	Va.	rob	l	rs			sa	vg	dm	ml	
Pilott (Wis.). R. Syn. Pilott of Wisconsin	Wis.										Not described.
Pilott of Wisconsin. BBL. Syn. of Pilott (Wis.)											
Pim's Beauty of the West. Hort'48. Syn. of Fallawater											
Pineapple (Rus.). Gb. Syns. Ananasnoe, Gov. list No. 988	Rus.	c	s	y		w	sa			m	
Pineapple (N.J.). Dap	N.J.?	ob	ms	pyrs	tj	w	psa			m	
Pineapple (Ohio). H	Ohio.	c	s	ru			sa	g		l	
Pine Apple. D. Syn. of Lucombe Pine											
Pine Apple Pippin. D. Syn. of Lucombe Pine											
Pine Apple Russet. M. Syn. of Pine Russet											
Pinecreek. R. Syns. Hamilton, Pine Creek Sweet	Pa	rc	l	wy	etj	w	s	vg		m	
Pineroyal. R. Syn. Pine Royal Pearmain											
Pine Royal Pearmain. GenF'32. Syn. of Pineroyal											
Pine Creek Sweet. D. Syn. of Pinecreek											
Pine Russet. L. Syns. Hardingham's Russet, Pine Apple Russet	Eur.	c	m	yru	jt	w	sa	vg		m	
Pine Strawberry. D	South	c	ml	pyb	j	y	s	g		l	
Pine Stump. A'91	N. C	obe	l	dc	c	y	s	g		m	
Piney Mountain. Cat. Syn. Yellow Mountain											Do.
Pink. L. Syn. Pink Sweeting	Pa	r	s	gr			s	g		me	
Pink Anis. IndB53	Rus.		m	r				g		me	
Pinkham. P'94. Syn. Pinkham's Keeper	Ohio	robl	s	yrs	ft	y	sa	g		l	
Pinkham's Keeper. P'94. Syn. of Pinkham											
Pinkney. R. Syn. Pinkney Sweet											Do.
Pinkney Sweet. BBL. Syn. of Pinkney											
Pink Sweeting. A'52. Syn. of Pink											
Pinneo's Favorite. D. Syn. of Dyer											
Pinner. D. Syns. Carrell's Seedling, Pinner Seedling	Eng	r	m	yru	ct	y	bsa			ml	
Pinner Seedling. D. Syn. of Pinner											
Pioneer (Pa.). D	Pa	robe	m	yrs	j	wy	psa	g		m	
Pioneer (Cal.). UCExR'97	Cal		m	gy				vg		l	
Pioneer (N.Z.). R. Syn. Pioneer of N. Z. (New Zealand)	N. Z										Do.
Pioneer of N. Z. BBL. Syn. of Pioneer (N.Z.)											
Piper. MagofH'45. Syn. Piper's Favorite	N. H			y				g		m	
Piper's Favorite. Cat. Syn. of Piper											
Pipka. Gb. Syn. Gov. list No. 369	Rus.										Do.
Pipka (——). Gb. Syn. of Little Pipka											
Pipka Champanskaya. Gb. Syn. of Champagne Pipka											
Pipka Dantsigskaya. Gb. Syn. of Dansic Pipka											
Pipka Gorkaja. Gb. Syn. of Gorke Pipka											
Pipka Gorkaya. Gb. Syn. of Gorke Pipka											
Pipka lietnaya. Gb. Syn. of Early Pipka											
Pipka ostrokonetchnaya. Gb. Syn. of Pointed Pipka											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Pipka Postillnaja. Gb. [Same as Gov. list No. 463.]											
Pipka postilnaya. Gb.											
Pipka Sacharnaja. Gb. Syn. of Sweet Pipka											
Pipka sacharnaya. Gb. Syn. of Sweet Pipka											
Pipka Saitchia. Gb. Syn. of Hare Pipka											
Pipka sladkaja. Gb. Syn. of Sweet Pipka											
Pipka sladkaya. Gb. Syn. of Sweet Pipka											
Pipka sladkaya (Avenarius). Gb. Syn. of Avenarius											
Pipka Winter. R. Syn. Pipka Winter Bogdanoff											Not described.
Pipka Winter Bogdanoff. CanExR'01. Syn. of Pipka Winter											
Pippin. D. Syn. of Pittsburg											
Pippin, Mosely. R. Syn. Pippin of Mosely											Do.
Pippin of Mosely. IllB45. Syn. of Pippin, Mosely											
Pitman. L. Syn. Pitman's Seedling											Do.
Pitman's Seedling. Cat. Syn. of Pitman											
Pitmaston. D. Syns. Pitmaston Nonpareil, Pitmaston Russet Nonpareil, Russet Nonpareil, St. John's Nonpareil.	Eng	rob	m	gru	fr	gy	sa			m	From Lindley.
Pitmaston Golden. L. Syns. Pitmaston Golden Pippin, Pitmaston Pippin.	Eng.?	r	s	pyru	ctj	y	s			ml	From Hogg.
Pitmaston Golden Pippin. D. Syn. of Pitmaston Golden											
Pitmaston Nonpareil. D. Syn. of Pitmaston											
Pitmaston Pine. L. Syn. Pitmaston Pine-Apple	Eng.?	c	s	yru	fc	y				ml	Do.
Pitmaston Pine-Apple. D. Syn. of Pitmaston Pine											
Pitmaston Pippin. GenF'33. Syn. of Pitmaston Golden											
Pitmaston Russet Nonpareil. BBL. Syn. of Pitmaston											
Pittsburg. R. Syns. Father Apple, Flat Pippin, Greasy Back, Pippin, Pittsburgh, Pittsburgh Favorite, Pittsburgh Pippin, Schwitzer Apple, Swiss, Swiss Apple, Swiss Pippin, Switzer Apple, William Tell, Wythe.	Pa	ob	l	pyb	tj	w	sa	g-vg	dkm	vl	
Pittsburgh. L. Syn. of Pittsburg											
Pittsburgh Favorite. H. Syn. of Pittsburg											
Pittsburgh Pippin. D. Syn. of Pittsburg											
Pittsfield. R. Syn. Pittsfield Stripe			vl	rs					dk	me	
Pittsfield Stripe. FHC. Syn. of Pittsfield											
Pitts Improved Winesap. Cat. Syn. of Pitts Winesap											
Pittstown Pippin. D. Syn. of Golden Pippin (Mass.)											
Pitts Winesap. L. Syn. Pitts Improved Winesap											Not described.
Pitzer Hill. Hort'47. Syn. of Pryor											
Planter. R. Syn. Planter's Favorite		obl	l	y	j			g	dm		
Planter's Favorite. TCF. Syn. of Planter											
Platt (Vt.). L. Syn. Platt's Sweet	Vt	rc	m	gyrs	j	y	s	g		l	
Platte. R. Syn. Platte a groose quene											Do.

Platte a grosse queue. IllB45. Syn. of Platte											
Platt's Sweet. D. Syn. of Platt (Vt.)											
Pleasant Garden. TennBI-IX. Syn. of Keicher											
Pleasant Valley. MagofH'53. Syn. Pleasant Valley Pippin	N. J.?	rc	m	gy	tj	y	sa	g-vg		m	
Pleasant Valley Pippin. D. Syn. of Pleasant Valley											
Pleasant Valley Pippin. IllB45. Syn. of Pomme Gris											
Pleasegood. R. Syn. Pleasegood Nonsuch	Ont.?	rob	l	yrs	tj	y		vg	d	m	
Pleasegood Nonsuch. CExR96. Syn. of Pleasegood											
Pilkanoff. MinnExR'90											Do.
Plikanoff Small. Gb. Syn. of White Pelikanoff											
Plodovitka. Gb. Syn. of Prolific											
Plodovitka jeltaya. Gb. Syn. of Yellow Prolific											
Plodovitka krupnaya. Gb. Syn. of Large Prolific											
Plodovitka Niemetskaya. Gb. Syn. of German Prolific											
Plodovitka Polskaya. Gb. Syn. of Polish Prolific											
Plodovitka rannaya. Gb. Syn. of Early Prolific											
Plodovitka sladkaya. Gb. Syn. of Prolific Sweeting											
Plodovitka sladkaya. Gb. Syn. of Sweet Prolific											
Plodowitka. Gb. Syn. of Prolific											
Plodowitka Cuadkaja. Gb. Syn. of Prolific Sweeting											
Plodowitka Ramaja. Gb. Syn. of Early Prolific											
Plum. D		rob	m	gyb	ftj	w	sa	vg		me	
Plumb Cider. L. Syn. Plumb's Cider	Wis.?	rc	m	gyrs	tj	w	sa			ml	Introduced by J. C. Plumb, Milton, Wis.
Plumb's Cider. Hort'72. Syn. of Plumb Cider											
Plumb Russet. R. Syn. Plumb's Russet											Not described.
Plumb's Russet. MinnExR'90. Syn. of Plumb Russet											
Plump. R. Syn. Plump Sweet											Do.
Plump Sweet. WVaB75. Syn. of Plump											
Plymouth Colony. Hort'74. Syn. of Golden Sweet (Ct.)											
Plymouth Greening. D. Syn. of May											
Poeschell. R. Syn. Poeschell's Sweet		ob	l	y			s	g		l	
Poeschell's Sweet. IllB45. Syn. of Poeschell											
Poet. R. Syn. Poet Dalrymple											Do.
Poet Dalrymple. BBL. Syn. of Poet											
Pollard. MagofH'58											Do.
Pointed. Gb. Syn. of Painted											
Pointed Pipka. Gb. Syn. Pipka ostrokonetchnaya, Pointed Pippin, Rgl. to Ia. No. 361.	Rus	c	l	rs			sa				
Pointed Pippin. IaB31. Syn. of Pointed Pipka											
Pointed White. Gb. Syn. of Painted White											
Po'keepsie Russet. D. Syn. of English Russet											
Poland. D. Syn. of Red Canada											
Poland Red Winter. MagofH'47. Syn. of Poland Winter											Do.
Poland Winter. IllB45. Syn. Poland Red Winter											
Polecat. E. Syn. of Skunk											
Polecat. D. Syn of Summer Queen											
Polhemus. T. Syn. of Moore Sweet											
Polinia Pearmain. D. Syn of Barcelona											
Polish. A'56. Syn. Red Polish	Mass.	rc	m	yrs	j	ws	psa	g-vg		m	
Polish Cinnamon. MHSC'86. Syns. Koritchnevoe Polskoe, Shro. to Ia. No. 39.	Rus.										Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Polisher. R. Syn. Polisher Herrenapfel	Rus.	ob	ml	ydrse		w	sa	g		m	
Polisher Herrenapfel. SDB76. Syn. of Polisher											
Polish Prolific. MHSC'86. Syns. Plodovitka Polskaya, Shro. to Ia. No. 123.	Rus.										Not described.
Polly. HB&T	Pa	oblc	ml	gyrs	j			vg		l	
Polly Bright. MagofH'53	Va.?	oblc		yrs	tj		psa	g		m	
Polo. IaH'97. Syn. of Winter Aport											
Polosatka Heidorna. Gb. Syn. of Heidorn											
Polosatka lietnaya. Gb. Syn. of Early Stripe											
Polosatka nalivnaya. Gb. Syn. of Striped Naliv											
Polosatka simnaya. Gb. Syn. of Winter Streaked											
Polosatka sladkaya. Gb. Syn. of Sweet Streaked.											
Polosatoe. Gb. Syn. of Red Streak											
Polosatoe Heidorna. Gb. Syn. of Heidorn											
Polosatoe Nalivnoe. Gb. Syn. of Streaked Naliv											
Polosatoe Naliwnoe. Gb. Syn. of Streaked Naliv											
Polosatoe Novgorodskoe. Gb. Syn. of Novgorod Streaked											
Polosatoe Nowgorodskoe. Gb. Syn. of Novgorod Streaked											
Polosatoe Sladkoe. Gb. Syn. of Sweet Streaked											
Polosatoe Sladskoe. Gb. Syn. of Sweet Streaked											
Polosstaja Schlenka. Gb. Syn. of Green Streaked											
Polumiron. IaH'83. Syns. Crossed Barbel, Gov. list No. 198, Polu Miron	Rus.										Do.
Polu Miron. Gb. Syn. of Polumiron											
Polu Stekianka. Gb. Syn. of Half Glassy											
Polusteklianka. Gb. Syn. of Half Glassy											
Pomaria. R. Syns. Greening Pomaria, Pomera, Pommaria Greening	S. C		l		j			vg		l	
Pomera. BBL. Syn. of Pomaria											
Pomeroy (1st). D. Syn. Taunton	Eng	rc	m	gyrs	fj	y	s	p		m	
Pomeroy (2d). D	Eng	rob	m	pyb	t	w	bsa	p		m	
Pomeroy (3d). D	Mass.	rob	m	yrs	tmj	w	psa	g-vg		m	
Pomeroyal. K	Conn.?	rob	l	yb				vg		l	
Pomfret. MagofH'53											Do.
Pommaria Greening. IllB45. Syn. of Pomaria											
Pomme Carle. GenF'33. Syn. of Mala Carle											
Pomme d'Anis. E. Syn. of Fenouillet Gris											
Pomme d'Api. DomEnc. Syn. of Lady											
Pomme d'Api Rouge. D. Syn. of Lady											
Pomme d'Apis. DomEnc. Syn. of Lady											
Pamme d'Argent. D. Syn. of Sartha											
Pomme d'Aunee. D. Syn. of Alant											
Pomme de Berlin. D. Syn. of Court-Pendu-Plat											

Pomme de Caractère. D. Syn. of Drap d'Or											
Pomme de Caractère. K. Syn. of Fenouillet Jaune											
Pomme de Charles. GenF'33. Syn. of Mala Carle											
Pomme de Cadillac. D. Syn. of Holland Rose											
Pomme de Cuir. D. Syn. of Pomme Gris											
Pomme de Fer. MHSC'77. Syn. of Dery											
Pomme de Glace. K. Syn. of White Astrachan											
Pomme de Jaune. D. Syn. of Sartha											
Pomme de Jaune de la Sartha. D. Syn. of Sartha											
Pomme de Laak. D. Syn. of Dutch Mignonne											
Pomme de Lestre. K. Syn. of Lestre											
Pomme de Malingre. D. Syn. of Malingre											
Pomme de Neige. K. Syn. of Fameuse											
Pomme d'Or. Lin. Syn. of Golden Pippin (Eng.)											
Pomme d'Orange. D. Syn. of Isle of Wight											
Pomme Double Agathe. D. Syn. of Agathe											
Pomme d'Outre Passe. D. Syn. of Early Autumn											
Pomme de Pasteana. MagofH'42. Syn of Pasteana											
Pomme de Perroquel. D. Syn. of Suisse											
Pomme de Quatre Gouts. K. Syn. of Violette											
Pomme de Roi. MagofH'36											Do.
Pomme de Rose. E. Syn. of Rose											
Pomme de Saint Julien. D. Syn. of Saint Julien											
Pomme du Caen. D. Syn. of Canada Reinette											
Pomme Finale. GenF'33. Syn. of Mala Carle											
Pomme Granate. D. Syn. of Granat											
Pomme Gris. Lin. Syns. Gray Apple, Grise, Leather Apple of Turic, Pomme de Cuir, Pomme Gris d'Or, Pomme Grise.	Fr.? Can.?	rob	ms	gru	t		rsa	vg-b	d	ml	
Pomme Gris d'Or. Dap. Syn. of Golden Gray											
Pomme Gris d'Or. D. Syn. of Pomme Gris. [Some doubt as to correctness.]											
Pomme Grise. D. Syn. of Pomme Gris											
Pomme Pigeon. K. Syn. of Pigeon											
Pomme Poire. GenF'33		r		ru				g	d	vl	
Pomme poire, GenF'33. Syn. of Nonpareil											
Pomme Princesse. K. Syn. of Princesse											
Pomme Regelans. D. Syn. of Cornish Gilliflower											
Pomme Romarin Rouge. D. Syn. of Red Romarin											
Pomme Rose. D. Syn. of Lady											
Pommeroy. D. Syn. of Lady Sweet											
Pomme Royal. G. Syn. of Dyer											
Pomme Royale. K. Syn. of Dyer											
Pomme Royale (erroneously). T. Syn. of Pound Royal											
Pomme Royal (of some). E. Syn. of Green Seeknofurther											
Pomme Roye. D. Syn. of Pennock											
Pomme Rubance. D. Syn. of Suisse											
Pomme Saint Sauveur. D. Syn. of Sauveur											
Pomme Sans. MagofH'39											Do.
Pomme Suisse. D. Syn. of Suisse											
Pomme Violette. DomEne. Syn. of Red Autumn											
Pomme Water. W	Ill.?	re	ml	rs			sa	vg	d	m	
Pomme Water. K. Syn. of Pomme Water Sweet											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Pomme Water (of Ill). Hort'47. Syn. of Dyer											
Pomme Water Sweet. Lin. Syns. Pomme Water, Pumwater Sweet		rc	ml	gyrs	tj	yw	ps	g-vg	dk	m	
Pommier nain de Rennette. CB116. Syn. of Rennette											
Pomone d'Apis. Th. Syn. of Lady											
Pompey. D. Syn. of Victuals and Drink											
Pomplon. C			l	gy						me	
Pond. MagofH'43											Not described.
Pond Sweet. IllH'73											Do.
Ponlavinskoe. MHSC'86. Syn. Shro. to Ia. No. 121	Rus.										Do.
Ponto. L. Syn. Ponto Pippin	Eng	rc	m	gyb	ct	gw	bsa			ml	From Hogg.
Pontoise. L. Syn. Bellede Pontoise			l	r	fj		sa			l	
Ponto Pippin. D. Syn. of Ponto											
Ponylk. AlaB98											Not described
Poole. A'60											Do.
Poorhouse. D. Syns. Winter Green, Winter Queen	Tenn	rob	l	ygru	cmj	y	sa	vg		l	
Poor Man. R. Syn. Poor Man's Friend											Do.
Poor Man's Friend. BBL. Syn. of Poor Man											
Pope. D. Syn. Pope's Apple	Eng	robc	l	yrs	j	y	rs	vg		l	From Hogg.
Pope's Apple. D. Syn. of Pope											
Poplar Block. BBL											Not described.
Poplar Bluff. W		r		rs			sa				
Poplar Bluff. IllB45. Syn. of Smith											
Poplar Pear. MoH'88											Do.
Popoff. Gb. Syns. Gov. list No. 247, Popoff's Streaked, Popouka Polosataja, Popovka polosataya.	Rus.										Do.
Popoff Streaked. Cat. [Probably same as Popoff.]											Do.
Popoff's Streaked. Gb. Syn. of Popoff											
Popouka Polosataja. Gb. Syn. of Popoff											
Popovka polosataya. Gb. Syn. of Popoff											
Poppleton. (LC)	Mich	c	ml	y			s	vg	dk	ml	
Poppy Greening. D. Syn. of Honey Greening											
Poppy Greenup. IndH'72. [Perhaps identical with Honey Greening.]											Do.
Poppy Quamp. W. Syn. of Quamp											
Popular Bluff. D. Syn. of Smith											
Popyquamp. MagofH'53. Syn. of Quamp											
Porch. R. Syn. Dartt's Porch											Do.
Porter. NEF'31. Syns. Jennings, Yellow Summer Pearmain, Porter Apple.	Mass.	oblc	ml	y	jf		sa	vg-b	dkm	me	
Porter. Dap. Syn. of Southern Porter											
Porter Apple. IllB45. Syn. of Porter											

Porter Best. R. Syn. Porter's Best. [Grown by G. P. Peffer, of Wis.]											Do.
Porter's Best. Hort'72. Syn. of Porter Best											
Porter Early. R. Syn. Porter's Early			ms					vg		e	
Porter's Early. A'71. Syn. of Porter Early											
Porter Favorite. R. Syn. Porter's Favorite											Do.
Porter's Favorite. A'79. Syn. of Porter Favorite											
Porter Nonsuch. R. Syn. Porter's Nonsuch	Conn	obc	sa	yrs	fj	yw	sa	vg		ml	
Porter's Nonsuch. A'77. Syn. of Porter Nonsuch											
Porter Spitzenburg. R. Syn. Porter Spitzenburgh	Conn.?	rc	l	rc	cj	ws	psa	g-vg		l	
Porter Spitzenburgh. D. Syn. of Porter Spitzenburg											
Portsmouth Sweet. Cole. Syn. of Ledge											
Portugal. GenF'33. Syn. of Canada Reinette											
Portugal Gray. L. Syns. Graue Portugiesische Reinette, Portugal Gray Reinette, Reinette Grise de Portugal.			ms	grb	t	gw	psa			ml	
Portugal Gray Reinette. D. Syn. of Portugal Gray											
Posarts Nalivia. IndB53	Rus		l	y			a		km	m	Probably same as Possart.
Posey. L. Syns. Posey's Red, Posey's Red Winter		rob	ms	yrs	tm	w	sa	g		vl	
Posey's Red. D. Syn. of Posey											
Posey's Red Winter. D. Syn. of Posey											
Possart. Gb. Syns. Possart's Nalivia, V. R. S. to Ia. No. 39, Possart's Nativ.	Rus										Not described.
Possart's Nalivia. Gb. Syn. of Possart											
Possart's Nativ. MinnB1. Syn. of Possart											
Posteley. D. Syn. Posteley's Seedling		rc	m	gyb	cj	y	bsa	g-vg		l	
Posteley's Seedling. D. Syn. of Posteley											
Postichonka. Gb. Syn. of Shepherd											
Potalnoe. MHSC'86. Syn. Shro. to Ia. No. 106	Rus										Do.
Potomac. P'95	W. Va	rob	vl	gyb	ftj	y	sa	vg		ml	
Pot Pie Apple. D. Syn. of Winesap											
Potter. A'85. Syns. Potter's Large, Potter's Large Apple, Potter's Large Seedling.	Eng	roblc	l	gyb		w	sa		k	m	
Potter's Early. Hort'75. Syn. of Knowles											
Potter's Large. D. Syn. of Potter											
Potter's Large Apple. D. Syn. of Potter											
Potter's Large Grey Seedling. E. Syn. of Fill Basket											
Potter's Large Seedling. D. Syn. of Fill Basket											
Potter's Large Seedling. D. Syn. of Potter											
Potter Red. ColExR'88											Do.
Potter Sweet. D. Syn. of Leicester											
Pottinger. W. Syns. Big Red, Large Winter Red	South	rob	l	yrs	j	y	ba	g	km	ml	
Potts. A'95											Do.
Pott Seedling. R. Syn. Pott's Seedling											Do.
Pott's Seedling. CB116. Syn. of Pott Seedling											
Poughkeepsie Russet. NEF'29. Syn. of English Russet											
Pound. Gb. Syns. Funtovoe, Funtowoe, Gov. list No. 360	Rus										Do.
Pound. D. Syn of Fallawater											
Pound. H. Syn. of Gloria Mundi											
Pound. D. Syn. of Nickajack											
Pound Autonowka. CanH'94	Rus	obl	vl	wg	f		sa			l	
Pound Apple. C		ob	vl	pyrs	j	y	sa		k	m	Uncertain as to identity.
Pound Cake. D. Syn. Royal Pearmain	South	robc	l	yrru	ct	y	sa	g-vg		ml	
Pound Georgia. IllB45											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Pound July. L. Syn. Pound's July	Ky	re	l	gwb	ftj	w	s	g-vg		me	
Pound's July. D. Syn. of Bough											
Pound's July. D. Syn. of Pound July											
Pound N. C. A'77		obe	l	yr	fj	gw	sa	vg		l	
Pound Pippin. IndF'40. Syn. of Fall Pippin											
Pound Red. R. Syn. Pound Red Streak											Not described.
Pound Red Streak. Cat. Syn. of Pound Red											
Pound Royal. D. Syns. Pomme Royale (erroneously), Winter Pound Royal.	Fr.?	roble	l	yw	vt		sa	g		l	
Pound Royal. K&S	Ala.?		l	gy						e	A local name in Alabama. Perhaps not Dyer.
Pound Royal. E. Syn. of Green Seeknofurther											
Pound Royale. W		c	l	yg	vtj	w	sa	vg	dk	me	Differs from Pound Royal, says Dr. Warder.
Pound Royale. D. Syn. of Summer Pound											
Pound Royal (erroneously). Cole. Syn. of Lowell											
Pound Royal (incorrectly). Dap. Syn of Long Red											
Pound Royal (of some). D. Syn. of Fall Pippin											
Pound Royal (of some). D. Syn. of Golden Pippin (N. E.)											
Pound Royal of the Putnam List. D. Syn. of Summer Pound											
Pound Sour. Dap. Syn of Golden Pippin (N. E.)											
Pound Sweet (Mich.?). W	Mich.?	r	l	y			s	g		l	
Pound Sweet (Ind.). W	Ind	r	l	rs			sa	vg		l	
Pound Sweet. D		re	l	gyb	tmj	y	s			m	
Pound Sweet. D		r	l	r	mj	w	s				
Pound Sweet. D. Syn. of Pumpkin Sweet (Ct.)											
Pound Sweet (of some). D. Syn. of Moore Sweet											
Pound Sweet (of some West). E. Syn. of Sweet Pippin											
Poveshon. DomEnc	N. J	ob	s	dr		y	s	g	c	m	
Powell. L. Syn. Powell's Russet	Eng	rob		ru	f	w	bsa			ml	From Ronalds.
Powell Beauty. L. Syn. Powell's Beauty	Pa		ml				sa	vg		me	
Powell's Beauty. SP&L. Syn. of Powell Beauty											
Powell's Russet. GenF'33. Syn. of Powell											
Powers (Ohio). PFar'66. Syn. Miller's Apple	Ohio	rob	l	yb	fj	w	sa	vg		m	
Powers (N. Y.). D	N. Y	re	m	wrs	cj	ws	sa	g		m	
Powers. D. Syn. of Buncombe											
Powers. D. Syn. of Primate											
Pownal. L. Syn. Pownal Spitzenburgh	Vt	robe	ml	yrs		y	sa	g		ml	
Pownal Spitzenburgh. NEF'29. Syn. of Pownal											
Prager. D. Syn. of Grey Reinette											

Prager. GenF33. Syn. of Sykehouse											
Prager. D. Syn. of Winter Gray											
Praire Rambour Reinette. D. Syn. of Canada Reinette											
Prairie. L. Syns. Calville des Prairies, Prairie Calville, Renetteu, Wilden Apfel.		rob	m	yr	tj	w	sa			m	From Annals of Pomology.
Prairie Beauty. BBL											Not described.
Prairie Calville. D. Syn. of Prairie											
Prairie Gem. CanB37	Ont	rob	s	yc	fcj		sa	g	k	e	
Prairie Queen. Cat											Do.
Pramsdil l. L. Syn. Pramsdill's Sweet							s				Do.
Pramsdill's Sweet. Cat. Syn. of Pramsdill											
Prather Apple. D. Syn. of Summer Cheese											
Pratt. MagofH'53. Syn. Pratt's Sweet	N. Y	rc	l	pyrs	ctj	yw	bs	vg		l	
Pratt's Fall Greening. MagofH'37. Syn. of Pratt Green											
Pratt Green. R. Syn. Pratt's Fall Greening	Mass		l	g				g		m	
Pratt's Sweet. D. Syn. of Pratt											
Premium (Ohio). L. Syn. Premium of 1858	Ohio	rc	ml	y			s	vg	k	m	
Premium (Ala.). W. Syn. Prize Sweet	Ala										Do.
Premium of 1858. W. Syn. of Premium (Ohio)											
Presh. L. Syn. Presh's Winter	Ky	rc	ml	pyb	fc	y	sa	vg		l	
Presh's Winter. Dap. Syn. of Presh											
President (N. H.). D	N. H	rob	l	pyb	fj	y	sa	g		m	
President (Tenn.). IndF'40	Tenn	rc	vl	ydrs		vw	msa	g	km	l	Warder credits origin to Indiana. It is a mistake.
President (Mass.). Lin	Mass	r	l	y			sa	g		m	
President (Mich.?). W	Mich.?	obl	l	y			sa	g		l	
President de Fay's Dumonceau. D. Syn. of Dumonceau											
President Ewing. Cat. [Probably identical with Ewing.]											Not described.
President Ewing. IllB45. Syn. of Ewing											
President Smith. WisB45	Wis	r	l	yr				g		l	
Press. D	Pa	ob	ml	wyrs	jt		psa	g		l	
Press Ewing. D. Syn. of Ewing											
Press Ewing. MoB6. Syn. of Rome											
Prewit. Dap	Ky	obc	m	yrs	mj	y	sa			vl	
Price. W. Syns. Price's Sweet, Price's Winter Sweet, Price (of South Carolina).		rc	ml	rs			s	g		m	
Price Choice. R. Syn. Price's Choice	Iowa	rob	l	yrs		ws		g		m	Originated in 1874 by Mrs. J. B. Wilson, Ruthven, Iowa.
Price's Choice. SDB76. Syn. of Price Choice											
Price Early. R. Syn. Price's Early Lemon											Not described.
Price's Early Lemon. MagofH'53. Syn. of Price Early											
Price (of South Carolina). IllB45. Syn. of Price											
Price Sweet. R. Syn. Price's Sweet		ob	l	gy	mj	yw	vs	g		l	May be same as Price.
Price's Sweet. A'75. Syn. of Price											
Price's Sweet. IllH'83. Syn. of Price Sweet											
Price's Winter Sweet. Hort'72. Syn. of Price											
Pride of Australia. BBL											Not described.
Pride of Duplin. Cat. Syn. of Duplin											
Pride of Glenora. BBL											Do.
Pride of Richmond. IllB45											Do.
Pride of September. D. Syn. of September											
Pride of Tennessee. TCF	Tenn.?	ob		r				g	m	e	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Pride of the Hudson. A'99		robc	ml	rs	fj	w	sa	vg		l	This will hereafter be known as Barringer.
Pride of the South. A'75											Not described.
Pride of the Valley. A'69. Syn. of Deseret Pippin											
Pride of Texas. ASB&S. Syn. of Texas											
Pride of Washington. P'95. Syn. of Cantrel											
Priest. L. Syns. Blue Sweet, Molasses Sweet, Priest's Sweet	Mass	rc	m	yrs	ft	w	ps	g		vl	
Priestley. K. Syn. of Priestly											
Priestley's American. D. Syn. of Priestly											
Priestly. C. Syns. Bartlett, Priestley, Preistley's American, Red Cathead.	Pa	robl	l	yrs	mj	w	a	g	m	l	
Priestly (of some). D. Syn. of Bullett											
Priestly Russet. R. Syn. Priestly Russetting			m	ru				vg		l	
Priestly Russetting. IllB45. Syn. of Priestly Russet											
Priest's Sweet. D. Syn. of Priest											
Primate. MagofH'50. Syns. Belle Rose, Early Baldwin, Early Tart Harvest, Harvest Apple, Highland Pippin, Jenkins Summer Pippin, July Apple, North American Best, Powers, Rough and Ready, Ryerson, Scott, Sour Harvest, Zour Bough.	N. Y.?	robc	m	gwb	vt	w	sa	vg-b	d	me	
Primiting. D. Syn. of White Juneating											
Prince. W. Syn. Prince of Orange	Eur	robl	m	pyb	t	yw	sa	g		m	
Prince Albert of Prussia. CanExR'01. Syn. of Albert of Prussia											
Prince Alfred. BBL											Do.
Princeall. NEF'27											Do.
Prince Apple. IaH'82. Syn. of Royal Table											
Prince Bismark. FEY. Syn. of Bismarck											
Prince's Early Harvest. H. Syn. of Early Harvest											
Prince Fall. L. Syn. Prince's Fall Pippin		r	l	y			sa	g		m	
Prince's Fall Pippin. W. Syn. of Prince Fall											
Prince George's County Pippin. P'95. Syn. of Spalding											
Prince's Harvest. C. Syn. of Early Harvest											
Prince Imperial. Cat. Syn. of Rudolph											
Prince Imperial Rudolph. AndN. Syn. of Rudolph											
Prince's Large Red and Green Sweet. D. Syn. of Red and Green											
Prince's Large Red and Green Sweeting. C. Syn. of Red and Green											
Princely. Hort'59. Syn. Hazeldeen	Pa	obc	m	yrs	tj	y	pmsa	g-vg		ml	
Prince of Wales. A'97. Syn. of Wales											
Prince Queen. R. Syn. Prince's Queen											Do.
Prince's Queen. IllH'71. Syn. of Prince Queen											
Prince Rudolph. BBL. [Possibly same as Rudolph.]											Do.
Prince's Table Apple. K. Syn. of Loskrieg											

Prince Yellow. R. Syn. Prince's Yellow Winter		ob	m	y			sa	vg		l	
Prince's Yellow Harvest. Lin. Syn. of Early Harvest											
Prince's Yellow Winter. IllB45. Syn. of Prince Yellow											
Princess Anne Beauty. Cat. Syn. of Anne											
Princesse. L. Syn. Pomme Princesse	Eur	ob	ml	rs			s			m	
Princesse Noble. D. Syn. Grosser Edler Prinzessinapfel	Ger	rc	m	yrs	fj	yw	psa			m	From Hogg.
Princesse Noble. GenF'33. Syn. of Golden Reinette											
Princesse Noble des Chartreaux. D. Syn. of Chartreaux											
Princesse Noble, of the French. Lin. Syn. of Golden Reinette											
Princess' Harvest. F. Syn. of Early Harvest											
Princess Louise. A'89. Syn. of Louise											
Princess Noble Zoete. D. Syn. of Court-Pendu Plat											
Princess Royal. A&H											Not described.
Princess Sweet. IllH'86											Do.
Princeton. Dap	Mass	ob	m	pyrs	ftj	w	psa	g-vg		ml	
Princeton Sweet. MassH'71											Do,
Prinz. GarM'60	Ger	rc	l	yrb	jt	y	bsa	g-vg		m	
Prior's Late Red. Cole. Syn. of Pryor											
Prior's Red. Cole. Syn. of Pryor											
Private. IllB45											Do.
Prize Sweet. IllB45. Syn. of Premium											
Prizetaker. SBro			ml	dr				vg		l	
Profusion. L. Syn. Gillett's Profusion	Ohio										Do.
Professor. CB116											Do.
Prof. Goff. MinnExR'90											Do.
Progress (Ct.). MagofH'43. Syns. Esquire Miller's Best Sort, Miller's Best Sort.	Conn	rob	m	yb	tej		sa	g-vg		vl	
Progress (Ont.). CanB37	Ont		s	yr	fcj		sa	g		me	
Proliferous. L. Syn. Proliferous Reinette	Eng	r	m	yrs	j	yw	rbsa			m	From Hogg.
Proliferous Reinette. D. Syn. of Proliferous											
Prolific. IaH'83. Syns. Gov. list No. 246, Plodovitka, Plodowitka, Shro. to Ia. No. 132.	Rus		m					vg		e	
Prolific Anis. Gb. Syns. Gov. list No. 471, Anisovaya plodovitka, Anisowaja plodowitka, Prolific Anisette.	Rus										Not described.
Prolific Anisette. Gb. Syn. of Prolific Anis											
Prolific Beauty. D	Ohio	rob	l	yrs	t	wy	a	p	km	m	
Prolific Beauty. D. Syn. of Pennock											
Prolific Blush. A'69	Pa	obe	ml	yb			sa		km	me	
Prolific Sweet. D	Conn	rc	ml	g	t	w	ps	g	k	ml	
Prolific Sweeting. Gb. Syns. Gov. list No. 351, Plodovitka Sladkaya, Plodowitka Cuadkaja.	Rus	rob	m	y			s			e	
Prop. D	Pa	ob	m	pyrs	tj	w	psa	g		ml	
Prother. L. Syn. Prother's Winter	South	c	m	y			sa	g	dm	l	
Prother's Winter. W. Syn. of Prother											
Provost. BBL											Do.
Prudle. CH	Wis	oblc	m	rs	j			vg	d	l	
Pruit. R. Syn. Pruit Apple											Do.
Pruit Apple. IllH'68. Syn. of Pruit											
Prunus. BBL											Do.
Prussia. BBL											Do.
Prussian. D. Syn. of Colvert											
Prussian Pippin. D. Syn. of Costard											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh texture.	Flesh color.	Flavor.	Quality.	Use.	Season.	Remarks.
Pryor. L. Syns. Bersford, Big Hill, Bonford, Conford, Pitzer Hill, Prior's Late Red, Prior's Red, Pryor's Pearmain, Pryor's Red, Red Russet (of some).	Va.?	rob	m	gyrsc	tj	y	vrsa	vg	dkm	ml	
Pryor's Pearmain. T. Syn. of Pryor											
Pryor Red (Seedling). MichB129	Ill										Not described.
Pryor's Red. NEF'30. Syn. of Pryor											
Pucker End. D	N. Y	rc	l	pycb	cj	y	sa	g		m	
Puckett. Dap. Syn. of Summer King											
Puckett's Summer. Dap. Syn. of Summer King											
Pudky. CanExR'01											Do.
Pullman. P'95	Wash	obc	ml	wyr	f	y	sa	vg		ml	
Pum de Grips. GenF'32											
Pumpkin. Cat. Syn. Queen of the South	South?										Do.
Pumpkin. Cat. Syn. Stillwell's Royal											Do.
Pumpkin Russet. D. Syn. Flint Russet, Kingsbury Russet, Pumpkin Sweet, Sweet Russet, York Russet.	N. E.?	r	l	pygru			rvs	g		ml	
Pumpkin Sweet (Ct.). NEF'34. Syns. Lyman's Large Yellow, Lyman's Pumpkin Sweet, Pumpkin Sweeting, Rhode Island Sweet, Round Sweet, Sweet Lyman's Pumpkin, Vermont Pumpkin Sweet, Vermont Sweet, Yankee Apple.	Conn	r	vl	wg		w	vs	g		m	
Pumpkin Sweet (Ct. or Mass.). K	Conn.? / Mass.?	rob	l	yru		yw	brvs	vg	k	m	
Pumpkin Sweet (Ohio). Syn. Sweet Russet of Ohio	Ohio	rc	l	yru			s	g	k	m	
Pumpkin Sweet. D. Syn. of Pumpkin Russet											
Pumpkin Sweeting. GenF'36. Syn. of Pumpkin Sweet (Ct.)											
Pumpkin Sweet (of some). D. Syn. of Cheeseboro											
Pumwater Sweet. MagofH'40. Syn. of Pommewater Sweet											
Punchbowl. Hort'48											Do.
Purity. BBL											Do.
Pushmataha. D. Syn. Sloan's Seedling	Ala	robc	ms	pyrs	jm	yw	psa	g		ml	
Putim. Gb. Syns. Putimskoe, Shro. to Ia. No. 100	Rus										Do.
Putimskoe. MHSC'86. Syn. of Putim											
Putnam Harvey. D. Syn. Putnam's Harvey		rob	ml	gru	ctj	w	sa			m	
Putnam's Harvey. MagofH'38. Syn. of Putnam Harvey											
Putnam Keeper. D	Ky	ob	l	yrs	cj	y	psa	g		l	
Putnam Russet. K. Syn. of Roxbury											
Putnam's Savewell. D. Syn. of Savewell											
Putnam Sweet. W	Ohio	ob	l	drs	t		s	vg	k	m	
Putneyite. D. Syn. Pantneyite		r	m	py	c		a			ml	
Pyle. A'71. Syns. Pyle's Large Red, Pyle's Red, Pyle's Red Winter	Pa	robc	l	rs			sa			l	

Pyle Green. L. Syn. Pyle's Green Winter											Do.
Pyle's Green Winter. Cat. Syn. of Pyle Green											
Pyle's Large Red. HB&T. Syn. of Pyle											
Pyle's Red. MoH'88. Syn. of Pyle											
Pyle's Red Winter. T. Syn. of Pyle											
Pyles Russett. D. Syn. of Piles											
Pyriform. Gb. Syns. Gruschaobrasnoe, V. R. S. to Ia. No. 12	Rus.										Do.
Pyrus Astracanica. D. Syn. of White Astrachan											
Pyrus Carnea. R. Syn. Pyrus Malus Carnea											Do.
Pyrus Edulis. R. Syn. Pyrus Malus Edulis											Do.
Pyrus Malus Carnea. BBL. Syn. of Pyrus Carnea											
Pyrus Malus Edulis. BBL. Syn. of Pyrus Edulis											
Pyrus Malus Sp. Rusea Pleno. (LC). [Ornamental only.]											Do.
Quaker. D. Syn. Quaker Apple	Pa.?	rc	m	yrs	cj	w	psa	g	m	ml	
Quaker Apple. A'56. Syn. of Quaker											
Quaker Beauty. WisB77											Do.
Quaker Harvest. W	Ohio	ob	s	y			sa	g		e	
Quaker (of some). D. Syn. of Streaked Pippin											
Quaker Pippin. PFar'53	Am	obl	m	gy			a	p		m	
Quaker (Virginia). W	Va	r		y			sa				
Quamp. L. Syns. Poppy Quamp, Popy Quamp	Ohio	r	l	y			s	p		m	
Quarrenden. Lin. Syns. Devonshire Quarrenden, Red Quarrenden, Sack Apple.	Eng	rob	ms	dc	cj	w	psa	g	d	me	
Quebec. IllH'98. Syns. Quebec Sweet, Quebec Winter Sweet	Que		m	yr				vg		l	
Quebec Red. R. Syn. Quebec Red Winter											Do.
Quebec Red Winter. MichB31. Syn. of Quebec Red											
Quebec Sweet. Cat. Syn. of Quebec											
Quebec Winter Sweet. BBCo. Syn. of Quebec											
Queen. IllB45			m	yrs			sa	vg		m	May be Buckingham.
Queen. H. Syn. of Buckingham											
Queen. DomEnc. Syn. of Summer Queen											
Queen. NEF'31. Syn. of Williams											
Queen Anne. PFar'48		obl	l	y			sa			m	
Queen's. GenF'33. Syn. of Borsdorffer											
Queen Anne. Cole. Syn. of Lowell											
Queen Anne. D. Syn. of Mother											
Queen Apple (erroneously). D. Syn. of Nix											
Queen's Apple of Forsythe. DomEnc. Syn. of Winter Queen											
Queen Charlotte. D	Ger	c	s	gb			bpsa			l	From Ronalds.
Queen Choice. L. Syn. Queen's Choice											Not described.
Queen's Choice. BBL. Syn. of Queen Choice											
Queen Muscatel. Gb. Syn. of Muscatel Reinette											
Queening. A'71. Syn. Early Queening	Pa.?	r	ms	yrs		w	sa			me	
Queen Louise. Gb. Syns. Konigin Louise, Shro. to Ia. No. 38	Rus.										Do.
Queen of Haywood. A'91. Syn. of Haywood											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks
Queen of Kiew. Gb. Syn. of Kief Reinette											
Queen of Sauce. D. Syn. of Sauce											
Queen of the Dessert. CGen'61. Syn. of Beauty of the Dessert											
Queen of the Dessert. Hort'47. Syn. of Newtown Spitzenburg											
Queen of the Kitchen. MichB31											Not described
Queen of the North. A'77. Syn. of North											
Queen of the Orchard. MassH'71. Syn. of Orchard											
Queen of the Pippins. D. Syn. of Queen Pippin											
Queen of the South. Cat. Syn. of Pumpkin											
Queen of the Valley. D. Syn. of Valley											
Queen of the West. Cat. Syn. of Queen (West)											
Queen Pippin. L. Syns. Queen of the Pippins, Reine des Reinettes	Eur	rc	m	yrs	fc	yw	sa	g-vg		m	
Queen (West). L. Syn. Queen of the West											Do.
Quermes. L. Syn. Belle des Quermes	Fr.?		l					vg		ml	
Queter. CanExR'01		ob	m	gwb	c	w	sa	p		me	
Quillins. L. Syn. Calvil d'Quillins		obl	l		fcj	g	sa	vg		l	
Quince (Cole). D. Syns. Cole's Quince, Turn off Lane	Me	rob	m	yb	ct	yw	psa	vg	k	m	
Quince (Coxe). C. Syns. Pear Apple, Quince Apple, Quince of Coxe, Seneca Spice.	N. E.?	rob	ml	y	t	yw	bpsa	vg	k	m	
Quince Apple. DomEnc. Syn. of Quince (Coxe)											
Quince of Coxe. AHortA'69. Syn. of Quince (Coxe)											
Quince Tart. Hort'46											Do.
Quincy. R. Syn. Quincy Early											Do.
Quincy Early. A'77. Syn. of Quincy											
Quinton. Cat											Do.
Rabbit's Head. D. Syn. of Chestoa											
Rabine. D	Eng	rob	ml	gyrs	tc	y	a		dk	m	From Hogg.
Rabum. W	South	obl		rs			sa				
Race. L. Syn. Race's Red	N. Y	r	m	yeb	tj	ws	psa			me	
Race's Red. A'73. Syn. of Race											
Radford. R. Syn. Radford Beauty											Not described.
Radford Beauty. BBL. Syn. of Radford											

Ragan. D. Syns. Ragan Apple, Ragan's Red	Ind	re	ml	gyrs	j	y	psa	g-vg	dkm	m	A seedling of Ralls.
Ragan Apple. IndF'40. Syn. of Ragan											
Ragan (incorrectly). IllH'02. Syn. of Reagan. [Reagan now believed to be Gano.]											
Ragan's Red. A'56. Syn. of Ragan											
Ragan Red Sweet. R. Syn. Ragan's Red Sweet											Not described.
Ragan's Red Sweet. IllB45. Syn. of Ragan Red Sweet											
Ragan Seedling. L. Syn. Ragan's Seedling	Ind	ob		rs			sa				Of doubtful existence.
Ragan's Seedling. W. Syn. of Ragan Seedling											
Ragan Yellow. L. Syns. Ragan's Yellow, Regan's Yellow	Tenn.?	re	m	gy	fmj	y	sa	g		me	May be identical with Horse.
Ragan's Yellow. WHyS. Syn. of Ragan Yellow											
Rager. MagofH'53											Not described.
Ragland. A'71	Va							vg			Do.
Ragsdale. P'95 Syn. Smith's Seedling	Ala	re	l	gyb	cj	y	bsa	vg		l	
Rainbow. SBro	Mo.?	e	vl	yrs	fj	y	sa	vg		me	
Raindel. IllH'83											Do.
Ralls. L. Syns. Copperschmidt, Geneton, Geniton, Indiana Jannetting, Janet, Janette, Janetting, Janiton, Jefferson Pippin, Jeniton, Jennett, Missouri Jannetting, Neverfail, Raule's Gennetting, Raul's Jannetting, Raule's Janet, Raule's Jannette, Raul's Jennetting, Rawles Genet, Rawl's Janet, Rawle's Janet, Rawle's Jannet, Rawle's Jennette, Red Neverfail, Rock Remain, Rock Rimmon, Royal Janette, Winter Genneting, Winter Jannetting, Winter Neverfail, Yellow Janette.	Va.? Fr.?	obe	m	yrse	tj	wy	psa	g-vg	dmk	vl	
Ralph. W		ob		y			sa				
Ramanite (?) F. Syn. of Romanite											
Rambo. DomEnc. Syns. Bread and Cheese, Delaware, Fall Romanite, Gray Romanite, Large Rambo (?), Ramboulette (?), Rambouillet, Romanite, Seek-no-further, Striped Rambo, Terry's Redstreak, Trumpington.	Pa	rob	m	ywrs	vt	gw	rmsa	vg	dk	m	
Rambo (of Western Collections). MagofH'49. Syn. of Red Rambo											
Rambouillet D. Syn. of Rambo											
Ramboulette (?) H. Syn. of Rambo											
Rambour Barre. CanExR'96. Syn. of Winter St. Lawrence											
Rambour d'Ete. C. Syn. of Summer Rambo											
Rambour France. D. Syn. of Summer Rambo											
Rambourg. R. Syn. Rambourg d'Ete. [Probably Summer Rambo.]											Do.
Rambourg d'Ete. MoH'67. Syn. of Rambourg											
Rambourg Papeleu. D. Syn. of Rambour Papeleu											
Rambour Gros. D	Eng.?	roble	l	yrs	cj	w	a	g		ml	From Ronalds.
Rambour Gros. D. Syn. of Summer Rambo											
Rambour Lorraine. A'77. Syn. of Grosh											
Rambour Papeleu. D. Syn. Rambourg Papeleu	Rus	robe	l	yrs	c	yw	ba	g	m	ml	
Rambour Queen. Cat											Not described.
Rambour Queen. P'91. Syn. of Rambour Reinette											
Rambour Reinette. Gb Syns. Gov. list No. 502, Rambour Queen, Russian Rambour Queen, Russiche Rambour Reinette, Russkui Ramburovui renet.	Rus		l	rs				vg		m	
Rambour Rose. D. Syns. Koolapfel, La Mere des Pommes, Rambour Rouge.		re	l	yrs	c	gw	a	g	k	m	From Annals of Pomology.
Rambour Rouge. D. Syn. of Rambour Rose											
Ramsdale's Sweeting. H. Syn. of English Sweet											
Ramsdell. R	Conn.?	e	ml	rse			s	vg		ml	Probably same as English Sweet.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Ramsdell Red. W. Syn. Ramsdell's Red Sweeting	Conn	oblc	ml	yrs	j	y	bvs	vg	k	m	Mr. Lyon considered this identical with English Sweet.
Ramsdell's Red. W. (?) Syn. of English Sweet											
Ramsdell's Red Pumpkin Sweet. M. Syn. of English Sweet											
Ramsdell's Red Sweeting. MagofH'38. Syn. of Ramsdell Red											
Ramsdell's Red Winter. D. Syn. of English Sweet											
Ramsdell's Sweet. D. Syn. of English Sweet											
Ramsdell's Sweeting. D. Syn. of English Sweet											
Ramshorns. MagofH'39			l	dr				p		m	
Ranakonski. MinnExR'90											Not described.
Rance. L. Syn. Red Rance		rc	ms	yr	fj	y	rsa	g-vg		ml	
Randal Bert. E. Syn. of Randall											
Randall. L. Syns. Randal Bert, Randall's Best, Randel's Best, Randell Best, Randell's Best.	Ohio?	rob	m	gyrs	t	w	s			ml	
Randall's Best. W. Syn. of Randall											
Randel's Best. D. Syn. of Randall											
Randell Best. D. Syn. of Randall											
Randell's Best. D. Syn. of Randall											
Randolph. P'95		ob	ms	ywrsc	fj	yw	sa	g		e	
Randolph Sweet. GarM'63	Pa	rob	ml	gyb	tj	w	rs	vg		vl	
Ranette Kiluski. Gb. Syn. of Kief Reinette											
Rankins. MoH'84	Mo		ml	rs	j			vg			Brought to notice by H. C. Kirshbaum, Tolona, Mo. Not described.
Rankin Favorite. R. Syn. Rankin's Favorite											
Rankin's Favorite. HuC. Syn. Rankin Favorite											
Ransom. Dap. Syn. Red Streak	Conn	rob	ml	yrs	tj	yw	psa	vg		m	
Rapahannock.. MagofH'53. Syn. of Rappahannock											
Rappahannock. R. Syn. Rapahannock											Do.
Rareripe. R. Syn. Rare Ripe		ob	m	y			sa	g		vl	
Rare Ripe. IllB'45. Syn. of Rareripe											
Raritan. L. Syns. Raritan Sweet, Rariton Sweeting	N. J	ro	m	yb	t	w	s	g	k	m	
Raritan Sweet. MagofH'44. Syn. of Raritan											
Rariton Sweet. D. Syn. of Michael Henry											
Rariton Sweeting. DomEnc. Syn. of Raritan											
Rasche. Hort'67	Mo.	rob	m	gy	cj	y	sa	vg	d	l	
Raspberry. MHSC'86. Syns. Gov. list No. 288, Malinovka, Malinovskoe, Malinowskoe, Shro. to Ia. No. 113.	Rus.	obl	m	'y				g		e	
Rasumoff. Gb. Syns. Gov. list No. 974, Rasumowski Noschok, Razumoffsky's Downy, Razumovskui Moschok.	Rus.										Do.

Rasumowski Noschok. Gb. Syn. of Rasumoff											
Ratsburg. WisB45											Do.
Rattle. Gb. Syns. Gov. list No. 441, Gremuschka, Grimuschka, Rattling	Rus										Do.
Rattlebox. D. Syn. Hollow Core		r	ms	gyrs	tj	w	sa	g		me	
Rattling. Gb. Syn. of Rattle											
Raule's Genet. Cat. Syn. of Ralls											
Raule's Gennetting. Cole. Syn. of Ralls											
Raule's Janet. Cole. Syn. of Ralls											
Raule's Jannette. E. Syn. of Ralls											
Raul's Jannetting. D. Syn. of Ralls											
Raul's Jennetting. D. Syn. of Ralls											
Ravelston. L. Syns. Ravelston Pippin, Revelstone Pippin	Scot	rob	m	gyrs	f	y	ps	g		me	
Ravelston Pippin. D. Syn of Ravelston											
Rawle's Genet. D. Syn. of Ralls											
Rawle's Janet. Lin. Syn. of Ralls											
Rawle's Jannet. D. Syn. of Ralls											
Rawle's Jennette. E. Syn. of Ralls											
Rawling. L. Syns. Rawling's Fine Redstreak, Rawling's Red Streak, Red Streaked Rawling.	Eng	r	l	yrs	tj	y	s	g	k	l	
Rawling's Fine Redstreak. D. Syn. of Rawling											
Rawling's Red Streak. D. Syn. of Rawling											
Rawlinson. IllH'98											Do.
Rawl's Janet. E. Syn. of Ralls											
Ray Apple. D. Syn. of Munson											
Razumoffsky's Downy. Gb. Syn. of Rasumoff											
Razumovskia Moschok. Gb. Syn. of Rasumoff											
Read's Anglo-American. Hort'54. Syn. of Anglo-American											
Read's Baker. D. Syn. of Beaufin											
Reagan. ArkB49. Syns. Black Ben Davis, Ragan?	Ark?	robl	ml	drs			sa			l	Now thought to be Gano.
Real Nonsuch. Hort'47. Syn. of Red Canada											
Ream. R. Syn. Ream Favorite											Not described.
Ream Favorite. BBL. Syn. of Ream											
Reasor. R. Syn. Reasor Green	Va	re	ml	gb	j		ma	vg		l	
Reasor Green. SLN. Syn. of Reasor											
Rebecca. MagofH'53. Syn. Daddy	Del	ob	m	rwyb	tj		psa	g-vg	d	me	
Rebel. P'91	Va	rob	m	yr		yw	sa	vg	d	ml	
Rebel. CBCo. Syn. of America											
Rebristoe. Gb. Syn. of Ribbed											
Rebristoe nalivnoe. Gb. Syn. of Ribbed Naliv											
Recumbent. MHSC'86. Syns. Lieby, Lejanka	Rus		m	yrs				g	k	ml	
Recumbent. MinnBS3. Syn. of Hibernal											
Red Aberdeen. CanExR'01		c	m	gyr	cj	w	ma	g		l	
Red Abram. Dap. Syn. of Abram											
Red and Green. L. Syns. Bedford Sweet, Large Early Red, Large Green and Red Sweet, Large Red and Green Sweeting, Large Red Sweeting, Prince's Large Red and Green Sweet, Prince's Large Red and Green Sweeting, Red and Green Sweet, Red and Green Sweeting, Red Bough, Red Pound Sweet, Sallie Sweet, Virginia Sweet, Wheelock Sweet.		oble	vl	gwrs	t	w	s	g	k	me	
Red and Green Sweet. NEF'26. Syn. of Red and Green											
Red and Green Sweeting. Lin. Syn of Red and Green											
Red and Long. R. Syn. Red and Long Pearmain											Do.
Red and Long Pearmain. APC'50. Syn. of Red and Long											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Red Ananas. SDB76	Rus	obobl	ms	yw	fj	w	sa	g		me	
Red Anis. Gb. Syns. Anis krasnui, Gov. list No. 985, Red Anisette	Rus		l	rs				vg		ml	
Red Anisette. Gb. Syn. of Red Anis											
Red Aport. (LC)	Rus	obc	ml	rs			sa	g		m	
Red Apple. A'54	Pa	rob	ms	rs	t	ws		g		l	Transactions Am. Pom. Society.
Red Arcad. MHSC'86. Syns. Arkad krasnui, Gov. list No. 476, Red Arcade, Rother Arkad.	Rus										Not described.
Red Arcade. Gb. Syn. of Red Arcad											
Red Ashmore. D. Syn. of Ashmore											
Red Ashmore. IllB45. Syn. of Red Astrachan											
Red Astracan. M. Syn. of Red Astrachan											
Red Astrachan. K. Syns. Abe Lincoln, Astrachan Red, Astrachan Rouge, Astrachaner rother, Deterding's Early, Early Rus, Red Ashmore, Red Astracan, Rother Astrakan, Vermilion d'Ete.	Rus	rc	ml	gyrc	cmj	w	a	g-vg	dmk	me	
Red Astrachan. Gb. Syn. of Transparent Astrachan											
Red Autumn. L. Syns. Calville d'Automne, Calville Rouge, Calville Rouge d'Automne, Erd Beere, Pomme Violette, Red Autumn Calville, Rosseau (incorrectly), Strawberry of Switzerland.	Fr	rc	ml	gydc	cmj	w	ra	g-vg		me	
Red Autumn Calville. D. Syn. of Red Autumn											
Red Baldwin. GenF'33. Syn. of Baldwin											
Red Baldwin Pippin. GenF'32. Syn. of Baldwin											
Red Battulin. IaH'82. Syn. of Batullen											
Red Belle Fleur. D. Syns. Belle Fleur, Belle Fleur Red, Belle Fleur Rouge, Red Bellflower, Striped Belle Fleur, Striped Bellflower, Wigwam.	Fr	oblc	l	gyrs	t	w	sa	p		l	
Red Bellflower. Wn. Syn. of Marshall Red											
Red Bellflower. Cat. Syn. of Marshall Seedling											
Red Bellflower. E. Syn. of Red Belle Fleur											
Red Bellflower (incorrectly). Dap. Syn. of Long Red											
Red Bellflower (of some). H. Syn. of Western Beauty											
Red Ben Davis. EGM. Syn. of Gano											
Red Bertim. Cat. Syn. Gheimer											Do.
Red Biet. Cat. [Possibly an abbreviation of Bietigheimer.]											Do.
Red Bietigheimer. T. Syn. of Bietigheimer											
Red Black. Gb. Syns. Gov. list No. 966, Tchernokrasnoe, Tuchernokrasnoe.	Rus										Do.
Red Borovinka. Gb. Syns. Borovinka krasnaya, Borowinka krasnaja, Gov. list No. 278, Red Mushroom.	Rus	robl	vl		f	w	sa		k	me	Described by Hansen as Red Mushroom.
Red Borsdorfer. K. Syn. of Borsdorffer											
Red Bough. E. Syn. of Red and Green											

Red Butchelm. IdaB6											Not described.
Red Calville. C. Syns. Caillot Rosat, Calville Rouge, Calville Rouge d'Anjou, Calville Rouge d'Automne, Calville Rouge d'Hiver, Calville Rouge Normande, Calville Royale d'Hiver, Calville vraie des Allemands, Cushman's Black, Red Winter Calville, Sanguinole, Spice of some West.	Fr	rc	m	rs	t		msa	p		ml	
Red Calville. Gb. Syn. of Erdbeer											
Red Calville. Gb. Syn. of Winter Livland											
Red Canada. MagofH'47. Syns. Bullman, Canada Red, Donahoe, Nonsuch, Nonsuch Old, Old Nonsuch, Poland, Real Nonsuch, Richfield, Richfield Nonsuch, Steele's Red (erroneously), Steele's Red Winter, Welch's Spitzenberg Winter Nonsuch.	Conn.? Mass.?	obc	m	yrsc	tc	w	bsa	vg	dm	vl	
Red Carver. P'95	Pa	rc	m	ywrs	fj	y	rbsa	g		l	
Red Cathead. D. Syn. Cathead (of some)	Va	rc	l	yb	tj	y	psa	g-vg		m	
Red Cathead. E. Syn. of Priestly											
Red Cedar. W	Ohio?		m	dr		y	sa	g		vl	
Red Cedar. MoH'83. Syn. of Cedar											
Red Cheek (Ct.). D	Conn	robc	m	wb	tj	w	psa			l	
Red Cheek (Mass.). MagofH'45	Mass	rc	m	wbc	tj	w	psa			m	
Red Cheek (N. J.). D	N. J	roblc	m	wybc	tj	w	sa			ml	This may be Monmouth.
Red Cheek. Lin. Syn. of Belden											
Red Cheek. D. Syn. of Fall Orange											
Red Cheek. Cole. Syn. of Maiden Blush											
Red Cheek. E. Syn. of Monmouth											
Red Cheek Bellflower. Dap. Syn. of Ewalt											
Red Cheeked. Gb. Syn. of Romianka											
Red Cheek Pippin. GenF'51. Syn. of Monmouth											
Red Cheese. A'89		ob	ml	yrs		y	sa				
Red Cider. JTL. Syns. Red Crab, Red Smith's Cider			l	r	t		sa	g		l	Said to be distinct from Smith.
Red Cider Crab. IndH'88. Syn. of Kentucky Red											
Red Cloud. MinnHort'96	Minn	r	m	yrs	ftj	ws	sa	vg			
Red Codlin. D. Syn. of Forest											
Red Crab. A'75											Not described.
Red Crab. JBW&B. Syn. of Kentucky Red											
Red Crab. A. (?) Syn. of Red Cider											
Red Crafton. D. Syn. of Scarlet Crafton											
Red Davis. MoH'85. [Claimed to be a sport of Ben Davis.]											Do.
Red Detroit. T. Syns. Black Apple (of some), Crimson Pippin, Detroit, Detroit Red, Large Black.	Can.?	rc	ml	dcp	cj	ws	sa	g	km	ml	
Red Detroit. E. Syn. of Black Detroit											
Red Dettmer. MichB118	Rus	robc		rs			sa			m	
Reddick. MagofH'36. Syn. Reddock											Do.
Redding. R. Syn. Redding's Nonpareil	Conn	r	ms	gru				g	d	l	
Redding's Nonpareil. GenF'33. Syn. of Redding											
Reddock. MagofH'47. Syn. of Reddick											
Red Doctor. M. Syn. of Doctor											
Red Duchess. L. Syn. Red Duchess of Oldenburgh											Do.
Red Duchess of Oldenburgh. Cat. Syn. of Red Duchess											
Red Duck. Gb. Syn. of Red Pine											
Red Duck Apple. MHSC'81. Syn. of Anasapfel Rother											
Red Elser. BBL											Do.
Red Elserapfel. IndH'86											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Red Everlasting. DomEnc	Va	obl	s	dr						vl	
Red Everlasting. Dap. Syn. of Greyhouse. [May Seek-no-further.]											
Red Everlasting. Dap. Syn. of Simmons Red											
Red Face. A'77	Iowa	obc	ml	gyrs	tj	yw	sa	vg		me	
Red Fall Pippin. D. Syn. of Buncombe											
Red Favorite. A'52	Pa	ob	m		j		sa				Transactions Am. Pom. Society.
Red Foundling. BBL											Not described.
Red Gilliflower. E. Syns. Cornish Gilliflower, Gilliflower Red, Harkness New Favorite, Red Seek-no-further.	South	oblc	m	r		w	rsa			ml	Possibly more than one variety referred to.
Red Gilliflower. MagofH'50. Syn. of Black Gilliflower											
Red Gilliflower. W. Syn. of Buncombe											
Red Gilliflower. D. Syn. of Cornish Gilliflower											
Red Gilliflower. Dap. Syn. of Striped Gilliflower											
Red Gilliflower (erroneously). W. Syn. of Scollop Gilliflower											
Red Gilliflower (of some). A'75. Syn. of Long Red											
Red Gloria Mundi (of some). D. Syn. of Buckingham											
Red Gloria Mundi (?). E. Syn. of Fall Queen. [Fall Queen is probably Buckingham.]											
Red Golden. L. Syn. Red Golden Pippin											Not described.
Red Golden Pippin. Cat. Syn. of Red Golden											
Red Graft. IndH'72. [May be Baldwin]											Do.
Red Graft. MagofH'35. Syn. of Baldwin											
Red Gravenstein. CanH'93. Syn. of Banks											
Red Grove. MagofH'52. Syn. of Grove											
Red Harman. WVaB75	W. Va										Do.
Red Harvest. SBro. Syn. Stribling			l	rs				vg	dm	e	May possibly be Red June, of which it is a synonym.
Red Harvest (of some). Dap. Syn. of Red June											
Red Hawthornden. MagofH'51. Syn. of Hawthornden											
Red Hazel. D. Syn. of Nickajack											
Red Horse. D	Ky.?	ob	m	drs	ctj	y	sa	vg		ml	
Red Horse (of some). D. Syn. of Buckingham											
Redhouse. DomEnc				r					c	l	
Red Houst. TCF. Syn. of Houst											
Red Hub. JVL	N. C		l	rs	j			vg			
Redick. D	Conn	rob	ms	yrs	tj	y	psa	g		m	Reddick and this probably identical.
Red Ingestrie. GenF'33	Eng	oblo	s	yrs	fj		sa	g	d	m	
Red Jacket. MagofH'43											Not described.

Red Janet. MoH'88. Syn. of Red Jennett											
Red Jennett. MoB6. Syn. Red Janet			l	r				p			Claimed to be distinct from Ralls.
Red Jewell. D	Ky	rob	s	der	fej	y	sa	g-vg		ml	
Red Jewell (of Ky.). IllB15. Syn. of Limbertwig											
Red July. Cat											Not described.
Red June. IndF'40. Syns. Blush June, Carolina June, Carolina June Red, Carolina Red, Carolina Red June, Georgia June, Jones' Early Harvest, June Apple, Knight's Red June, North Carolina Red June, Red Harvest (of some), Red Juneating, Susy Clark, Wilson June.	N. C. ?	oc	ms	yrc	vtj	ws	sa	g-vg	dm	e	There are two distinct apples, yet very similar.
Red June. E. Syn. of Margaret											
Red Juneating. NEF'27. Syn. of Early Strawberry											
Red Juneating. GenF'33. Syn. of Margaret											
Red Juneating. F. Syn. of Red June											
Red June Sweet. D. Syn. of June Sweet											
Red Jungfern. Gb. Syns. Rother jungfern, V. R. S. to Ia. No. 38	Rus										Not described.
Red Kane. AmF'51											Do.
Red Koroshavka. MHSC'81											Do.
Red Lady Finger. D. Syn. of Buncombe											
Red Lake. IndH'91. [This may be a crab.]											Do.
Red Leaf. L. Syn. Red Leaf Russet				ru				g		l	
Red Leaf Russet. AndN. Syn. of Red Leaf											
Red Limbertwig. ArkB19. Syn. of Heiges											
Red Limber Twig. D. Syn. of Limbertwig											
Redling. DomEne. Syn. of Cooper Market											
Red McMahon. (LC)	N. W										Do.
Red Margaret. F. Syn. of Margaret											
Red Market (of Mich.). L. Syn. of Flushing											
Red May. A'75			s	r						ve	
Red Miron. MHSC'86. Syns. Miron krasnui, Shro. to Ia. No. 163	Rus										Do.
Red Mormon. D. Syn. of Mormon											
Red Mountaineer. Cat											Do.
Red Mushroom. Cat. Syn. of Mushroom											
Red Mushroom. Gb. Syn. of Red Borovinka											
Red Must. D. Syn. of Must											
Red Naliv. Gb. Syns. Nalivnoe krasnoe, Shro. to Ia. No. 156	Rus										Do.
Red Neverfail. D. Syn. of Ralls											
Red Nonsuch. A'79											Do.
Red Oak. R. Syn. Red Oak Russet											Do.
Red Oak Russet. PFar'52. Syn, of Red Oak											
Red Oats. IllB15											Do.
Red or Black Gilliflower. H. Syn. of Black Gilliflower											
Red Ox (Pa.). W. [May be Pennock.]	Pa										Do.
Red Ox (Ill.?). [Tyler McWhorter claimed this as different from Pennock.]	Ill. ?										Not described. Grown by T. McWhorter, of Illinois.
Red Ox (Pa.). R. Syn. Red Ox Apple. [A summer apple, and therefore distinct from Pennock.]	Pa										Not described.
Red Ox. D. Syn. of Pennock											
Red Ox Apple. A'52. Syn. of Red Ox (Pa.)											
Red Paradise. R. Syn. Red Paradise Sweet			l	r	evj	w	s	g	de	ml	
Red Paradise Sweet. WBKJ. Syn. of Red Paradise											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Redpath. R. Syn. Redpath Fall Seedling	Minn	rob	m	grs			sa	g		m	It is probable that this is Ridpath
Redpath Fall Seedling. SDB76. Syn. of Redpath											
Red Pawpaw. IllB45. Syn. of Pawpaw											
Red Pearmain. T. Syn. of Kaighn. [Same as Long Red in Downing's Appendix.]											
Red Pearmain. E. Syn. of Long Red											
Red Pearmain (of the West). D. Syn. of Winter Pearmain											
Red Pennock. D. Syn. of Pennock											
Red Petersburg. Gb. Syns. Petersburgskoe krasnoe, Rgl. to Ia. No. 191	Rus										Not described
Red Phoenix. E. Syn. of Long Red											
Red Pigeon. Gb. Syns. Rother winter taubenapfel, V. R. S. to Ia. No. 43	Rus										Do.
Red Pine. Gb. Syns. Ananasapfel rother, Gov. list No. 60, Red Duck, Rother Anasapfel.	Rus										Hansen thinks it identical with Yellow Transparent.
Red Pippin (Md.). Syn. Red Pippin of Maryland	Md										Not described
Red Pippin (N. Y.). IH&S. Syn. Streaked Pippin	N. Y		l	grs						l	
Red Pippin. D. Syn. of Ben Davis											
Red Pippin. E. Syn. of Long Red											
Red Pippin. D. Syn. of Nickajack											
Red Pippin. D. Syn. of Streaked Pippin											
Red Pippin. P'95. Syn. of Swadley											
Red Pippin of Maryland. IllB45. Syn. of Red Pippin (Md.)											
Red Polish. D. Syn. of Polish											
Red Pound. L. Syn. Red Pound Sweet		c	l	rs			s	g		m	
Red Pound. S&W. Syn. of Baxter											
Red Pound Sweet. D. Syn. of Red and Green											
Red Pound Sweet. W. Syn. of Red Pound											
Red Pumpkin Sweet. D. Syn. of English Sweet											
Red Quarrenden. GenF'33. Syn. of Quarrenden											
Red Queen. IllH'91			m	gyrs							This may be Red Reinette of Gibb.
Red Queen. Gb. Syn. of Red Reinette											
Red Queening. D. Syn. of Crimson Queen											
Red Rambo. MagofH'49. Syn. Rambo (of Western collections)		rob	m	rb	t		sa			m	Possibly same as Rambo
Red Ranee. W. Syn. of Ranee											
Red Raspberry. Gb. Syns. Malinooka krasnaya, Rgl. to Ia. No. 1260	Rus		ms	y			sa			m	
Red Reinette. Gb. Syns. Gov. list No. 316, Red Queen, Reinette rother, Rothe Reinette.	Rus	rc	ml	gyb		gw	sa		k	l	Hansen calls this Red Queen.
Red Repka. ColExR'91											Not described.
Red Republican. NWFG'52	Pa	rob	l	rs			sa	g		ml	

Red Reserve. A'77											Do.
Red Riches. OklB2. Syn. Romaner											Do.
Red Robinson. W		r		rs			sa				
Red Romanite. T. Syn. of Gilpin											
Red Romarin. D. Syns. Mela de Rosmarino, Mela di Rosmarino rossa, Pomme Romarin Rouge, White Italian Rosemary apple.	Italy	oboblc	l	yb	fc	w	a			l	From Annals of Pomology.
Red Rubicon. Cat											Not described.
Red Rukin. Gb. Syns. Rukinskoe krasnoe, Shro. to Ia. No. 55	Rus.										Do.
Red Russet (N. H.). Cole	N. H.	rc	l	rru	ct	y	rsa	vg	dkm	l	Resembles Baldwin with a more russet skin.
Red Russet (Ark.?). IllH'89	Ark.?		m	rru				vg-b		l	Perhaps same as Pryor, of which R. R. is a synonym.
Red Russet (of some). C. Syn. of Golden Pearmain											
Red Russet (of some). JBW&B. Syn. of Pryor											
Red Russian. WVaB7											Not described.
Red Seedling. W	Ohio	ob	l	rs			sa	p		m	
Red Seek-no-farther. D	Pa.?	ob	m	gyrs	ctj	wg	sa	g		ml	
Red Seek no further. K. Syn. of Keiser											
Red Seek no further. D. Syn. of Red Gilliflower											
Red Serinkia. Gb. Syns. Rother Serinkia, V. R. S. to Ia. No. 44	Rus.										Do.
Red Shropsavine. D. Syn. of Sops-of-Wine											
Red Shropshirevine. Cole. Syn of Sops-of-Wine											
Red Sided. Gb. Syns. Gov. list No. 176, Krasnabakoe, Krasnabokoe, Shro. to Ia. No. 142.	Rus.	obl	s	r	fj	ws	sa	vg		ml	
Red Simmons. IllB15. Syn. of Simmons											
Red Sine Qua Non. Cat											Do.
Red Smith's Cider. Cat. Syn. of Red Cider											
Red Spice. L. Syn. Red Sweet Spice	Ohio	ob	s	rs			s	g		m	
Red Spice. Lin. Syn. of Fenouillet Rouge											
Red Spitzenburg. R. Syn. Spitzenburg Red	Ill	c	ml	rs			sa	p		l	
Red Spitzenburg. GenF32. Syn. of Long Red											
Red Spitzenburgh. T. Syn. of Kaighn. [This is Long Red of Downing's Appendix.]											
Red Spitzenburgh. D. Syn. of Richard											
Red Stellin. ColExR'88	Ger										Do.
Red Stetiner. Cat	Rus.? Ger.?										Do.
Red Stettin. CanExR'01		ob	l	gyr	f	gy	sa			l	Perhaps same as Red Stellin, of Colorado report.
Red Stettiner. BBL. Syn. Rother Stettiner. [Red Stellin, Red Stettin, and Red Stetiner may be identical.]	Ger.? Rus.?	rob	m	grb	fj	gw	sa	vg		l	
Redstreak (Eng.). DomEnc. Syns. Herefordshire Red Streak, Johnson, Red Streak, Scudamore's Crab, Scudamous Crab.	Eng	r	m	yrs	f	y	rsa	g	c	l	
Redstreak (Rus.). Gb. Syns. Gov. list No. 367, Polosato	Rus.	c	l	rs			sa	g	k	m	
Red Streak. EWR. Syn. of Domine											
Red Streak. Dap. Syn. of Ransom											
Red Streak. Lin. Syn. of Redstreak											
Red Streak. H. Syn. of Redstripe											
Redstreak. MagofH'47. Syn. of Wine											
Red Streaked Rawling. D. Syn. of Rawling											
Redstripe. CGen'59. Syns. Carolina Red Stripe, Early Red Margaret (incorrectly), Early Red Streak, Early Red Stripe, English Red Stripe, Harvest Red Streak, Red Streak, Red Stripe, Rockhill's Summer Queen.	Ind	oblc	m	wrsc	tj	w	psa	g	dkm	ml	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Red Stripe. D. Syn. of Redstripe											
Red Stripe (of Pennsylvania). IllB45. Syn. of Stripe											
Red Summer Calville. A'83. Syns. Calville Summer red, Gov. list No. 182, Kalvil krasnui lietnui, Kalville Kwasnuiletny.	Rus.										Not described.
Red Sweet (N.J.) C. Syn. Red Sweeting	N.J.	r	s	r	f	w	s		c	m	
Red Sweet (Ohio). W	Ohio	ob	ml	rs			s	g		l	
Red Sweet (Ohio). W	Ohio	ro	m	yrs	vtj	w	s	vg		ml	
Red Sweet Pippin. IndF'40. Syn. of Moore Sweet											
Red Sweet Pippin of Indiana. E. Syn. of Sweet Pippin. [Probably Moore Sweet.]											
Red Sweeting. Gb. Syns. Gov. list No. 555, Kras Sladkaya, Krass Sladkaja.	Rus.										Do.
Red Sweeting, GarCal. Syn. of Red Sweet											
Red Sweet Spice. W. Syn. of Red Spice											
Red Sweet Spice. W. Syn. of Sweet Spice											
Red Sweet Winesap. D. Syn. of Sweet Winesap											
Red Teat. Gb. Syn. of Red Titka											
Red Titka. Gb. Syns. Gov. list No. 975, Red Teat, Tetnekrasnoe, Titka krasnaya.	Rus.										Do.
Red Transparent. Gb. Syns. Gov. list No. 333, Skvosnoi krasnui, Skwosnoi krasnoi.	Rus.		s					vg	dk	e	
Red Vandevere. D. Syn. of Buncombe											
Red Vandevere. D. Syn. of Smokehouse											
Red Vandevere. D. Syn. of Vandevere											
Red Wamir. F. [Evidently a misprint; should be Warrior.]											
Red Warrior. IaH'96. Syn. of Mitchell											
Red Warrior. W. Syn. of Warrior											
Red Warrior (erroneously). D. Syn. of Nickajack											
Red Wine. Gb. Syns. Gov. list No. 343, Rother Weinapfel, Weinapfel rother (herbst, Rgl.).	Rus.	rob	m	wb	tj	vw	sa	g	m	e	Hansen considers it of German origin.
Red Winesap. W	Pa		ml					g		l	May not differ from Winesap.
Red Winter. DomEnc			m	r				g	dm	l	
Red Winter Calville. D. Syn. of Red Calville											
Red Winter Nonsuch. Lin. Syn. of Hubbardston											
Red Winter Pearmain. D. Syn. of Buncombe											
Red Winter Pearmain. E. Syn. of Long Red											
Red Winter Pearmain. IllH'70. Syn. of Milam											
Red Winter Pearmain. E. Syn. of Westfield											
Red Winter Pennock. APC'50. Syn. of Pennock											

Red Winter Pippin. IllH'85	Ill.?		m	r	f		sa	vg			
Red Winter Sweet (Va.? Ky.?). D	Va.? Ky.?	re	m	yrsc	c	y	rs	g	k	l	
Red Winter Sweet (Ill.). IllH'70	Ill	ob	ms	yb	cmj	y	rs	g		vl	
Red Winter Sweet. D. Syn. of Sweet Romanite											
Red Winter Sweet. IllH'71. Syn. of Sweet Vandervere											
Red Winter Sweet (of some). B. Syn. of Moore Sweet											
Red Winter Sweeting. Lin. Syn. Large Red Sweet										m	Not described.
Reed. D	N.Y	r	m	wrs	tj	ws	psa	g		m	
Reed Golden. (LC). Syn. Reed's Golden Pippin	N.J.?	rob	m	ybru	fj	y	rsa			l	
Reed's Golden Pippin. Dap. Syn. of Reed Golden											
Reeves' Favorite. P'95. Syn. of Vineland											
Refugee. IllB45. Syn. of Winesap											
Regan's Yellow. JBW&B. Syn. of Ragan Yellow											
Regel. IaB31	Rus.		m							vl	Prof. Budd makes this No. 169, which is Gibb's Green Sweet.
Regel. N. Syn. of Green Sweet											
Regmalard. L. Syn. Reinette de Regmalard											Not described.
Regular. Dap. Syn. of Cooper Market											
Reid Golden. MichB129	N.J.?	ob		yr				g	k	e	Probably distinct from Reed Golden.
Reine des Reinettes. W. Syn. of Queen Pippin											
Reinette a feuille d'Acuba. NYExR'92. Syn. of Acuba-leaved Reinette											
Reinette Ananas. CanExR'01		re	m	yg	cj	w	sa	g		l	
Reinette Batarde. GenF'33. Syn. of Borsdorffer											
Reinette Bauman. D. Syn. of Bauman											
Reinette Blanche. D. Syn. of French Reinette											
Reinette Blanche d'Espagne. GenF'33. Syn. of White Spanish											
Reinette Blanche d'Espagne (erroneously). K. Syn. of Fall Pippin											
Reinette Blanche dite Prime. D. Syn. of French Reinette											
Reinette Calville. D		robl	m	yrs	tj	y	p			ml	From Diel.
Reinette Canada. B. Syn. of Canada Reinette											
Reinette Cœur de France. MagofH'41. Syn. of Cœur de France											
Reinette Coulon. D. Syn. of Coulon											
Reinette d'Aix. GenF'33. Syn. of Golden Reinette											
Reinette d'Aizerna. GenF'33. Syn. of Breda											
Reinette d'Angleterre. D. Syn. of English Reinette											
Reinette d'Angleterre. D. Syn. of Golden Pippin (Eng.)											
Reinette Daniel. D		rob	m	wyru	j	w	ba	g		ml	
Reinette d'Anjou. D. Syn. of Anjou											
Reinette de Bayeux. D. Syn. of Bayeux											
Reinette de Breda. GenF'33. Syn. of Breda											
Reinette de Bretange. IllB45											Not described.
Reinette de Caen. GenF'33. Syn. of Canada Reinette											
Reinette de Canada Grise. GenF'33. Syn. of Royal Russet											
Reinette de Canada Platte. GenF'33. Syn. of Royal Russet											
Reinette de Canterbury. D. Syn. of Canterbury											
Reinette de Caux. NYExR'96	Fr	rob	m	gyr	cj		sa	g	k	l	Probably same as Caux.
Reinette de Caux. D. Syn. of Caux											
Reinette de Champagne. D. Syn. of Champagne											
Reinette de Citron. D. Syn. of Citronen											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Reinette de Clareval. D. Syn. of Clareval											
Reinette d'Espagne. GenF'33. Syn. of White Spanish											
Reinette d'Esperen. Dap. Syn. of Esperen											
Reinette d'Ete Blanc. D. Syn. of Summer Reinette											
Reinette de Flandre. D. Syn. of Flanders Reinette											
Reinette de Frisland. D. Syn. of Frisland											
Reinette d'Holland. D. Syn. of Holland											
Reinette de Hongrie. D. Syn. of Hongrie											
Reinette de Hoya. Dap. Syn. of Hoya											
Reinette de Laak. MagofH'51. Syn. of Laak											
Reinette de la Chine. IllB45. Syn. of Lachine											
Reinette de Landsberg. Dap. Syn. of Landsberg											
Reinette de la Rochelle. D. Syn. of Rochelle Reinette											
Reinette de Luxemburg. AndN. Syn. of Luxemburg											
Reinette de Madere. IllB45. Syn. of Madere											
Reinette de Middlebourg. D. Syn. of Middlebourg											
Reinette de Misnie. GenF'33. Syn. of Borsdorffer											
Reinette de Normandy. D. Syn. of French Reinette											
Reinette d'Orleans. D. Syn. of Orleans											
Reinette d'Orleans. D. Syn. of Tournay											
Reinette d'Osnabruck. D. Syn. of Osnabruck											
Reinette de Regmalard. BBL. Syn. of Regmalard											
Reinette der Tyrol. D. Syn. of Tyroler											
Reinette des Carmes. GenF'33. Syn. of Barcelona											
Reinette des Menonites. D. Syn. of Menonisten											
Reinette des Reinettes. IllB45		rob	ml	rs			sa	g-vg		l	
Reinette de Thorn. D. Syn. of Thorn											
Reinette de Versailles. IllB45											Not described.
Reinette Diel. D. Syn. of Diel											
Reinette Dolbear. IllB45. Syn. of Dolbear											
Reinette Doré. D. Syn. of Dorè											
Reinette Doree. K. Syn. of Dorè											
Reinette Doree. GenF'33. Syn. of Dutch Mignonne											
Reinette Doree. D. Syn. of Konig											
Reinette Doree de Van der Laans. D. Syn. of Vanderlaans											
Reinette du Canada. GenF'33. Syn. of Canada Reinette											
Reinette du Canada à Cortes. GenF'33. Syn. of Canada Reinette											
Reinette du Canada Blanche. GenF'33. Syn. of Canada Reinette											
Reinette Duchesse de Brabant. D. Syn. of Duchesse de Brabant											
Reinette du Caux. Cat. [Probably same as Reinette de Caux.]											Do.

Reinette du Roi. D. Syn. of Konig											
Reinette du Thorn. D. Syn. of Thorn											
Reinette du Vigan. D. Syn. of Vigan											
Reinette Edelkonig. Dap. Syn. of Edel-Konig											
Reinette Etoile. D. Syn. of Etoile											
Reinette Etoile. D. Syn. of Star Reinette											
Reinette Franche. C. Syn. of French Reinette											
Reinette Franche Grauwe. GenF'33. Syn. of Grey French											
Reinette Giden. GenF'33. Syn. of Golden Reinette											
Reinette Golden. GenF'33. Syn. of Golden Reinette											
Reinette Grain d'Or. D. Syn. of Grain d'Or											
Reinette Gris d'Anjou. Cat. Syn. of Anjou											
Reinette Grise. D. Syn. of Grey French											
Reinette Grise. C. Syn. of Grey Reinette											
Reinette Grise. D. Syn. of Winter Gray											
Reinette Grise Brownlee's. D. Syn. of Brownlee											
Reinette Grise d'Hiver. C. Syn. of Grey Reinette											
Reinette Grise d'Hiver. D. Syn. of Winter Gray											
Reinette Grise de Portugal. D. Syn. of Portugal Gray											
Reinette Grise Extra. D. Syn. of Grey Reinette											
Reinette Grise Extra. D. Syn. of Winter Gray											
Reinette Grise Francaise. D. Syn. of Grey French											
Reinette Grise Francaise. D. Syn. of Winter Gray											
Reinette Grise Haute Bonte. D. Syn. of Haute Bonte											
Reinette Grosse du Canada. GenF'33. Syn. of Canada Reinette											
Reinette Jaune Hatif. D. Syn. of Early Yellow											
Reinette Jaune Tardive. K. Syn. of Dorè											
Reinette Krudner's. IndH'87. Syn. of Krudner											
Reinette Kurski. MHSC'81. Syn. of Kursk Reinette											
Reinette Liubski. Gb. Syn. of Lubsk Reinette											
Reinette Muscateller. Gb. Syn. of Muscatel Reinette											
Reinette Musque. D. Syn. of Yellow Bellflower											
Reinette Nelguin. GenF'33. Syn. of Bseda											
Reinette Noir. R. Syn. Reinette Noir Sanguine		r	m	dr		y		p		l	
Reinette Noir Sanguine. MagofH'41. Syn. of Reinette Noir											
Reinette Nonpareil. GenF'33. Syn. of Nonpareil											
Reinette Oberdeich. BBL											Do.
Reinette Ontz. Dap. Syn. of Ontz											
Reinette Pearmain. H											Do.
Reinette Pippin. D	Fr.?	obe	m	y	cj	w	bsa	g		ml	
Reinette Platè. D. Syn. of Borsdorf											
Reinette Poire. K. Syn. of Pear Rennet											
Reinette Quarrendon. D	Fr	rob	ml	yrs	e	w	a			ml	From Album de Pomologie.
Reinette rothe. Gb. Syn. of Red Reinette											
Reinette Rouge. GenF'33. Syn. of Barcelona											
Reinette Rouge de Nieman. D. Syn. of Nieman											
Reinette Rousse. D. Syn. of Barcelona											
Reinette Rousse. D. Syn. of Dorè											
Reinette Rousse de Boston. D. Syn. of Roxbury											
Reinette St. Lambert. D. Syn. of St. Lambert											
Reinette Scharlock. Gb											
Reinette Superfine. JW. Syn. of Superfine											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Reinette Swisse. D. Syn. of Swiss Reinette											
Reinette Tardive Nouvelle. D. Syn. of Late Reinette											
Reinette Triomphante. Lin. Syn. of Triomphante											
Rinette Vellners Gold. GenF'33. Syn. of Uellners											
Reinette Van Mons. NEF'29. Syn. of Van Mons											
Reinette Verte. D. Syn. of Green Reinette											
Reinette Vervaene. D. Syn. of Vervaene											
Reinette Beelin. Gb. Syn. of White Reinette											
Reipka Kislaya. Gb. Syn. of Acid Repka											
Reist. A'56	Pa.?	r	l	y	f		sa	vg		e	
Reliance. RNY'70	Wis.	obe		pyrs	tmj	w	sa	g-vg		l	From Rural New Yorker.
Relish. IllB15		ob	m	r			sa	g		m	
Remenskoe. IaH'82	Rus.	r	m	yb				vg		l	
Renard. L. Syn. Louise Renard	Belg	robe	m	yb	t	vw	sa				From Annals of Pomology.
Renaud. R. Syn. Renaud's Seedling											Not described.
Renaud's Seedling. AmGar'93. Syn. of Renaud											
Renet bielui. Gb. Syn. of White Reinette											
Renet Kievskui. Gb. Syn. of Kief Reinette											
Renet Kurski. Gb. Syn. of Kursk Reinette											
Renet Liubskui. Gb. Syn. of Lubsk Reinette											
Renetten. D. Syn. of Prairie											
Renetts Woroneschski. Gb. Syn. of Voronesh Reinette											
Renet Voroneshskui. Gb. Syn. of Voronesh Reinette											
Renish May. Cat. Syn. of Myers. [This is May reduced from May of Meyers.]											
Renner. MagofH'53											Do.
Rennette. CB116. Syn. Pommier nain de Rennette											Do.
Renol. R. Syn. Renol's June											Do.
Renol's June. IllH'96. Syn. of Renol											
Renwick. R. Syn. Early Renwick											Do.
Repka. B. Syns. Riepka, Shro. to Ia. No. 139	Rus.	r	ml	y			sa	g		e	
Repka Aport. MHSC'86. Syns. Aport Reptschuti, Aport rieptchatui, Gov. list No. 261, O'Porto Turnip Seedling, Rieptchatui aport, Shro. to Ia. No. 137.	Rus.		vl					g	m	e	
Repka Arcad. MHSC'96. Syns. Arkad rieptchatui, Shro. to Ia. No. 59	Rus.										Do.
Repka Kislaja. Gb. Syn. of Acid Repka											
Repka Malenka. A'83. Syn. Little Seedling	Rus.	re	s	rs			msn	g	k	ml	This is probably Little Repka. Bul. 8 is in error.
Repka Malenka. Syn. of Little Repka											
Repka Rosowaja. Gb. Syn. of Rosy Repka											
Repolovka. IaH'82. Syn. Shro. to Ia. No. 1	Rus.										Not described.

Repouka. Gb. Syn. of Riepovka											
Repra. OntExR'82											Do.
Repristoe Walisonoe. Gb. Syn. of Ribbed Naliv											
Republican. Hort'65		ob	m	yrs							May be identical with Republican Pippin.
Republican Pippin. MagofH'40	Pa	ob	l	yrs	tj	w	psa	g	k	m	
Requa. R. Syns. Fuqua (perhaps erroneously), Requa Seedling	Mo							vg		vl	
Requa Seedling. MoH'85. Syn. of Requa											
Reschestwenskoe. NYExR'83											Not described.
Reserve. R. Syn. Reserve Codling											Do.
Reserve Codling. IllH'84. Syn. of Reserve											
Resonant. Gb. Syns. Gov. list No. 352, Svonkoe, Swonkoe	Rus										Do.
Resor Green. Cat											Do.
Reuben. A'95	N. Y.?	oble	l	yg	efj	w	a	vg	km	ml	
Revel. Gb. Syns. Gov. list No. 170, Revelskoe, The Revel	Rus										Do.
Revel Borsdorf. Gb. Syns. Borsdorfer Revaler, Borsdorf Revel Apple, Gov. list No. 122.	Rus		m					vg	dm	m	
Revel Glass. MHSC'86. Syns. Glass Revel, Gov. list No. 186, Rgl. to Ia. No. 170, Revelskoe (Gov. list), Shro. to Ia. No. 149, Steklianka Revelskaja, Steklianka Revelskaya.	Rus										Do.
Revel Pear. Gb. Syns. Gov. list No. 338, Grusheffka Revelskaja, Grushevka Revelskaya, Rgl. to Ia. No. 379.	Rus		m					g	dm	e	
Revel Pigeon. MHSC'86. Syns. Revelskoe golubinoe, Rgl. to Ia. No. 123, Shro. to Ia. No. 66, Taubenapfel Revaler.	Rus	robe	ml	gyrs	j	w	sa	vg		me	
Revelskaja Polosatoe. Gb. Syn. of Revel Streaked											
Revelskoe. Gb. Syn. of Revel											
Revelskoe golubinoe. Gb. Syn. of Revel Pigeon											
Revelskoe (Gov. list). Gb. Syn. of Revel Glass											
Revelskoe polosatoe. Gb. Syn. of Revel Streaked											
Revelstone Pippin. D. Syn. of Ravelston											
Revel Streaked. Gb. Syns. Gov. list No. 557, Revelskaja Polosatoe, Revelskoe polosatoe, Streaked Revel.	Rus										Do.
Reynard. A'81	N. S.	roble	vl	gy					km	l	Distinct from Renard, a Belgian variety.
Rhea. P'95	Tenn	roble	m	yrs		w	sa	g-vg	dk	me	
Rhenish May. D. Syn. of May											
Rhenish May (of Illinois). W. Syn. of May											
Rhoda. IaH'96											Not described.
Rhode Island. (LC). Syns. Bell Dubois, Burlington Greening, Greening, Greening Rhode Island, Green's Inn, Greenling Von Rhode Island, Hampshire Greening, Jersey Greening, Rhode Island Greening, Russine.	R. I.	robe	l	yg	tej	y	a	vg	dkm	ml	
Rhode Island Greening. DomEnc. Syn. of Rhode Island											
Rhode Island Secknofurther. D. Syn. of Ferris											
Rhode Island Sweet. MagofH'53. Syn. of Pumpkin Sweet (Ct.)											
Rhodes. L. Syn. Rhodes' Orange	Ga	rob	m	yrs	tj	w	psa	g		me	
Rhodes' Orange. D. Syn. of Rhodes											
Riabinouka. Gb. Syn. of Berry											
Riabinovka. Gb. Syn. of Berry											
Ribbed. Gb. Syns. Gov. list No. 461, Rebristoe, Strong-ribbed	Rus										Do.
Ribbed Gilliflower. Dap. Syn. of Scollop Gilliflower											
Ribbed Greening. D. Syn. of Golding											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Ribbed Naliv. Gb. Syns. Gov. list No. 285, Rebristoe Nalivnoe, Repristoe Walisonoe, Turnipy Juicy Apple.	Rus.		l								Not described.
Ribston. L. Syns. Beautiful Pippin, Formosa Pippin, Glory of York, Ribstone Pippin, Ribston Park Pippin, Ribston Pippin, Rockhill's Russet, Travers.	Eng	re	ml	ybru	fe	y	a	vg	d	vl	
Ribston Park Pippin. AmF'23. Syn. of Ribston											
Ribstone Pippin. C. Syn. of Ribston											
Ribston Pippin. NEF'32. Syn. of Baddow											
Ribston Pippin. K. Syn. of Ribston											
Richard (N. Y.). MagofH'52. Syns. Derrick's Graft, Derrikinan, Dick's Graft, Red Spitzenburgh, Richard's Graft, Strawberry, Uncle Richard's Graft, Wine, Wine Strawberry.	N. Y	rob	m	yrs	tj	y	psa	vg	d	me	
Richard (Rus.). MHSc'86. Syns. Grand Richard, Shro. to Ia. No. 62	Rus.										Do.
Richard's Graft. D. Syn. of Richard (N. Y.)											
Richardson. Cole	Mass.	re	l	rb	tj	gw	msa	g	d	me	
Richardson's Red. ArkB49. Syn. of Beach											
Richardson Winter. W	Mass.	ob		y			sa	g		l	
Richfield. H. Syn. of Red Canada											
Richfield Nonsuch. Cole. Syn. of Red Canada											
Richland. LWC&CO											Do.
Richland Beauty. SDB76	Minn	ob	m	gyrs		w	psa	g		m	Oldenburg seedling, Rice Co., Minn.
Richland Sweet. R. Syn. Richland Winter Sweet							s			l	Not described.
Richland Winter Sweet. Cat. Syn. of Richland Sweet											
Richmond. E	Ohio	rob	l	pyrs	tj	w	s	g		ml	
Richmond's No. 1. W. [Described by Warder.]	Ohio	r	m	rs			s	g		l	
Richmond's No. 4. W. [Described by Warder.]	Ohio	r		rs			sa	g		m	
Richmond's No. 5. W. [Described by Warder.]	Ohio	r		y			sa	g		l	
Richmond's No. 6. W. [Described by Warder.]	Ohio	r		rs			sa	g		m	
Richmond Red. L. Syn. of Richmond's Red	Ohio	r	l	r			sa	g		m	
Richmond's Red. W. Syn. of Richmond Red											
Richmond Sweet. IllB45											Do.
Rich Pippin. W. Syn. of Rock Pippin											
Rich Spicy. IllB45											Do.
Richtor. PaB18											Do.
Rich Winter. ColExR88											Do.
Rieter. BBL											Do.
Ridge. L. Syn. Ridge Pippin	Pa.?	re	ml	yru	cj	y	sa	g	m	vl	
Ridge Pippin. GenF'33. Syn. of Ridge											
Ridge Pippin. W. Syn. of Rock Pippin											

Ridley. F											Do.
Ridley. DomEne. Syn. of Cooper Market											
Riegel. A'97	Ga		ml	yrs			sa	vg		me	
Riehl. R. Syn. Riehl's No. 1	Ill.?										Do.
Riehl's No. 1. IllH'99. Syn. of Riehl											
Riepka. Gb. Syn. of Repka											
Riepka kislaya. Gb. Syn. of Acid Repka											
Riepka Malenkaya. Gb. Syn. of Little Repka											
Riepka rosavaya. Gb. Syn. of Rosy Repka											
Riepovka. Gb. Syns. Gov. list No. 323, Repouka, Turnip	Rus	rob	ml	yrsc	fj	w	a		k	m	
Rieptchatui aport. Gb. Syn. of Repka Aport											
Riest. D	Pa	r	l	y	f		psa	g		me	
Rigaer herbst Streifling. Gb											
Rigaer Skvosnoi naliv. Gb. Syn. of Riga Transparent											
Rigaer skwosnoi naliv. Gb. Syn. of Riga Transparent											
Riga Stripe. SDB76	Rus	robc	l	ygrsc	fj	w	sa	vg		m	
Riga Translucent. Gb. Syns. Shro. to Ia. No. 52, Skvosneena Rishkaya	Rus										Do.
Riga Transparent. Gb. Syns. Gov. list No. 287, Rigaer Skvosnoi naliv, Rigaer Skwosnoi naliv, Riga Transparent Juicy.	Rus										Do.
Riga Transparent Juicy. Gb. Syn. of Riga Transparent											
Rightman. A'87											Do.
Rigley. D	Pa	rc	m	pyrs	mj	w	sa	g		l	
Rigley. DomEne. Syn. of Cooper Market											
Rijmer. IllB45		ob	m	rs			sa			m	
Rina. IllH'99											Do.
Ringer. BBCo											Do.
Riordan. R. Syn. Riordan Sweet			m	wy			s				
Riordan Sweet. AB&Co. Syn. of Riordan											
Rioter. DelExR'95											Do.
Ripley. Dap. Syns. Ripley's Claret, Ripley Claret Seedling	Ill	obc	ml	gbc	fmj	w	sa	vg		me	From Journal of Horticulture.
Ripley's Claret. Dap. Syn. of Ripley											
Ripley Claret Seedling. AJofHIX. Syn. of Ripley											
Risley. R. Syn. Risley Pippin											Not described.
Risley Pippin. S&W. Syn. of Risley											
Rissler. A'85											Do.
Rissley. GenF'48. Syn. of Lowell											
Rist. MoH'90	Nebr		m							ve	First cultivated by S. Barnard of Tablerock, Nebr.
Rittenhouse. A'97	N. J		m	yb				vg		l	
Ritter. MagofH'53	Pa	rob	m	yrs	tj	w	psa	g		m	
Ritter. Hort'56. Syn. of Jackson (Pa.)											
Rival. AmGar'02											Not described.
Rival Golden Pippin. K. Syn. of Wick											
River. NEF'31	Mass	obc	ml	yrs	jt		psa	g	dk	me	
Rivers. L. Syn. Rivers Strawberry											Do.
Rivers Codlin. BBL											Do.
Rivers Strawberry. Cat. Syn. of Rivers											
Riviere. IllB45											Do.
Roadstown. L. Syn. Roadstown Pippin	N. J	ob	l	gy	t	w	sa	g-vg	k	vl	
Roadstown Pippin. D. Syn. of Roadstown											
Roane. L. Syn. Roane's White Crab	Va	r	s	y					c	m	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Roane's White Crab. C. Syn. of Roane											
Roa Yon. D. Syn. of Lady Sweet											
Roberson. EWR	Va	robl	l	yr	cj	y	sa			l	
Roberson Pippin. MoH'72											Not described.
Roberson Red. IllH'72	{Ky.? / Tenn.?}	r		yrs			sa	g		l	Robertson is probably correct.
Roberson's White. T. Syn. of Robertson White											
Roberson Winter. R. Syn. Roberson's Winter											Not described.
Roberson's Winter. JVL. Syn. of Roberson Winter											
Robert Bruce. GarM'60	N. C	ob	ml	c	cj	w	p			me	From Gardener's Monthly.
Robert Kimball. CGen'69	N. H							g	dk	m	
Robert Pippin. MoH'88											Not described.
Roberts. D. Syn. Roberts Seedling	Ohio	rob	m	pyb	tj	w	psa	vg		m	
Robertson's Pearmain. D. Syn. of Buncombe											
Robertson Red. L. Syn. Robertson's Red	Ky	obl	m	rs			sa	p		l	
Robertson's Red. W. Syn. of Robertson Red											
Robertson's Superb. W. Syn. of Winter Queen. [Probably Buckingham.]											
Robertson White. L. Syns. Roberson's White, Robertson's White, Robinson's White.	Va	rob	m	gy	cj	y	sa	g		m	
Robertson's White. W. Syn. of Robertson White											
Roberts Seedling. D. Syn. of Roberts											
Robey. D. Syns. Robey's, Robey's Seedling	Va	robe	l	yrs	j	y	psa	g		m	
Robey's. W. Syn. of Robey											
Robey's Limbertwig. IllB45. Syn. of Limbertwig											
Robey's Seedling. A'52. Syn. of Robey											
Robin. D	Fr	obc	ml	yrs	fj	w	sa			vl	From Annals of Pomology.
Robinett. JWK											Not described.
Robinson. H. Syn. Robinson Pippin	Iowa	robc	ms	gyb	tj	wy	msa	vg		l	
Robinson. Syn. of Stark											
Robinson of Va. BBL											Do.
Robinson Pippin. L. Syn. Robinson's Pippin	Eng	rob	s	gyb	tj	g	a			l	
Robinson Pippin. MoH'99. Syn. of Robinson											
Robinson's Pippin. D. Syn. of Robinson Pippin											
Robinson's Streak. Dap. Syn. of Ben Davis											
Robinson Stripe. W	Ohio	c	m	rs			sa	g		m	
Robinson's Superb. D. Syn of Farrar											
Robinson Sweet. L. Syn. of Robinson's Sweet	Vt	r	m	rs	fj		s				
Robinson's Sweet. D. Syn. of Robinson Sweet											
Robinson's White. F. Syn. of Robertson White											

Robison Red. IndH'75	Tenn									vl	Doubtless this should be Robertson Red.
Robnett. CW. Syn. of Scarlet Cranberry											
Robson White. IndH'81											Not described.
Rocella. BBL											Do.
Rochelle. CanH'94	Que	rob	l	ygrs						l	May be Rochelle Reinette of Downing.
Rochelle Reinette. D. Syn. Reinette de la Rochelle		roble	l	yb	tj	w	sa			l	Transactions Am. Pom. Society.
Rochester. L. Syn. Rochester Pippin	N. Y.	rob	l	gyb	etj	w	sa	vg-b		l	Name first published in Horticulturist, '71, 208.
Rochester Pippin. Hort' 71. Syn. of Rochester											
Rochester Sweet. BBL											Not described.
Rock (Ala.). Cat	Ala										Do.
Rock (N. H.). D. Syn. Rock Apple	N. H	rob	l	yrs	tj	w	sa	g		m	
Rock (Pa.). D	Pa	obc	m	w	tj	w	sa	g		me	
Rock (Ohio?). A'95	Ohio?										Do.
Rock Apple. D. Syn. of Lansingburg											
Rock Apple. Dap. Syn. of Nelson Rock											
Rock Apple. NEF'31. Syn of Runnells											
Rock Apple. W. Syn. of Rock (N. H.)											
Rockbridge. R. Syn. of Rockbridge's Sweet											Do.
Rockbridge's Sweet. FDNCo. Syn. of Rockbridge											
Rockhill's Russet. D. Syn. of Ribston											
Rockhill's Summer Queen. W. Syn. of Redstripe											
Rockingham. MagofH'53											Do.
Rockingham Red. D. Syn. of Allum											
Rock Pippin. D. Syns. Lemon, Rich Pippin, Ridge Pippin, Walnut Stem	Ohio ?	oblc	m	yb	f		sa	g	km	vl	Somewhat confused with Ridge, which see.
Rockport. L. Syn. Rockport Sweet	Mass.	rob	m	gyb	j	w	bs	g-vg	dk	vl	
Rockport Sweet. D	Ohio						s				Probably same as Rockport. Downing thought so.
Rockport Sweet. W. Syn. of Rockport											
Rockremain. D. Syn. of Ralls											
Rock Rimmon. Lin. Syn. of Ralls											
Rock Sweet. D. Syn. Byfield	Mass.	robc	ms	rs	tj	w	rs	g-vg	k	me	
Rockwood. Dap	Me	robl	m	gyb	tmj	w	sa			l	
Roe. R. Syn. Roe's Golden											Not described.
Roe's Golden. IllH'96. Syn. of Roe											
Rohe. R. Syns. Rohe's Favorite, Rohrer's Favorite	Ill	rob	m	r			mu			l	Not sure as to correct spelling—Rohe? Rohrer?
Rohe's Favorite. IllH'96. Syn. of Rohe											
Rohrer's Favorite. WBro. Syn. of Rohe											
Roi-Tres-Noble. Dap. Syn. of Edel-Konig											
Rolen. L. Syns. Rolen's Keeper, Rowland		r	m	rru	r	gy	a	g-vg	d	vl	
Rolen's Keeper. W. Syn. of Rolen											
Rolfe. Hort'75. Syn. Macomber	Me	ob	m	rs			sa	g		ml	
Rolla. Hort'74			m		c		sa	g	k	vl	Probably distinct from Rollin, of Downing.
Rolla (?). D. Syn. of Rollin											
Rolland. D. Syn. of Belle Bonne											
Rollen. R. Syn. Rollen's Juneating											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Rollen's Juneating. A'58. Syn. of Rollen											
Rollin. D. Syn. Rolla?	N. C	rob	m	yrs	cf		sa	g-vg	d	ml	
Rollins Pippin. SDB76	Minn	rob	ml	gy	fj	w	sa	g	k	l	Not especially promising.
Rollins Prolific SDB76	Minn	rc	m	yg	jf	w	sa	g		l	
Rollins Russet. IaH'94											Not described.
Rolph. WisB45. [This may be Rolfe.]											Do.
Roman Beauty. E. Syn. of Rome											
Romaner. AmGar'01. Syn. of Red Riches											
Romanite. D. Syns. Broad River, Ramanite, Romanite of the South, Southern Romanite	South?	rc	s	yrb	fj	y	psa	g-vg	dm	vl	
Romanite. F. Syn. of Gilpin											
Romanite. W. Syn. of Pennock											
Romanite (incorrectly). Dap. Syn. of Greyhouse. [May Seek-no-further.]											
Romanite of New Jersey. C. Syn. of Rambo											
Romanite of the South. F. Syn. of Romanite											
Romanite of the West. Cole. Syn. of Gilpin											
Romankirgger. MagofH'47											Do.
Romanknight. D. Syn. of Gilpin											
Roman Knight. DomEnc. Syn. of Greyhouse											
Roman Knight. D. Syn. of Pennock											
Romanoff. MHSC'86. Syns. Romanovka, Shro. to Ia. No. 151	Rus										Do.
Romanovka. Gb. Syn. of Romanoff											
Roman Stem. DomEnc. Syn. French Pippin (of some)	N. J	r	m	wybru	tjf		prsa	vg	d	ml	
Roman Sweet. R. Syn. Roman Sweet Pippin											Do.
Roman Sweet Pippin. IllH'72. Syn. of Roman Sweet											
Romarin. L. Syns. Romarin Blanche, White Romarin	Italy	oblc	m	pyb	f	yw	sa			l	From Annals of Pomology.
Romarin Blanche. D. Syn. of Romarin											
Rome. L. Syns. Foust's Rome Beauty, Gillett's Seedling, Press Ewing, Phoenix, Roman Beauty, Rome Beauty, Royal Red, Starbuck.	Ohio	robe	l	yrs	tj	y	sa	g	m	ml	
Rome Beauty. D. Syn. of Rome											
Romenskoe. A'83. Syns. Gov. list No. 599, Omensk (name of a place), Romnenskoe, Shro. to Ia. No. 11.	Rus										Not described.
Romenskoe. SDB76. Syn. of Romna											
Rome Sweet. BBL											Do.
Romlanka. Gb. Syns. Gov. list No. 445, Redcheeked	Rus										Do.
Romna. IaB90. Syn. Romenskoe	Rus	obc	ml	gyr	fje	w	sa	g	k	l	Prof. Budd regards this as identical with Romenskoe.
Romnenskoe. Gb. Syn. of Romenskoe											
Ronk. IndH'88	Ind		l					g			A Vandervere Pippin seedling.

Root. R. Syn. Root's Early. [Exhibited by Elliott at Buffalo Hort. meeting, 1846.]											Not described.
Root's Early. Hort'46. Syn. of Root											
Rosa. D.	Fr	r	l	pyrs	tj	w	sa			ml	From Album de Pomologie.
Roschdestwenskoe. Gb. Syn. of Christmas											
Rose. L. Syn. Pomme de Rose		rob	l	yrb	c	w	a			ml	
Rose. D. Syn. of China Rose											
Rosea. IllB45											Not described.
Rose Apple of China. C. Syn. of China Rose											
Roseau. D.	Eur		l	dr	cj		rsa	g		ml	
Roseau d'Automne. C. Syn. of Autumn Rose											
Roseau (incorrectly). E. Syn. of Autumn Rose											
Rose Bee. Dap	Pa	robe	m	pyrs	tmj	ws	sa	g		ml	
Rosebud. Dap	Del	rob	m	yrs	j	wy	bsa	g		l	
Rose Calville. D.	Fr	rc	m	yrc	tj	w	sa	g		ml	
Rose-Colored Lady Apple. D. Syn. of Rose Lady											
Rosedale. P'95. Syn. Rosedale Pippin	Tenn	rob	ml	wyrsc	tj	y	sa	g-vg		m	
Rosedale Pippin. TennBX-1. Syn. of Maloney											
Rosedale Pippin. A'91. Syn. of Rosedale											
Rose de Holland. D. Syn. of Holland Rose											
Rose de la Benauge. D. Syn. of Holland Rose											
Rose Lady. L. Syns. Api Gros Pomme de Rose, Rose-Colored Lady Apple.	Fr	r	m	pyb	fj	yw	sa		d	vl	
Rosemarin. HuC	Ger	oboblc	l	yr	fc	w	a				
Rosemary. D. Syn. Rosemary Russet	Eng.?	rc	m	grru	fr	y	sa	g	dk	l	From Ronalds.
Rosemary Russet. D. Syn. of Rosemary											
Rosenhager. MHSC'86. Syns. Gov. list No. 569, Slender Rose	Rus	obc	l	rs	fcj	w	sa	g		l	
Rose Red. RNY'71	N. Y.	rob	m	wrs	fvtj	y	sa	vg	d	m	
Rose Tendre. D. Syn. of Holland Rose											
Roshdestvenskoe. Gb. Syn. of Christmas											
Rosinkruger. MagofH'53											Not described.
Rosovka. Gb. Syn. of Rosy											
Rosovoe. Gb. Syn. of Rosy											
Rosowoe. Gb. Syn. of Rosy											
Rospisnoe. Gb. Syn. of Painted											
Ross (Ky.). L. Syn. Ross of Ky											Do.
Ross (Wis.). P'93	Wis	obc	m	yb	f	y	sa	g		vl	
Rosseau. NAPC'49. [Reported as very hardy in Wisconsin.]											Do.
Rosseau (incorrectly). D. Syn. of Red Autumn											
Ross Green. MagofH'53. Syn. Ross' Green	Va	ob		y			sa				
Ross' Green. W. Syn. of Ross Green											
Ross Greening. D. Syn. of Virginia Greening											
Ross No. 1. Cat											
Ross No. 2. Cat											
Ross Nonpareil. GenF'33. Syns. Nonpareil, Ross' Nonpareil, Spice Russet.	Ire	robe	ms	yru	t	gw	ma	vg-b	d	m	
Ross' Nonpareil. H. Syn. of Ross Nonpareil											
Ross of Ky. Cat. Syn. of Ross (Ky.)											
Rostocker. GenF'33. Syns. Annaberger, Berliner Glassapfel, Bodickheimer, Matapfel, Rothe Hernapfel, Rothe Stettiner, Stetting Rouge.	Ger	ob	l	yb					k	vl	From Hogg.
Rosy. Gb. Syns. Gov. list No. 274, Rosovka, Rosovoe, Rosowoe, V. R. S. to Ia. No. 11.	Rus										Not described.
Rosy Aport. Gb. Syns. Aport rosovoe, Aport rosovui, Aport Rosowui, Gov. list No. 269, O'Porto Rosy, shro. to Ia. No. 90.	Rus										Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Rosy Genet. WVaB75											Not described.
Rosy Little Turnip. Gb. Syn. of Rosy Repka											
Rosy Red. IndH'63	N. Y.? Ind.?	robe	m	yrs		ys	bsa	g	d	ml	Warder's and Downing's descriptions disagree.
Rosy Repka. Gb. Syns. Gov. list No. 200, Repka Rosowaja, Riepka rosavaya, Rosy Little Turnip.	Rus		l				sa	g	m	m	
Rosy Voronesh. Gb. Syns. Rgl. to Ia. No. 1277, Voronesh Rosy, Voroneshskui rosovui.	Rus		l	y			sa	vg	d	l	
Rothe Hernapfel. D. Syn. of Rostocker											
Rother Ananas. D. Syn. of Ananas											
Rother Anasapfel. Gb. Syn. of Red Pine											
Rother Arkad. Gb. Syn. of Red Arcad											
Rother Astrakan. D. Syn. of Red Astrachan											
Rother August Apfel. D. Syn. of August Red											
Rother Elserapfel. MHSC'86	Ger		m	yr			msa		k	vl	
Rother Esk. MichB31											Not described.
Rothe Reinette. Gb. Syn. of Red Reinette											
Rother Herbststrichapfel. D. Syn. of Early Autumn											
Rother Herbstcalville. MoH'67. Syn. of Herbstcalville											
Rother jungfern. Gb. Syn. of Red Jungfern											
Rother serinkia. Gb. Syn. of Red Serinkia											
Rother Sommer Calville. D. Syn. of Summer Calville											
Rother Stettiner. SDB76. Syn. of Red Stettiner											
Rother Taubenapfel. D. Syn. of Pigeon											
Rother Weinapfel. Gb. Syn. of Red Wine											
Rother Winter Taubenapfel. Gb. Syn. of Red Pigeon											
Rothe Sommer pass pomm. D. Syn. of August Red											
Rothe Stettiner. D. Syn. of Rostocker											
Rotstrahliger Konig. Gb. Syn. of King Stripe											
Rouen. L. Syn. Pigeonette de Rouen	Eur	oble	l	pyrs	t	w	sa	g		l	From Annals of Pomology.
Rouen Pigeon. L. Syn. Pigeon de Rouen	Eur	o	m								
Rough and Ready. GenF'50. Syn. of Primate											
Roundaway. R. Syn. Roundaway Magnum Bonum											Not described,
Roundaway Magnum Bonum. BBL. Syn. of Roundaway											Do.
Round Borsdorf. Gb. Syns. Borsdorfer runder, Rgl. to Ia. No. 356	Rus										
Round Cathead. E. Syn. of Catshead											
Round Top. C. Syn. of Eggtop											
Round Wassen. A'87. Syn. of Wassen											
Round Waxen Arcade. Gb. Syn. of Waxen Arcad											
Round White. Gb. Syn. of White Skrute											

Round Winter. L. Syn. Round Winter Nonsuch	Eur.?	rob	l	gyrs	tj	gw	s			l	From Hogg.
Round Winter Nonsuch. D. Syn. of Round Winter											
Rowe. D. Syn. Rowe's Seedling	Eng	re	l	g	j	gw	p		k	me	From Ronalds.
Rowe's Seedling. D. Syn. of Rowe											
Rowland. D. Syn. of Rolen											
Rowland Keeper. MagofH'53											Not described.
Rowland Red. R. Syn. Rowland's Red Streak											Do.
Rowland's Red Streak. Magof H'50. Syn. of Rowland Red											
Roxanna. WisHort'98	Wis	c	m	yes	f	w	sa	vg		l	
Roxbury. (LC). Syns. Belpre Russet, Boston Russet, Howe's Russet, Marietta Russet, Putnam Russet, Putnam's Russet, Reinette Rousse de Boston, Roxbury Russet, Roxbury Russeting, Russet Golden, Sylvan Russet, Warner Russet.	Mass	rob	ml	yru	mj	gw	ra	g-vg	km	vl	
Roxbury Russet. GenF'32. Syn. of Roxbury											
Roxbury Russeting. Th. Syn. of Roxbury											
Roxbury Sweet. MagofH'38											Do.
Royal. Gb. Syns. Gov. list No. 208, Korolenskoe, Korolewskoe, Shro. to Ia. No. 45.	Rus										Do.
Royal Codlin. H. Syn. of Codlin											
Royal George. S&W											Do.
Royale. D. Syn. of Konig											
Royale d'Angleterre. D. Syn. of Herefordshire											
Royal Grise Reinette. D. Syn. of Royal Reinette											
Royal Janette. A'95. Syn. of Ralls											
Royal Jubilee. BBL											Do.
Royal June. A'75											Do.
Royal Limbertwig. Hort'68	N.C.	ob	ml	gyr		y	psa	g-vg	dk	vl	
Royal Limbertwig. Cat. Syn. of Goosepen											Do.
Royal Milding. GenF'33											
Royal Pearmain. W	Ohio	r	l	y			sa	vg		l	
Royal Pearmain. C. Syn. of Merrit Pearmain											
Royal Pearmain. D. Syn. of Pound Cake											
Royal Pearmain. Syn. of Summer Pearmain											
Royal Pearmain. H. Syn. of Watson											
Royal Pearmain (of some). GenF'33. Syn. of Herefordshire											
Royal Pippin. W	Va	r	l	y			s	g		me	
Royal Pippin (of Ill.). D. Syn. of Baltimore											
Royal Pippin. D. Syn. of Carter											
Royal Pippin. W. Syn. of Day											
Royal Red. W	Ill	c	m	rs			sa	g		m	Royal Red of Hort.'73, 120 may be Rome.
Royal Red. MoH'67. Syn. of Rome											
Royal Red of Kentucky. Dap. Syn. of Winesap											
Royal Reinette. D. Syn. Royal Grise Reinette	Eng	c	ms	yrs	fj	yw	bsa			vl	From Lindley.
Royal Russet. C. Syns. Leather Coat, Leather Coat Russet, Old Royal Russet, Passe Pomme de Canada, Reinette de Canada Grise, Reinette de Canada Platte, Royal Russiting.		robc	m	ygru	fr	gw	a	g		ml	
Royal Russeting. DomEnc. Syn. of Royal Russet											
Royal Shepherd. D	Eng.?	rob	ml	gyb	c	gw	bpa		k	m	From Hogg.
Royal Somerset. D	Eng.?	rob	m	pyrs	tj	y	psa		k	ml	Do.
Royal Somerset. GenF'33. Syn. of London Pippin											
Royal Sweet. MagofH'53			l				s	g			

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Royal Table. MHSC'86. Syns. Furstlicher tafelapfel, Shro. to Ia. No. 5	Rus	c	l	rs			sa	vg		l	
Rshev Miron. L. Syns. Miron rshevski, Rschev's Miron, Shro. to Ia. No. 120	Rus										Not described.
Rschev's Miron. Gb. Syn. of Rshev Miron											
Rubets. MHSC'86. Syns. Cut Apple, Gov. list No. 204, Rubez, Shro. to Ia. No. 148.	Rus										Do.
Rubets bielui. Gb. Syn. of White Rubets											
Rubets rebristui nalivnoi. Gb. Syn. of Juicy Ribbed											
Rubets vinogradnui. Gb. Syn. of Wine Rubets											
Rubets Zelnui. Gb. Syn. of Green Rubets											
Rubez. Gb. Syn. of Rubets											
Rubez Belui. Gb. Syn. of White Rubets											
Rubez Selonnin. Gb. Syn. of Green Rubets											
Rubez vinogradnui. Gb. Syn. of Wine Rubets											
Rubicon. Hort'69	Mich	r	ml	yrc	fj	y	sa	vg	dm	l	May be same as Pawpaw.
Rubicon. D. Syn. of Pawpaw											
Ruby Gem. JTI			m	r	tj		sa	vg		me	
Ruck. R. Syn. Ruck Late Nonsuch											Not described.
Ruck Late Nonsuch. BBL. Syn. of Ruck											
Rucker. R. Syn. Rucker's Orange Pippin											Do.
Rucker's Orange Pippin. FDNCo. Syn. of Rucker											
Ruckman. L. Syns. Golden Pearmain, Ruckman's, Ruckman's Pearmain.	N. C	r	m	rs			sa	g		vl	
Ruckman's. W. Syn. of Ruckman											
Ruckman's Pearmain. DomEnc. Syn. of Golden Pearmain											
Ruckman's Pearmain. Th. Syn. of Ruckman											
Ruckman's Red. D. Syn. of Nickajack											
Ruddy. R. Syn. Ruddy Greening											Do.
Ruddy Greening. MagofH'38. Syn. of Ruddy											
Rudolph. R. Syns. Crown Prince Rudolph of Austria, Prince Imperial Rudolph.		ob	ml	gr	fj	y	sa	g		me	
Rue. L. Syn. Rue's Reliance	N. C									me	
Ruedy. R. Syn. Ruedy Seedling											Do.
Ruedy Seedling. BBL. Syn. of Ruedy											
Rue's Reliance. JVL. Syn. of Rue											
Ruggles. MagofH'35. Syn. Ruggles' Queening											Do.
Ruggles' Queening. MagofH'42. Syn. of Ruggles											
Rukinskoe krasnoe. Gb. Syn. of Red Rukin											
Rule. L. Syns. Rule's Summer Sweet, Rule's Summer Sweeting	Pa	obl	m	y				p		me	Transactions Amer. Pom. Society.
Rule's Summer Sweet. A'52. Syn. of Rule											

Rule's Summer Sweeting. E. Syn. of Rule											
Rum. L. Syn. Rum Apple	Vt	ob	m	ybc	tj	w	sa	g		l	
Rum Apple. W. Syn. of Rum											
Runnells. D. Syns. Runnels, Rock Apple	Me	r	m	gb	f			g	m	vl	Maine Pomological Report.
Runnels. T. Syn. of Runnells											
Running. L. Syns. Running Apple, Texas Dwarf											Not described.
Running Apple. Cat. Syn. of Running											
Ruscine. MagofH'53											Do.
Rushford. WisHort'01. Syn. of Parmetta											
Rushock. L. Syns. Charles Pearmain, Rushock Pearmain	Eng	r	ms	yeru	fcj	y	bsa			l	From Hogg.
Rushock Pearmain. D. Syn. of Rushock											
Rush. MagofH'53											Not described.
Russam. E. Syn. of Long Red											
Russell. A'91	Me.? Ont.?	robl	m	yr	tmj	w	sa	vg	d	e	
Russet. Cat	N. Y										Do.
Russet Coated Nonpareil. GenF'33. Syn. of Nonpareil Russet											
Russet Golden. D. Syn. of Golden Russet (N. Y.)											
Russet Golden. D. Syn. of Golden Russet (Eng.)											
Russet Golden. Cat. Syn. of Roxbury											
Russet Golden Pippin. D. Syn. of Golden Pippin (Eng.)											
Russet Greening. IllB45		ob	l	g			sa	vg			
Russeting. IllB45											Do.
Russet Milam. L. Syn. Rusticoat Milam		re	m	rru			sa	g		l	
Russet Nonpareil. D. Syn. of Pitmaston Nonpareil											
Russet Pearmain (Ct.). Lin	Conn	re	m	yb		y	brsa	g		l	
Russet Pearmain (?). W	(?)	r	m	ru			sa	g		l	
Russet Pearmain. Dap. Syn. of Hunt Russet											
Russet Seek-no-further. MagofH'49. Syn. of Westfield											
Russet Sweet. GenF'32											Do.
Russet Table. L. Syn. Russet Table Pearmain	Eng	re	s	ygru	fr	y	sa	vg	d	l	From Ronalds.
Russet Table Pearmain. D. Syn. of Russet Table											
Russian. E. Syn. of Court-Pendu Plat											
Russian. MoB6. Syn. of McAfee											
Russian Astrachan. IaB'90	Rus		ml	rs						e l	Claimed by Professor Budd to differ from Red Astrachan.
Russian Baldwin. P'95	Rus	rob	ml	grsc	fj	yw	sa	vg	dkm		
Russian Calville. Gb. Syns. Kalvil Ruskui, V. R. S. to Ia. No. 19	Rus										Not described.
Russian Crab. N. Syn. of Tetofski											
Russian Emperor. Lin. Syn. of Alexander											
Russian Gravenstein. MHSC'86. Syns. Gov. list No. 105, Grafensteiner, Grafensteiner Russicher, Russicher Grafensteiner, Shro. to Ia. No. 135.	Rus		m	rs			sa	vg		m	
Russian Green. Gb. Syn. of Green Butskaya											
Russian Hagloe. Dap. Syn. of Summer Hagloe											
Russian Ice Apple. K. Syn. of White Astrachan											
Russian Monarch. IndH'89											Do.
Russian Pippin. PN											Do.
Russian Rambour Queen. Gb. Syn. of Rambour Reinette											
Russian Sweet. Cat											Do.
Russian Transparent. D	Rus.?	re	l	yb			s	g	k	ml	
Russian Transparent. DrHS. Syn. of Yellow Transparent											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Russian Tyrol. CanExR'01											Not described.
Russicher Grafensteiner. Gb. Syn. of Russian Gravenstein											Do.
Russine. D. Syn. of Rhode Island											
Russische Rambour Reinette. Gb. Syn. of Rambour Reinette											
Russkui Ramburovine renet. Gb. Syn. of Rambour Reinette											
Rusticoat Milam. W. Syn. of Russet Milam											
Rustycoat. ArkB21			m						g		May be identical with Milam.
Rusty Coat Milam. D. Syn. of Milam											
Rusty Core. D. Syn. of Ohio Nonpareil											
Rutherford. ArkB49	Ark	obl	l	gyb	f	y	sa	g		l	
Rutledge. TVM	Texas		l	rs				vg		l	
Rutman. R. Syn. Rutman's Green											Not described.
Rutman's Green. MichB31. Syn. of Rutman											
Ryerson. Dap. Syn. of Primate											
Rymer. GenF'33. Syns. Caldwell, Cordwall, Green Cossings, Newbold's Admiral Duncan, Newbold's Duke of York.	Eur	rob	m	pyb	ft	y	sa	g		vl	
Sabaaka. AlaB98. [May be same as Sabadka.]											Do.
Sabadka. (LC). [Probably identical with preceding.]	Eur										Do.
Sabadkia Sertchika. WashB26											Do.
Sabaros. AndN			m	y	fc			vg		l	
Sable. L. Syn. Sable Sweet	Vt	robe	m	wyrs	tj	w	s	g		me	
Sable Sweet. D. Syn. of Sable											
Saburouskoe. Gb. Syn. of Aloe											
Saccharine. Gb. Syn. of Zakoritnoe											
Saccharine Pipka. Gb. Syn. of Sweet Pipka											
Sacharnoe. Gb. Syn. of Sugar Sweet											
Sacharnoe jeltoe. Gb. Syn. of Yellow Sugar											
Sachaiswan. Gb. Syn. of Saxonian (?)											
Sack and Sugar. Hort'47. Syn. Morris' Sack and Sugar	Eng	rc	s	py	j	w	s	g		me	
Sack Apple. GenF'33. Syn. of Quarrenden											
Sadovskoe. Gb. Syn. of Garden											
Sadowskoe. Gb. Syn. of Garden											
Safforth. Cat	Wis.?										Do.
Safstaholm. MHSC'86	Swed	rc	m	gwrs	jf	w	sa	g		e	Origin, Sweden. From F. J. Peterson, Waconia, Minn.
Saillie Sweet. Dap. Syn. of Red and Green											
Sailly. L. Syns. Sailly Autumn, Salle	N. Y	robe	m	gyb	vt		sa	g		me	
Sailly Autumn. Syn. of Sailly											
St. Antoine. MagofH'39. Syn. St. Antoine Hall	Que		l	dr				g	k	vl	

St. Antoine Hall. MagofH'51. Syn. of St. Antoine											
St. Edmunds. R. Syn. St. Edmunds Pippin											Not described.
St. Edmunds Pippin. BBL. Syn. of St. Edmunds											
St. Hilaire. BBL. [Possibly same as Hilaire.]											Do.
St. Hilaire. Dap. Syn. of Hilaire											
Saint James. MHSC'86	Can.	obl	ml	yrru	ftj	y	sa				
St. Joe. R. Syn. St. Joe Seedling	Mo	r		rs			sa		dm	ml	
St. Joe Seedling. AHortA'69. Syn. of St. Joe											
Saint Johnsbury. Bul8. Syn. Saint Johnsbury Sweet	Vt	rob	m	yrs	ej	y	s	vg	dkm	l	
Saint Johnsbury Sweet. MeExR'93. Syn. of Saint Johnsbury											
St. John's Nonpareil. D. Syn. of Pitmaston Nonpareil											
St. John Strawberry. Dap. Syn. of Early Strawberry											
Saint Julian. D. Syn. of Saint Julien											
Saint Julien. D. Syns. Concombre des Chartreaux, De Saint Julien, Heilige Julian's Apfel, Pomme de Saint Julien, Saint Julian, Seigneur d'Orsay.	For.?	rc	m	ywgb	fr	yw	s			ml	From Lindley.
St. Lambert. L. Syn. Reinette St. Lambert	Belg.?	rob	ml	yrcp	fj	yw	p			m	From Annals of Pomology.
St. Lawrence. MagofH'39. Syns. Corse's St. Lawrence, Fall St. Lawrence, Montreal, Saint Lawrence, York and Lancaster.	Can.?	obc	l	yrsc	cjt	ws	sa	g-vg	dm	m	
Saint Lawrence. W. Syn. of St. Lawrence											
St. Louis. BBL											Not described.
St. Louis Ortley. W	Mo	obl	l	y			sa	g		l	Perhaps not distinct from Ortley.
St. Mary's Pippin. GenF'33. Syn. of Downton											
St. Peter. A'81											Not described.
St. Peters. Gb. Syn. of Petrovskoe											
St. Petersburg. MagofH'41											Do.
Saint Sauveur. D. Syn. of Sauveur											
St. Valery. AmGar'90											Do.
St. Vrain. ColB17											Do.
Saitchia pipka. Gb. Syn. of Hare Pipka											
Saitschia Pipka. Gb. Syn. of Hare Pipka											
Sakaritnoe. Gb. Syn. of Zakoritnoe											
Saksonskoe. Gb. Syn. of Saxonian											
Salem. A'77. [Thought to be identical with Buckingham.]											Do.
Salem. D. Syn. of Salem Sweet											
Salem Seedling. W		c		rs			sa				
Salem Sweet. D. Syn. Salem	Mass.	robc	ml	yb	ct	y	s	g		m	
Salina. MagofH'50											Do.
Salisbury. L. Syn. Salisbury Pippin											Do.
Salisbury Pippin. Cat. Syn. of Salisbury											
Salle (?). D. Syn. of Sailly											
Sallie Sweet. R. Syn. Sallie's Sweet		rc	s	rs			s	g		ml	
Sallie's Sweet. IllB15. Syn. of Sallie Sweet											
Sally. L. Syn. Aunt Sally			ml	y	t		sa			ml	
Sally Gray. GO. Syn. Sally Grey	Ky.?	ob	m	r	j		sa			mc	
Sally Grey. A'79. Syn. of Sally Gray											
Salman. R. Syn. Salman's Sweet											Do.
Salman's Sweet. WVaB75. Syn. of Salman											
Saloine. OreB22											Do.
Salome. IllH'78	Ill	rc	m	pyrs	ftj	wy	sa	vg	dkm	vl	
Salopian. L. Syn. Salopian Pippin	Eng	ob	m	ygb	j	w			k	m	From Ronalds.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Salopian Pippin. D. Syn. of Salopian											
Sambor. BBL											Not described.
Sam's Crab. GenF'33. Syn. of Longville											
Sam Kuehn. R. Syn. Sam Kuehn Sweet											Do.
Sam Kuehn Sweet. BBL. Syn. of Sam Kuehn											
Sampson. Cat											Do.
Sam. Rawling's. D. Syn. of Hoary Morning											
Samtouchee. IllB45. [Probably same as Santauchee.]											Do.
Sam Wingard. D. Syn. of Mangum											
Sam Young. GenF'33. Syn. of Young											
San Antonio. A'81											Do.
Sanborn. JVC											Do.
Sandbrook. JWK			m	rs				vg		e	
Sanders. R. Syns. Sanders' June, Saunders' June											Do.
Sanders' June. IndF'40. Syn. of Sanders											
Sanderson. Dap. Syn. Saunderson	Miss	robl	ml	wrs	tj	ws	psa			me	
Sandle. BBL											Do.
Sandringham. BBL											Do.
Sandwich. Cat											Do.
Sandy Glass. MHSC'86. Syns. Glassy Sand, Gov. list No. 597, Pesolschnaja Steklianka, Pesotchnoe Steklianovoe, Shro. to Ia. No. 24, Steklianka pesotchnaya.	Rus	rob	l	y	j	w	sa	vg	dm	l	
Saner. R. Syn. Saner's Sweet											Do.
Saner's Sweet. MagofH'53. Syn. of Saner											
Sangamon. R. Syns. Herndon's Seedling, Sangamon Red Streak	N. C										Do.
Sangamon Red Streak. MoH'70. Syn. of Sangamon											
Sanguinale. D. Syn. of Red Calville											
Sanguineus. D. Syn. of Fameuse											
Sankermanky. NYB15											Do.
Santa. W	South Ga.?	obl		y			sa				
Santa Clara King. A. Syn. of Skinner											
Santauchee. Hort'58. Syns. Panther, Wildcat	N. C	rc	l	w	etj	w	sa	g		ml	
Sapron. GenF'?3		robl	m	r				g	dk	m	
Sapson. K. Syn. Sapsonvine		r	s	rse	cj	ws	psa	g	d	me	
Sapson. E. Syn. of Sops of Wine											
Sapsonvine. · K, Syn. of Sapson											
Sarah. A'73	Me	obe	l-vl	yrs	etj	w	bsa		km	m	
Sarchett. MagofH'53											Do.
Sargent. R. Syn. Sargent's Late Red	N. H							g		l	

Sargent's Late Red. RNY'71. Syn. of Sargent											
Sartha. L. Syns. Pomme d'Argent, Pomme de Jaune, Pomme de Jaune de la Sartha, Sartha's Yellow.	Fr	r	ms	y	fcj	yw	sa				From Annals of Pomology.
Sartha's Yellow. D. Syn. of Sartha											
Sary Synap. IndH'87. Syn. of Persian											
Sassafras. L. Syn. Sassafras Sweet	Va.?									me	This may prove to be Haskell.
Sassafras Sweet. Cole. Syn. of Haskell											
Sassafras Sweet. Wg. Syn. of Sassafras											
Sauce. L. Syns. Queen, Queen of Sauce	Eng.?	ob	l	gyrs	fcj	y	sa	g	k	ml	From Hogg.
Sauer Grauech. MoH'87. Syn. of Grauech											
Saunders. L. Syn. Saunders Winter Sweet											Not described.
Saunders' June. IndF'40. Syn. of Sanders											
Saunderson. A'77. Syn. of Sanderson											
Saunders Winter Sweet. Cat. Syn. of Saunders											
Saunkernaty. McB96	Rus.		s	g				g		l	
Santa. Dnp	Ga	ob	ml	py	tj	wy	sa	g		vl	Santa and Santa probably identical.
Sauveur. L. Syns. Calville Saint Sauveur, Pomme Saint Sauveur, Saint Sauveur.	Fr	roble	l	yb	tj	w	a	g		m	From Annals of Pomology.
Savage. L. Syn. Savage's Cheese	Ga	ob	m	yrs	j	w				m	
Savage's Cheese. D. Syn. of Savage											
Savewell. D. Syns. Cornell's Savewell, Putnam's Savewell	N. Y	robe	m	pyb	etj	y	sa	g		l	
Savoy. JVC. Syn. Hall's No. 3											Not described.
Sawyer. AJofH11	Ill	c	m	ybc	tj	y	bsa	g		vl	From Amer. Journal of Horticulture.
Sawyer Sweet. D. Syns. Sawyer Sweeting, Sawyer's Sweeting			l	gb		w	s	g		m	
Sawyer Sweet. A'73. Syn. of Golden Sweet											
Sawyer Sweeting. K. Syn. of Sawyer Sweet											
Sawyer's Sweeting. Lin. Syn. of Sawyer Sweet											
Saxon. A'79											Not described.
Saxonian (?). Gb. Syns. Gov. list No. 437, Sachoiswan, Saksonskoe	Rus.	robe	ml	yrs		w	a		k	me	
Saxon Priest. AlnB98											Do.
Saxton. Dnp. Syn. Fall Stripe	Mass. or Conn.	rob	m	yrs	etj	y	sa	g-vg		me	Saxton and Fall Stripe probably identical.
Saxton. T. Syn. of Fall Stripe											
Sayler. BBL. [Probably same as Ned]											Not described.
Saylor. D. Syn. of Ned											
Scalloped Gilliflower. GenF'33. Syn. of Scollop Gilliflower											
Scandiana Mala. E. Syn. of Fort Miama											
Scarlet Bough. R. Syn. Early Scarlet Bough											Do.
Scarlet Cranberry. MichB169. Syn. Robnett	Va.?	ob	ml	rs			sa	g		l	
Scarlet Crofton. D. Syn. Red Crofton	Ire	ob	m	yrru	fc		rs			m	From Lindley.
Scarlet Golden Pippin. K. Syn. of Scarlet Pippin (Eng.)											
Scarlet Leadington. D	Scot	re	ml	yrs	fcj	ys	sa			ml	From Hogg.
Scarlet Nonpareil (Eng.?). NEF'32. Syn. New Scarlet Nonpareil	Eng.?	robe	m	wrs	fj	yw	sa	vg	d	m	
Scarlet Nonpareil (Ohio)	Ohio	obe	s	rs			sa	g		e	
Scarlet Pearmain. GarCal. Syns. Bell's Sarlet Pearmain, Oxford Peach, Sigler's Red?	Eng	c	m	yrsc	cj	ws	sa	vg	d	me	
Scarlet Pearmain (incorrectly). E. GenF'33. Syn. of Long Red											
Scarlet Perfume. Syn. of Cole											
Scarlet Pippin (Eng.). L. Syn. Scarlet Golden Pippin	Eng									vl	Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Scarlet Pippin (Ont.). CanB37	Ont	ob	m	yrsc	t	w	rsa	g		ml	
Scarlet Queening. D. Syn. of Crimson Queen											
Scarlet Strawberry. A'97											Not described.
Scarlet Sweet. W. Syn. Scarlet Sweeting	Ohio	robc	m	yrsc	tj	yw	ps	g-vg	km	ml	
Scarlet Sweeting. H. Syn. of Scarlet Sweet											
Scarlet Tiffing. D	Eng	rob	ml	pyb	tcj	w	pa			m	From Hogg.
Scented. Gb. Syns. Duchovoe, Duchowoe, Gov. list No. 264, Smelling	Rus										Not described.
Scented White. Gb. Syns. Biel duchovoya, Shro. to Ia. No. 136	Rus										Do.
Schaeffer. Dap. Syn. of Shaffer											
Schaeffer Early. BBL. Syn. of Shaffer											
Schaffer. A'81. Syns. Schaffer's Early, Schaffer's Early Red, Schaffer's Garden.	Pa	obc	m	pyrs	tj	w	psa	g-vg		mc	Schaffer and Shaffer may be identical.
Schaffer's Early. GarM'59. Syn. of Schaffer											
Schaffer's Early Red. D. Syn. of Schaffer											
Schaffer's Garden. D. Syn. of Schaffer											
Schafnase. Gb. Syn. of Sheepnose											
Schapotchka. Gb. Syn. of Little Hat											
Schapotschka. Gb. Syn. of Little Hat											
Scharik kremera. Gb											
Scharlottenthaler Golba. A'83. Syn. of Thaler											
Schelkorka. Gb. Syn. of Silken											
Schell. GarM'39	Va		l	y	vj	y		vg		mc	
Schirokolitchiks. Gb. Syn. of Broadcheek											
Schlanka. R. Syn. Schlanka Bog											Not described.
Schlanka Bog. IllH'02. Syn. of Schlanka											
Scholkowka. Gb. Syn. of Silken											
Scholti Arkad. Gb. Syn. of Yellow Arcad											
Scholtinaliw. Gb. Syn. of Yellow Naliv											
Scholtoe Sladkoe. Gb. Syn. of Yellow Sweet											
Schoolfield. Hort'73. Syn. Schoonfield	{Ark.? Tenn.?}									l	Do.
Schoolmocker. Syn. of Schoonmaker											
Schoolmaster. BBL											Do.
Schoonfield. MoH'73. Syn. of Schoolfield											
Schoonmaker. D. Syn. Schoolmocker		rob	l	yb	c	yw	bsa	g-vg		l	
Schreveton. L. Syn. Schreveton Golden Pippin	Eng	r	s	yru	tc	y		g		vl	
Schreveton Golden Pippin. D. Syn. of Schreveton											
Schrivkolitschiko. Gb. Syn. of Broadcheek											
Schroder. R. Syn. Schroder's Black		ob	ms	grs			sa	g		vl	
Schroder's Black. IllB45. Syn. of Schroder											

Schroeder. SDB76. Syns. Tuttle's Charlamoff, Upright Charlamoff	Rus	rob	l	drs	j	w	a	g	.....	me	Apparently distinct from Schroder.
Schull. FDNCo											Not described.
Schuyler. L. Syn. Schuyler's Sweet	N. Y	rob	l	py	tmj	w	s	g-vg	.....	m	
Schuyler's Sweet. A'71. Syn. of Schuyler											
Schwitzer Apple. D. Syn. of Pittsburg											
Scioto. L. Syn. Scioto Beauty	Ohio	ro	ms	wyrs	tj	w	psa	g	.....	vl	
Scioto Beauty. D. Syn. of Scioto											
Selenka Sladkaya. Gb. Syn. of Green Sweet											
Selonne. Gb. Syn. of Zelenka											
Scolloped Gilliflower. D. Syn. of Scollop Gilliflower											
Scollop Gilliflower. D. Syns. Five Quartered Gilliflower, Gilliflower Scolloped, Jellyflower, Red Gilliflower (erroneously), Ribbed Gilliflower, Scalloped Gilliflower, Scolloped Gilliflower, Striped Gilliflower.	Eur. ?	re	ml	pyrs	ftj	y	sa	g	k	ml	
Scollop Gilliflower (incorrectly). Dap. Syn. of Striped Gilliflower											
Scotch Harvest. CGen'61											
Scotch Bridget. D. Syn. of Bridget											
Scotch Red. P'93	N. C	robl	m	r	c	w	s	g	dm	me	
Scotch Virgin. D. Syn. of Virgin											
Scott. L. Syn. Scott's Best	N. Y	rob	ml	yrs	ftj	w	sa	g-vg	.....	m	
Scott. D. Syn. of Baker											
Scott. D. Syn. of Primate											
Scott's Best. D. Syn. of Scott											
Scott Cluster. R. Syn. Scott's Cluster											
Scott's Cluster. SCExR'98. Syn. of Scott Cluster											Do.
Scott Winter. (LC). Syns. Scott's Winter, Wilcox's Winter	Vt	re	m	rs	.....	.....	a	g	mk	vl	Possibly another apple with same name.
Scott's Winter. MHSc'77. Syn. of Scott Winter											
Scribner. L. Syn. Scribner Spitzenburgh	N. Y	re	m	pyrs	etj	wy	sa	g-vg	.....	l	
Scribner Spitzenburgh. AmF'59. Syn. of Scribner											
Scrinka. Gb. Syn. of Scrinkia											
Scrivener. L. Syn. Scrivener's Red		roble	m	rs	j	.....	r	.....	c	m	
Scrivener's Red. C. Syn. of Scrivener											
Scudamous's Crab. MagofH'37. Syn. of Redstreak											
Scudamous Crab. E. Syn. of Redstreak											
Scullins. R. Syn. Scullins Summer	N. J	.....	s	rs	.....	.....	.....	vg	dk	me	
Scullins Summer. AmGar'88. Syn. of Scullins											
Seaconk. L. Syn. Seaconk Sweet	Conn	roble	m	rs	c	w	s	g	.....	vl	
Seaconk Sweet. D. Syn. of Seaconk											
Seaford. P'95	Del	r	m	yrsc	fj	gy	rsa	vg	.....	l	
Seager (Pa.). T	Pa	obc	m	pyrs	tj	w	rsa	g-vg	.....	me	Perhaps identical with Seager of N. J.?
Seager (N. J.?). A'60	N. J. ?	re	l	yrsc	fjt	yw	sa	g-vg	dk	me	Do.
Seager. D. Syn. of Townsend											
Seago. D. Syn. of Mangum											
Seal. P'95	Ind	rob	m	yrsc	ftj	y	msa	vg	.....	l	
Seaman. L. Syn. Seaman's Sweet	N. Y	rob	m	wrs	j	w	s	g	k	m	
Seaman's Sweet. D. Syn. of Seaman											
Seaver. W. Syns. Can of Coxe (Probably of Cole), Grafton Sweet, Seaver Sweet, Winter Sweeting.	Ohio	roble	m	yb	tj	y	s	g	.....	ml	Perhaps two distinct varieties.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Seavers. A'91	Iowa?							g	m	vl	Probably differs from Seaver, of Warder.
Seaver Sweet. NEF'26. Syn. of Seaver											
Secrist. L. Syn. Secrist's	Ind	ob	l	y			s	vg		l	
Secrist's. W. Syn. of Secrist											
Sedgwick. RNY'71	Ind.?	rob	l	yrs	cjt	y	sa	vg			
Seedless (Vt.). D	Vt	obr	ms	gyb		w	msa	g		m	
Seedless (Va.). AmGar'90. Syn. Seedless Apple	Va		m				sa	g		l	
Seedless Apple. TVM. Syn. of Seedless (Va.)											
Seedless and Coreless. Cat											Not described.
Seedling, Baxter's Red. BBL											
Seedling, Baxter's Yellow. BBL											
Seedling from I. F. Fay. MagofH'52. Syn. of Fay (Seedling)											
Seedling from N. A. Haven. MagofH'52. Syn. of Ledge											
Seedling from A. A. Mullett. H. Syn. of Mullett											
Seedling Gilpin. W. Syn. of Gilpin (Seedling)											
Seedling Janet. W. Syn. of Janet Seedling											
Seedling Neverfail. W. Syn. of Neverfail Seedling											
Seedling of Kinnard. BBL											
Seedling of Stark. BBL											
Seedling Paul. W											
Seedling, Pomme d'Api. A'73	Va	ob	m	yr		yw		vg-b	d	l	
Seed of Red Apple. BBL											
Seedling Rambo. AHortA'70. Syn. of Campbell											
Seedsville Sweet. D. Syn. of Yankee Spy											
Seek-no-further. MagofH'49. Syn. of Keiser											
Seek-no-further. C. Syn. of Rambo											
Seek-no-further. C. Syn. of Westfield											
Seeknofurther, New England Red. Lin. Syn. of Westfield											
Seek-no-further of Autumn. K. Syn. of Watson											
Seeknofurther of Coxe. D. Syn. of Green Seeknofurther											
Seek-no-further (of some). D. Syn. of Vanderspiegel											
Seeknofurther (of some erroneously). E. Syn. of Cooper											
Seek-no-further-Westchester. W. Syn. of Ferris (N. Y.)											
Seek-no-further-Westfield. W. Syn. of Westfield											
Seek-no-further White. H		ob	l	yw			sa	vg		m	
Seek-no-further Winter. GenF'33. Syn. of Fall Seeknofurther											
Seek-no-further White. H. Syn. of Green Seeknofurther											
Seever. E. Syns. Seevers, Seever's Redstreak, Seever's Seedling	Ohio	r	m	pyrs	j	y	sa	vg		m	Probably distinct from Seaver, of Warder.

Seevers. JW&S. Syn. of Seever											
Seever's Redstreak. E. Syn. of Seever											
Seever's Seedling. Hort'49. Syn. of Seever											
Seigneur d'Orsay. GenF'33. Syn. of Saint Julien											
Sekula. AlaB98											Not described.
Selby. L. Syn. Selby Bellflower		re	l	gy	tj	yw	sa	g		l	From Gardener's Monthly.
Selby Bellflower. GarM'60. Syn. of Selby											
Selma (Ohio). E	Ohio	rob	ml	yru		yw	bsa	vg		m	
Selma (Ala.). W	Ala	obl	l	rs			sa	vg		l	
Selma. D. Syn. of Bradford											
Selwood. L. Syn. Selwood's Reinette	Eng	rob	l	grs	t	gw	bpsa		k	l	From Hogg.
Selwood's Reinette. D. Syn. of Selwood											
Selymes. AlaB98											Not described.
Semper. RNY'70	N. Y	robe	m				sa			vl	
Senator. ArkB49. Syn. of Oliver											
Seneca. L. Syn. Seneca Favorite	N. Y.?										Do.
Seneca Favorite. MagofH'53. Syn. of Seneca											
Seneca Spice. D. Syn. of Quince (of Coxe)											
September. Wg. Syn. Pride of September	Pa	re	l	y	tj	y	sa	vg	d	m	
September Beauty. BBL											Do.
Sergeant. L. Syn. Sergeant's Sweet	Mass	r	m	pyb	t		vs		k	m	
Sergeant's Sweet. K. Syn. of Sergeant											
Serianka. Gb. Syn. of Serinkia											
Serinka. CanExR'01. [Probably same as Serinkia.]											Do.
Serinkia. MHSC'81. Syns. Gov. list No. 337, Grayest, Lehmapfel (Serianka), Serianka, Serinka. Shro. to Ia. No. 107.	Rus	rob	ml	pyrs	fj	w	sa	g		me	
Settin Pippin. D. Syn. of Dutch Mignonne											
Settle. L. Syns. Adams White, English Codlin (incorrectly), Gloucester White (incorrectly), Hex's White, Hick's White, Settle Pippin, Settle's Superb, Superb White.	Md.? Va.?	robe	m	rb	fetj	w	sa			m	
Settle Pippin. T. Syn. of Settle											
Settle's Superb. Dap. Syn. of Settle											
Seyler. P'95	Tenn	r	ml	wrse	mfj	y	sa	g		me	
Seyinka. IndH'87. [Probably same as Serinkia.]											Do.
Sewall. IndH'87. Syn. of Sewell											
Sewell. R. Syns. Sewall, Sewell's Favorite	Ala	obl	l	y	fm					e	
Sewell's Favorite. JIN. Syn. of Sewell											
Sexton. L. Syn. Sexton's Golden Seedling	Cal	rob	l	y			a		dk	m	
Sexton's Golden Seedling. Wn. Syn. of Sexton											
Seymore. A'77											Do.
Shabbona. JVC											Do.
Shackleford. IllH'83. Syn. Shackleford's Best	Mo	robl	l	yrs		y	sa	vg	km	vl	
Shackleford's Best. IllH'83. Syn. of Shackleford											
Shade. R. Syn. Shade's Winter											Do.
Shade's Winter. MichB31. Syn. of Shade											
Shaffer. Dap. Syns. Bender, Schneffer, Schaeffer Early, Shaffer's Garden, White King.	Pa	obe	ml	wyb	tj	w	sa	g	km	m	Schaffer and Shaffer probably identical.
Shaffer's Garden. Dap. Syn. of Shaffer											
Shaker. W. Syn. of Early Pennock											
Shaker Apple. Hort'51. Syn. of Early Pennock											
Shaker Greening. D. Syns. Hampshire Greening, Shaker Pippin	N. H	obe	m	gy	tej	y	bsa	g		vl	
Shaker Pippin. CanH'91. Syn. of Bethel											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Shaker Pippin. D. Syn. of Shaker Greening											
Shaker Red. IllH'69. [May be Shaker Redstreak.]											Not described.
Shaker Redstreak. W. Syn. Shaker Red Streak		c	l	rs			sa	g		m	
Shaker Red Streak. Hort'54. Syn. of Shaker Redstreak											
Shaker Summer. R. Syn. Shaker's Summer. [Possibly Early Pennock.]											Do.
Shaker's Summer. Hort'60. Syn. of Shaker Summer											
Shaker's Yellow. PFar'52. Syn. of Early Pennock											
Shakespeare. D	Eng	robe	m	gbs	fcj	gy	bsa		d	vl	
Shanasess. OreB22											Do.
Shanee. MoH'83											Do.
Shannon. Dap. Syns. Shannon Apple, Shannon Pippin	Ark.?	obc	l-vl	py	cj	y	msa	g		ml	Yet uncertain as to identity of this and Ohio Pippin.
Shannon. IllB45. Syn. of Grindstone											
Shannon. D. Syn. of Ohio Pippin											
Shannon Apple. CAG. Syn. of Shannon											
Shannon Improved. SBro		obc	l	y						l	Name objectionable.
Shannon Pippin. Dap. Syn. of Shannon											
Sharke. L. Syn. Sharke's Greening		c		yg			sa				
Sharke's Greening. W. Syn. of Sharke											
Sharp. NYExR'93. Syns. Sharp Apple, Sharpe's Sweet		obobl	ms	yb	ft	w	sa	vg-b		me	
Sharp Apple. IllB45. Syn. of Sharp											
Sharp's Apple. A'71. Syn. of Newville											
Sharpe's Early. D. Syn. of Summer Queen											
Sharpe Greening. R. Syn. Sharpe's Greening	N. C	ob	m	gyb	j		sa	g		l	
Sharpe's Greening. D. Syn. of Sharpe Greening											
Sharpe's Sweet. IllB45. Syn. of Sharp											
Sharp's Mountain. RNY'70. Syn. of Newville											
Sharp Pennsylvania. FDNCo											Not described.
Sharp Russet. R. Syn. Sharp's Russet	Ont		m	ru						l	
Sharp's Russet. DomEnc. Syn. of Sharp Russet											
Sharp's Seedling. RNY'70. Syn. of Newville											
Sharp's Spice. D. Syn. of Fall Wine											
Sharp Winter. R. Syn. Sharp's Winter		ob	m	yb				vg		l	
Sharp's Winter. A'85. Syn. of Sharp Winter											
Shasta Blood. P'95	Cal	robl	l	gyrse	tj	yws	sa	g		l	Flesh deeply tinged with red; hence the name.
Shaver. R. Syn. Shaver's Sweet											Not described.
Shaver's Sweet. ABW. Syn. of Shaver											
Shaw (N. H.). A'87. Syn. Shaw's Favorite	N. H	c		r			sa			me	
Shaw (Cal.). A'81											Do.

Shaw's Favorite. A'87. Syn. of Shaw (N. H.)											
Shawmut. Cole	Mass	r	s	y	f		sa	g		vl	
Shaw Surprise. BBL											Do.
Sheank. MagofH'46	Mass.?		s	yrs		y		g		vl	
Sheddan. TennBl-IX	Tenn	rob	l	gyr	tfj	y	sa	vg		vl	
Sheepnose (Mears). W. Syn. Sheepnose of Mears	Ohio?	rc	ms	gy	tj	yw	bsa	g	dk	l	
Sheepnose (N. J.?). D	N. J.?	rc	m	yb	fj	y	sa	g		m	
Sheepnose (Rus.). Gb. Syns. Gov. list No. 128, Schafnase	Rus										Do.
Sheepnose (Ohio). W	Ohio?	c	s	y			sa	g		l	
Sheepnose (Sigerson). W	Mo	c		y			sa			l	
Sheepnose (of Va.). BBL											Do.
Sheepnose (Coxe). Lin. Syn. of Bullock											
Sheepnose. D. Syn. of Eggtop											
Sheepnose. Dap. Syn. of Fox											
Sheep Nose. E. Syn. of Ladyfinger											
Sheepnose Crab. Cat. Syn. of Red June. [On the authority of Mr. T. T. Lyon.]											
Sheepnose of Mears. W. Syn. of Sheepnose (Mears)											
Sheepnose (of some). E. Syn. of Long Red											
Sheep Shire. AHortA'69. Syn. of Flory											
Sheep's Snout. DomEnc. Syn. of Bullock											
Sheet. L. Syn. Sheet's Fall Cheese											Do.
Sheet's Fall Cheese. Cat. Syn. of Sheet											
Sheffield. L. Syn. Lord Sheffield											Do.
Shelborne's Sweet. Dap. Syn. of Spice Sweet											
Shell. D	Va	r	l	y	j	y	r			me	
Shelley. P'94	N. Y	ob	l	gye	fjt	y	sa	vg	dm	ml	
Shelling. MichB31											Do.
Shenk. P'95	Va	rc	ml	ywrs	ftj	yw	sa	vg		vl	
Shepardson. A'91	R. I										Do.
Shepard Sweet. R. Syn. Shepard's Sweet											Do.
Shepard's Sweet. A'85. Syn. of Shepard Sweet											
Shepherd. Gb. Syns. Gov. list No. 475, Holdfast, Pastichovka, Postichenka, V. R. S. to Ia, No. 15.	Rus										Do.
Shepherd Fame. R. Syn. Shepherd's Fame	Eng.?	rob	l	pyrs	t	y	s			ml	From Hogg.
Shepherd's Fame. D. Syn. of Shepherd Fame											
Shepherd Keeper. R. Syn. Shepherd's Keeper	Md	r	m	r						l	
Shepherd's Keeper. FDNCo. Syn. of Shepherd Keeper											
Shepherd Pearmain. BBL											Not described.
Shepherd Perfection. BBL											Do.
Shepherd's Pippin. D. Syn. of Alfriston											
Shepley. R. Syn. Shepley's											Do.
Shepley's. IllB45. Syn. of Shepley											
Shepp. MoH'99. Syn. of York Imperial											
Sheppard. L. Syn. Sheppard Sweet, Sheppard's Sweet	Conn	reobl	m	yrs	t	w	ps	g	k	m	
Sheppard Sweet. A'95. Syn. of Sheppard											
Sheppard's Sweet. D. Syn. of Sheppard											
Sheridan. BBL											Do.
Sheriff. Dap. Syn. American Beauty (incorrectly)	Pa	rob	ms	pyrs	ftj	w	sa	g		l	
Sherman. L. Syns. Sherman's Favorite, Sherman's Sweet	N. Y	ob	ml	gyb	cjt		s	vg		ml	
Sherman's Favorite. Dap. Syn. of Sherman											
Sherman Pomme Gris. R. Syn. Sherman's Pomme Gris											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Shermman's Pomme Gris. RNY'61. Syn. of Sherman's Pomme Gris											Not described.
Sherman's Sweet. RNY'70. Syn. of Sherman											
Sherwood. NMB4. [May be Chenango.]											
Sherwood's Favorite. D. Syn. of Chenango											
Shiawassee. (LC). Syns. Michigan Beauty, Shiawassee Beauty	Mich	ob	m	wrse	ftj	vw	bsa	vg	dm	ml	
Shiawassee Beauty. MagofH'60. Syn. of Shiawassee											
Shilling. MoH'88											Do.
Shiloh. R. Syn. Shiloh Pippin											Do.
Shiloh Pippin. IllH'68. Syn. of Shiloh											
Shilpit. JVC. Syn. Hall's No. 6											Do.
Shining. R. Syns. Gov. list No. 973, Shining Aromatic	Rus		m	yr				g		e	
Shining Aromatic. Gb. Syn. of Shining											
Shinn. R. Syn. Shinn Sweet											Do.
Shinn Sweet. BBL. Syn. of Shinn											
Shinnston. A'97	W. Va	rc	l	gyrs			sa	g		l	
Shipley. L. Syns. Shipley Green, Shipley's Green	Md	robl	m	gr			a	p	k	vl	
Shipley Green. A'52. Syn. of Shipley											
Shipley's Green. D. Syn. of Shipley											
Shippen. L. Syns. Shippen's Russet, Shippen's Russeting	Pa	ob	l	ygru		g	sa	g	m	l	
Shippen's Russet. GenF'33. Syn. of Shippen											
Shippen's Russeting. C. Syn. of Shippen											
Shipper. R. Syn. Shipper's Russet											Do.
Shipper's Russet. GarCal. Syn. of Shipper											
Shirk. AmGar'90	Ind			r			vs	vg		m	
Shirley. JSK	Tex		m	rs						vl	
Shirley. Cole. Syn. of Foundling											
Shirley Keeper. L. Syn. Shirley's Keeper											Do.
Shirley's Keeper. Cat. Syn. of Shirley Keeper											
Shockley. D. Syns. Dixie, Horse Bud, Neverfail, Waddell Hall	Ga	rc	ms	pyrb	cj		rmsa	g	d	vl	
Shoemaker. BBL											Do.
Shone. A'99	N. J	rc	l	r			ma		dkm	l	
Shop. MagofH'36	Pa	r		rs			sa				
Shopler. ColExR'89											Do.
Short. R. Syn. Short's Sweet											Do.
Short's Sweet. IndH'73. Syn. of Short											
Shreeve. W. Syn. of Hannah											
Shreve. IndH'74. Syn. of Hannah											
Shrieve. MagofH'53. [Probably same as Hannah.]											Do.
Shrode. R. Syn. Shrode Winter											Do.
Shrode Winter. BBL. Syn. of Shrode											

Shropshirevine. Dap. Syn. of Sops-of-Wine											
Siberian August. D. Syn. of July											
Siberian Harvey. NEF'26											Do.
Sibley. R. Syn. Yellow Sibley								vg	dk		
Sidehill. MagofH'38											Do.
Sidney Sweet. Dap. Syn. of King Sweet											
Siegende. R. Syn. Siegende Reinette											Do.
Siegende Reinette. BBL. Syn. of Siegende											
Sigerson. L. Syn. Sigerson's Ortley	Mo	obl	l	y			sa	g		l	A seedling of Ortley.
Sigerson's Ortley. W. Syn. of Sigerson											
Sigfried. BBL											Not described.
Sigler. R. Syn. Sigler's Pound	Ohio	rob	vl	ygb	j	w	ba	g	km	ml	Described and illustrated in A. Hort. A. for 1870.
Sigler's Pound. W. Syn. of Sigler											
Sigler Red. L. Syn. Sigler's Red	Ohio	rob	ml	rs			sa	vg	d	me	
Sigler's Red. (?) D. Syn. of Scarlet Pearmain											
Sigler's Red. APC'50. Syn. of Sigler Red											
Sigler's Red. E. Syn. of Summer Pearmain											
Sigler's Red. N. Syn. of Watson											
Siglus. R. Syn. Siglus Seedling	Ohio		m					vg			
Siglus Seedling. A'56. Syn. of Siglus											
Signifinger. Th. Syn. of Westfield											
Sikull. L.	Eur										Not described.
Sikurl. BBL											Do.
Silken. Gb. Syns. Gov. list No. 220, Schelkovka, Scholkowka, Shro. to Ia. No. 75, Silken Leaf.	Rus										Not described. (May be Yellow Aread.)
Silken Leaf. IaB'90. Syn. of Silken. [Probably same as Yellow Aread.]											
Silliman. MagofH'53											Not described.
Sillix. W	Pa	robl	ms	pyrs	femj	y	ma	vg		l	
Siloam. P'86	Ark	ob	m	yrs	fj	y	sa	vg		l	
Silvan. IdaB6. [Probably Sylvan Russet, syn. of Roxbury.]											Do.
Silver Pippin. DomEnc											
Silver Russet. H				ru				vg			Do.
Silver Sweet. S&W											Do.
Simbirsk. R. Syn. Simbirsk No. 10		re	m	yrs	c	y	sa	g		me	
Simbirsk No. 9. SDB76	Rus	obe	l	yrs	j	w	sa	g	k	me	
Simbirsk No. 10. CanExR'01. Syn. of Simbirsk											
Simmon. D. Syn. of Holly											
Simmond Red. BBL. Syn. of Simmons Red											
Simmons. A'71	Wis		s					g		e	
Simmons Red. R. Syns. Red Everlasting, Simmond Red, Simmons' Red.	Ga	obe	ml	pyrs	ftj	gy	sa	vg		ve	
Simmons' Red. A'79. Syn. of Simmons Red											
Simmons' Red. PJB. Syn. of Simson											
Simmons Seedling. Cat											Do.
Simmons Winter. R. Syn. Simmons' Winter			ml					vg		l	
Simmons' Winter. IllB45. Syn. of Simmons Winter											
Simms. IllH'96. [Probably same as Sims.]											Do.
Simnee polosatoe. Gb. Syn. of Winter Streaked											
Simnui biel. Gb. Syn. of Ivory											
Simon. Cat											Do.
Simond. R. Syn. Simond Sweeting											Do.
Simond Sweeting. MagofH'36. Syn. of Simond											
Simon's Red. Cat. Syn. of Everbearing											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Simpson. IllH'95	Ill			rs				vg		ml	
Simpson's Pippin. D. Syn. of Ord											
Simpson's Seedling. D. Syn. of Ord											
Simpson Sweet. D	Pa	roblob	m	gyb	mj	w	s	g		ml	
Sims. IllH'89. [Thought to be a seedling of Ben Davis.]											Not described.
Simson. R. Syns. Simmons' Red, Simson's Red		rob	ml	yrs	j	y	s	vg	c	e	May be Ord of Downing.
Simson's Red. GHM&S. Syn. of Simson											
Sinap. WisHort'99. Syn. Sinap Alma	Rus.?								m	vl	A late keeper, grown in the Crimea for market.
Sinap Alma. Hort'56. Syn. of Sinap											
Sinclair's Yellow. D. Syn. of Early Harvest											
Sine-Qua-Non. GenF'33. Syn. Cornel's Early	N. Y	rc	m	gy	vtj	w	sa	g	d	me	
Sink. MagofH'53	Pa	rc	m	wrs	tj	vws	bsa	g	k	me	
Sir William Gibbons. D. Syn. of Gibbons											
Sise. MagofH'53	N. H		m	yr				g		l	
Sisk. Dap	Md	ob	ml	pyrs	tj	wy	psa			ml	
Sitz. R. Syn. Sitz Beauty											Not described.
Sitz Beauty. DelExR'95. Syn. of Sitz											
Skalanka Bogdanoff. JNCo	Rus.	c	m	y						l	Probably identical with Sklanka, of Iowa B. 31.
Skeleton. P'95	Ark.	rc	l	ywrs	tj	y	rsa	g		e	
Skerospelka rannaja. Gb. Syn. of Earliest											
Skinner. L. Syns. Santa Clara King, Skinner's Pippin, Skinner's Seedling.	Cal	obc	l	rs			sa	vg-b	dk	m	From San Jose (Cal.) Agriculturist.
Skinner's Pippin. Wn. Syn. of Skinner											
Skinner's Seedling. A'71. Syn. of Skinner											
Skisck. IaH'85											Not described.
Sklanka. IaB31	Rus.	oblc	ml	gb	cj	w	sa	vg		l	
Sklankabog. IllH'96. [Probably a contraction of Sklanka of Bogdanoff.]											Do.
Sklanka, of Bogdanoff. BBL. [Doubtless identical with Skalanka Bogdanoff.]											Do.
Skorospelka rannaya. Gb. Syn. of Earliest											
Skorospieloe krasnoe. Gb. Syn. of Early Red											
Skrijapel. Gb. Syn. of Cross											
Skrijapel sladkui. Gb. Syn. of Sweet Cross											
Skrischapfel. Gb. Syn. of Cross											
Skrout. R. Syn. Skrout German	Rus.?		ml	wyrs	ftj		a		dk	l	
Skrout German. ACT. Syn. of Skrout											
Skrushapfel. IaB31. Syn. Voronish list No. 42	Rus.									l	

Skrut Bulowoi. Gb. Syn. of White Skrute											
Skrut bielevoi. Gb. Syn. of White Skrute											
Skrute. MHSC'81. Syn. V. R. S. to Ia. No. 21	Rus.										Do.
Skrute Niemetskui. Gb. Syn. of German Skrute											
Skunk. W. Syn. of Skunk											
Skunk. C. Syns. Polecat, Skunk	N. J		l	y	j	y	psa	g		m	
Skunk (erroneously). D. Syn. of Streaked Pippin											
Skroasnoi Naliv. Gb. Syn. of Transparent Naliv											
Skrosneena. Gb. Syn. of Translucent											
Skrosneena Rishkaya. Gb. Syn. of Riga Translucent											
Skrosneena skorospietlaya. Gb. Syn. of Early Translucent											
Skrosnoi bielui. Gb. Syn. of White Transparent											
Skrosnoi jeltui. Gb. Syn. of Yellow Transparent											
Skrosnoi krasnui. Gb. Syn. of Red Transparent											
Skrosnoi naliv. Gb. Syn. of Transparent Naliv											
Skrosnoi Zelenui. Gb. Syn. of Green Transparent											
Skwosnoi Beeloe. A'83. Syn. of White Transparent											
Skwosnoi krasnoi. IaB90. Syn. of Red Transparent											
Skwosnoi Schstoi. A'83. Syn. of Yellow Transparent											
Skwosnoi Selennoe. Gb. Syn. of Green Transparent											
Sladkoe jeltoe. Gb. Syn. of Yellow Sweet											
Slank-a-bog. IllH'99. [Being tested by H. M. Dunlap.]											Do.
Slast. Gb. Syns. Apple Sweet, Gov. list No. 783	Rus.										Do.
Sleason. MoB6											Do.
Sleathe. L. Syn. Sleathe's Ivory	Ohio	ob	s	y			sa	g		l	
Sleathe's Ivory. W. Syn. of Sleathe											
Sleeper. D. Syns. Sleeping Beauty, Winter Sleeping Beauty	Eng.?	rob	m	yb	etj	yw	a			ml	From Hogg.
Sleeper's Yellow. H. Syn. of Early Pennock											
Sleeping Beauty. D. Syn. of Sleeper											
Sleight. L. Syns. Sleight's Lady Apple, Slight's Lady Apple	N. Y	rob	s	yb			sa	vg	d	ml	A seedling of Lady.
Sleight's Lady Apple. D. Syn. of Sleight											
Slender Rose. Gb. Syn. of Rosenhager											
Slight's Lady Apple. A'67. Syn. of Sleight											
Slingerland. L. Syn. Slingerland Pippin	N. Y	rob	ml	yrs	tj	w	bsa	g-vg	d	ml	
Slingerland Pippin. D. Syn. of Slingerland											
Sloan's Seedling. D. Syn. of Pushmataha											
Slug. L. Syn. Slug Sweeting	R. I.	c	m	y			s	g	k	m	
Slug Sweeting. W. Syn. of Slug											
Small Admirable. L. Syn. Small's Admirable	Eng.?	ro	ml	py	f	y	sa			m	From Hogg.
Small's Admirable. D. Syn. of Small Admirable											
Small Black. D. Syn. of Black											
Smalley. D. Syn. Spice	Conn	obe	m	yb	tj		bpsa	g		m	
Small Griton. Cat											Not described.
Small Hall. GLA		rob	ms	r	tej	y	sa	vg		l	
Small Pippin. L. Syn. Small's Pippin		obl	s	rs			sa	p		l	
Small's Pippin. W. Syn. of Small Pippin											
Small Red. R. Syn. Small Red (of Purdy)		ob	s	r			a			e	
Small Red (of Purdy). IllB45. Syn. of Small Red											
Small Red Long Keeper. IllB45. Syn. of Gilpin											
Small Red Romanite. Cat. Syn. of Gilpin											
Small Romanite. D. Syn. of Gilpin											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Smart. R. Syn. Smart Prince Arthur											Not described.
Smart Prince Arthur. BBL. Syn. of Smart											
Smelling. Cat, IllH'91	Rus	oblc	m	rs			sa	g	k	e	
Smelling. Gb. Syn. of Scented											
Smiley. MoH'87. Syns. Smiley's Fall Red, Smiley's Red, Thill's Favorite.	Mo	obc	m	yrs	tj	w	msa	vg	dk	m	
Smiley's Fall Red. MoH'89. Syn. of Smiley											
Smiley's Red. MoH'85. Syn. of Smiley											
Smith. IndH'72. Syns. Choice Kentuck, Cider, Fowler, Fuller, Jackson Winesap, Pennsylvania Cider, Poplar Bluff, Popular Bluff, Smith's, Smith's Cider.	Pa	robc	ml	yrs	tjc	w	pmsa	g	m	ml	
Smith's. W. Syn. of Smith											
Smith's Beauty of Newark. D. Syn. of Oldenburg											
Smith's Cider. D. Syn. of Smith											
Smith Favorite (Me.). L. Syn. Smith's Favorite	Me	robl	m	pyrs	tj	yw	sa		km	m	
Smith Favorite (Ohio). R. Syn. Smith's Favorite	Ohio	obc	l	yrb					km		
Smith's Favorite. A'72. Syn. of Smith Favorite (Me.)											
Smith's Favorite. A'75. Syn. of Smith Favorite (Ohio)											
Smith's Favorite. A'75. Syn. of Mother Favorite											
Smithfield Spice. Cole. Syn. of Dyer											
Smith Gilliflower. R. Syn. Smith's Gilliflower											Do.
Smith's Gilliflower. MagofH'38. Syn. of Smith Gilliflower											
Smith Seedling. R. Syn. Smith's Seedling	Ohio	rc	l	yb	t			vg		ml	Origin, Coshocton Co., Ohio.
Smith's Seedling. P'95. Syn. of Ragsdale											
Smith's Seedling. MagofH'46. Syn. of Smith Seedling											
Smith Summer. L. Syn. Smith's Summer		ob	l	y	j		s	vg		e	
Smith's Summer. A'54. Syn. of Smith Summer											
Smith's Winter. MoH'73. Syn. of Smith Winter											
Smith Winter. R. Syn. Smith's Winter. [May be Smith.]											Not described.
Smokehouse. Wg. Syns. English Vandevere, Gibson's Vandevere, Mill Creek, Mill Creek Vandevere, Red Vandevere.	Pa	rob	ml	yrsc	fjc	y	sa	g	km	ml	
Smokehouse (?). E. Syn. of Vandevere											
Smokehouse Greening. IllH'68											Do.
Smoky Arcad. MHSc'86. Syns. Arkad dimtchatui, Arkad duimtschataja, Gov. list No. 864, Shro. to Ia. No. 60, Smoky Arcade.	Rus	rob	m	gy	f	w	s	vg		me	
Smoky Arcade. Gb. Syn. of Smoky Arcad											
Smokytwig. W	Ky	oblc	ms	y			s	g		l	
Smolensk. Gb. Syns. Shro. to Ia. No. 98, Smolenskoe	Rus										Do.
Smolenskoe. Gb. Syn. of Smolensk											
Smyrna. D. Syn. of Chenango											

Snedlker. D		re	l	yrs	ejt	y	bsa	g		ml	
Sneed. P'91. Syn. Sneed Cider	Ala	rob	m	ygrs	mj	w	a		e	ve	
Sneed Cider. P'91. Syn. of Sneed											
Sneep. R. Syn. Sneep's											Do.
Sneep's. MichB31. Syn. of Sneep											
Snepp. R. Syns. John Snepps', Snepp's, Snepps', Snepps' Nonsuch	Ind	rob	ml	py	tfj	y	ma	vg	dk	ml	
Snepp's. W. Syn. of Snepp											
Snepps'. D. Syn. of Snepp											
Snepps' Nonsuch. IndH'78. Syn. of Snepp											
Snider. Hort'72. Syn. of Snyder											
Snorter. Dup. Syn. of McAfee											
Snorter. D. Syn. of McAfee. [Striped Winter.]											
Snow. D. Syn. of Fameuse											
Snow Apple. Cole. Syn. of Fameuse											
Snow Chimney. D. Syn. of Fameuse											
Snow Russet. MagofH'41											Do.
Snyder. DDH. Syn. Snider	Pa				t		sa	g		l	Snider and Snyder are possibly the same.
Snyder Large. R. Syn. Snyder's Large											Not described.
Snyder's Large. A'81. Syn. of Snyder Large											
Soden. R. Syn. Soden Sweeting											Do.
Soden Sweeting. MagofH'42. Syn. of Soden											
Sodena. BBL											Do.
Softling. MagofH'53											Do.
Solree. A'87. Syn. Giant Swaar. [Probably same as Sorree.]											Do.
Sol. Carter. D. Syn. of Buckingham											
Sol. Carter. T. Syn. of Equinetely. [Equinetely is probably Buckingham.]											
Sol. Edwards. A'83											Do.
Solomon. L. Syn. King Solomon	Ga	rob	ml	yrs	mj	y	sa	g-vg		me	
Solotoi Arkad. Gb. Syn. of Golden Arkad											
Somers. L. Syn. Somers' Winter											Do.
Somerset (Me.). D. Syn. Somerset (of Maine)	Me	rob	l	yrs	tj	ys	sa			m	
Somerset (N. Y.). D. Syns. New York Somerset, Somerset New York	N. Y.	re	ms	ywru	vtj	w	rsa	vg-b	d	m	
Somerset Harvest. D. Syn. of Garrettson											
Somerset, New York. MichB169. Syn. of Somerset (N. Y.)											
Somerset (of Maine). MeExR'93. Syn. of Somerset (Me.)											
Somer's Winter. Cat. Syn. of Somers											
Somerton. L. Syn. Somerton Sweet	Ohio						s			m	Do.
Somerton Sweet. W. Syn. of Somerton											
Sommer birnapfel. Gb. Syn. of Summer Pear											
Sommergewuerzapfel. MoH'87. Syn. of Wuerzapfel											
Sommerset. L. Syn. Sommerset Lasting	Eng	rob	l	yb	t	w	bsa	g	km	l	From Ronalds.
Sommerset Lasting. D. Syn. of Sommerset											
Sommer Weisser Calville. Gb. Syn. of White Summer Calville											
Sonoma. L. Syns. Cook's Seedling, Sonoma Seedling	Cal	re	ml	rs			a			l	
Sonoma Seedling. Wn. Syn. of Sonoma											
Soo. JNCo	Iowa		l	gr			sa			l	One of Thompson's seedlings.
Sophia. KN		r	l	r	t	yw	sa	vg		vl	
Sopsavine. K			m	rs			sa			e	May be a synonym of Sops-of-Wine.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Sops in Wine. E. Syn. of Sops-of-Wine											
Sops-of-Wine. D. Syns. Bell's Early, Bell's Favorite, Bennington, Dodge's Early Red, Early Washington, Hominy, Red Shropsavine, Red Shropshirevine, Sapson, Shropshirevine, Sops in Wine, Striped Shropshire, Washington, Williams' Favorite (erroneously), Worden's Pie Apple.	Eur	r	m	yrs	m	ws	psa	g	d	me	
Sorree. A'95. [Probably same as Soiree.]	Minn	r	l	y	fc	y	n		k	m	
Soskrieger. D. Syn. of Champaign											
Sototoreffka. Gb. Syn. of Zolotareff											
Soulsson. L. Syn. Souisson Russet		rc	m	ycbru	tjc	w	bsa	vg		l	
Souisson Russet. D. Syn. of Souisson											
Soulard. IllH'69	Mo	obc	ml	wrs	vtj	w	sa	vg		m	
Soulard Hybrid. AmGar'89											Not described.
Sour Bough. D	N. Y.?	rc	m	y		w	bsa	g	k	m	Possibly identical with Champlain.
Sour Bough. D. Syn. of Champlain											
Sour Bough. D. Syn. of Summer Pippin											
Sour Bough (of some). D. Syn. of Tart Bough											
Sour Harvest. D. Syn. of Primate											
Sour Rambo. W	Ohio										Not described.
Sour Sweet. R. Syn. Sour Sweeting											Do.
Sour Sweeting. GenF'32. Syn. of Sour Sweet											
Sour Turnip. Gb. Syn. of Acid Repka											
Southern Fall Pippin. D. Syn. of Buncombe											
Southern Golden. L. Syn. Southern Golden Pippin	South	r		y			sa				This may be Green Cheese.
Southern Golden Pippin. D. Syn. of Green Cheese											
Southern Golden Pippin. W. Syn. of Southern Golden											
Southern Greening. W	Ga	ob	m	y			sa			l	This may also be Green Cheese.
Southern Greening. D. Syn. of Green Cheese											
Southern Home. Cat. Syn. Home Vandevere											Not described.
Southern King. MichB31											Do.
Southern Lady. D	N. C	ob	s	wbc	tj	y	ma	vg		m	
Southern Limbertwig. TexB16											Do.
Southern Mammoth. BAC		r	l	rs	vf	y		vg		ml	Cultivated in west Tennessee.
Southern Pearmain. IllB45											Not described.
Southern Pennock. IllB45											Do.
Southern Porter. A'77. Syns. Fall, Hog Pen, Jones, Kidd, Long, Porter	S. C	rc	m	y	tj	w	rsa			me	
Southern Queen. IllB45											Do.

Southern Romanite. Syn. of Romanite											
Southern Striped June. HuC. Syn. of Margaret											
Southern Winter. IllB45		re	ml	gy			sa	g-vg	k	ml	
Southern Winter King. IllB45											Do.
South Hero. A'81											Do.
South Lincoln Beauty. AmGar'99. Syn. of Arlington											
South Mountain. W	Pa									l	Do.
Souvenir. IllH'82											Do.
Sovari. (LC)	Eur										Do.
Sovereign. D	Eng	oblob	s	yb	fr		s			vl	From Ronalds.
Spade. BBL											Not described.
Spafford. L. Syn. Spafford Russet	Ohio	re	m	yru	mj	gw	sa	g	d	l	
Spafford Russet. MagofH'44. Syn. of Spafford											
Spalding. P'95. Syn. Prince George's County Pippin	Md	re	l	gy	ftj	y	sa	g-vg		l	
Spalding's Early Seedling. MagofH'43. Syn. of Spalding Seedling											
Spalding Seedling. MagofH'39. Syn. Spalding's Early Seedling	Mass									e	Not described. Probably same as Early Spaulding.
Sparhawk. MagofH'57			vl								Not described.
Spark. L. Syns. Celestial Sparks, Spark's, Spark's Late	South	roblc	l	gybc	t	w	psa	g	k	ml	
Spark's. D. Syn. of Spark											
Spark's Late. D. Syn. of Spark											
Sparta. BBL											Do.
Spaulding's Early Seedling. MagofH'44. Syn. of Early Spaulding											
Special. P'94	Wis	rob	m	ygrs	fj	y	ma	vg		l	
Speckled. A'69. Syn. Westbrook		robl	l	ywb	t	w	sa	g		ml	
Speckled. Dap. Syn. of Fall Orange											
Speckled Golden Reinette. GenF'33. Syn. of Barcelona											
Speckled Oley. A'54. Syn. of Alsace											
Speckled Oley. D. Syn. of Oley											
Speckled Pearmain. D. Syn. of Barcelona											
Speckled Sweet. D. Syn. of Carmel											
Spectator. D	N. Y	roblo	m	yb	tj	w	sa	p		me	
Speer. AmGar'99. Syn. Big Estray	Rus.?	rob	ml	y	cj	w	a	g		m	Named in honor of R. P. Speer, Cedar Falls, Iowa
Spencer. MagofH'52. Syn. Spencer's Pippin	Mo		vl	r						e	
Spencer's Sweeting. K. Syn. of Hartford											
Spencer's Early. H. Syn. of Hightop Sweet											
Spencer's Pippin. DomEnc. Syn. of Spencer											
Spice (Ohio). W	Ohio	r	m	y			sa	g		l	
Spice (Va.). W. Syn. Spice Apple	Va										Not described.
Spice. D. Syn. of Smalley											
Spice Apple. K. Syn. of Fenouillet Gris											
Spice Apple. T. Syn. of Spice (Va.)											
Spice Apple (of some). Syn. of Old Town											
Spice Apple. DomEnc. Syn. of Spice Sweet											
Spiced Aromatic. MinnB'90											Do.
Spiced Ox Eye. MagofH'44. [May be Newtown Spitzenburg.]	Ohio?	oblob		yrs	j	y	sa	g			From the Cincinnati Horticultural Society, 1844.
Spiced Ox Eye. D. Syn. of Newtown Spitzenburg											
Spiced Ox Eye. E. Syn. of Vandevere. [Probably Newtown Spitzenburg.]											
Spiceland. L. Syn. Spiceland Sweet	Ind	c	m	rs			sa	g		l	
Spiceland Sweet. W. Syn. of Spiceland											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Spice (of New York). IllH'72	N. Y.?	robl	ml	w	ftj		sa	vg	d	m	
Spice (of some West). E. Syn. of Red Calville											
Spice Pippin. W	Ohio	r	l	y			sa	g		l	
Spice Pippin. H. Syn. of Ortley											
Spice Russet. E. Syns. Imperial Russet, Sweet Russet of some (erroneously).	Ohio	rob	ms	yru	fj	w	ma	vg		ml	
Spice Russet (?). W. Syn. of Ross Nonpareil											
Spice Sweet (1). Cole. Syns. Berry Bough, Shelborne's Sweet	Mass	ob	m	py	f		s			me	Three descriptions under this name, probably of one apple.
Spice Sweet (2). Th. Syns. Spice Apple, Spice Sweeting, Spurr Apple, Sweet Spice.	Mass	ob	m	y			s	g		me	
Spice Sweet (3). L. Syn. Spice Sweeting	Mass	rob	m	rs			s	g	k	me	
Spice Sweeting. W	Ind	r		y			s				
Spice Sweeting. Lin. Syn. of Spice Sweet (2)											
Spice Sweeting. E. Syn. of Spice Sweet (3)											
Spicken. IndH'72											Not described.
Spine. DomEnc											Do.
Spitzenburg. F. Syn. of Esopus											
Spitzenburgh. D. Syn. of Newtown Spitzenburg											
Spitzenburgh Æsopus. DomEnc. Syn. of Esopus											
Spitzenburgh Esopus. T. Syn. of Esopus											
Spitzenburg-Flushing. DomEnc. Syn. of Flushing											
Spitzenburg Kaighn's. H. Syn. of Kaighn											
Spitzenburgh Newtown. DomEnc. Syn. of Newtown Spitzenburg											
Spitzenburg-Red. W. Syn. of Red Spitzenburg											
Sponge (1). D		rob	l	grs		w	sa		k	m	
Sponge (2). D		oble	m	grs	mj	w	a	g		m	Elliott represents this as large and very good.
Spotted. L. Syn. Spotted Pippin	Ill	r	l	y			sa	vg		l	
Spotted Pippin. D. Syn. of Buel											
Spotted Pippin. W. Syn. of Spotted											
Sprague. D		oblrc	ms	y	jt	y	sa	g		m	
Sprang. A'77	Pa	rob	l-vl	gy	ftj	yw	sa	vg		l	
Spreading Pipka. Gb. [Same as Gov. list No. 463.]											
Spring. D. Syn. of Baddow											
Springdale. ArkB60	Ark	rob	m	gyrs	t	yg	sa	g		l	
Springer. D. Syn. Springer's Seedling	Ohio	robl	s	ygrs	f		sa	p		vl	
Springer's Seedling. MagofH'48. Syn. of Springer											
Spring Grove. L. Syn. Spring Grove Codlin	Eng	rc	m	gyb	cj	gy	ba		k	m	

Spring Grove Codlin. GenF'33. Syn. of Spring Grove											
Springhill. R. Syn. Spring Hill Pippin		r	l	yb			s	g		ml	
Spring Hill Pippin. IllB45. Syn. of Springhill											
Springhill Spitzenburg. A'62		ob	ml	ru			sa	vg		l	
Springhouse. A'77	Pa	obe	ml	gyrs	ft	yw	sa	vg		l	
Springlake. A'77	Utah		m	dr		y	sa			l	
Spring Orange. L. Syn. Orange	N. H.	r	s	y					k	vl	
Spring Pippin. D. Syn. of Springport											
Springport. L. Syns. Spring Pippin, Springport Pippin	N. Y	robl	ml	y	c	yw	sa			vl	
Springport Pippin. D. Syn. of Springport											
Spring Swaar. IllB45		obe	l	gy			a	vg		l	
Spurr Apple. K. Syn. of Spice Sweet											
Spurrier. A'97		ob	m	wyrs			sa	vg	k	ml	
Spy. Wg. Syn. of Northern Spy											
Spy Wine. IndH'88	Ind	re	ml	ybr	ct	y	sa	vg		m	
Squash. MagofH'43											Not described.
Squire. L. Syn. Squire's Greening	Eng	rob	ml	gb	f	yw	bsa		k	vl	From Hogg.
Squire Brown. MassH'70	Vt.?	robl		dr	tj	ws		vg	d	me	
Squire's Greening. D. Syn. of Squire											
Staalcubs. W. Syn. of Vandevere											
Staats. L. Syn. Staats' Sweet	N. J.	re	m	yrs	j	yw	bps	g-vg		l	
Statts' Sweet. D. Syn. of Staats											
Stach. MoH'85. [Probably intended for Stack.]											Not described.
Stack. W. Syn. Stack Apple	Ind	re	ml	rs	fj	y	sa	g		ml	From Transactions Indiana Hort. Society.
Stack Apple. IndH'67. Syn. of Stack											
Stackyard. D	Pa	ob	m	gyrsru	ctj	w		g		m	
Stadt-haus. Cat											Not described.
Stagg's Nonpareil. GenF'33. Syn of Early Nonpareil (Eng.)											
Stalben. BBL											Do.
Stalclubs. Syn. of Vandevere											
Stamford. L. Syn. Stamford Pippin	Eng	r	ml	y	fte	y	o		d	l	From Hogg.
Stamford Pippin. D. Syn. of Stamford											
Stanard. NYAg'48. Syns. Stanard's Seedling, Stannard	N. Y	robe	ml	gyrs	cvj	yw	rsa	vg	k	l	
Stanard's Seedling. MagofH'53. Syn. of Stanard											
Standard. Cat. [Doubtless a misprint for Stanard.]											Not described.
Stanley. D. Syns. Stanley's, Stanley's Early, Stanley's Seedling	Ala	re	l	gy	tmj	w	sa	g		m	
Stanley's. W. Syn. of Stanley											
Stanley's Early. Hort'56. Syn. of Stanley											
Stanley's Seedling. D. Syn. of Stanley											
Stanley Winter. L. Syn. Stanley's Winter Sweet	Me	ob	l	rsp	j		s			l	From Maine Pom. Report.
Stanley's Winter Sweet. D. Syn. of Stanley Winter											
Stannard. W. Syn. of Stanard											
Stannard Seedling. KN			l	r	cj			vg	dm	m	Probably identical with Stanard.
Stansill. A'60	N. C.	rob	m	ygb		y	sa	g-vg		ml	
Stanton. CLW	Iowa		l	dr	j		a		dk	l	
Star. D	N. Y	rob	m	vrse		w	psa	g		m	
Starbuck. DelExR'95. Syn. of Rome											
Star in the West. ABW. Syn. Star of the West. [This may be a crab.]	Minn									e	Not described.
Star of the West. Hort'72. Syn. of Star in the West											
Stark. PFar'68. Syns. Robinson, Yeats	Ohio	re	l	gyrs	cmj	y	ma	g	mk	vl	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Starke. AHortA'69	Ill.?										Doubtless same as Stark.
Starkey. D	Me	obc	m	pyrs	tj	w	psa		mk	ml	
Stark Keeper. R. Syn. Stark's Keeper											Not described.
Stark's Keeper. ArkB21. Syn. of Stark Keeper											
Star Lady. L. Syns. Api Etoile, Star Lady Apple	Fr	ob	s	yb			sa	vg	d	vl	
Star Lady Apple. D. Syns. of Star Lady											
Starr. D	N. J	rob	ml	gw		w	psa	g	k	me	
Starratt. MassH'77											Do.
Star Reinette. D. Syns. Calville Etoile, Reinette Etoile	Belg	r	m	r	t	w	sa			m	From Album de Pomologie.
Star White. IllH'90											Not described.
Staudt. A'56	Pa	rc	l	rs	ftj	w	sa	vg		ml	
Stayman. L. Syn. Stayman's Summer	Kans	rc	m	gyrs	vj	gw	bsa	g	dkm	me	From Western Pomologist.
Stayman. IllH'02. Syn. of Stayman Winesap											
Stayman McAfee. L. Syn. Stayman's McAfee											Not described.
Stayman's McAfee. Cat. Syn. of Stayman McAfee											
Staymans No. 1. JWK											
Stayman's No. 2. JWK											
Stayman's Summer. Dap. Syn. of Stayman											
Stayman Superior. BBL											Do.
Stayman Sweet. R. Syn. Stayman's Sweet	Kans		ml	r			s			l	
Stayman's Sweet. JWK. Syn. of Stayman Sweet											
Stayman Sweet Winesap. BBL. [Doubtless same as Stayman Sweet.]											Do.
Stayman Winesap. L. Syns. Stayman, Stayman's Winesap	Kans	obc	ml	gyrs	ftj	y	rma	vg-b	dm	vl	
Stayman's Winesap. Dap. Syn. of Stayman Winesap											
Stearns. L. Syn. Stearns' Greening, Stearns' Winter Greening	Ind	ob	m	gb	tj	yw	sa	vg		vl	
Stearns' Greening. Dap. Syn. of Stearns											
Stearns' Winter Greening. A'77. Syn. of Stearns											
Steele Janet. R. Syn. Steele's Janet or Hunter Apple	Mo.?	ob			f				m	vl	
Steele's Janet, or Hunter Apple. Hort'68. Syn. of Steele Janet											
Steele Red. L. Syn. Steele's Red	Mass.?	c	m	rs			sa	g		l	
Steele's Red. W. Syn. of Steele Red											
Steele's Red (erroneously). A'83. Syn. of Morris Red											
Steele's Red (erroneously). W. Syn. of Red Canada											
Steele's Red Winter. Cole. Syn. of Baldwin											
Steele's Red Winter. D. Syn. of Red Canada											
Steele Sweet. NEF'32. Syns. Steele's Sweet, Steel's Sweet	Conn	r	m	yb	cj	w	s	g		l	
Steele's Sweet. W. Syn. of Steele Sweet											
Steel's Sweet. D. Syn. of Steele Sweet											
Stehley. W	Pa	ob	l	rs			sa	g		vl	May be Hiester.
Stehley. D. Syn. of Hiester											

Stein. A'83											Not described.
Steklianka. A'83. [May be Glass of the Gibb list.]											Do.
Steklianka. Gb. Syn. of Glass											
Steklianka Bogdanoff. Gb. Syn. of Bogdanoff Glass											
Steklianka kremera. Gb. Syn. of Kremer Glass											
Steklianka kremer's. Gb. Syn. of Kremer Glass											
Steklianka ostrokovskaya. Gb. Syn. of Ostrokoff											
Steklianka pesotchnaya. Gb. Syn. of Sandy Glass											
Steklianka Revels kaja. Gb. Syn. of Revel Glass											
Steklianka Revelskaya. Gb. Syn. of Revel Glass											
Steklianka Selonka. Gb. Syn. of Green Glass											
Steklianka Zelinka. Gb. Syn. of Green Glass											
Stekliannoe duchistoe. Gb.											
Stekliannoe Duchesstoe. Gb. [Same as Gov. list No. 973.]											
Stekliannoe Simovoe. Gb. Syn. of Winter Glass											
Stekliannoez Simowoe. Gb. Syn. of Winter Glass											
Stenkirk. Cat. [This and Stenkyrka probably identical.]											Do.
Stenkyrka. MHSC'86	Swed	r	m	yrs	ft	w	sa	g		l	
Stepanoff. Gb. Syns. Gov. list No. 213, Shro. to Ia. No. 114, Stepanoff's Apple, Stepanouka, Stepanovka.	Rus										Do.
Stepanoff's Apple. Gb. Syn. of Stepanoff											
Stepanouka. Gb. Syn. of Stepanoff											
Stepanovka. Gb. Syn. of Stepanoff											
Stephen. MHSC'86											
Stephenson. L. Syns. Stephenson's Winter, Stevenson's Winter, Steven's Winter.	Miss	rob	m	gyrs	fj	w	psa	g		l	
Stephenson's Pippin. A'89. Syn. of McAfee											
Stephenson Seedling. R. Syn. Stephenson's Seedling		robc	l	yrs	ftj	yw	sa	vg		l	Possibly same as Stephenson.
Stephenson's Seedling. A'77. Syn. of Stephenson Seedling											
Stephenson's Winter. D. Syn. of Stephenson											
Stepp. TennBI-IX	Tenn	rob	l	ygrs	ftj	y	sa	vg-b	d	m	
Steptoe. P'94	Wash	r	l	py	fcj	y	sa	vg		ml	
Sterling. L. Syns. American Beauty, Beauty of America, Sterling Beauty.	Mass	rc	l	yr	ctj	y	rsa	vg	dm	vl	
Sterling Beauty. D. Syn. of Sterling											
Sterling Castle. BBL											Not described.
Sterling's Seedling. Cat. Syn. of Springhouse											
Sterns. BBL											Do.
Stettiner Gelber. MHSC'86. Syn. of Yellow Stettin											
Stettiner Rother. MHSC'81. Syn. of Red Stettiner											
Stetting Rouge. GenF'33. Syn. of Rostocker											
Steubenraugh. TexB16. Syn. Steubenwaugh											Do.
Steubenwaugh. BBL. Syn. of Steubenraugh											
Steve. L. Syns. Baldwin's Summer, Early Russet, Steve Baldwin	Conn	ob	ms	wru	tj	w	sa	vg	dk	me	
Steve Baldwin. Dap. Syn. of Steve											
Stevens. GO	Tex	ob	ms	yrs				g		me	
Stevens Gilliflower. R. Syn. Stevens' Gilliflower	Me	rc	l	wrs	t	w	psa			l	
Stevens' Gilliflower. Cole. Syn. of Stevens Gilliflower											
Stevenson Pippin. A'77. [This may be McAfee or Dwight.]											Do.
Stevenson Pippin. Dap. Syn. of Dwight											
Stevenson Pippin. AmGar'01. Syn. of Maccabee. [Doubtless McAfee.]											
Stevenson Red. R. Syn. Stevenson's Red											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Stevenson's Red. TexB16. Syn. of Stevenson Red											Not described.
Stevenson's Winter. W. Syn. of Stephenson											
Stevens' Winter. IllH'02. Syn. of Stephenson											
Stew. R. Syn. Stew Pippin											Do.
Stew Pippin. IllH'71. Syn. of Stew											
Steward. OL	Tex		m	rs				vg		l	
Steward Golden. R. Syn. Steward's Golden		ob	m	gyb	cj	w	sa			l	This may be Fulton.
Steward's Golden. CanExR'01. Syn. of Steward Golden											
Stewart. W		e		rs			sa				
Stewart's Golden. MoB6. Syn. of Fulton											
Stewart Nonpareil. L. Syn. Stewart's Nonpareil	Ohio	rc	s	rs			sa	g	dk	e	Possibly may be Tetofski; so thought Dr. Warder.
Stewart's Nonpareil. D. Syn. of July											
Stewart's Nonpareil. W. Syn. of Stewart Nonpareil											
Stewart Seedling. BBL											Not described.
Stibbard. L. Syn. Stibbard's Seedling											Do.
Stibbard's Seedling. Cat. Syn. of Stibbard											
Stickney. R. Syn. Early Stickney. [May be a crab.]	Wis.?										Do.
Stiles. KanFM'86	Kans		s		f	w	sa	p		l	
Stillman. L. Syn. Stillman's Early	N. Y	rc	s	yb	t	y	psa	g	d	me	
Stillman's Early. D. Syn. of Stillman											
Stillwater. L. Syns. Grandmother, Stillwater Sweet	Ohio	rc	m	gyb	ft	yw	s	g-vg	k	m	
Stillwater Blush. CGen'59. Syn. of Claybank											
Stillwater Sweet. D. Syn. of Stillwater											Do.
Stillwell. R. Syn. Stillwell's Pippin											
Stillwell's Pippin. MagofH'53. Syn. of Stillwell											
Stillwell's Royal. Cat. Syn. of Pumpkin											
Stinson. P'95	Tenn	r	l	yrsc	fcj	yw	sa	vg		me	
Stint. R. Syn. Stint's Large Yellow											Do.
Stint's Large Yellow. MagofH'53. Syn. of Stint											
Stire. D. Syn. of Forest Styre											
Stirling. R. Syn. Stirling Castle											Do.
Stirling Castle. S&W. Syn. of Stirling											
Stirzaker. L. Syn. Stirzaker's Early Square	Eng	r	ms	yru	t	w	psa			me	From Hogg.
Stirzaker's Early Square. D. Syn. of Stirzaker											
Stock. RNY'61. Syn. Stock Apple											Not described.
Stockade. L. Syn. Stoekade Sweet	Ohio	rob	ms	rs			s	g	k	vl	
Stockade Sweet. D. Syn. of Stockade											
Stock Apple. IndH'66. Syn. of Stock											
Stock Sweet. W	Ohio										Do.

Stockton. MagofH'53											Do.
Stoke. R. Syn. Stoke Edith Pippin											Do.
Stoke Edith Pippin. BBL. Syn. of Stoke											
Stoll. L. Syn. Stoll's Russet											Do.
Stoll's Russet. Cat. Syn. of Stoll											
Stone. A'56	Mich									l	Do.
Stone. D. Syn. of Grindstone											
Stone Antonovka. CanH'94		oble	l	yg	cj	yw	sa			me	
Stone Eureka. R. Syn. Stone's Eureka		obe	m	gy	je	w	sa			e	Said to be distinct from Heisler.
Stone's Eureka. WmCh. Syn. of Heisler											
Stone's Eureka. BBL. Syn. of Stone Eureka											
Stone Excelsior. R. Syn. Stone's Excelsior											Not described.
Stone's Excelsior. Cat. Syn. of Stone Excelsior											
Stone Pippin. DomEne. Syn. White Stone Pippin	Eng	oble	m	y	f		s			vl	From Lindley.
Stone Pippin. D. Syn. of Birmingham											
Stone Pippin. D. Syn. of Gogar											
Stone Sweet. L. Syn. Stone's Sweet	Ohio										Not described.
Stone's Sweet. APC'50. Syn. of Stone Sweet											
Stonewall. W. Syn. Stonewall Jackson	{Ala.? {Va.?	re	m	wyrs	fj	w	bsa	g		vl	
Stonewall. L. Syn. of Stonewall Jackson											
Stonewall Jackson. D. Syn. Stonewall	N.S.	robe	ml	yrs	tj	wy	sa	vg		l	
Stonewall Jackson. D. Syn. of Stonewall											
Stonor. L. Syn. Stonor Park	Eng	c	m	yrs	t	w	bsa	g	d	m	From Ronalds.
Stonor Park. D. Syn. of Stonor											
Stony Royd. R. Syn. Stony Royd Pippin		r	m	gy					d	vl	
Stony Royd Pippin. GenF'33. Syn. of Stony Royd											
Storing. L. Syn. Norfolk Storing	Eng	rob	l	yg	tje	w	bsa		km	ml	
Storr's Wine. Dap. Syn. of McAfee											
Story. P'92	Ohio?	re	ml	rs	fm	gy	s	vg	m	vl	
Stott. R. Syn. Stott's Russet	Ont.?			ru						l	
Stott's Russet. OntExR'82. Syn. of Stott											
Stoupka. Gb. Syn. of Stupka											
Stout. P'95	Ind	robl	m	y	c	yw	sa	g		m	
Stover. R. Syn. Stover's Best											Not described.
Stover's Best. FDNCo. Syn. of Stover											
Straat. NEF'79. Syn. of Stroat											
Strachan. Hort'72	Ill.?										Do.
Straintown. IllH'96. Syn. of Strinestown											
Strandt. W. Syn. of Straudt											
Stranger. L. Syns. Gov. list No. 970, Green Citron, Green Stranger, Tchushenka Zelenaya, Tuhnginka Selomaja.	Rus										Do.
Straudt. D. Syn. Strandt	Pa	re	l	dre	ft	w	sa	g		m	
Strawberry. D. Syn. of Chenango											
Strawberry. E. Syn. of Late Strawberry											
Strawberry Apple. M. Syn. of Margaret											
Strawberry of Switzerland. D. Syn. of Red Autumn											
Strawberry. D. Syn. of Richard											
Strawberry. Wg. Syn. of Turn off Lane											
Strawn. D. Syn. Strawn's Seedling	Va		ml	yrs	j	y	a	g		vl	
Strawn Harrison. R. Syn. Strawn's Harrison											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Strawn's Harrison. MoH'70. Syn. of Strawn Harrison											
Strawn's Seedling. A'52. Syn. of Strawn											
Strawn Seedling. A'69. Syn. of Buckingham											
Streaked Dutchman. MagofH'44. Syn. of Dutchman											
Streaked Naliv. Gb. Syns. Gov list No. 330, Juicy Streaked, Polosatoe Nalivnoe, Polosatoe Naliwnoe.	Rus	oblc	m	ywb		w	psa	g		me	
Streaked Pippin. D. Syns. Hempstead, Quaker (of some), Red Pippin, Skunk (erroneously).	N. Y	robl	l	pyrs	tj	y	psa	g-vg		ml	
Streaked Pippin. IH&S. Syn. of Red Pippin											
Streaked Revel. Gb. Syn. of Revel Streaked											
Streaked Sweet. Gb. Syn. of Sweet Streaked											
Streifling Edler Winter. Gb. Syn. of Noble Redstreak											
Streintown Pippin. P'93. Syn. of Strinestown											
Stribling. W	Tenn	ob	m	wrs	tj	w	psa	g-vg	d	me	
Stribling. SBro. Syn. of Red Harvest											
Striefling. CanExR'01		r	ms	grs	cj	w		g		l	Probably the same as Noble Redstreak.
Strifling d'Hiver. K,. Syn. of Asteurs											
Strinestown. (LC). Syns. Straintown, Streintown Pippin, Strinestown Pippin.	Pa	rc	m	yb	cmjt	w	sa		km	vl	
Strinestown Pippin. Dap. Syn. of Strinestown											
Stripe. R. Syn. Red Stripe of Pennsylvania		oblc	m	yrs			sa	vg		e	This may be Redstripe.
Striped Anis. IaB90	Rus		m				sa	vg	dk	m	
Striped Ashmore. W	Ohio	r	ml	rs			sa	g		m	
Striped Ashmore (?). E. Syn. of Vandevere											
Striped Beaufin. D. Syn. Striped Beefing	Eng	rob	l	rs			a			vl	From Lindley.
Striped Beefing. BBL. Syn. of Striped Beaufin											
Striped Belle et Bonne. D	N. E	rob	l	wyrs	cj	w	bsa	g	m	m	
Striped Belle Fleur. D. Syn. of Red Belle Fleur											
Striped Bellflower. H. Syn. of Red Belle Fleur											
Striped Bellflower. W	Ohio	obl	l	rs			sa	g		m	
Striped Bellflower. Dap. Syn. of Striped Gilliflower											
Striped Calville. Gb. Syns. Shro. to Ia. No. 103, Kalvil polosatui	Rus										Not described.
Striped Domine Pippin. Hort'72. Syn. of Domine											
Striped Gilliflower. W. Syns. Red Gilliflower, Scollop Gilliflower (incorrectly), Striped Bellflower.		roblc	l	rs			sa	g	m	m	
Striped Gilliflower. D. Syn. of Scollop Gilliflower											
Striped Harvest. GenF'32. Syn. of Harvest Redstreak											
Striped Holland. L. Syn. Striped Holland Pippin	Hol	r	l	yrs		w	sa	g	k	m	From Lindley.
Striped Holland Pippin. D. Syn. of Lincolnshire											

Striped Holland Pippin. D. Syn. of Striped Holland											
Striped Hop. PFar'60											Not described.
Striped July. WHyS	Tenn		ml	yrs	f	y	sa	vg		e	
Striped June. NEF'30	Va	obl	s	rs			sa	g		e	Probably identical with Red June.
Striped June. E. Syn. of Bevan											
Striped June. D. Syn. of Margaret											
Striped Juneating. NEF'33. Syn. of Margaret											
Striped Mohawk. D. Syn. of Mohawk											
Striped Monstrous Reinette. D. Syn. of Striped Reinette											
Striped Nally. Gb. Syns. Polosatka Nalivnaya, Shro. to Ia. No. 125	Rus										Not described.
Striped Pearmain. Dap. Syn. of Long Red											
Striped Pearmain. Dap. Syn. of McAfee											
Striped Pearmain. D. Syn. of McAfee (Striped Winter)											
Striped Pippin. A. Syn. Striped Sweet Pippin		rob	ml	rs			sa	vg	dm	l	
Striped Porter. NEF'60		roble	l	yrs	cj	w	sa			m	From New England Farmer.
Striped Quarrenden. GenF'33. Syn. of Margaret											
Striped Rambo. D. Syn. of Rambo											
Striped Red Harvest. Dap. Syn. of June Sweet											
Striped Reinette. L. Syn. Striped Monstrous Reinette	Eng	r	l	gyrs	tj		a		k	m	From Ronalds.
Striped R. I. Greening. D. Syn. of Domine											
Striped Rhode Island Greening. E. Syn. of Wells											
Striped Shropsavine. D. Syns. Curtiss Early Stripe, Striped Shropshirevine		oble	s	pyrs	c		p			me	
Striped Shropshire. Dap. Syn. of Early Strawberry											
Striped Shropshire. Hort'75. Syn. of Sops of Wine											
Striped Shropshirevine. Cole. Syn. of Striped Shropsavine											
Striped Sweet. W	Ohio	r	ml	rs			s	p		m	
Striped Sweet Harvest. Dap. Syn. of June Sweet											
Striped Sweeting. IndH'72			l	yrs			s	g		e	
Striped Sweet June. Cat	Ky.?										Not described.
Striped Sweet Pippin. GBB. Syn. Hunt			ml	rs	t		r	vg	dm	l	
Striped Sweet Pippin. Dap. Syn. of McAfee											
Striped Sweet Pippin. IllH'71. Syn. of Striped Pippin											
Striped Sweet Pippin. D. Syn. of McAfee (Striped Winter)											
Striped Vandevere. D Syn. of Vandevere											
Striped Winter. IaB'90. Syn. Orel list No. 6	Rus.?		m	yrs				vg		l	
Striped Winter Pearmain. Dap. Syn. of McAfee (Striped Winter)											
Striped Winter Pearmain. D. Syn. of Striped Winter. [This is McAfee.]											
Stripling. IllH'96											Do.
Stroat. MagofH'38. Syn. Straat	N. Y	rc	ml	yg	vt	y	bsa	g		m	
Strode. L. Syns. Strode's, Strode's Birmingham	Pa	oble	ms	y	j	y	sa	g-vg	d	m	
Strode's. D. Syn. of Strode											
Strode's Birmingham. D. Syn. of Strode											
Stromson. R. Syn. Stromson's Winter	South	r	m	gyrs			sa	g		l	
Stromson's Winter. IllH'72. Syn. of Stromson											
Strong-ribbed. Gb. Syn. of Ribbed											
Strother. W	Va										Do.
Strubel. D	Pa	roble	ml	yrs	cj	y	sa	g		l	
Stuart. (LC). Syns. Stuart's Golden, Stump (incorrectly)	Ohio	ob	ms	y	tj	wy	psa	vg		vl	
Stuart (Ia.). IaH'97											Do.
Stuart's Golden. Dap, MoH'89, BBL. Syn. of Stuart											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Stummer. R. Syn. Stummer Pippin		obe	m	gr	fr		sa			l	This and Sturmer may be identical.
Stummer Pippin. CanExR'96. Syn. of Stummer											
Stump (N. Y.). Dap	N. Y	roble	ms	wrsc	tj	w	psa	g-vg		m	
Stump (Del.?). D	Del.?	ob	m	yb	cjt	w	sa	g		m	
Stump (incorrectly). Dap. Syn. of Stuart											
Stump the World. MontB12											Not described.
Stupka. Gb. Syns. Gov. list No. 207, Stoupka	Rus										Do.
Sturgil. Cat											Do.
Sturmer. L. Syn. Sturmer Pippin	Eng	obe	ms	ybc	c		rsa	g		vl	This and Stummer may be the same.
Sturmer Pippin. K. Syn. of Sturmer											
Stymer's. AHortA'69. Syn. of Stymus											
Stymus. A'67. Syn. Stymer's	N. Y	obe	m	yrs	ftj	w	sa	vg		m	
Styre. C. Syn. Forest Styre	Eng	r	m	py	f		a	g	c	ml	
Styre. D. Syn. of Forest Styre											
Sudbury. L. Syns. Sudbury Sweet, Sudbury Sweeting	Mass.?	re	m	yrs	mtj	w	rs	g		ml	
Sudbury Sweet. D. Syn. of Sudbury											
Sudbury Sweeting. MagofH'42. Syn. of Sudbury											
Sudley. R. Syn. Lady Sudley											Not described.
Sudlow. R. Syns. Franklin's Golden Pippin, Sudlow's Fall Pippin	Am	re	m	y	cj	yw	rsa	g-vg		m	From Hogg.
Sudlow's Fall Pippin. GenF'33. Syn. of Sudlow											
Suffield. L. Syn. Lord Suffield	Eng	c	ml	gyb	ft	w	bsa		k	me	
Suffolk. L. Syn. Suffolk Beauty	N. Y	rob	m	ywru		w	sa			me	From Gardener's Monthly.
Suffolk Beauty. GarM'66. Syn. of Suffolk											
Sugar. W		c	l	y			s	p		l	
Sugar and Brandy. D	Eng	re	m	yb	j	vy	vs			me	From Hogg.
Sugar and Water. W	Ohio	c	m	rs			s	p		m	
Sugar Ball. NWC		ob	ml	y	t		vs			me	
Sugar Barbel. Gb. Syn. of Sugar Miron											
Sugarloaf. W. Syns. Sugar Loaf Greening, Sugar Loaf Pippin	Pa	obl		y			sa				
Sugar Loaf Greening. E. Syn. of Sugarloaf											
Sugarloaf Pippin. D. Syn. Hutching's Seedling	Eng	oble	m	yw	fj	w	ma	g		e	
Sugar Loaf Pippin. Gen.F33. Syn. of Sugarloaf											
Sugar Miron. Gb. Syns. Gov. list No. 368, Mirone Sacharni, Miron Sacharuni, Rgl. to Ia. No. 151, Sugar Barbel.	Rus	obe	ml	y			sa	g			
Sugar Pippin. Cat											Not described.
Sugar Sweet (Mass.). D	Mass	robe	l	yb	fr	w	s	g		l	
Sugar Sweet (Rus.). Gb. Syns. Gov. list No. 217, Sacharnoe	Rus										Do.
Suisse. D. Syns. Pomme de Perroquet, Pomme Rubanee, Pomme Suisse.	Fr.?	re	ml	grs	tmj	w	sa	g			

Suislepper. Gb. Syn. of Switzer											
Sullivan. P'95	Tenn	obe	m	ywrsc	ftj	y	sa	vg		l	
Sultan (Rus.). Gb. Syns. Gov. list No. 344, Sultanapfel	Rus.										Do.
Sultan. JTL			m	y				vg		ve	
Sultanapfel. Gb. Syn. of Sultan (Rus.)											
Summer. Cat. Syn. Sweet Bellflower											Do.
Summer Aport. Gb. Syns. Aport letney, Aport letny, Aport lietnee, Gov. list No. 166, Summer O'Porto.	Rus.	ob	ml	y			sa	vg		l	
Summer Banana. BBL											Do.
Summer Belle Fleur. E. Syn. of Summer Bellflower											
Summer Bellflower (N. Y.). Cole. Syn. Summer Belle Fleur	N.Y.	oble	ml	yb	ft	w	sa	g		me	
Summer Bellflower (Pa.). NEF'33. Syn. Summer Bellflower of Pennsylvania.	Pa	oble	l	y	ftj	yw	sa	g		me	
Summer Bellflower. A'95. [Probably distinct from S. B. of N. Y. and Pa.]											Do.
Summer Bellflower of Pennsylvania. D. Syn. of Summer Bellflower (Pa.)											
Summer Blush. DomEne								vg		e	
Summer Broaden. D. Syn. of Broaden											
Summer Broadend. D. Syn. of Broaden											
Summer Calville. H. Syns. Calville d'Ete, Calville Rouge d'Ete, Madeleine, Rother Sommercalville, Summer Red Calville.	Fr	rc	m	ywrs	t	ws	sa	g		me	
Summer Cheese. NEF'30. Syns. Cheese Apple, Findlay Apple, Fall Cheese, Gloucester Cheese, Maryland Cheese, Prather Apple.	Va.?	ob	m	yb	tj	w	sa	g		me	
Summer Cheese. E. Syn. of Mangum											
Summer Cheese. Dap. Syn. of Summer King											
Summer Colman. D. Syn. of Broaden											
Summer Extra. MoH'83	Ky.	robl	ml	yrb	tj	yw	sa	vg		e	
Summer Golden. L. Syns. Summer Golden Pippin, Summer Pippin	Eng	oble	s	y	fc	y	rsa	g-vg	d	me	
Summer Golden Pippin. GenF'33. Syn. of Summer Golden											
Summer Green. W	Pa	c	m	rs			sa	vg		e	
Summer Green Skin. BBL											Do.
Summer Hagloe. D. Syn. Hagloe		ob	l	wyrs	tj	w	sa	g-vg	dkm	m	
Summer Harvey. D	N. B.?	rob	l	gybru	tj	w	bsa	g		me	
Summer Horse. D. Syn. of Horse											
Summerhouse. Hort'54. [Exhibited at Chicago Oct., 1853.]											Do.
Summer Janet. W		r	m	pyrs	t	y	sa	g		me	
Summer Jenneting. D. Syn. of Fall Jenneting											
Summer King. Dap. Syn. Cheese, King, Puckett, Puckett's Summer, Summer Cheese, Summer King of Kerr.	N. C.?	rob	ml	ygrc	j	wy	bsa			me	From Western Gardener.
Summer King of Kerr. BBL. Syn. of Summer King											
Summer Limbertwig. W	Va. or N. C.	ob	m	pyrs	tfj	w	sa	vg	d	me	
Summer Livland. Gb. Syns. Gov. list No. 580, Livlandischer Sommer, Summer Lowland, Tierlandischer Sommer.	Rus.	rob		rs			sa			e	
Summer Lowland. Gb. Syn. of Summer Livland											
Summer Marigold. DomEne	Eng	rc	m	yrs	j		bpsa			me	
Summer Nonpareil. D. Syn. of Early Nonpareil (Eng.)											
Summer O'Porto. Gb. Syn. of Summer Aport											
Summerour. D. Syn. of Nickajack											
Summerout. IllB45											Not described.
Summer Paradise. L. Syns. August Pippin, Hare, Hare Pippin, Paradise Summer, Summer Sweet Paradise, Sweet Dumpling.	Pa	rob	l	pgyb	tcj		s	g-vg	dk		
Summer Pear. Gb. Syns. Gov. list No. 69. Sommer birnapfel	Rus.										Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Summer Pearmain (Am.) K. Syns. American Summer Pearmain, American Pearmain, Autumn Pearmain, Early Summer Pearmain, Watkin's Early.	Am	roble	m	yrsc	vt	y	rpma	b	d	me	
Summer Pearmain (Eng.) DomEnc. Syns. American Pearmain (erroneously), Autumn Pearmain, English Summer Pearmain, Parmain d'Ete, Royal Pearmain Siegler's Red, Summer Pearmain.	Eng	oblo	m	gyrs		yw		vg		m	
Summer Permain of Mount Bohannan. A'56. [Probably Syn. of Bohanon.]											
Summer Pegatch. (LC). [This and S. Pogatch doubtless identical.]	Eur										Not described.
Summer Pennock. A'95. Syn. of Early Pennock											
Summer Pippin. D. Syns. Calkin's Pippin, Champlain, Geneva Pearmain, Haverstraw Pippin, Large Golden Pippin, Nyack Pippin, Paper Apple, Sour Bough, Tart Bough, Underdunk, Walworth.		roble	ml	pyb	tj	w	psa	g	km	me	Probably same as Champlain.
Summer Pippin (N. Y.). A'62. Syns. Sour Bough, Tart Bough	N. Y	oblc	ml	gybc	t	w	psa			me	This and preceding probably identical.
Summer Pippin. D. Syn. of Champlain											
Summer Pippin. D. Syn. of Holland											
Summer Pippin. A'75. Syn. of Kentucky. [This is probably an error.]											
Summer Pippin. Lin. Syn. of Summer Golden											
Summer Pippin (of Mass.). R. Syn. Summer Pippin											
Summer Pippin. DomEnc. Syn. of Summer Pippin (of Mass.)											
Summer Pogatch. WashB25. [Doubtless same as Summer Pegatch.]											Not described.
Summer Pound. L. Syns. Orange, Pound Royal, Pound Royal of the Putnam's List, Summer Pound Royal, Summer R. I. Greening.		robc	l	gw	ftj	w	sa	g-vg	km	me	
Summer Pound Royal. D. Syn. of Summer Pound											
Summer Queen. DomEnc. Syns. Early Queen, Lancaster Queen, Large Summer Queen, Orange Apple, Pole Cat, Queen, Sharpe's Early, Swett's Harvest.	N. J.?	rc	l	yrs		y	ra	vg	km	me	
Summer Queening. DomEnc. Syn. of Crimson Queen											
Summer Queen of Missouri. A'77	Mo.?	obc	vl	gyrs	tj	yw		g	m	me	Claimed as distinct from Summer Queen.
Summer Rambo. D. Syns. Frank Rambour, Rambour d'Ete, Rambour France, Rambour Gros, Summer Rambour.	Fr	ob	ml	pgyrs	t		sa	g		me	
Summer Rambo. A'77. Syn. of Grosh											
Summer Rambo of Penn. FDNCo			vl	yrs			sa	g		me	This is probably Grosh.
Summer Rambour. C. Syn. of Summer Rambo											
Summer Red. W	South									me	
Summer Red. A'60. Syn. of Coffman											
Summer Red. Cat. Syn. of Late Russian											
Summer Red Calville. DomEnc. Syn. of Summer Calville											
Summer Red Pearman. DomEnc											Not described.

Summer Redstreak. Cat.											Do.
Summer Reinette. D. Syns. Reinette d'Ete Blanc, Weisse Sommer Reinette, Weisse Wack's Reinette.	Ger	rob	vl	yb	fj	w	s			m	From Diel.
Summer Rhode Island Greening. D. Syn. of Summer Pound											
Summer Rose. C. Syns. Glass Apple, Lippincott, Lippincott's Early, Lodge's Early, Wolman's Harvest, Woolman's Early, Woolman's Harvest, Woolman's Striped Harvest.	N. J.	rob	ms	yrs	tj	w	sa	vg	dk	me	
Summer Russet. NAPC'49		r	s	ru			sa				
Summer Russet. D. Syn. of Sweet Russet											
Summer Scarlet. R. Syn. Summer Scarlet Pearmain		c	m	yb				vg		e	
Summer Scarlet Pearmain. Wg. Syn. of Summer Scarlet											
Summer Seeknofurther. W. Syn. Seeknofurther Summer	Ohio	r	l	rs			s	g		me	
Summer Seek-no-further. IllB45. Syn. of Dumelow (of Wisconsin)											
Summer Spitzenburg. R. Syns. French Spitzenburgh, Summer Spitzenburgh.	N. Y.	rc	m	wrs	mj	yw	sa	g-vg		me	
Summer Spitzenburgh. Dap. Syn. of Summer Spitzenburg											
Summer Sweet (Ct.). D. Syn. Summer Sweet Russet	Conn	obc	m	yru	etmj	w	s	g	k	me	
Summer Sweet (Ga.). W.	Ga.	ob	l	y			s	g		me	
Summer Sweet. Hort'74. Syn. of Golden Sweet											
Summer Sweet. Cole. Syn. of Hightop Sweet											
Summer Sweet. Dap. Syn. of King Sweet											
Summer Sweeting. IndH'72											Not described.
Summer Sweeting. MagofH'48. Syn. of Hightop Sweet											
Summer Sweet Paradise. A'60. Syn. of Autumn Paradise											
Summer Sweet Paradise. Lin. Syn. of Summer Paradise											
Summer Sweet Russet. Lin. Syn. of Summer Sweet (Ct.)											
Summer Tenchat Egg. D. Syn. of Tenchat											
Summer Thorle. GenF'33. Syn. of Thorle											
Summer Traveler. GenF'33. Syn. of Margaret											
Summer Wafer. AlaB98. Syn. of Wafer											
Summer White. L. Syns. Calville Blanc, Calville Blanche d'Ete, Summer White Calville, Wahrer Weiser Sommercalville, White Calville, White Summer Calville.		rob	m	pyru	t	w	ps			me	From Hogg.
Summer White Calville. DomEnc. Syn. of Summer White											
Summum Bonum. W. Syn. of Bonum											
Summum Bonum. D. Syn. of Chief Good											
Sumner. R. Syn. Sumner Pie. [Shown by R. P. Sumner.]	Mass.										Not described.
Sumner Pie. MagofH'43. Syn. of Sumner											
Sumnol Kalville. SDB76	Rus.	oblc	m	wrs	tfj	w	sa	vg	d	m	Not certainly distinct from several named sorts.
Sunbeam. CanExR'01											Not described.
Sunday. L. Syn. Sunday Sweet	Ill	ob	s	y			s	g		l	
Sunday Sweet. W. Syn. of Sunday											
Superb. D.	N. C.	rob	ml	g	c	y	rsa	g-vg		l	
Superb. SDB76. Syn. of Oligher (?)											
Superb Sweet. M	Mass.	rc	ml	pyrs	vtj	w	s	g-vg	k	m	
Superb White. Dap. Syn. of Settle											
Superfine. L. Syn. Reinette Superfine	Fr		vl					vg		vl	
Superior. MagofH'51											Do.
Superior White. A'69. Syn. of Parry White											
Surecrop. SBro	Ark	c	l	rs					dk	e	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Surprise. GenF'32	Eur	r	s	wy		vys	sa	p	k	ml	Flesh deeply stained with red.
Surprise (of Wis.). BBL											Not described.
Surrey. L. Syn. Surrey Flat Cap	Eng	rob	ml	pgru	fr	y		vg	d	ml	
Surrey Flat Cap. D. Syn. of Surrey											
Susan. A'73. Syn. Susan Spice, Susan's Spice	Pa	ob	m	wcb	j	yws	psa	g	d	m	From Gardener's Monthly.
Susannah. D	S. C	oblc	l	gy	c		r			vl	From Sumner's manuscript.
Susan Spice. GarM'59. Syn. of Susan											
Susan's Spice. GarM'59. Syn. of Susan											
Sussapfel van Avenarius. Gb. Syn. of Avenarius											
Sussapfel van Toenarius. Gb. Syn. of Avenarius											
Susy Clark. Dap. Syn. of Red June											
Sutton. E. Syns. Beauty, Hubbardston Nonsuch, Sutton Beauty, Sutton's Beauty.	Mass	robc	ml	pyrsc	ctj	w	sa	vg	dkm	ml	Possibly more than one variety included in synonyms.
Sutton. H. Syn. of Hubbardston											
Sutton Beauty. Cole. Syn. of Sutton											
Sutton's Beauty. N. Syn. of Sutton											
Sutton Early. L. Syn. Sutton's Early	N. S	robc	ml	wy	tj	w	bsa		k	me	
Sutton Export. NEF'49	Mass	robl	m	yru	f			g		vl	
Sutton's Early. A'75. Syn. of Sutton Early											
Sutton Seedling. L. Syn. Sutton's Seedling	South	r		rs			sa				
Sutton's Seedling. W. Syn. of Sutton Seedling											
Svinets. Gb. Syn. Apple "Lead," Gov. list No. 426, Shro. to Ia. No. 92, Swinez.	Rus										Not described.
Svinsovka. MHSC'81. Syn. Gov. list No. 362	Rus										Do
Svinsovka. Gb. Syn. of Lead											
Svintsovka. Gb. Syn. of Lead											
Svonkoe. Gb. Syn. of Resonant											
Svonkoe ili Dinnoe. Gb. Syn. of Bell (Melonen)											
Svonkoe ili Dinnoe. Gb. Syn. of Melonen											
Swaager. L. Syn. Mount Swaager	Mass	r	m	y			sa	p		l	
Swaar. DomEnc. Syn. Hardwick	N. Y	rob	l	gy	ft	y	rsa	vg-b	dk	ml	
Swadley. P'95. Syn. Red Pippin	Tenn	ob	m	ywrsc	ftj	yw	sa	vg		m	
Swain. A'62											Do.
Swamp. IndH'76. [Shown at the Centennial.]											Do.
Swan. Gb. Syns. Gov. list No. 370, Lebedka, Shro. to Ia. No. 50	Rus										Do.
Swan Sweet. Cat											Do.
Swasey. RNY'70	Ohio	ob	s	yb	ct	w	sa	g		ml	
Swasey. IllB45. Syn. of Sweet Bellflower (of Wyandot County)											

Swayzie. R. Syns. Swayzie Pomme Grise, Swazy	Can	robl	s	yru	etj	gy	sa	vg	dk	l	Misspelled in Bulletin 8.
Swayzie Pomme Grise. S&W. Syn. of Swayzie											
Swazie's Pomme Gris. Dap. Syn. of Golden Gray (?)											
Swazy. Buls. Syn. of Swayzie. [Misspelled in Bulletin 8.]											
Sweeney. L. Syn. Sweeney Nonpareil	Eng	rc	m	grub	fej		a		k	vl	
Sweeney Nonpareil. GenF'33. Syn. of Sweeney											
Sweet Alice. BBL											Not described.
Sweet Ammidon. R. Syn. Ammidon's Fall Sweet											Do.
Sweet and Sour. DomEne		ob	l	gy			s	p		ml	Singular, but of no value.
Sweet Anis. Gb. Syns. (Anis Sacharnui), Gov. list No. 403, Sweet Anisette.	Rus.										Not described.
Sweet Anisette. Gb. Syn. of Sweet Anis											
Sweet Aport. Gb. Syns. Aport Sladkui, Shro. to Ia. No. 108	Rus.										Do.
Sweet Baldwin. D		rob	m	yrs	mj	y	s	g		m	
Sweet Belle. L. Syns. Belle et Bonne, Sweet Belle et Bonne		robc	ml	yru	mj	y	rs	g		m	
Sweet Belle et Bonne. D. Syn. of Sweet Belle											
Sweet Bellflower. D. Syns. Butter (of some), Sweet Butter		rob	ml	gyb	t	yw	s	g		m	
Sweet Bellflower. D. Syn. of Autumn Bough											
Sweet Bellflower. Cat. Syn. of Summer											
Sweet Bellflower (of Pa.). BBL	Pa.?										Do.
Sweet Bellflower (of some). H. Syn. of Applebutter											
Sweet Bellflower (of Wyandot Co.). D. Syns. Swasey, Sweet Bellflower (of Wyandot County.)	Ohio.	roblc	ml	gyru	mjt	y	s	g	dkm	m	Authors' descriptions differ.
Sweet Bellflower (of Wyandot County). D. Syn. of Sweet Bellflower (of Wyandot Co.).											
Sweet Ben. R. Syn. Sweet Ben Davis	Ark	rob	l	{ gyw rcp }	j	w	s	g		l	
Sweet Ben Davis. P'95. Syn. of Sweet Ben											
Sweet Borovinka. Gb. Syns. Borovinka Sladkaya, Borowinka Sladkaja, Gov. list No. 874, Sweet Mushroom.	Rus.	c	l	yrs	fj	w	s	g		me	
Sweet Bough. D. Syn. of Bough											
Sweet Buckingham. JVL		obc	l	yrs			s	vg		ml	
Sweet Butter (?). D. Syn. of Sweet Bellflower											
Sweet Cann. D. Syn. of Cann											
Sweet Crimson. IndH'72. Syn. of Crimson											
Sweet Cross. Gb. Syns. Shro. to Ia. No. 8, Skrijapel Sladkui	Rus.	ob	ml	rs							
Sweet Dixon. OL	N.C		ml	rs			s	vg			
Sweet Doctor. D	Pa	rob	m	yrs	tj	w	rs	g		m	
Sweet Dumpling. Dap. Syn. of Summer Paradise											
Sweet Fall. L. Syn. Sweet Fall Pippin	N. Y	ob	l	y			s	g	k	m	
Sweet Fall Pippin. D. Syn. of Sweet Fall											
Sweet Fameuse (Wis.). IllH'97	Wis			r		w	vs				
Sweet Fameuse (Que.). Syn. Sweet Fameuse No. 2 of St. Hilaire	Que	ob	ml	yrs	j	w	rmsa	g-vg		ml	
Sweet Fameuse No. 2 of St. Hilaire. VtB83. Syn. of Sweet Fameuse (Que.)											
Sweet Gate. W	Ohio	ob	m	y			s	g		m	
Sweet Genet. F. Syn. of Sweet Janet											
Sweet Gilliflower (Mich.). H	Mich	c	m	rs			s	g		l	Probably identical with Sweet Bellflower (of Wyandot Co.).
Sweet Gilliflower. W		r	m	rs			s	g		m	
Sweet Golden Pippin. D. Syn. of Autumn Swaar											
Sweet Golden Russet. T		c	ml	yru			s			me	
Sweet Greening. Th		rob	l	gyb		w	s	g		l	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Sweet Harvest. D. Syn. of Bough											
Sweet Harvey. D. Syn. of Sweet Vandervere											
Sweethead. IllH'99		rc	l	yrs			s			e	
Sweetheart. R. Syn. Early Sweetheart	Mo	rob	l	y	tmj	y	msa	vg-b	dm	ve	This may be Bough.
Sweet Home. D. Syn. of Dulce Doman (Domum?L.)											
Sweeting. F. Syn. of Golden Sweet											
Sweeting, Well's. D. Syn. of Wells Sweet											
Sweet Janet. W. Syn. Sweet Genet	Ind	rc	l	yrsc	j	y	bs	g	km	ml	A seedling of Ralls.
Sweet Jersey. D. Syn. of Hampton Late											
Sweet Jonathan. IllH'97			m	dr			s	vg		l	
Sweet June. IndF'40. Syn. of Hightop Sweet											
Sweet June of Ill. E. Syn. of Hightop Sweet											
Sweet King. D	N. Y	rc	m	yrs	tj	w	s	g-vg		ml	
Sweet Limbertwig. Cat											Not described.
Sweet Limbertwig. TennBX-I. Syn. of Harpole											
Sweet London Winter. H. Syn. of London Sweet											
Sweet Longfield. IaB31	Rus	oblc	l	yb	fr	w	s	vg	dk	me	Hansen says name changed from Kursk Reinette.
Sweet Lyman's Pumpkin. Lin. Syn. of Pumpkin Sweet (Ct.)											
Sweet Maiden's Blush. D. Syn. of Campfield											
Sweet Maiden's Blush. D. Syn. of Griffith											
Sweet Mary. MagofH'57	Tenn	rc	ml	wy	tj	yw	s			me	
Sweetmeats. A'56	Ind	c	ms	rru	t	y	vs	vg	k	ml	Origin, Putnam Co., Ind., from seed of Pryor.
Sweet Mensk. Gb. Syns. Gov. list No. 595, Mtsenskoe Sladkoe, Mzenskoe Sladkoe, Mzensk Sweet, Shro. to Ia. No. 49.	Rus	robl	vl	rs			sa	g			
Sweet Miron. MHSc'86											Not described.
Sweet Moscow. SDB76	Rus	rc	ms	gy	f	w	vs	vg		me	Name suggested for one from which label was lost.
Sweet Mother. AJofHVII	Mass		m	r	t	w	s	g		ml	
Sweet Mushroom. Gb. Syn. of Sweet Borovinka											
Sweet Nonsuch. NWFG'52. Syn. of Sweet Romanite											
Sweet Orange. P'95	Ark	ob	ml	py	vcj	y	s	g		l	
Sweet Pear (Ind.). CGen'61	Ind.?	c	m	yb	tj	w	s	vg	dk	m	
Sweet Pear (Ohio). D	Ohio	rc	m	y			s	vg		m	
Sweet Pear (Rus.). Gb. Syns. Gov. list No. 965, Grusсheffka Sladkaja, Gruschevka Sladkaya.	Rus	rob	sm	yb	j	w	s	g		ml	
Sweet Pearmain. DomEnc. Syn. Herrick Sweet	Ohio	rc	m	rs	jt	w	brs	vg		vl	
Sweet Pearmain (of some). D. Syn. of Sweet Winesap											
Sweet Pennock. L. Syn. Sweet Winter Pennock	Ohio	rob	ml	rs			s	p		ml	

Sweet Pine. Hort'59. [Mentioned by T. McWhorter, of Ill.]											Not described.
Sweet Pipka. Gb. Syns. Gov. list No. 321, Gov. list No. 406, Pipka Sacharnaja, Pipka Sacharnaya, Pipka Sladkaja, Pipka Sladkaya, Saccharine Pipka, Sweet Pippin.	Rus.	oble	m	yw	fj	w	s	g		m	
Sweet Pippin. C. Syns. Moore's Sweeting, Pound Sweet of some West, Red Sweet Pippin of Indiana.		rob	m	yrb	fmj		s	g		ml	Probably distinct from Moore Sweet.
Sweet Pippin. D. Syn. of Hog Island											
Sweet Pippin. D. Syn. of Moore Sweet											
Sweet Pippin. InB31. Syn. of Sweet Pipka											
Sweet Prolific. Gb. Syns. Plodovitka Sladkaya, Shro. to Ia. No. 73	Rus.										Not described.
Sweet Queen. D. Syn. Dale's Sweet Fall Queen	Pa	oble	l	wrs	t	w	ps	p		m	
Sweet Rambo. D	Pa	rob	m	yrs	j	w	ps	g-vg	k	m	
Sweet Rambo (incorrectly). A'77. Syn. of Grosh											
Sweet Redstreak. D. Syn. of Sweet Vandervere											
Sweet Rhode Island Greening. Dap. Syn. of New Greening. [Probably identical with Curtis Greening.]											
Sweet Ribbed Gillifiower. D	Conn	roble	l	rs	emj	w	s	g		m	
Sweet Romanite. D. Syns. Orange Sweet (erroneously), Red Winter Sweet, Sweet Nonsuch.		rob	m	gyrs	tj	yw	rs	g-vg	dk	ml	
Sweet Russet (1). Wg. Syn. Summer Russet		reob	s	yru	vtj	w	rs	vg		me	
Sweet Russet (2). D	Mass.	ob	m	yru	t	w	rs	g		ml	
Sweet Russet (3). D. Syn. Sweet Russet of Kentucky		oble	s	ru	f	yw	s	p		ml	
Sweet Russet. D. Syn. of Cheeseboro											
Sweet Russet. D. Syn. of Pumpkin Russet											
Sweet Russet. T. Syn. of Pumpkin Sweet											
Sweet Russet of Kentucky. W. Syn. of Sweet Russet (3)											
Sweet Russet of Ohio. W. Syn. of Pumpkin Sweet											
Sweet Russet (of some erroneously). D. Syn. of Spice Russet											
Sweet Seedling. H	Ind							g			This is probably the Sweet Janet.
Sweet Seeknofurther. D	N. H	rc	ml	ygb	fj		s	g		vl	
Sweet Seeknofurther. D. Syn. of Goble											
Sweet Spice. L. Syn. Red Sweet Spice	Ohio	ob	s	rs			s	g		m	
Sweet Spice. Lin. Syn. of Spice Sweet											
Sweet Spitzenburg. CAG			m	r			s			vl	
Sweet Sponge. W	Ohio?	ob	m	yw	t	w	s	g		e	
Sweet Streaked. Gb. Syns. Gov. list No. 196, Polosatka Sladkaya, Polosatoe Sladkoe, Polosatoe Sladskoe, Shro. to Ia. No. 77, Streaked Sweet.	Rus.										Not described.
Sweet Stripe. MHSc'86	Rus.	obc	m	grs		w	s		d	me	
Sweet Swaar. D. Syn. of Autumn Swaar											
Sweet Vandervere. D. Syns. Red Winter Sweet, Sweet Harvey, Sweet Redstreak.	West.	rob	m	yrs	tjm		s	g	k	ml	
Sweet Wealthy. SDB76	Minn	r	m	gyrs	fj	w	ps	vg		m	From seed of Wealthy, by O. M. Lord, in 1874.
Sweet Willie. D. Syn. of Willie											
Sweet Wine. Hort'62	Ohio	r	s	rs			s	g		m	
Sweet Wine. D. Syn. of Fall Wine											
Sweet Winesap. D. Syns. Henrick Sweet, Henry Sweet, Ladies' Sweet (of some), Red Sweet Winesap, Sweet Pearmain (of some).	Pa	obc	m	rc	tj		rs	g-vg		l	
Sweet Winesap. CBCo. Syn. of Hendricks											
Sweet Winter. MagofH'38		r	m	grs	f		s	g		l	
Sweet Winter Nonsuch. FDNCo											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Sweet Winter Pennock. W. Syn. of Sweet Pennock											
Sweet Winter Rambo. JVC		r	m	yrs	fe		s			l	
Sweet Winter Spitzenburg. Dap	Vt.?	robe	m	y	tmj	y	vs	vg		ml	
Swenker. DelB95		obe	ml	gyr	j	y	sa	g			
Swett's Harvest. DomEnc. Syn. of Summer Queen											
Swinez. Gb. Syn. of Svinets											
Swinsovka. IaB31	Rus.		ml	gy	fj		sa		d	l	
Swinzoffka. Gb. Syn. of Lead											
Swiss. T. Syn. of Pittsburg											
Swiss Apple. D. Syn. of Pittsburg											
Swiss Pippin. D. Syn. of Pittsburg											
Swiss Reinette. D. Syn. Reinette Suisse	Eur	obe	ml	y	ctj	y	psa	vg		ml	
Switch. R. Syn. Switch Willow											Not described.
Switch Willow. MagofH'53. Syn. of Switch											
Switz. R. Syn. Switz Pippin	Pa	obe	l	gybr	tj	yw	sa	vg-b		l	
Switzer. Gb. Syns. Gov. list No. 304, Suislepper	Rus.	rob	m	y			sa	vg	dm	ml	
Switzer Apple. T. Syn. of Pittsburg											
Switz Pippin. A'77. Syn. of Switz											
S. Wochinskoe. Gb. Syn. of Vochin											
Swonkoe. Gb. Syn. of Resonant											
Sykehouse. GenF'33. Syn. Syke-House Russet	Eng	ob	m	gru	fcj	y	sa			ml	From Ronalds.
Syke-House Russet. GenF'33. Syn. of Sykehouse											
Sylvan. IllH'96											Not described.
Sylvan Russet. D. Syn. of Roxbury											
Sylvan Sweet. WisB45			l	ypb	t	w	s	g		e	This may be a crab.
Sylvester. PFar'60. Syn. The Sylvester Apple	N. Y	rob	ms	wbc	tcj	vw	sa	vg	dk	m	
Sylvester Pie. R. Syn. Sylvester's Pie	N. Y		ms	yr							
Sylvester's Pie. A'58. Syn. of Sylvester Pie											
Symmes. L. Syn. Symmes' Harvest	Va.	r		rs			sa			e	
Symmes' Harvest. W. Syn. of Symmes											
Symonds. R. Syn. Symonds Nonpareil											
Symonds Nonpareil. GenF'33. Syn. of Symonds											
Synap. IaB90. Syn. of Persian											
Synonym. A'87. [This may be a misprint.]											Not described.
Syoset. IllB45											Do.
Table. L. Syn. Table Greening	Me.	r	m	g	j		psa	g		l	
Table Greening. Cole. Syn. of Table											
Tacoma. R. Syn. Tacoma of Stark											Do.
Tacoma of Stark. BBL. Syn. of Tacoma											
Taft. A'71	Mo.?	ob	ms	yrs	ft	w	sa	vg		l	

Taggart. R. Syn. Taggart Sweet							s				Do.
Taggart Sweet. ColExR'88. Syn. of Taggart											
Takapuna. R. Syn. Takapuna Russet. [This and Takaquna probably identical.]				ru							Do.
Takapuna Russet. BBL. Syn. of Takapuna											
Takaquna. SBro	For									l	This and Takapuna doubtless identical.
Talbert. OkIB2. Syn. of Talbot											
Talbot. FTR. Syns. Talbert, Talbot Pippin	Tex		ml	gyrs	fj	y		vg		ml	
Talbot Pippin. LTS. Syn. of Talbot											
Talent. P'94	Wis.	rob	l	y	tj	y	rsa	vg		l	
Tallafero. K	Va.?		m	wrs			a	g	c		
Tallman's Sweet. W. Syn. of Tolman											
Tallman Sweeting. GenF'38. Syn. of Tolman											
Tallman's Sweeting. D. Syn. of Tolman											
Tallow Apple. D. Syn. of Lowell											
Tallow Pippin. E. Syn. of Lowell											
Tall Sweet. Cat. [May be Hightop Sweet.]											Not described.
Talltop. A'89. [May be Hightop Sweet.]											Do.
Talman Sweet. N. Syn. of Tolman											
Talman's Sweet. D. Syn. of Tolman											
Talman Sweeting. Cole. Syn. of Tolman											
Talman's Sweeting. G. Syn. of Tolman											
Talpehocken. H. Syn. of Fallawater											
Tama. JNCo	Iowa		m		fc		s			l	One of Thompson's seedlings.
Tankerd. MHSC'81											Not described.
Tanner. L. Syns. Tanner's No. 1, Tanner's Winter	South?	obe	m	wyrs	j	wy	sa	g-vg		ml	
Tanner's No. 1. IllH'72. Syn. of Tanner											
Tanner Strawberry. BBL											Do.
Tanner's Winter. Dap. Syn. of Tanner											
Tardive de Joucret. D. Syn. of Joucret											
Tariff. MagofH'43											Do.
Tart Bough (N. Y.?). D. Syn. Sour Bough (of some)	N. Y.?	ob	m	y			a	g	k	e	
Tart Bough (2). D		re	s	w	ftj	w	sa	g	dk	me	
Tart Bough. D. Syn. of Champlain. [This and Summer Pippin may be identical.]											
Tart Bough. GenE'33. Syn. of Early Harvest											
Tart Bough. A'62. Syn. of Summer Pippin. [May be same as Champlain.]											
Tart Harvest. L. Syn. Early Tart Harvest		obe	m	wgb	vtj	w	sa	vg		me	Ripe about two weeks later than Early Harvest.
Tarvey. L. Syn. Tarvey Codlin	Eng	c	l	gyr	j	w	sa	g	k	m	From Hogg.
Tarvey Codlin. D. Syn. of Tarvey											
Tashkin. Gb. Syns. Shro. to Ia. No. 141, Taskinskoe	Rus.										Not described.
Taskinskoe. Gb. Syn. of Tashkin											
Tassen Hassen. IaH'02											Do.
Taubenapfel Revaler. Gb. Syn. of Revel Pigeon											
Taubenfarbige Apfel. D. Syn. of Pigeonette											
Taunton. D	Ala. or Ga.	obe	l	gyrs	tj	w	a	g		m	
Taunton. D. Syn. of Pomeroy											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Taunton Golden. L. Syn. Taunton Golden Pippin	Eng	r	m	yru	fe	y	sa			l	From Hogg.
Taunton Golden Pippin. D. Syn. of Taunton Golden											
Taunton Maid. L. Syn. Fair Maid of Taunton	Eng	rob	s	pyb	tj	yw	s			ml	Do.
Taylor. IllH'95. Syn. Taylor Red	Ohio	ob	m	rs			sa	g	m	l	
Taylor Garden. R. Syn. Taylor's Garden											Not described.
Taylor's Garden. IllH'69. Syn. of Taylor Garden											
Taylor Harvest. L. Syn. Taylor's Harvest		rob	ml	y			sa	g-vg	dk	e	
Taylor's Harvest. IllB'45. Syn. of Taylor Harvest											
Taylor Red. W. Syn. of Taylor											
Taylor Seedling. R. Syn. Taylor's Seedling. [Highly commended by The Horticulturist.]	Eng										Do.
Taylor's Seedling. Hort'58. Syn. of Taylor Seedling											
Taylor Winter. L. Syn. Taylor's Winter											Do.
Taylor's Winter. Cat. Syn. of Taylor Winter											
Tazewell. R. Syn. Tazewell Seek-no-Further	Ill.?										Do.
Tazewell Seek-no Further. BBL. Syn. of Tazewell											
(*Tcherеztetchnui.*) Gb. Syn. of Overflowing											
Tchernoe Derevo. Gb. Syn. of Blackwood											
Tchernokrasnoe. Gb. Syn. of Redblack											
Tchuilotchnoe. Gb											
Tchushenka Zelenaya. Gb. Syn. of Stranger (Green)											
Tchutilotchnoe. Gb. Syn. of Aromatic (Gibb)											
Tecumseh. BBL											Do.
Teignmouth. D. Syn. of Tinmouth											
Telfer. L. Syn. Telfer's Sweet											Do.
Telfer's Sweet. BBL. Syn. of Telfer											
Teller. BBL											Do.
Templeton. R. Syn. Templeton Winter Sweet							s			l	Do.
Templeton Winter Sweet. MagofH'38. Syn. of Templeton											
Temptation. Cat											Do.
Tenan Red. D. Syn. of Ben Davis											
Tenderskin. AHortA'68. Syn. Tender Skin	S.C	rc	ms	yrs	tvj	y	psa	g-vg	d	ml	
Tender Skin. W. Syn. of Tenderskin											
Tender Sweet. MagofH'43											Do.
Tenkassen. Cat											Do.
Tennessee Early Red. Dap. Syn. of Early Strawberry											
Tennessee Mammoth. A'97. Syn. of Gloria Mundi											
Tennessee Red. W	Tenn	c	m	rs			s	g		m	
Tennessee Wilding. W	Tenn	obl	m	rs			sa	g		l	
Tenon Hills. D. Syn. of Belle et Bonne. [Probably Belle Bonne.]											
Ten Shillings. D		rob	m	gyru	t	yw	sa			m	From Hogg.

Tenterden. L. Syn. Tenterden Park	Eng.?	r	m	ygrs	tcj	gw	bsa			ml	Do
Tenterden Park. GenF'33. Syn. of Tenterden											
Terral. R. Syns. Terral's Late, Terrall's Late, Terrall, Terrill's Late	South	obl	l	wrs	tj	w	psa	g		m	
Terral's Late. D. Syn. of Terral											
Terrall. BBL. Syn. of Terral											
Terrall's Late. W. Syn. of Terral											
Terrill's Late. IllH'86. Syn. of Terral											
Terry. A'97. Syn. Terry Winter	Ga	rc	s	yr		y	bsa	vg-b	dm	l	
Terry's Redstreak. D. Syn. of Rambo											
Terry Winter. PJB. Syn. of Terry											
Terwilliger. FHC. Syn. Terwilliger's Favorite	Wis		m					vg		vl	
Terwilliger's Favorite. A'83. Syn. of Terwilliger											
Teschonka. Gb. Syn. of Lejanka											
Tetipsky. ColExR'88. [This is probably Tetofski.]											Not described.
Tetuckrasnoe. Gb. Syn. of Red Titka											
Tetofski. W. Syns. Russian Crab, Tetofsky	Rus	robc	m	yrs	j	w	a	g	km	me	This is Warder's spelling. It is doubtless correct.
Tetofski (erroneously). D. Syn. of July											
Tetofsky. Lin. Syn. of Tetofski											
Tetovka. IllH'86. [This may be Tetofski.]											Not described.
Teubner. R. Syn. Teubner's. [This and Tuebner doubtless the same.]											Do.
Teubner's. MoH'68. Syn. of Teubner											
Teubner's Cider. A'67. Syn. of Tuebner Cider. [This and Tuebner doubtless the same.]											
Teubner's Golden. A'67. Syn. of Tuebner Golden. [Probably a misprint. See Downing.]											
Teuchat. L. Syns. Chucket Egg, Summer Teuchat Egg, Teuchat's Egg	Eng.?	oblc	ms	pyrs	tj		psa?			me	From Hogg.
Teuchat's Egg. D. Syn. of Teuchat											
Teuton Sweet. W. Syn. of Trumbull											
Teuton Sweeting. E. Syn. of Trumbull											
Tevokee. Cat											Not described.
Tewksbury. L. Syns. Fink's Seedling, Tewksbury Blush, Tewksbury Winter Blush.	N.J	ob	s	yb	j	y	sa	vg	d	vl	
Tewksbury Baron. BBL											Do.
Tewksbury Blush. Lin. Syn. of Tewksbury											
Tewksbury Winter Blush. C. Syn. of Tewksbury											
Texas. L. Syn. Pride of Texas		rc	m	y			sa	g		vl	
Texas Dwarf. Cat. Syn. of Running											
Texas Red. TVM			l	rs				g		l	
Texas Red. Dap. Syn. of Winesap											
Thaler. Gb. Syns. Charlottenthaler, Charlottenthaler Gelber, Charlottenthalskoe jeltoe, Gov. list No. 342, Scharlottenthaler Golba, Shro. to Ia. No. 147.	Rus										Do.
The Cook. L. Syn. The Cook's Favorite	Ind	obc	m	y			sa	g	k	me	
The Cook's Favorite. W. Syn. of The Cook											
The Guild. BBL											Do.
Them. L. Syn. Them's Red Streak		r	m	grs			a			l	
Them's Red Streak. MagofH'44. Syn. of Them											
The Queen. AndN		rob	l	ywr						ml	
The Revel. Gb. Syn. of Revel											
The Sylvester Apple. F. Syn. of Sylvester											
Thickset. D. Syn. of Cluster Golden											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Thill's Favorite. MoH'85. Syn. of Smiley											
Thinskin. MagofH'36											Not described.
Thintwig. Gb. Syns. Gov. list No. 478, Thin Twig Streaked, Tonkovietka polosataya, Tonkowetka polosataja.	Rus.										Do.
Thin Twig Streaked. Gb. Syn. of Thintwig											
Thomas (Md.). MagofH'53. Syn. Thomas Apple	Md.?	rc	l	gy	tj		psa			ml	
Thomas (Mo.). MoH'99	Mo			gy							
Thomas. D. Syn. of Milam											
Thomas Andrew Knight. AmGar'99. Syn. of Charles Ross											
Thomas Apple. MagofH'53. Syn. of Thomas (Md.)											
Thomas Fall. R. Syn. Thomas' Large Fall											Do.
Thomas' Large Fall. IndH'72. Syn. of Thomas Fall											
Thomas Gatch. W. Syn. of Gatch											
Thomas Late. L. Syn. Thomas' Late	South	ob		rs			sa			l	
Thomas' Late. W. Syn. of Thomas Late											
Thomas Sweet. Dap. Syn. of King Sweet											
Thomberry. IllB45		ob	ml	yb			sa	vg		l	
Thompkins. Cole. [Cole calls this very fine, but does not describe it.]			l								Do.
Thompson. IllH'01											Do.
Thompson (Tenn.). BAC	Tenn									e	
Thompson (Iowa). JNCo. Syn. Thompson's Seedling No. 24	Iowa	robl	ml	grs	cj	w	sa	g		l	One of Thompson's Iowa seedlings.
Thompson. (Me.). NEF'48											
Thompson Favorite. R. Syn. Thompson's Favorite	Me		l	rs				vg		e	
Thompson's Favorite. NEF'50. Syn. of Thompson's Favorite											
Thompson's Seedling No. 24. SDB76. Syn. of Thompson (Iowa)											
Thompson 29. MichB177. [This is probably Judson of Bulletin 8.]											
Thompson Morris. R. Syn. Thompson's Morris											Not described.
Thompson's Morris. A'81. Syn. of Thompson Morris											
Thompson Sweet. R. Syn. Thompson's Sweet											Do.
Thompson's Sweet. IllH'93. Syn. of Thompson Sweet											
Thoral Pippin. D. Syn. of Thorle											
Thoresby. R. Syn. Thoresby Seedling		robl	m	r					d	l	
Thoresby Seedling. GenF'33. Syn. of Thoresby											
Thorle. D. Syns. Summer Thorle, Thoral Pippin, Thorle Pippin, Watson's New Nonsuch, Whorle Pippin.	Scot	ob	s	yrs	fcj	yw	sa			me	From Ronalds.
Thorle Pippin. GenF'33. Syn. of Thorle											
Thorn. L. Syns. Reinette de Thorn, Reinette du Thorn	Hol	rob	ml	yrs	tj	w	rsa			ml	From Annals of Pomology.
Thornton (Ala.). R. Syns. Thornton Seedling, Thornton's Winter	Ala	r	vl	grs	j		s			vl	
Thornton (LC). L										l	Probably same as preceding.

Thornton Pippin. NEF'33		r	m	rsru			sa	g			
Thornton Seedling. A'89. Syn. of Thornton (Ala.)											
Thornton's Winter. K&S. Syn. of Thornton (Ala.)											
Thorp. MoH'88. [Said to be a seedling of Winesap.]											Not described.
Threespot. R. Syn. Three-Spot Baldwin											Do.
Three-Spot Baldwin. BBL. Syn. of Threespot											
Throne. ColExR'88											Do.
Thurman. Hort'73. Syn. Water Core	Mo.?										Do.
Thurmond. W. Syn. of Julian											
Tibbett. L. Syn. Tibbett's Seedling	Mich	c	l	y			sa				
Tibbett Pearmain. BBL											Do.
Tibbett's Seedling. A'60. Syn. of Tibbett											
Tice. IaH'96											Do.
Tierlandescher Sommer. Gb. Syn. of Summer Livland											
Tiesen. R. Syn. Tiescu Nansen											Do.
Tiescu Nansen. ColExR'88. Syn. of Tiesen											
Tiesenhausen. Gb. Syns. Gov. list No. 190, Tiesenhausenskoe	Rus.	oble	l	yru	j	w	a		k	m	
Tiesenhausenskoe. Gb. Syn. of Tiesenhausen											
Tift. L. Syns. Tift's Sweet, Tift Sweeting, Tift's Sweeting	Mass.	ob	m	gru		y	rvs	g	k	m	
Tift's Sweet D. Syn. of Tift											
Tift Sweeting. T. Syn. of Tift											
Tift's Sweeting.. Syn. of Tift											
Tillaqua. D. Syns. Big Fruit, Tillaquah, Tillaquau	N. C	rob	ml	yrs	mj	w	bsa	g-vg		l	
Tillaquah. Hort'58. Syn. of Tillaqua											
Tillaquau. A'95. Syn. of Tillaqua											
Tilnoe. MinnExR'90											Do.
Timothy. D. Syn. of Titus											
Timothy Titus Sort. D. Syn. of Titus											
Tinmouth. D. Syns. Teignmouth, Tinmouth Sweet, Vermont Pippin	Vt	ob	ml	wyb	jt	w	psa	g-vg	d	ml	
Tinmouth Sweet. IllB45. Syn. of Tinmouth											
Tinson's Red. D. Syn. of Buncombe											
Tipka. Gb. Syn. of Lipka											
Tippecanoe. P'95	Ind	r	l	yb	fej	y	sa	g		m	
Titka krasnaya. G. Syn. of Red Titka											
Titkova. MHSC'81	Rus.		vl	yrs				g	km	e	May be a misprint for Titovka.
Titouka (?). Cat. Syn. of Titovka											
Titovca. T. Syn. of Titovka											
Titovka. Gb. Syns. Gov. list No. 230, Shro. to Ia. No. 134, Titouka, Titovca, Titus Apple, Titus Riga.	Rus.	obobl	l	rs			sa	g	km	me	
Titovka Department. SDB76	Rus.	rob	ml	ygrsc	f	w	sa	g		m	Name suggested as only temporary.
Titovka Speer. SDB76	Rus.	robl	ml	yrs	j	ws	a			me	Do.
Titus (N. Y.). L. Syns. Hang-On, Timothy, Timothy Titus Sort, Titus Pippin, Well Apple.	N. Y	roble	l	pyb	jt	wy	bsa	g	m	l	
Titus (Rus.). A'83. Syn. Titouka	Rus.	r	l	rs	cj		sa	g	dkm	me	Prof. Budd claims this to be the true Titus, of Russia.
Titus Apple. B. Syn. of Titovka											
Titus Pippin. IH&S	N. Y	obl		y	t					l	
Titus Pippin. Lin. Syn. of Titus (N. Y.)											
Titus Riga. SDB76. Syn. of Titovka											
Tobias. AmGar'90											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Tobias Black. AmGar'90											Not described.
Tobias Pippin. NYB15											Do.
Toccoa. D. Syn. Muskmelon	Ga	rc	m	yb	t	y	sa	g	k	me	
Tod's Golden Pippin. D. Syn. of Ortley											
Todd. R. Syn. Todd Pippin		r	l	y		w	sa	g			
Todd Pippin. RYN'70. Syn. of Todd											
Todd Seedling. R. Syn. Todd's Seedling	Mo.?	robl	vl	gyrs	tj	y	sa	vg		l	
Todd's Seedling. A'77. Syn. of Todd Seedling											
Todd Sweet. R. Syn. Todd's Sweet	Mo		l	rs			s	vg		l	
Todd's Sweet. MoH'70. Syn. of Todd Sweet											
Toker. L. Syn. Toker's Incomparable	Eng	rob	vl	gyrs	fctj	y	a	g	k	m	From Hogg.
Toker's Incomparable. D. Syn. of Toker											
Tolbert. D	Pa	r	m	rs	mjt	y	sa	g		me	
Toll. R. Syn. Toll de Rhin											Not described.
Toll de Rhin. Cat. Syn. of Toll											
Tolman. Wg. Syns. Brown's Golden Sweet, Tallman's Sweet, Tallman Sweeting, Tallman's Sweeting, Talman Sweet, Talman's Sweet, Tallman Sweeting, Talman's Sweeting, Tolman Sweet, Tolman Sweeting, Tolman's Sweeting.	R. I	r	m	wyb	fr	w	s	g	dk	vl	
Tolman Sweet. Lin. Syn. of Tolman											
Tolman Sweeting. Th. Syn. of Tolman											
Tolman's Sweeting. MagofH'49. Syn. of Tolman											
Tolotoreff. EON	Rus		vl	gyrs				g		ml	
Tom Apple. Dap. Syn. of Tom Austin											
Toma Red. Hort'60. Syn. of Tompkins King											
Tom Austin. L. Syns. Austin Apple, Tom Apple	Conn	robc	l	pwyrs	tj	w	sa	g	km	me	
Tommy. P'95. Syn. Tommy Sweet	N. Y	r	m	yw	fjt	y	s	vg		m	
Tommy Red. D. Syn. of Tompkins King											
Tommy Sweet. P'95. Syn. of Tommy											
Tompkins. Hort'47. Syn. of Dyer											
Tompkins Apple. Hort'48. Syn. of Dyer											
Tompkins County King. T. Syn. of Tompkins King											
Tompkins King. A. Syns. King, King Apple, King of Tompkins, King of Tompkins County, Toma Red, Tommy Red, Toms Red, Tompkins County King, Winter King.	N. J.?	rcob	l	yrs	cjt	y	sa	vg-b	dm	l	
Tom Potter. D	Eng	robc	m	yrs	j		sa			m	
Tom Putt. DelExR'95											Do.
Toms Red. D. Syn. of Tompkins King											
Tom Woodward Pippin. D. Syn. of Ortley											
Tonkovietka polosataya. Gb. Syn. of Thintwig											

Tonkowitka polosataja. Gb. Syn. of Thintwig											
Toole. L. Syn. Toole's Indian Rareripe		rc	l	gyb	t	gw	bsa	g	k	m	
Toole's Indian Rareripe. D. Syn. of Toole											
Topal. W.	Va.	ob		rs			sa				
Torrington. R. Syn. Torrington Pounder	Conn.?		l					p			
Torrington Pounder. MagofH'47. Syn. of Torrington											
Tough. NEF'49.	Mass.				vf					vl	
Toule. L. Syn. Marie Pinel de la Toule											Do.
Tournay. L. Syns. Court Pendu de Tournay, Reinette d'Orleans	Hol.	rc	ms	t	w		sa				From Annals of Pomology.
Tower. L. Syn. Tower's Glory	Eng.?	r	m		tj	y	bsa		k	vl	From Hogg.
Tower's Glory. D. Syn. of Tower											
Tower of Glammis. GenF'33. Syn. of Glammis											
Towne. A'62.											Not described.
Town House. Dap. Syn. of Burlington Pippin											
Townsend. AmF'53. Syns. Hocking, Seager	Pa.	obc	m	pyrs	t	w	sa	g-vg	d	mc	
Townsend. T. Syn. of Hocking											
Townsend Beauty. L. Syn. Townsend's Smiling Beauty	Eng.	rob	l	yb	tj		a		k	vl	From Hogg.
Townsend's Smiling Beauty. D. Syn. of Townsend Beauty											
Tracy. L. Syn. Tracy's Favorite											Not described.
Tracy's Favorite. IllH'01. Syn. of Tracy											
Trader. L. Syn. Trader's Fancy	Pa.	rob	m	gyrs	etj	w	sa	g-vg	km	vl	
Trader's Fancy. D. Syn. of Trader											
Trader Red. R. Syn. Trader's Red		ob	m	g				vg		l	
Trader's Red. IllB45. Syn. of Trader Red											
Tranham. W. [Probably a synonym of Nickajack.]	South.										Do.
Transcendent Seedling. SDB76.											
Translucent. Gb. Syns. Shro. to Ia. No. 110, Skvosneena	Rus.										Do.
Transparent. W		ob		yw			s				
Transparent. MinnB83. Syn. of Yellow Transparent											
Transparent Apple of the Crimea. NEF'33. Syn. of Yellow Transparent											
Transparent Astrachan. Gb. Syns. Astrackanskoe skvasnoe, Astrackanskoe Skwasnoe.	Rus.										May possibly be White Astrachan.
Transparent Codlin. D.		roblc	m	pyb	tj		s			mc	From Lindley.
Transparent de Croncelles. BBL.											Not described.
Transparent de Moscovie. K. Syn. of White Astrachan											
Transparent de Zurich. D. Syn. of Zurich											
Transparent Juicy. Gb. Syn. of Transparent Naliv											
Transparent Naliv. Gb. Syns. Gov. list No. 153, Skvasanoi Nalin, Skvosnoi Naliv, Transparent Juicy.	Rus.										Do.
Transparent Pippin. D. Syn. of Wick											
Transparent Zoar. T.	Ohio	ob	l	wb	vtj	w	sa	vg	d	m	
Transport. IndF'40	Ind.	rob	ml	wyb	tj	yw	msa	g-vg	dk	ml	
Traveler. SBro	For.									c	
Travers'. GenF'33. Syn. of Ribston											
Treadle Hole. D. Syn. of Trumpeter											
Trechtrshromnoe. Gb. Syn. of Overflowing											
Trenham. D. Syn. of Nickajack											
Trenton. CanH'99											Do.
Trenton Early. IndF'40. Syns. Codling, English Codlin		obc	ml	yg	vt		sa	g	dk	mc	
Trenton Early. E. Syn. of Golden Sweet											
Trenton Early. D. Syn. of Old Codlin											
Trenton Pippin. W	Ohio	c	m	y							

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Trescott. L. Syn. Trescott Russet	Conn	rc		yru			msa	g		vl	
Trescott Russet. D. Syn. of Trescott											
Tresling. MagofH'53											Not described.
Triangle. MagofH'43											Do.
Trimble. L. Syn. Trimble County											Do.
Trimble County. BBL. Syn. of Trimble											
Trinkle. BBL											Do.
Triomphante. L. Syns. Reinette Triomphante, Victorious Reinette	Ger	obl	l	py	fj	y	psa	g		l	
Trippes. R. Syn. Trippes' Horse	South	rc		rs			sa				Probably same as Horse.
Trippe's Horse. D. Syn. of Horse											
Trippes' Horse. D. Syn. of Trippes											
Trippes Railroad. L. Syn. Trippes Railroad	South	r		rs			sa				
Trippes' Railroad. W. Syn. of Trippes' Railroad											
Triumph. IllH'76	Ill		ml	yrs			sa	g		vl	
Trobeerapfel. R. Syn. Trobeerapiel Nietschner's											Not described.
Trobeerapfel Nietschner's. IndH'87. Syn. of Trobeerapfel											
Trout Apple. D. Syn. of Blue Mountain											
Trovinger. JRJ	Ohio		m	r			s	vg		l	
Troy. IllH'97											Do.
True Spitzenburgh. D. Syn. of Esopus											
Trumble County Beauty. IllH'89. Syn. of Trumbull County											
Trumbull. L. Syns. Teuton Sweet, Teuton Sweeting, Trumbull Sweet, Trumbull Sweeting.	Ohio	rob	m	wyb	jt	w	s	vg	k	m	
Trumbull County. R. Syn. Trumble County Beauty											Do.
Trumbull Sweet. F. Syn. of Higby											
Trumbull Sweet. W. Syn. of Trumbull											
Trumbull Sweeting. E. Syn. of Trumbull											
Trumpeter. D. Syn. Treadle	Eng	obl	l	gy	cj	gw	sa			m	
Trumpington. D. Syn. of Delaware											
Trumpington (?). D. Syn. of Rambo											
Trunnell. MagofH'39											Do.
Trusling. R. Syn. Lady Trusling. [Probably Trusler.]	Ind										Do.
Try Me. A'77											Do.
Tsarkui Schip. Gb. Syn. of Czar Thorn											
Tschernoe Drewo. Gb. Syn. of Blackwood											
Tsiganka. MHSC'8 1. Syn. of Gipsey											
Tsitronnoe Tsarskoe. Gb. Syn. of Imperial Citron											
Tubbs. R. Syn. Tubbs Iron Clad	Wis ?	ob	m	yb		y	sa	g		m	
Tubbs Iron Clad. MinnExR'90. Syn. of Tubb											
Tubner's Golden. AJofHIV. Syn. of Tuebner Golden											

Tuchernokrasnoe. Gb. Syn. of Red-Black											
Tucker. Cole		rob	m	gy	cj		sa		k	me	
Tucker. W		r		y			s			l	
Tudor. L. Syn. Tudor Sweeting	Pa	r		y			s				
Tudor Sweeting. W. Syn. of Tudor											
Tuebner Cider. L. Syns. Teubner's Cider, Tuebner's Cider	Mo	r	ms	yr		y	a		c	m	
Tuebner's Cider. D. Syn. of Tuebner											
Tuebner Golden. L. Syns. Teubner's Golden, Tubner's Golden, Tuebner's Golden.	Mo	r	s	y			a			me	
Tuebner's Golden. D. Syn. of Tuebner Golden											
Tufts. R. Syns. Tuft's, Tuft's Baldwin, Tuft's Seedling											
Tuft's. D. Syn. of Tufts											
Tuft's Baldwin. D. Syn. of Tufts											
Tuft's Seedling. MagofH'48. Syn. of Tufts											
Tuhuginka Selonaja. Gb. Syn. of Stranger (Green)											
Tulip. D. Syns. Calville Tulipee, Dutch Tulip, Tulipen Calville, Tulp, Tulpen.	Hol	r	ms	yb	tj	yw	sa	g		ml	
Tulipen Calville. D. Syn. of Tulip											
Tulp D. Syn. of Tulip											
Tulpehocken. D. Syn. of Fallawater											
Tulpen. D. Syn. of Tulip											
Tulpenhocking. MagofH'53. Syn. of Fallawater											
Tunnell. ArkB49. Syn. Tunnell's Sweet	Ark	rob	ml	gyrs	fj	y	s	vg	d	ml	
Tunnell's Sweet. IllH'01. Syn. of Tunnell											
Turk Cap. L. Syn. Turk's Cap	Eng.?	rob	l	yru	fej	y	sa		k	m	
Turk's Cap. D. Syn. of Turk Cap											
Turkey. L. Syn. Turkey Greening	Conn	obe	l	gb	tj	g	sa	p		ml	
Turkey Greening. D. Syn. of Turkey											
Turnbull's Seedling, No. 1. MinnHort'97											
Turnbull's Seedling, No. 2. MinnHort'97											
Turnell. ColExR'88. [This may be Tunnell.]											Do.
Turner. L. Syn. Turner's Green	Ohio?	c	m	y			sa	p		l	
Turner's Cheese. D. Syn. of Green Cheese											
Turner's Green. W. Syn. of Turner											
Turney. R. Syn. Turney's Greening											Do.
Turney's Greening. IllB45. Syn. of Turney											
Turnfell. IllH'97											Do.
Turn in the Lane (?). Syn. of Turn off Lane											
Turnip. Gb. Syn. of Riepovka											
Turnipy Juicy Apple. Gb. Syn. of Ribbed Naliv											
Turn off Lane. D. Syns. Strawberry, Turn in the Lane, Winter Strawberry.	N. J	obe	ms	yrs	t	w	bsa	g		vl	
Turn off Lane. A'79. Syn. of Quince (Coles)											
Tuscaloosa. D. Syn. Tuscaloosa Seedling	Ala	robe	ml	yrs	fj	y	sa	g-vg	dm	ml	
Tuscaloosa Seedling. D. Syn. of Tuscaloosa											
Tuscaloosa Sweet. D	Ky	ob	l-vl	ygb	ct	yw	bs	vg		m	
Tusoff. IllH'96. [Probably same as Zusoff.]											Do.
Tuttle. D		re	ml	yrs	tj	w	psa	g-vg		ml	This and the following probably identical.
Tuttle (Ct.). Dap	Conn	robe	m	pyrs	tj	w	psa	g		ml	
Tuttle of Geneva. A'71	N. Y.?	rob	m	y	ftj	w	sa	vg			Probably same as Tuttle.
Twenty Months. Cat											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Twenty Ounce. MagofH'44 Syns. Aurora, Blessing, Cayuga Red Streak, Coleman, Congress Apple?, Dunlap's Aurora, Eighteen Ounce Apple, Governor Seward, Lima, Morgan's Favorite, Twenty Ounce Apple, Twenty Ounce Pippin (erroneously), Wine of Connecticut.	Conn	rc	vl	gyrs	c		psa	g-vg		ml	
Twenty Ounce Apple. D. Syn. of Twenty Ounce											
Twenty Ounce Pippin. D. Syn. of Cabashea											
Twenty Ounce Pippin (erroneously). T. Syn. of Twenty Ounce											
Twin. D		ob	ml	ywrs	fcj		sa	g	dk	m	T. T. Lyon manuscript.
Twin Apple. Dap. Syn. of Lucy											
Twin Cluster Pippin. D. Syn. of Cluster Golden											
Twisty. P'95	Ohio	rob	s	ywrsc	ftj	y	sa	vg-b	d	me	
Twitchell. L. Syn. Twitchell's Sweet	N. H	rc	m	rp	t	ws	vs	g	k	ml	
Twitchell's Sweet. D. Syn. of Twitchell											
Twitty's Paragon. TennBI-IX. Syn. of Paragon											
Two Face. BBL											Not described.
Two Years Keeper. RGN			m	r	f			g		vl	
Twyford. P'95. Syn. Twyford Beauty	Aust.?	rc	l	ywrsc	cj	y	sa	g		m	
Twyford Beauty. P'95. Syn. of Twyford											
Tyler. L. Syn. Tyler's Rennet	Va	r	m	y			sa			me	
Tyler. D. Syn. of Hollow Crown											
Tyler Apple. D. Syn. of Congress											
Tyler Kernel. BBL											Do.
Tyler No. 15. SDB76											
Tyler's Rennet. F. Syn. of Tyler											
Tyre. L. Syn. Tyre Beauty	N. Y	rob	m	pyrs	ct	w	ba	g		me	From Rural New Yorker.
Tyre Beauty. D. Syn. of Tyre											
Tyroler. L. Syns. Reinette der Tyrol, Tyroler Pippin	Switz	r	sm	yrs	f	ws	s			l	From the Verger.
Tyroler Glanz-reinette. D. Syn. of Glanz											
Tyroler Pippin. D. Syn. of Tyroler											
Tyroler Taubenapfel. IndH'87. [Probably same as Tyroler.]											Not described.
Tyrone. H	Ire		l	rs				vg	dk	l	
Tyrrestrup. CanExR'01		robl	l	gb	j	w	sa			me	
Tyson. R. Syn. Tyson's Red											Do.
Tyson's Red. GLA. Syn. of Tyson											
Uehella. IllB45. Syn. of Maiden Blush											
Ugo. BBL											Do.
Uklah. BBL											Do.
Ukraine. Gb. Syns. Gov. list No. 290, Shro. to Ia. No. 10, Ukrainer, Ukrainskoe.	Rus										Do.
Ukrainer. IndH'87. Syn. of Ukraine											

Ukrainskoe. MHSC'81. Syn. of Ukraine											
Ukraint. BBL. [Probably same as Ukraine.]											
Uli. R. Syn. Hans Uli											Do.
Ulloa. IllB45											Do.
Uncle Archy. MagofH'46	Ohio	rc	ml	gru	tj	y		vg		l	Named for Archibald Gardener, Coshocton Co., Ohio.
Uncle Ben. BBL											Not described.
Uncle Billie. BBL. Syn. Uncle Billy											Do.
Uncle Billy. BBL. Syn. of Uncle Billie											
Uncle Jack. P'95. Syn. of Mack											
Uncle Jessie. Cat											Do.
Uncle John. D	Pa	ob	m	wrs	tj	w	sa	g-vg		m	
Uncle Richard's Graft. D. Syn. of Richard											
Uncle Sam. CanExR'01											Do.
Uncle Sam's Best. D. Syn. of Fall Wine											
Uncle Zeeke. Dap. Syn. of McAfee											
Underdunk. D. Syn. of Champlain											
Underdunk. D. Syn. of Summer Pippin. [This and Champlain probably identical.]											
Underleaf. L. Syn. Hertfordshire Underleaf	Eng	c	l	y			sa			me	
Underwood. IaH'97	Iowa	r	l	yrs			sa	vg		l	
Union (Iowa). D	{Ind.? / Iowa?	}roble	m	yrs						l	Lewis Jones's manuscript.
Union (Ohio). W	Ohio	ob	m	rs			sa	g		e	
Unique. D	Fr	oblc	m	yb	fj	w	sa	g		m	
University. SDB76. Syn. Duchess No. 103	Iowa	ob	l	yb		y	psa	vg		m	Oldenburg seedling, 1882; C. G. Patten, Charles City, Iowa.
Unknown. (Ga.?) Syn. Great Unknown	Ga.?	robc	l	yb	tj	y	sa	vg		ml	Dr. White's manuscript.
Unknown (Ind.?). IndH'80	Ind.?	r	l	yrs						l	Description by Dr. Warder.
Updegraff. D	Pa	robc	m	pyrs	tj	w	psa	g		m	
Upp. P'92	Ohio	obc	m	ygr	mt	y	sa	g		ml	
Url Manly. W	Ill	r	m	y			sa	vg		l	
Utah. R. Syn. Utah Red Winter	Utah	r	l	dr						vl	
Utah Red Winter. DMM. Syn. of Utah											
Uthlout. MoH'85	Mo		m	y				vg		m	
Utter. Hort'55. Syn. Utters, Utter's Large Red, Utter's Red	Ill.?	ob	ml	pyrs	tj	w	psa	g		ml	
Utters Hort'55. Syn. of Utter											
Utter Early. R. Syn. Utter's Early Red											Not described.
Utter's Early Red. A'73. Syn. of Utter Early											
Utter's Large Red (?). Cat. Syn. of Utter											
Utter's Red. N. Syn. of Utter											
Uxbridge Spice. Dap. Syn. of Capron											
Vajalma (Hun). BBL											Do.
Valandigham's Wine. Dap. Syn. of McAfee											
Vale Mascal. L. Syn. Vale Mascal Pearmain		r	ms	gyb	c	y	s				From Hogg.
Vale Mascal Pearmain. GenF'33. Syn. of Vale Mascal											
Valley. L. Syn. Queen of the Valley	Conn.?	rc	ml	yrs	jt	w	psa	g-vg		m	
Valley. Dap. Syn. of Van Horn											
Van Buren. D	Ga	rc	ml	yru	jt	y	sa	g	d	vl	White's manuscript.
Vance. L. Syns. Vance's Early, Vance's Harvest	Ill	obc	s	yb	tj	y	psa	g	d	me	
Vance's Early. D. Syn. of Vance											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Vance's Harvest. D. Syn. of Vance											
Van Deman. CanExR'96		rob	m	yrs	mj	w	a	g		e	
Vandenabeele. D	Eur	oblc	l	yrs	t	yw	sa			l	From Annals of Pomology.
Vanderlaans. L. Syns. Golden Reinette de Van der Laans, Reinette Doree de Van der Laans.	Hol	re	m	g	f	gw	psa			m	From the Verger.
Vandernoot. D	Belg	re	l	yrs	tj	w	sa			m	From Album de Pomologie.
Vanderspiegel. MagofH'47. Syn. Seek-no-further (of some)	Vt	re	ms	yrs	ej	y	psa	g		l	
Vanderveer. D. Syn. of Vandevere											
Vandervere. Lin(?). Syn. of Newtown Spitzenburg											
Vandervere. D. Syn. of Vandevere											
Vandervere (Coxe). W. Syn. of Vandevere											
Vandervere (Elliott). W. Syn. of Vandervere Pippin											
Vandervere of Cincinnati. E. Syn. of Vandevere											
Vandervere Pippin. D. Syns. Big Vandevere, Great Vandaver, Indiana Vandevere, Imperial Vandevere, Large Vandervere, Mountain Vandevere, Vandervere (Elliott), Vandevere Yellow, Watson's Vandevere, Windower, Yellow Vandervere.	Pa.?	obc	vl	yrs	c	w	a	g	k	ml	
Vandervere Pippin. E. Syn. of Vandevere											
Vandervere Pippin (of some). E. Syn. of Gray Vandervere											
Vandevere. DomEnc. Syns. Baltimore (of some, incorrectly), Fall Vandervere, Fall Vandevere, Gibbon's Smathhouse, Gibbon's Smokehouse, Gray Vandervere, Green Vandevere, Imperial Vandervere, Lasting Vandevere, Little Vandevere of Indiana, Mill Creek, Mill Creek Vandervere, Old Vandervere, Ox Eye of O, Pennsylvania Vandevere, Red Vandervere, Red Vandevere, Smokehouse, Spiced Ox Eye, Staalclubs, Staalcubs, Stalclubs, Striped Ashmore (?), Striped Vandervere, Striped Vandevere, Vanderveer, Vandervere, Vandervere (Coxe), Vandervere of Cincinnati, Vandervere Pippin, Vandevere of Pa., Vandiver, Watson's Vandervere, White Vandevere, Yellow Vandervere, Yellow Vandevere.	Del	ob	m	yrs	t	y	sa	g	k	ml	
Vandevere Improved. Cat. Syn. Family Favorite											Not described.
Vandevere of N. Y. D. Syn. of Newtown Spitzenburg											
Vandevere of Pa. D. Syn. of Vandevere											
Vandevere of Stark. BBL											Do.
Vandevere Yellow. H. Syn. of Vandervere Pippin											
Vandiver. D. Syn. of Vandevere											
Vandyne. D		re	l	yb	tj	w	sa	g	d	m	
Van Dyne. GenF'33. E. Syn. of Ortley											
Van Hay. L. Syn. Van Hay's No Core. [Probably Vanhoy.]											Do.
Van Hay's No Core. Cat. Syn. of Van Hay											
Van Horn. Dap. Syn. Valley	Ohio	ob	ms	yb	tj	w	sa			l	

Vanhoy. NCB149. Syn. Van Hoy No Core	N. C	robl	vl	yrs	fj	y	sa	vg	dm	l	
Van Hoy No Core. JVL. Syn. of Vanhoy											
Van Kleek's Sweet. Dap. Syn. of Hog Island											
Vanlear. MagofH'53											Do.
Van Mons. L. Syns. Reinette Van Mons, Van Mons Reinette		robe	s	ybru		y	rsa	vg		l	
Van Mons Reinette. D. Syn. of Van Mons											
Vanoy. BBL. [Probably same as Vanhoy.]											Do.
Van Spike. Cat											Do.
Vanswick. R. Syn. Vanswick's Sweet											Do.
Vanswick's Sweet. OreB22. Syn. of Vanswick											
Vanwinkle. DomEne. Syn. of Granniwinkle											
Vargul. MHSC'81. Syns. Gov. list No. 277, Shro. to Ia. No. 16, Wargul	Rus										Do.
Vargulek. MHSC'81. Syn. Shro. to Ia. No. 12	Rus										Do.
Varick. D. Syn. of Democrat											
Varmins Pippin. C. Syn. of Warren											
Vasilis Largest. Gb. Syn. of Basil (the Great)											
Vasilist. R. Syn. Vasilist, largest. [Probably Basil (the Great).]											Do.
Vasilist, largest. MinnExR'90. Syn. of Vasilist											
Vasilli. IllH'91. Syn. of Basil (the Great)											
Vasilui Velikui. Gb. Syn. of Basil (the Great)											
Vaughn. BBL											Do.
Vaughn Pippin. L. Syns. Colonel Vaughn's, Vaughn's Pippin		c	s	yb	cj	ws	s			m	From Hogg.
Vaughn's Pippin. D. Syn. of Vaughn Pippin											
Vaughn Winter. L. Syn. Vaughn's Winter	Ky	ob	m	wyrs	tjm	y	sa	g	d	l	
Vaughn's Winter. W. Syn. of Vaughn Winter											
Vaugoyeau. D. Syn. Cadeau du General		re	l	yrs	tj	w	sa			l	From Annals of Pomology.
Vegers. R. Syn. Conquest de Vegers											Not described.
Veineal. L. Syn. Veineal Russet	Ill	r	s	ru			sa	p		m	
Veineal Russet. W. Syn. of Veineal											
Vena Rosa. IaH'00											Do.
Venus. P'93	Wis	oblc	l	yb	f	y	psa	g		l	
Verbena. P'95	Wis	ob	m	yrsc	fj	y	sa	vg		l	
Vermillion. R. Syn. Vermillion Royce	Fr	robe	m	yrs	cj	y	bsa	vg		l	
Vermillion d'Ete. D. Syn. of Red Astrachan											
Vermillion Royce. D. Syn. of Vermilion											
Vermont. T. Syn. of Champlain. [Probably Walworth. See A'52, 60.]											
Vermont. E. Syn. of Walworth (?)											
Vermont Beauty. AHortA'68		robe	vl	y	ft	y	r	vg		me	
Vermont Pippin. D. Syn. of Tinmouth											
Vermont Pumpkin Sweet. D. Syn. of Pumpkin Sweet											
Vermont Queening. IllH'68											Do.
Vermont Strawberry. AHortA'68		rob	vl	yes	ftj		sa	vg		m	
Vermont Sweet. S&W. Syn. of Pumpkin Sweet											
Vermont Winter. R. Syn. Vermont Winter Pippin											Do.
Vermont Winter Pippin. A'81. Syn. of Vermont Winter											
Vernon. MagofH'53											Do.
Veronesh. R. Syn. Veronesh Marmalade											Do.
Veronesh Marmalade. TexB16. Syn. of Veronesh											
Verplank. R. Syns. Verplank Golden Reinette, Verplank Golden Russet	N.Y.?		s	yru			s		d		
Verplank Golden Reinette. NAPC'49. Syn. of Verplank											
Verplank Golden Russet. NAPC'49. Syn. of Verplank											
Versaillaise. L. Syn. Versaillaise Reinette	Fr	re	m	yru	ftj	w	sa	g-vg		ml	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Versaillaise Reinette. D. Syn. of Versaillaise											
Vervaene. L. Syn. Reinette Vervaene	Belg	ob	m	yb	f	gw	a	g		m	
Vestal. W. Syn. of Maiden Blush											
Via. F	Va	ob	m	y			sa	g		m	
Via Seedling. R. Syn. Via's Seedling. [Probably Via.]											Not described.
Via's Seedling VaB2. Syn. of Via Seedling											
Vicar. R. Syn. Vicar of Beighton											Do.
Vicar of Beighton. BBL. Syn. of Vicar											
Vickers. Dap. Syn. of Lankford											
Vick. R. Syn. Vick's Seedling											Do.
Vick's Seedling. MinnHort'99. Syn. of Vick											
Victor. IllH'88	Ill	rob		gyb				g		l	Origin, Marshall County, Ill.
Victor Hugo. Cat. Syn. of Hugo											
Victoria. MHSC'77. Syn. Victoria Pippin	Md	rob	ml	yrs	cj	wy	sa	g	km	m	
Victoria (incorrectly). D. Syn. of Alexander											
Victoria Pippin. D. Syn. of Ben Davis											
Victoria Pippin. Dap. Syn. of Victoria											
Victoria Red. D. Syn. of Ben Davis											
Victoria Sweet. Dap. Syn. Paterson's Sweet. [Downing's Notes.]	N. Y. ?	ob	m	yrsc	tj		rs	vg		m	
Victorious Reinette. Lin. Syn. of Triomphante											
Victuals. IllB'45		obc	l	y			s	vg		m	Probably Victuals and Drink.
Victuals and Drink. D. Syns. Big Sweet, Fall Green Sweet, Green Sweet of Ind., Pompey.	N. J	oblc	l	yru	t	y	brs	vg	dk	m	
Vigan. L. Syn. Reinette du Vigan	For	rc	m	yb	fj	ys	rsa			l	From Annals of Pomology.
Vilikui Mogul. Gb. Syn. of Great Mogul											
Vincent. L. Syn. Vincent Sweet	Ohio	r	m	y			s	p		m	
Vincent Sweet. W. Syn. of Vincent											
Vincent of Wis. R. Syn. Vincent Wis. Seedling	Wis. ?										Not described.
Vincent Wis. Seedling. MinnExR'90. Syn. of Vincent of Wis											
Vine. NCExR'89. Syn. Vine Apple	Va	oblc	ml	y		y		vg		ml	
Vine Apple. RGN. Syn. of Vine											
Vineland. P'95. Syn. Reeves' Favorite	Tenn	ob	ml	gyrsc	fj	gy	sa	vg		ml	
Vinense Rouge.[a] SDB76	Rus	robc	ml	gyrs	fj	w	sa	g	dk	ve	See footnote.
Vinnoe. Gb. Syns. Shro. to Ia. No. 93, V. R. S. to Ia. No. 4	Rus										Not described.
Vinograd. MinnBl											Do.
Vinterpostof. MHSC'86	Swed		l	grb				g		l	
Violet. Wn	Cal	c	l				sa			ml	
Violette. D. Syn. La Violette, Pomme de Quatre Gouts	Eng. ?	oblc	m	drpb	jt	ws	a		k	ml	From Ronalds.
Virgenitt. MagofH'38											Not described.

Virgin. MagofH'52. Syns. Scotch Virgin, White Virgin	Scot	ob	m	pyrs	tj	w	a	.....	k	ml	From Hogg.
Virginia Apple. F. Syn. of Virginia Greening											
Virginia Beauty. P'95	Va	rc	ml	gyrs	fj	gy	s	vg	d	l	
Virginia Blush. PFar'47				ywb	cj	y	a			m	
Virginia Cathead. MagofH'52											Not described.
Virginia Crab. DomEnc. Syn. of Hewes											
Virginia Greening. Syns. Green Mountain Pippin, Ross Greening, Virginia Apple, Virginia Pippin.	Va.?	ob	l	gyb	c	y	psa	g	km	vl	
Virginia July. IllB45		ob	l	y			sa	vg		me	
Virginia June (Miss.). W	Va.? Miss.?	obe	ml	gy		y	s	g	k	me	
Virginia June (Ind.). W. Syn. June Apple	Va.? Ind.?	r	ml	yrs		w	a	g	km	e	
Virginia June. Dap. Syn. of Margaret											
Virginia May. W	Va	r	s	y			sa	g		e	
Virginia May. Dap. Syn. of White Juneating											
Virginia Pippin. D. Syn. of Ben Davis											
Virginia Pippin. D. Syn. of Virginia Greening											
Virginia Pippin. IllB45. Syn. of Virginia Red											
Virginia Pippin. MagofH'53. Syn. of Yellow Newtown											
Virginia Quaker. W	Va.?	rc	s	gy	f	yw	bsa	g	d	me	
Virginia Queen. DOM	Va.?		l	rs				g			
Virginia Red. R. Syns. Virginia Pippin, Virginia Red Pippin											Not described.
Virginia Red Pippin. IllB45. Syn. of Virginia Red											
Virginia Red Streak. IllB45. Syn. of Virginia Streak											
Virginia Spice. D		obe	m	w	je	y	sa	g		m	
Virginia Streak. R. Syn. Virginia Red Streak		ob	m	rsru			sa	vg		l	
Virginia Sweet. D. Syn. of Marble											
Virginia Sweet. Dap. Syn. of Red and Green											
Virginia Sweeting. Cat											Do.
Virginie. L. Syn. Bonne Virginie	Belg	rc	m	gyb	f	w	a	g		m	From Album de Pomologie.
Virgin Sweet. MagofH'53											Not described.
Vislouchoe. Gb. Syn. of Pendant Ear											
Visodskoe (*Visotskoe Rgl.*). Gb. Syn. of Visotskoe											
Visotskoe. Gb. Syns. Shro. to Ia. No. 150, Visodskoe (Visotskoe Rgl.)	Rus										Do.
Vnisodskoe. MHSC'86											Do.
Vochin. Gb. Syns. Fokins Apple, Fokinskoe, Gov. list No. 218, S. Wokinskoe, Vochinskoe, Wochin's apple.	Rus										Do.
Vochin's Crimean. Gb. Syn. of Crimean (Vochin)											
Vochinskoe. Gb. Syn. of Vochin											
Volga. R. Syn. Volga Cross	Rus	ob	l	gy	fj	yw	sa	vg		vl	
Volga Cross. IaB31. Syn. of Volga											
Volney. Dap	Ill	ob	m	yb	tj	wy	sa			vl	
Volunteer.[a] L. Syn. Wilson's Volunteer	Ohio	rob	l	yrs	tj	gy	sa	g	k	l	
Von Rezina. MagofH'37											Do.
Von Towarius Sweet. Gb. Syn. of Avenarius											
Vorgunok. Gb. Syns. Gov. list No. 565, Vorgunox, Wergunoks, Worgunok?	Rus	rob	ml	gyrs	j	w	sa	g		m	
Vorgunox. SDB76. Syn. of Vorgunok											
Vor. No. 9. IaB31. Syn. of Early Sweet											

[a] Hansen, in S. D. B. 76, 110, says, "This variety and Red Transparent, Count Orloff, Grand Sultan, Green Transparent, and Aromatic Spike No. 354 are identical, or very similar."

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flesh. Flavor.	Quality.	Use.	Season.	Remarks.
Voronesh. Cat.											Not described
Voronesh Arcad. Gb. Syns. Voroneshskoe Arkad, V. R. S. to Ia. No. 2	Rus.										Do.
Voronesh Cross. SDB76.	Rus.	ob	l	yrs	j	w	sa	g		m	
Voronesh Cinnamon. Gb. Syns. Voroneshskoe koritchnevoe, V. R. S. to Ia. No. 9.	Rus.										Do.
Voronesh Reinette. Gb. Syns. Gov. list No. 282, Rennetto Woroneschki, Renet Voroneshskui, Woronech's.	Rus.										Do.
Voroneshskoe Arkad. Gb. Syn. of Voronesh Arcad											
Voroneshskoe koritchnevoe. Gb. Syn. of Voronesh Cinnamon											
Voroneshskoe Polskoe. Gb. Syn. of Flat Voronesh											
Voroneshskui rosovui. Gb. Syn. of Rosy Voronesh											
Voronish list No. 42. IaB31. Syn. of Skrushapfel											
Voronesh Rosy. IaB'90. Syn. of Rosy Voronesh											
Vorschtapel. Gb. Syn. of Warsztapfel											
Vorschtapel. Gb.											
Voscovoe. Gb. Syn. of Waxen											
Voss. L. Syn. of Voss' Winter	Va.	r	ml	w	fj	wy	sa	g	dk	ml	
Voss' Winter. W. Syn. of Voss											
Vrai Drap d'Or. D. Syn. of Drap d'Or											
Vulcan. SDB76											This is probably Late Strawberry.
Wabash. MagofH'58. Syn. Wabash Bellflower	Pa	roble	l	yrsru	fe	w	bsa	g		m	
Wabasha. MinnHort'94	Minn	ob	m	yb	j	w	sa		k	ml	
Wabash Bellflower. Dap. Syn. of Long Red											
Wabash Bellflower. MagofH'58. Syn. of Wabash											
Waddell. L. Syns. Waddell Hall, Waddell's Hall	South	rc	s	pyrs	jt	w	psa	g		l	Probably identical with Shockley. See T., 240
Waddell Hall. T. Syn. of Shockley											
Waddell Hall. D. Syn. of Waddell											
Waddell's Hall. Hort'52. Syn. of Waddell											
Wade. R. Syn. Wade's Sweet	Wis.	c	m	yrs			s	g		l	
Wade's Sweet. CH. Syn. of Wade											
Wadhurst. L. Syn. Wadhurst Pippin	Eng	rc	l	yrs	cj	y	ba		k	ml	
Wadhurst Pippin. D. Syn. of Wadhurst											
Wading. R. Syns. Wading River Sweet, Winter Sweet	N. Y	robe	vl	gwb			s	vg	km	l	
Wading River Sweet. A'95. Syn. of Wading											
Wafer. R. Syn. Summer Wafer	Ala.?										Not described
Wagener. Hort'48. Syn. Wagoner	N. Y	rob	ml	yrsc	vtj	y	sa	vg-b	dkm	ml	
Wagener Improved. SBro	Ark		l	r					dk	l	Not certainly distinct
Wagoner. W. Syn. of Wagener											

Wahle. BBL											Not described.
Wahrer Weiser Sommercalville. D. Syn. of Summer White											
Wahr Reinette. GenF'33. Syn. of Canada Reinette											
Walf. MinnHort'97	Minn							g		vl	
Waite. A'87											Do.
Wakeman. Dap Syn. of Baltimore											
Walb. D. Syn. of Nickajack											
Walbridge. RNY'70. Syns. Edgar County Redstreak, Edgar Redstreak	Ill	obe	m	wyrs	fetj	w	sa	g		vl	
Walbridge. A'73. Syn. of Cogswell											
Waldo. UCExR'92											Do.
Waldomer. MagofH'53											Do.
Waldon. A'77. Syns. Waldona, Waldron	Va		vl					vg	d		
Waldona. A'81. Syn. of Waldon											
Waldorf. WisHort'00	Wis			yb					k	m	
Waldron A'81. Syn. of Waldon											
Waldour. WVaB75											Do.
Wales. L. Syn. Prince of Wales											Do.
Wales Pippin. R. Syn. Wales' Pippin											Do.
Wales' Pippin. MagofH'37. Syn. of Wales Pippin											
Walker. (LC)											Do.
Walker Beauty. R. Syn. Walker's Beauty	Pa		vl	yer	f		sa	vg		l	
Walker's Beauty. W&TSCo. Syn. of Walker Beauty											
Walker Greening. L. Syn. Walker's Greening	South	ob		gy			sa			l	
Walker's Greening. W. Syn. of Walker Greening											
Walker Pippin. L. Syn. Walker's Pippin	South	r		y			sa			l	
Walker's Pippin. W. Syn. of Walker Pippin											
Walker's Sweet. ArkB49. Syn. of Evans											
Walker's Winter. D. Syn. of Walker Yellow											
Walker Yellow. L. Syns. Walker's Winter, Walker's Yellow	{Ga.? {Pa.?	rc	l	y	j	yw	a	g	k	vl	
Walker's Yellow. D. Syn. of Walker Yellow											
Walkup. R. Syn. Walkup Seedling		robl		y			sa	g		me	
Walkup Seedling. IllB45. Syn. of Walkup											
Wall. IllB45. [Thought to be very hardy.]	N. W										Do.
Wall. D. Syn. of Nickajack											
Wallace. L. Syn. Wallace's Green Pippin	Ky									l	
Wallace's Green Pippin. W. Syn. of Wallace											
Wallace Howard. A'83. Syn. Boatman's Seedling	Ga	obl	l	gyr	f	yw	bsa	g		ml	
Wallace Kitchen. A'77	Utah?	obe	m	yrs	tj	y	rsa	vg		m	
Waller. R. Syn. Firm Waller											Do.
Wall Sweet. (LC)	N. W										Do.
Wallworth. MagofH'50. Syn. of Walworth											
Walmer Court. GenF'33. Syn. of Cowarne Queen											
Walnut Stem. D. Syn. of Rock Pippin											
Walpole. MagofH'45	Mass	r	m	yrs	tj		sa	vg		m	
Walsh. L. Syn. Walsh's Seedling	Cal	c	l	y			sa			l	Introduced in 1888 by James Waters, of California.
Walsh's Seedling. Wn. Syn. of Walsh											
Walter. CanH'97											Not described
Walter Pease. P'95. Syn. of Pease											
Waltham. L. Syns. Waltham Abbey, Waltham Abbey Seedling	Eng	rc	l	yb	tj	y	s			ml	From Lindley
Waltham Abbey. GenF'33. Syn. of Waltham											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Waltham Abbey Seedling. GenF'33. Syn. of Waltham											
Waltz Apple. D. Syn. of Peck											
Walworth. MagofH'50. Syns. Large Golden Pippin, Vermont, Wallworth, Walworth Pippin.	N. J.	roble	l	y			sa			m	
Walworth. D. Syn. of Champlain											
Walworth. D. Syn. of Summer Pippin. [This and Champlain may be identical.]											
Walworth Pippin. CanExR'01. Syn. of Walworth											
Wander. D. Syn. of Nickajack											
Wandering Spy. JBW&B	Ark	rc	l	yr	jc	w	sa	g	m	l	
Wandon. R. Syn. Wandon's Blush				yb							Not described
Wandon's Blush. ColExR'88. Syn. of Wandon											
Wanstall. D. Syn. Green Steel Apple	Eng	rc	m	yrs	fcj	y	s			vl	From Hogg.
Wantland. MagofH'53											Not described
Wapperyaw. R. Syn. Wapperyaw Sweeting											Do.
Wapperyaw Sweeting. IndH'72. Syn. of Wapperyaw											
Ward (Ohio). H	Ohio	obl	l	rs		yw	sa			ml	Described by Ohio Pomological Society.
Ward (Eng.?). D	Eng.?	ob	m	gb			a			vl	Described by Forsyth.
Ward Late. R. Syn. Ward's Late Seek-no-further								g			Not described.
Ward's Late Seek-no-further. IllB45. Syn. of Ward Late											
Wareham. R. Syn. Wareham Russet				ru							Do.
Wareham Russet. NEF'31. Syn. of Wareham											
Waren. BBros	Tex		vl	dr	f		sa	vg		l	
Warfield. CGen'64	Iowa	rob	m	yb	mj	w	sa	g	k	m	Introduced by Suel Foster
Wargul. Gb. Syn. of Vargul											
Waring. JRJ			l	r				g	m	l	
Warner. L. Syn. Warner's King	Eng.?	robl	vl	yru	tc	w	bsa		k	l	From Hogg
Warner's King. D. Syn. of Warner											
Warner Russet. D. Syn. of Roxbury											
Warner Seedling. BBL											Not described
Warraschke. L. Syn. Warraschke de Guben	Rus.	robc	ml	gb	ftm	w	s			ml	From the Verger.
Warraschke de Guben. D. Syn. of Warraschke											
Warren. C. Syn. Varmin's Pippin	N. J.	obl	l	y			sa			m	
Warren Pennock. D. Syn. of Early Pennock											
Warren Pippin. IndF'40. Syn. of Ortley											
Warren Pippin. D. Syn. of Yellow Bellflower											
Warren Seedling. R. Syn. Warren's Seedling	Mass.										Not described.
Warren's Seedling. MagofH'36. Syn. of Warren Seedling											
Warren Spice. NEF'31											Do.

Warrior. L. Syn. Red Warrior	N. C.	rob	l	rs			sa	g		ml	
Warschon. BBL											Do.
Warsztapfel. Gb. Syns. Gov. list No. 451, Vorschtapel											Do.
Wart. R. Syn. Wart's Early											Do.
Wart's Early. MagofH'44. Syn. of Wart											
Warter's Golden Pippin. D. Syn. of Golden Pippin (Eng.)											
Warwickshire Pippin. D. Syn. of Wyken											
Washington. A'56	N. Y.?							g	dk	me	Doubtless identical with Washington Strawberry.
Washington. D. Syn. of Sops-of-Wine											
Washington (incorrectly). D. Syn. of Bough											
Washington of Maine. Dnp. Syn. of Washington Strawberry											
Washington Pearmain. D. Syn. of Black Detroit											
Washington Pearmain. NEF'50. Syn. of Red Canada											
Washington Royal. D. Syn. Palmer Greening	Mass.	rob	ml	ygb	cj	w	sa	g-vg	d	vl	
Washington Strawberry. D. Syns. Juniata, Washington of Maine	N. Y.	rc	l	yrsc	ctj	y	sa	vg		m	Probably identical with Washington.
Washington Sweet. D	Mass.	roble	ms	yb	cj	y	ps	g		m	
Washington Wine. WVaB75											Not described.
Waskaroe. Cat											Do.
Wassen. R. Syn. Round Wassen											Do.
Wasser. WBKJ											Do.
Wassilli Welikui. Gb. Syn. of Basil (the Great)											
Watauga. TennBX-I	Tenn	rob	l		ftj	w	sa	vg	d	m	Possibly same as Hoover.
Watch Apple. GenF'33. Syn. of Cambusnethan											
Watch Willow. A'62	Pa										Not described.
Water. A'54	Pa	roble	m	yb	vtj	w	psa	vg	d	m	
Watercore. A'75. Syn. of Ben Davis											
Water Core. MoH'73. Syn. of Thurman											
Wateree. W	South	ob		rs			sa				
Waterman. L. Syn. Waterman's Sweet		obe	m	yrsc	ctj	y	s	g		l	
Waterman's Sweet. D. Syn. of Waterman											
Watermelon. Gb. Syns. Arbusowskoe, Arbuzovskoe, Gov. list No. 551. Shro. to Ia. No. 43.	Rus.										Do.
Watermelon. D. Syn. of Hare											
Watermelon. Cole. Syn. of Melon											
Water Pippin. R. Syn. Water's Pippin											Do.
Water's Pippin. A'83. Syn. of Water Pippin											
Waterwonder. KanExR'91											Do.
Watkin's Early. E. Syn. of Summer Pearmain											
Watrous. BBL											Do.
Watrous Dumpling. D. Syn. of Dumpling											
Watson. L. Syns. Autumn Pearmain, Autumn Seek-no-further, Doctor Watson, English Summer Pearmain, Royal Pearmain, Seeknofurther of Autumn, Sigler's Red.	Pa.? Ind.?	ob	m	gwrsc	fj	wy	rsa	vg	d	me	
Watson Dumpling. L. Syn. Watson's Dumpling	Eng	r	l	ygrs	j		psa	g	k	ml	Possibly identical with Dumpling.
Watson's Dumpling. E. Syn. of Dumpling											
Watson's Dumpling. GenF'33. Syn. of Watson Dumpling											
Watson Favorite. L. Syn. Watson's Favorite	Me	rob	m	yb	j	y	psa	vg			From Country Gentleman.
Watson's Favorite. D. Syn. of Watson Favorite											
Watson's New Nonsuch. GenF'33. Syn. of Thorle											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Watson's Vandervere. E. Syn. of Vandevere											
Watson's Vandevere. D. Syn. of Vandervere Pippin											
Wattagah. Hort'58. Syn. of Hoover											
Wattaugah. D. Syn. of Hoover											
Watterson. WisB45											Not described
Watterson's No. 4. WisB45											
Watts'. H. Syn. of Peck											
Watwood. Dap	Ky	ob	m	wyb	fj	yw	psa			l	
Waugh. A'95. Syn. Waugh's Crab	Va	roble	s	rs	fmj	w	sa	g	c	vl	Only recommended for cider.
Waugh's Crab. A'52. Syn. of Waugh											
Waupaca. P'86	Wis	obc	m	yrs	tjc	y	sa			l	Originated with Wm. A. Springer.
Waupaca Greening. CH	Wis		ml	gy						l	
Wax. D		rob	l	ygb		w	s	g		ml	
Wax Apple. D. Syn. of Early Wax											
Wax Apple. IllB45. Syn. of Lady											
Waxen (Va.?). D. Syn. Waxen of Coxe	Va.?	rob	m	py	ctj	wy	sa	g		m	
Waxen (Rus.). Gb. Syns. Shro. to Ia. No. 160, Voskovoe	Minn.? Rus	rob	ml	yb	fj	y	sa	g		m	Hansen says this originated in Minnesota.
Waxen Arcad. Gb. Syns. Arkad kruglui voscovni, Arkad kruglui woskowoi, Gov. list No. 430, Round Waxen Arcad.	Rus										Not described
Waxen Juicy. Cat. [May be Waxen Naliv.]											Do.
Waxen Juicy. Gb. Syn. of Waxen Naliv											
Waxen Naliv. Gb. Syns. Gov. list No. 199, Naliv Voskovoi, Naleiv Woskowoi, Waxen Juicy.	Rus										Do.
Waxen (not of Coxe). Cole. Syn. of Belmont											
Waxen of Coxe. C. Syn. of Belmont											
Waxen of Coxe. T. Syn. of Waxen (Va.?)											
Waycross. R. Syn. Waycross Red	Ga.?	ob	ml	yrs	j	w	s	vg	dm	e	
Waycross Red. ChNCo. Syn. of Waycross											
Waycross Sweet. Cat. [Probably same as Waycross.]											Do.
Waycross White. Cat											Do.
Wayne. L. Syn. Wayne Beauty											Do.
Wayne Beauty. Cat. Syn. of Wayne											
Weakley. R. Syn. Weakley's Summer											Do.
Weakley's Summer. Hort'65. Syn. of Weakley											
Wealthy. AHortA'69. Syn. Hyde's King	Minn	rob	m	wyrsc	tj	ws	sa	vg	dm	m	First described in Western Farmer, 1869.
Wealthy Favorite. L. Syns. Bradley's Winter, Wealthy's Favorite, Winter Seedling.	Mich	rob	m	ybc	tj	wy	sa	vg	d	l	

Wealthy's Favorite. D. Syn. of Wealthy Favorite											
Weaver. L. Syn. Weaver Sweet	Ohio	ob	l	y			s	g		l	
Weaver Sweet. W. Syn. of Weaver											
Webb. A'73. Syn. Webb's Winter	{Miss.? / Ky.?}	r	m	yrs	ftj	w	psa	g		ml	
Webber. A'77											Not described.
Webb Kitchen. R. Syn. Webb's Kitchen Russet	Eng			rn						vl	
Webb's Kitchen Russet. GarM'59. Syn. of Webb Kitchen											
Webb Seedling. R. Syn. Webb's Seedling											Do.
Webb's Seedling. S&W. Syn. of Webb Seedling											
Webb's Winter. W. Syn. of Webb											
Webeetuck. R. Syn. We-Bee-Tuck	N. Y									e	Do.
We-Bee-Tuck. Hort'58. Syn. of Webeetuck											
Webster. R. Syn. George Webster											Do.
Webster Beauty. ColB17											Do.
Weck's Pippin. E. Syn. of Wick											
Wege. BBL											Do.
Wegenwega. IllH'81. [Possibly identical with Willow.]											Do.
Weidner. R. Syn. Weidner's Golden Reinette											Do.
Weidner's Golden Reinette. IllB45. Syn. of Weidner											
Weidner. Dap. Syn. of Early Ripe											
Weinapfel rother (herbst Rgl.). Gb. Syn. of Red Wine											
Weisse Antillische. D. Syn. of Winter Reinette											
Weisse Italianische Rosmarinapfel. D. Syn. of Italian											
Weisser Alabaster. Gb. Syn. of Alabaster											
Weisser Astrakan. D. Syn. of White Astrachan											
Weisse Reinette. D. Syn. of French Reinette											
Weisser Winter Calville. D. Syn. of White Calville											
Weisser Wintertafelapfel. Gb											
Weisse Sommer Reinette. D. Syn. of Summer Reinette											
Weisse Waek's Reinette. D. Syn. of Summer Reinette											
Welch. PaB18											Do.
Welch's Spitzenberg. Dap. Syn. of Red Canada											
Welch Sweet. IndH'77											Do.
Welcome. E. Syn. of Black Coal											
Welford. R. Syn. Welford Park Nonsuch. [May be Wellford.]											Do.
Welford Park Nonsuch. BBL. Syn. of Welford											
Well. R. Syn. Well Apple											Do.
Well Apple. IndH'72. Syn. of Well. [Probably identical with Wells.]											
Well Apple. D. Syn. of Titus											
Well Apple. E. Syn. of Wells											
Wellford. L. Syns. C. C. Wellford, Wellford's Yellow	Va	rob	s	pyrs	fj	y	sa	g		vl	
Wellford's Yellow. MoH'67. Syn. of Wellford											
Wellington. CAG. Syn. Duke of Wellington			l	r	t		sa			me	
Wellington. GenF'33. Syn. of Dumelow											
Wells. MagofH'18. Syns. Belle Tart, Cheat, English Rambo (of some), English Winter Redstreak (of some), Hogan, Striped Rhode Island Greening, Well Apple.	Md	r	m	rs			sa	g		l	
Wells. D. Syn. of Domine											
Wells. H. Syn. of Western Beauty											
Wells, of Ohio. H. Syn. of Domine											
Wells Summer. IllH'01											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Wells Sweet. Hort'75. Syns. Sweeting Well's, Well's Sweet, Wells' Sweeting, White Water Sweet.	N. Y.?	robl	m	gb	vtj	vw	s	g-vg	k	ml	
Well's Sweet. D. Syn. of Wells Sweet											
Wells' Sweeting. Cole. Syn. of Wells Sweet											
Welsh Pippin. D. Syn. of Marmalade											
Welter. R. Syn. Zawsen von Welter		r	s	ru			sa	g		l	
Welton Troy. PFar'60											Not described.
Weltry. P'94	N. Y	rob	m	gb	fcj	y	sa	vg	d	l	
Wemyss. L. Syn. Lady of the Weymss	Scot	r		pgb	j	w	sa			m	
Wentworth. R. Syn. Wentworth's Early	Ger		ml	r			sa	vg		ve	
Wentworth's Early. CBCo. Syn. of Wentworth											
Wergunoks. Gb. Syn. of Vorgunok											
Westbrook. Dap. Syn. of Fall Orange											
Westbrook. D. Syn. of Speckled											
Westbrook. AHortA'69. Syn. of Westbrooke											
Westbrooke. W. Syn. Westbrook	Va									l	Do.
Westbury. A'62		r	m	gys				g			
Westchester Seeknofurther. D. Syn. of Ferris											
Western. MagofH'47											Do.
Western Baldwin. P'93. Syn. of Babbitt											
Western Baldwin. D. Syn. of Pawpaw											
Western Beauty. RNY'61. Syns. Beauty of the West, Big Rambo, Musgrove's Cooper, Ohio Beauty, Ohio Nonpareil, Red Bellflower (of some), Wells.	Am	robe	l	gyrs	t	gw	sa	g		ml	Originally described by Judge Buel.
Western Beauty. W. Syn. of Grosh											
Western Beauty (erroneously). W. Syn. of Ohio Nonpareil											From Hogg.
Western Glory. L. Syn. Glory of the West	Eng.?	ob	l	yb	fj	yw	ba			m	
Western Spy. MagofH'48	Ohio	rob	ml	ybc	tj	y	bsa	g	dk	vl	
Westfield. Wg. Syns. Connecticut Seek-no-further, Marietta Seek-no-further, New England Seek-no-further, Red Winter Pearmain, Russet Seek-no-further, Seek-no-Further, Seeknofurther New England Red, Seek-no-further Westfield, Signifinger, Westfield Seek-no-further.	Conn	rc	l	grsm	ft	w	rsa	vg-b	dkm	ml	
Westfield Seek-no-Further. D. Syn. of Westfield											
West Grinstead Pippin. GenF'33. Syn. of Grinstead											
Westmoreland. L. Syn. Westmoreland Rambo	Tenn	ob	l-vl	gyrs	cjt	w	psa	g-vg		m	From seed of Rambo.
Westmoreland Long Start. D. Syn. of Long Start											
Westmoreland Rambo. Dap. Syn. of Westmoreland											
Weston. Cole	Mass.	rc	m	pyrs	mj	w	psa	g		m	
West's Spitzenberg. E. Syn. of Cat Pippin. [Doubtless same as Cut.]											
West's Spitzenberg. D. Syn. of Cut											

West Virginia. L. Syn. West Virginia King											Not described.
West Virginia King. Cat. Syn. of West Virginia											
Wet. R. Syn. Wet Apple											Do.
Wet Apple. IndH'72. Syn. of Wet											
Wetherell's Early. MagofH'53. Syn. of Wetherill											
Wetherill. L. Syns. Honey Sweet (of some), Wetherell's Early, Wetherill's White, Wetherill's White Sweeting, Wetherill's White Sweet, White Sweet, White Sweeting.	N.J.?	robe	m	wbc	tmj	w	s	g	k	m	
Wetherill's White. W. Syn. of Wetherill											
Wetherill's White Sweet. D. Syn. of Wetherill											
Wetherill's White Sweeting. E. Syn. of Wetherill											
Wetmore. TennBI-IX. Syn. Foster	Tenn	robl	ml	gyrs	ftj	gw	sa	g		l	
Wetsel. EWK. Syn. Wistal (erroneously)	Tex	r	l	gy				vg		e	Wistal is an error of Bulletins.
Welling Gb. Syn. of Pickle											
Wetwood. IllH'89											Not described.
Weyauwega. CH	Wis	ob	ml	yrs						l	
Weygenwega. IllH'81. [Probably identical with Willow.]											Do.
Wharton. W	Ohio	r	l	rs			sa	g		ml	
Wharton Favorite. L. Syn. Wharton's Favorite		ob	l	rs			sa	g		ml	
Wharton's Favorite. W. Syn. of Wharton Favorite											
Wharton White. R. Syn. Wharton's Large White											Do.
Wharton's Large White. IndH'72. Syn. of Wharton White											
Whatnot. IllH'99											Do.
Wheatyard. Dap. Syn. of Broadwater											
Wheeler. A'77	Wis	obe	ml	gyrs	tj	yw	sa	vg-b		ml	
Wheeler's Extreme. D. Syn. of Extreme											
Wheeler Russet. L. Syn. Wheeler's Russet	Eng	rob	m	yru	f	gw	bs			l	From Lindley.
Wheeler's Russet. DomEne. Syn. of Wheeler Russet											
Wheeler Sweet. L. Syns. Wheeler's Sweet, Wheeler's Sweeting	Ohio	re	m	yb	fmj	y	ps	g	k	m	
Wheeler's Sweet. D. Syn. of Wheeler Sweet											
Wheeler's Sweeting. W. Syn. of Wheeler Sweet											
Wheelock Sweet. D. Syn. of Red and Green											
Whig (Pa.). D	Pa	obe	ms	yrs	tj	w	msa	g		ml	
Whig (South). W	South	obe	m	y			sa	g		ml	Possibly identical with preceding.
Whinery. (LC). Syns. Whinery's Winter, Whinnery, Whinnery's Late Red.	Ohio	re	ml	rs	t	w	sa	g	km	l	
Whinery's Winter. JTL. Syn. of Whinery											
Whinnery. A'91. Syn. of Whinery											
Whinnery's Late Red. MichB31. Syn. of Whinery											
White. Gb. Syn. of Biel											
White Alexander. W		ob	m	y			sa	g		e	
White Aport. Gb. Syns. Aport bielui, Rgl. to Ia. No. 934	Rus										Not described.
White Apple. W	Ky	obl	s	y			s			l	
White Apple. E. Syn. of Belmont											
White Apple. Dap. Syn. of Parry White											
White Astracan. K. Syn. of White Astrachan											
White Astrachan. GenF'33. Syns. Astracan, Astracanischer Sommerapfel, Astrachaner Weisser, Glace de Zelande, Gov. list No. 44, Pomme de Glace, Pyrus Astracanica, Russian Ice Apple, Transparent de Moscovie, Weisser Astrakan, White Astracan.	Rus	r	m	wrs	t	w	sa	p		me	

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
White Baldwin. W	Ohio	c	l	wy			sa	p		m	
White Bauman. IllH'99											Not described.
White Beauty. Hort'51	Ohio	r	m	g	t	yw	sa	g		m	
White Belleflеur. D. Syn. of Ortley											
White Bellflower. D. Syn. of Ortley											
White Ben Davis. MoH'99											Do.
White Bogdanoff. R. Syn. Bogdanoff White	Rus		l	gw	tjf			vg	d		
White Borodovka. Gb. Syns. Biel Borodovskoe, Shro. to Ia. No. 37	Rus										Do.
White Cain. MagofH'52											Do.
White Calville. D. Syns. American White Winter Calville, Bonnet Carre, Calville Blanche d'Hiver, Calville White Winter, Niger, Weisser Winter Calville, White Winter Calville.	Fr	rc	m	yb	ct		psa	p	k	ml	
White Calville. D. Syn. of Summer White											
White Canada. R. Syn. White Canada Pippin											Do.
White Canada Pippin. DelExR'95. Syn. of White Canada											
White Carver. WHMCo			ml	y	ft		sa			e	
White Catlin. A'52. Syn. of White Catline											
White Catline. D. Syn. White Catlin		ob	s	gw	jt		p	g		m	
White Cockle. GenF'33. Syn. of Cockle											
White Codlin. H. Syn. of Dutch Codlin											
White Crimean. Gb. Syns. Gov. list No. 439, Krimskaja beel, Krimskaya biel, White Krim.	Rus	ob	m	yw	j	w	a	g	k	me	
White Crown. Dap. Syn. of McAfee											
White Cut. Gb. Syn. of White Rubets											
White Detroit. E											
White Doctor. PFar'53	Pa	rob	l	gy	t	w	bsa	g	km	m	
White Downing Blush. R. Syn. White Downing's Maiden's Blush											Do.
White Downing's Maiden's Blush. DelExR'95. Syn. of White Downing Blush.											
White Duchess. Cat											Do.
White Early. IndH'72											Do.
White Fall. L. Syns. Fall Pippin of Louisville, White Fall Pippin	Ky	rob	l	wy			sa	vg	dk	m	
White Fall Pippin. W. Syn. of White Fall											
White Fulwood (?). D. Syn. of Fulwood											
White Gilliflower. H											Do.
White Golden Sweet. T. Syn. of Baker Sweet											
White Graft of Wis. D. Syn. of Fall Orange											
White Greening. L. Syn. White Winter Greening											Do.
White Harvey. Hort'46											Do.
White Hawthornden. GenF'33. Syn. of Hawthornden											

White Hop. PFar'60											Do.
White Hoss. F											Do.
White Incomparable. D. Syn. Large White Incomparable Crab	Eng.?		ml	yw	cj		a		k	m	From Ronalds.
White Ingestrie. MagofH'50											Not described.
White Italian Rosemary Apple. K. Syn. of Red Romarin											
White June. D. Syn. of Yellow June											
White Juneating. DomEnc. Syns. Bracken, Carolina (of some), Caroline, Early Jennetting, Early May, Gennetting, Genniting, Ginnetting, Jeniting, Jennetting, Joanneting, Juneating, Juneating White, Juneting, May Apple, May Apple Pippin, May of Virginia, May Pippin, May Yellow, Owen's Golden Beauty, Primiting, Virginia May, Yellow June, Yellow May, Yellow May Pippin.	Eng	rob	s	gy	c	wy	psa	g	dm	ve	Described by Evelyn in [illegible]
White Juneating(?). H. Syn. of Bracken											
White Keeper. L. Syn. White's Long Keeper	Ind	r	l	rs			sa	g		vl	Origin, Plainfield, Ind.
White King. Dap. Syn. of Shaffer											
White Krim. Gb. Syn. of White Crimean											
White Lily. D. Syn. of Devonshire											
White London Pippin. GenF'46 Syn. of London											
White's Long Keeper. IndH'64. Syn. of White Keeper											
White Margil. E. Syn. of Margil											
White Melon. RGN			l	pg				vg		l	
White Melrose. D. Syn. of Melrose											
White Naliv. Gb. Syns. Belni Naliv, Bielui naliv, Gov. list No. 157, Juicy White, Nalivnoe bielui, Nalivnoe jeltui, Shro. to Ia. No. 133.	Rus										Hansen gives this as a syn of Yellow Transparent.
White Newell. Dap. Syn. of Fall Orange											
White Nonpareil. D	Belg.?	rob	m	gyr		w	a			vl	From Society of Van Mons.
White Orleans. MagofH'53											Not described.
White or Yellow June (of some). Dap. Syn. of Kirkbridge											
White Oslin. GenF'33. Syn. of Oslin											
White Paradise (Scot.). D. Syns. Egg, Eve, Lady's Finger, Long May, May, Paradise Pippin.	Scot	oblrc	m	yrs	tc	y	pa		k	m	
White Paradise (Ky.). W	Ky	obl	s	y			sa	g		ml	
White Paradise. Lin. Syn. of Lady Finger											
White Pearmain. L. Syns. Campbellite, White Winter Pearmain, White's Pearmain.		roblc	m	pyb	tcj	y	pmsa	vg	dkm	ml	
White Pearmain. E. Syn. of Michael Henry											
White's Pearmain. DomEnc. Syn. of White Pearmain											
White Pelikanoff. Gb. Syns. Beel Plikano Uskaja, Biel Pelikanovskaya, Gov. list No. 980, Plikanoff Small.	Rus										Do.
White Pigeon. Gb. Syns. Golubinoe beeloe, Golubino (bieloe not of Rgl.), Gov. list No. 317.	Rus	robc	ml	rs			sa	g		e	Hansen says No. 317 is Anis and not White Pigeon.
White Pippin (?). DomEnc. Syns. American White Winter Calville, Canada Pippin, Canada Reinette.	(?)	rob	l	gw	tcj	w	sa	vg-b	dkm	l	
White Pippin (Ky.). W	Ky	rob	l	gwy	fj	w	ba	g	mk	ml	
White Pippin. MagofH'47. Syn. of American White Calville											
White Pippin. D. Syn. of Norfolk Stone											
White Pippin. D. Syn. of Ortley											
White Pippin of O. Cole. Syn. of Canada Reinette											
White Queen. MagofH'52											Not described.
White Queen. Gb. Syn. of White Reinette. [Hansen calls it White Queen.]											
White Ralls. R. Syn. White Rawle's Janet											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
White Rambo. D	Pa	obc	m	yw	f	y	psa	g		m	Some claim it originated in Ohio.
White Rawle's Janet. IllB45. Syn. of White Ralls											
White Red. L. Syn. White Red Winter	South	obl	l	rs	j		rsa			vl	From the Country Gentleman.
White Red Winter. D. Syn. of White Red											
White Reinette. Gb. Syns. Gov. list No. 339, Reinetti beelui, Renet bielui, White Queen.	Rus	oblc	m	yw	j	w	psa	g		me	Hansen's leading name is White Queen.
White Robinson. A'54. Syn. of Winter Paradise											
White Romarin. D. Syn. of Romarin											
White Rubets. Gb. Syns. Bielui rubets, Gov. list No. 226, Rubets bielui, Rubez belui, V. R. S. to Ia. No. 5, White Cut.	Rus										Not described.
White Russet (Ire.). D	Ire	rob	l	yru	f		sa	g	d	m	From Lindley.
White Russet (Rus.). Gb. Syns. Beelowoe Scholto Seroe, Bielevoe jeltosieroe, Gov. list No. 881.	Rus										Not described.
White Russet No. 981. P'92	Vt	rob	l	gwyb	fj	w	sa	g		l	Probably same as preceding.
Whitescarver. A'71	Va	rob	m	yg	ctj	yw	psa	vg		m	
White Seedling. Cat											Not described.
White Seek-no-further. Hort'46		obc		gy			sa	vg		l	This answers the description of White Pippin.
White Seeknofurther. Lin. Syn. of Green Seeknofurther											
White Seeknofurther. D. Syn. of Ortley											
White Skrute. Gb. Syns. Gov. list No. 982, Round White, Skrut beelowoi, Skrut bielevoi.	Rus										Not described.
White Spanish. L. Syns. Camnesar, Cobbett's Fall Pippin, Concombre Ancien, D'Espagne, De Ratteau, Elgin Pippin, Fall Pippin (erroneously), Large Fall Pippin, Reinette Blanche d'Espagne, Reinette d'Espagne, White Spanish Reinette.	Spain	rob	vl	yg	ct	yw	rsa	vg	dm	m	Resembles Fall Pippin, but distinct.
White Spanish Reinette. D. Syn. of White Spanish											
White Spice. A'52	Pa	rob	l				sa	g		me	Distinct from Dyer.
White Spice. E. Syn. of Dyer											
White Spitzenberg. K. Syn. of White Spitzenburg											
White Spitzenburg. R. Syns. White Spitzenberg, White Spitzenburgh	Pa	rob	m	yb	j		bsa	g	d	ml	
White Spitzenburgh. GenF'33. Syn, of White Spitzenburg											
White Starkis. ColExR'88											Not described.
White Stone Pippin. D. Syn. of Norfolk Stone											
White Stone Pippin. D. Syn. of Stone Pippin											
White Sugar. BBL. [May be Autumnal Bough.]											Do.
White Sugar. D. Syn. of Autumnal Bough											
White Summer. L. Syn. White Summer Pippin	Eng.?	r	m	yru	t		sa?	g	d	me	From Ronalds.

White Summer Calville. Gb. Syns. Calville Weisser Sommer, Kalvil Weisser Sommer, Gov. list No. 2, Shro. to Ia. No. 40, Sommer Weisser Calville.	Rus										Not described.
White Summer Calville. Lin. Syn. of Summer White											
White Summer Pippin. D. Syn. of White Summer											
White Swan. Gb. Syns. Belaja Lebedka, Bielaya lebedka, Gov. list No. 219.	Rus										N. E. Hansen says this may be Yellow Transparent.
White Sweet. Gb. Syns. Bieloe Sladkoe, V. R. S. to Ia. No. 3	Rus										Not described.
White Sweet. TennBX-I. Syn. of Oostanaula											
White Sweet. D. Syn. of Wetherill											
White Sweeting. C. Syn. of Wetherill											
White Transparent. Gb. Syns. Gov. list No. 336, Skvosnoi bielui, Skwosnoi beeloe.	Rus										Do.
White Transparent. IllH'89. Syn. of Yellow Transparent											
White Vandervere. E. Syn. of Gray Vandervere											
White Vandevere. D. Syn. of Vandevere											
White Virgin. D. Syn. of Virgin											
White Vochin. Gb. Syns. Beel Wochins, Biel Vochina, Gov. list No. 364, Red Queen, White Wochins.	Rus	rob	ml	gyb	jf		sa	g		me	
Whitewater. L. Syn. Whitewater Sweet	Ohio	rob	s	yg	je	w	s	g		l	
White Water Sweet. Dap. Syn. of Wells Sweet											
Whitewater Sweet. MagofH'44. Syn. of Whitewater											
White Waxon. PE. [May be Waxen.]											Do.
White Wine. D		re	m	yru	fe	w	pa			m	
White Winesap. Hort'59. [White Apple in Lebanon Co., Pa.]	Pa.?										Do.
White Winter (N. C.). L. Syn. White's Winter	N. C	rob	m	yw	j		rsa?	vg		vl	From Country Gentleman.
White Winter (Pa.). D	Pa	r	s	yb	j	w	sa	g		vl	
White's Winter. D. Syn. of White Winter (N. C.)											
White Winter Calville. M. Syn. of White Calville											
White Winter Greening. Cat. Syn. of White Greening											
White Winter Pearmain. E. Syn. of Michael Henry											
White Winter Pearmain. D. Syn. of White Pearmain											
White Winter Pippin. IllH'86											Not described.
White Wochins. Gb. Syn. of White Vochin											
White Zurdel. NYB90											Do.
White Zurdel. IllB15. Syn. of Zurdel											
Whiting Seedling No. 1. MinnExR'90											
Whitman (Mass.). NEF'55	Mass	obl	ml	gyru			s			m	From New England Farmer.
Whitman (Kan.). KanFM'86	Kans		m	yrs	fc		a			l	
Whitmore. W	N. Y	r	m	y			s	g		m	
Whitmore Pippin. L. Syn. Whitmore's Pippin		e	m	ygb		wg	bsa			ml	From Lindley.
Whitmore's Pippin. D. Syn. of Whitmore Pippin											
Whitney (Ill.). L. Syn. Whitney Russet	Ill	rob	ms	yru	j	gy	bsa	vg-b	d	ml	Probably identical with the following.
Whitney (Can.?). D. Syns. Whitney Russet, Whitney's Russet	Can.?	obe	s	yrub	tj	y	rsa	vg	d	vl	Probably identical with the preceding.
Whitney Late. L. Syn. Whitney's Late Red											Not described.
Whitney's Late Red. Cat. Syn. of Whitney Late											
Whitney's No. 14. IllB15											
Whitney Russet. W. Syn. of Whitney (Ill.)											
Whitney Russet. D. Syn. of Whitney (Can.?)											
Whitney's Russet. T. Syn. of Whitney (Can.?)											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Whitney's Seedling. Cat											
Whitsell. R. Syn. Dr. Whitsell's Winter			m					g		vl	
Whittaker. IllH'71											Not described.
Whittemore. MagofH'35. [Probably same as Whitmore.]											Do.
Whorle Pippin. GenF'33. Syn. of Thorle											
Wick. Wg. Syns. Barlow, Court de Wick, Court of Wick, Court of Wick Pippin, Court of Wyck, Fry's Pippin, Golden Drop, Knightswick Pippin, Philip's Reinette, Rival Golden Pippin, Transparent Pippin, Week's Pippin, Wood's Huntingdon, Yellow.	Eng	rob	ms	yb	cj	y	a	vg	d	ml	
Wickham. L. Syns. Wickham's Pearmain, Wick Pearmain	Eng	rc	s	yrub	tcj	gy	sa	g	d	m	From Hogg.
Wickham's Pearmain. D. Syn. of Wickham											
Wick Pearmain. D. Syn. of Wickham											
Wide Adoption. IaH'91	Rus		m					g	dkm		
Wier. L. Syn. Wier Sweet		ob	m	yb	tjm	w	ps	g		l	
Wier Sweet. D. Syn. of Wier											
Wigwam. D. Syn. of Red Belle Fleur											
Wilcox. R. SDB76. Syns. Wilcox's Seedling, Wilcox's Winter	Iowa? Wis.?	obc	l	gyw	j	w	sa	g	k	l	Possibly two distinct varieties are here referred to. May be Scott Winter. See Ill. H. '00, p. 323
Wilcox's Seedling. IllH'89. Syn. of Wilcox											
Wilcox's Winter. IllH'00. Syn. of Scott Winter											
Wilcox's Winter. IllH'00. Syn. of Wilcox. [May be Scott Winter.]											
Wild Apple. AKC. Syn. of Yellow Forest											
Wild Apple from Wis. MinnExR'90											
Wildcat. D. Syn. of Santouchee											
Wilden Apfel. D. Syn. of Prairie											
Wilder. MoH'84											Not described.
Wild Goose. BBL											Do.
Wiley. Hort'72. Syn. Wiley's	Wis.?	c	l	rs			sa	p		l	
Wiley's. W. Syn. of Wiley											
Wiley Green. R. Syn. Wiley's Green		ob	m	gb			a	g		l	
Wiley's Green. IllB45. Syn. of Wiley Green											
Wiley Sweet. IndH'72. Syns. Wiley's Sweet, Wiley Sweeting	Ind	c	ml	r	mj		s	vg	dk	l	Origin, Posey County, Ind.
Wiley's Sweet. IllH'68. Syn. of Wiley Sweet											
Wiley Sweeting. IndH'75. Syn. of Wiley Sweet											
Wilfong. D. Syn. Willfong's	N. C	ob	ms	gyrs	fjt	w	psa	g		l	
Wilford. R. Syn. Wilford's Yellow											Not described.
Wilford's Yellow. TJG&S. Syn. of Wilford											

Wilfret. R. Syn. Wilfret's Winter Seedling	Minn									l	
Wilfret's Winter Seedling. MinnHort'01. Syn. of Wilfret											
Wilkins. R. Syn. Wilkins' Early											Do.
Wilkins' Early. MagofH'53. Syn. of Wilkins											
Wilkinson. R. Syn. Wilkinson Seedling											Do.
Wilkinson Seedling. IllH'89. Syn. of Wilkinson											
Willamette. P'93	Oreg	robe	l	yb	ftj	yw	sa	vg		l	
Willey. L. Syn. Willey's	Ind	r	l	rs			s	g		me	Origin, Clark County, Ind.
Willey's. W. Syn. of Willey											
Willfong's. Hort'65. Syn. of Wilfong											
William. IllB45			l					vg			
William's Favorite (erroneously). IllH'71. Syn. of Sops of Wine											
William Johnson. SDB76	Minn	oble	ml	gyrs		w	sa	g		l	Originated by Wm. Johnson, Farmington, Minn.
William Penn (Pa.). MagofH'53	Pa	robe	m	yrs	cj	y	psa	g-vg		l	
William Penn (Vt.). W	Vt	r	l	y			sa	vg		l	
William Pippin. L. Syn. William's Pippin	Eng.?	c	ms	pyrs		py	psa	g	dk	m	From Lindley.
William's Pippin. D. Syn. of William Pippin											
William Prince. IllB45		obe	ms	gy	vtj	w	sa	gvg	dk	ve	
Williams. NEF'30. Syns. Ladies Apple, Queen, Williams' Apple, Williams' Early, Williams' Early Red, Williams' Favorite, Williams' Favorite Red, Williams' Red.	Mass	roble	ml	dr		yw	sa	g	m	me	
Williams Apple. K. Syn. of Williams											
Williams' Early. D. Syn. of Williams											
Williams' Early Red. Cole. Syn. of Williams											
Williams' Favorite. NEF'34. Syn. of Williams											
Williams' Favorite Red. M. Syn. of Williams											
Williamson. Dap. Syn. of Domine											
Williams' Red. D. Syn. of Williams											
Williams' Red Winter. Dap. Syn. of Williams Winter											
Williams Sweet. WVaB75											Not described.
William Tell. D. Syn. of Pittsburg											
William White. L. Syn. William's White	Pa	obe	ms	wy	tj	y	psa	g		me	
William's White. D. Syn. of William White											
Williams Winter. L. Syn. Williams' Red Winter	Conn	obe	m	wrs	ftj	w	sa	g		l	
Willie. L. Syn. Sweet Willie	Ky		l	grs	ftj		s	g-vg		m	
Willis. Bul6	N. Y	r	vl	wr			s	g	dkm	e	This may be Willis Sweet of Downing.
Willis June. JVL. [May be Red June, of which Wilson June is a syn.]											Not described.
Willis Russet. W. Syn. Willis' Russet	Mass	obe	s	yru	tj		sa	vg	d	ml	
Willis' Russet. D. Syn. of Willis Russet											
Willis Sweet. D. Syns. Pear Lot, Pear Tree Lot, Willis Sweeting	N. Y	r	l	wrse	cjt	w	s	vg	dkm	me	
Willis Sweeting. MagofH'52. Syn. of Willis Sweet											
Willow. MagofH'48. Syns. James River, Willow Leaf (?), Willow Twig	Va.?	robe	ml	yrs		yg	ps	g	m	l	
Willow Apple. PFar'61. Syn. of Willowleaf											
Willowleaf. R. Syns. Willow Apple, Willow Leaf	Ohio	obe	l	rsp			sa	g	m	l	Distinct from Willow.
Willow Leaf. W. Syn. of Willowleaf											
Willow Leaf (?). E. Syn. of Willow											
Willow Leaf Pippin. D. Syn. of Ortley											
Willow Switch. A'56											Not described
Willow Twig. D. Syn. of Willow											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Wills. R. Syn. Fred Wills	Mo.?		l	gy			a	g			Described by N. J. Colman in MoH'63,p.7
Willsboro. D	N. Y.?	rc	m	yrs	cjt	yw	sa			l	Described by J. W. Bailey Plattsburg, N. Y.
Will's No. 2. IaH'85. Syn. of Windsor											
Wilmot. D. Syn. Wilmot's Seedling	Eng.?	c	m	yrs	tj	w	sa			e	From Ronalds
Wilmot's Seedling. D. Syn. of Wilmot											
Wilson (Mich.). W	Mich	rc	l	y	fj	y	bsa	vg	d	l	
Wilson (W. Va.). PFar'48	W. Va	rob	s	drs	fct	w	msa	vg-b	d	ml	May prove to be Black Annette (Warder)
Wilson (Ind.?). IndH'88	Ind.?		l					g	k	m	Grown by Mr. Wilson near Richmond, Ind.
Wilson June. D. Syn. of Red June											
Wilson's Large Red. IllB45. Syn. of Wilson Red											
Wilson's Large White. IndH'72. Syn. of Wilson White											
Wilson Pippin. W	Ind	rob	m	wy	tj	y	sa	g	k	ml	Grown and named by Reuben Ragan
Wilson Red. R. Syn. Wilson's Large Red	Ill.?	obc	l								
Wilson Summer. L. Syn. Wilson's Summer	N. C	rc	m	gyrs	tj	w	sa	g		mc	From Country Gentleman
Wilson's Summer. D. Syn. of Wilson Summer											
Wilson's Volunteer. W. Syn. of Volunteer											
Wilson White. R. Syn. Wilson's Large White											Not described
Wilton Sweet. MassH'74	N. S.	ob	l	yb				g			
Wiltshire. L. Syn. Harvey's Wiltshire Defiance	Eng	c	vl	yru	fcj	y	sa	vg		ml	From Hogg
Winchell. L. Syn. Winchell Seedling	Ohio	ob	l	rs			sa	vg		m	
Winchell Seedling. W. Syn. of Winchell											
Winchell Sweet. D	Conn	ob	ml	gyb	fj	w	rs	g	k	vl	
Windham. L. Syn. Windham Russet	Mass	rc	m	yru	mj	y	sa	g		vl	
Windham Russet. D. Syn. of Windham											
Windorf. WisHort'99	Wis.?							vg		l	Reported by Prof. E. S. Goff
Windower. E. Syn. of Gray Vandervere											
Windsor. P'89. Syns. Mill's No. 2, Windsor Chief	Wis	rc	ml	yr	fj	y	sa	g	m	ml	
Windsor Chief. WisH'94. Syn. of Windsor											
Wine. C. Syns. English Red Streak (incorrectly), Hays, Hays' Apple, Hayes' Fall, Hays' Winter, Hays' Winter Wine, Hollow Crown Pearmain, Pennsylvania Redstreak, Redstreak, Wine Apple, Wine of Pennsylvania, Winter, Winter Red, Winter Wine.	Del	rob	ml	yrs	jc	yw	sa	g-vg	mk	ml	
Wine. Cole. Syn. of Richard											
Wine Apple. IndF'40. Syn. of Fall Wine											
Wine Apple. Th. Syn. of Wine											

Wine (erroneously). E. Syn. of Jonathan										
Wine (erroneously). D. Syn. of Newtown Spitzenburg										
Wine-Fall. W. Syn. of Fall Wine										
Wine of Cole. E. Syn. of Fall Wine										
Wine of Connecticut. D. Syn. of Twenty Ounce										
Wine of Kansas. IllB45		ob	l				sa	vg		ml
Wine of Pennsylvania. JVL. Syn. of Wine										
Wine (of some). D. Syn. of Eggtop										
Wine Rubets. Gb. Syns. Cut Wine Apple, Gov. list No. 210, Rubets Vinogradnui, Rubez vuinogradnui.	Rus		ms	y			sa	g		e	Described by Prof. S. A. Beach in N. Y. Ex. R. '93.
Winesap. C. Syns. Holland's Red Winter, Potpie Apple, Royal Red of Kentucky, Texan Red, Wine Sop(?), Winter Winesap.	N. J	roble	m	drs	fe	y	sa	vg	dme	vl	
Winesap (erroneously). E. Syn. of Jonathan											
Wine Sop (?). E. Syn. of Winesap											
Wine Strawberry. T. Syn. of Richard											
Wine Sweet. Dap. Syn. of Winter Paradise											
Winfield. W		r		y			sa				
Wing. L. Syns. Wing Sweet, Wing Sweeting	N. Y.?	robe	ms	yrs	tmj	y	s	g-vg	k	m	
Wing Sweet. MagofH'53. Syn. of Wing											
Wing Sweeting. GenF'36. Syn. of Wing											
Winkler. IllH'96. [Possibly intended for Minkler.]											Not described.
Winn. L. Syns. Winn's Russet, Win Russet	Me		l	rurs	f		sa	g		vl	
Winnebago. JVC	Ill.?										Do.
Winn's Russet. D. Syn. of Winn											
Win Russet. Cole. Syn. of Winn											
Winslow. E	Va	rob	l	rs	tj	yw	sa	g		ml	
Winsor. R. Syn. Winsor Seedling. [Possibly intended for Windsor.]											Do.
Winsor Seedling. A'62. Syn. of Winsor											
Winsted. R. Syn. Winsted Pippin	Minn		ml				sa	g		l	
Winsted Pippin. IaB31. Syn. of Winsted											
Winter. C. Syn. of Wine											
Winter Anis Rennet. K. Syn. of Fenouillet Gris											
Winter Aport. Gb. Syns. Aportovoe Simovoe, Aportowoge Simowoe, Gov. list No. 279, Winter O'Porto.	Rus										Do.
Winter Banana. P'95. Syn. of Banana											
Winter Belle and Bonne. D. Syn. of Belle Bonne											
Winter Belleboon. D. Syn. of Belle Bonne											
Winter Bevane. BBL											Do.
Winter Birnapfel. Gb. Syn. of Winter Pear											
Winter Black. A'77		ob	l	gyrs	tj	w	sa	g		l	
Winter Blush. (LC). Syn. Winter Maiden's Blush. [Same as Winter Maiden Blush.]	Pa	oble	m	yb	et	w	sa	vg		l	From Gardener's Monthly. Description bad.
Winter Blush. D. Syn. of Fallawater											
Winter Boren. IllB45											Not described
Winter Borsdorffer. GenF'33. Syn. of Borsdorffer											
Winter Bough. W	N. Y	ob	l	y			s	g		l	A synonym of Cann, which it may be.
Winter Bough. D. Syn. of Cann											
Winter Broading. D. Syn. of Broadend											
Winter Brook. W	South	ob		y			sa			l	
Winter Brown. BBL											Not described.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Winter Buff. HB45											Not described
Winter Calville. R. Syn. English Winter Calville		r	ms	gyr	jc	w	sa			l	
Winter Canville. A'73		robl	l	gy	j	g	a	vg		l	Probably a misprint for Winter Calville
Winter Chandler. E. Syn. of Chandler											
Winter Cheese. E	Va	ob	l	rs			sa	g		l	
Winter Cheese. TWW&S. Syn. of Buckingham											
Winter Cheese. Cat. Syn. of Green											
Winter Cheese. D. Syn. of Green Cheese											
Winter Citron. CBCo	Rus	robl	l	yrs	fj		sa			vl	
Winter Citronenapfel. D. Syn. of Konig											
Winter Codlin. GenF'33	Eng	rc	m	wyrs	fmj	w	sa	g	k	l	
Winter Colman. D. Syns. Norfolk Colman, Norfolk Storing	Eng.?	rob	l	pyb	fc		a		k	l	From Lindley
Winter Duchess. CanExR'91	Iowa	r	l	yrs		y	sa	vg		m	Originated by C. G. Patten, Charles City, Iowa
Winter Duchess. FEY. Syn. of North Star											
Winter Eitron. DelExR'95											Not described
Winter Excelsior. JAY	N. C	obc	l	r	tc	y		g			
Winter Fameuse. JVC	Ill	ob	m	r	j		sa			l	
Winter Genneting. E. Syn. of Ralls											
Winter Glass. Gb. Syns. Glass Winter, Gov. list No. 171, Stekliannoe Simovoe, Stekliannoez Simowoe.	Rus										Do
Wintergold. R. Syn. Englischer Wintergoldparmane											Do
Winter Golden. Cat											Do.
Winter Golden Sweet. D. Syn. of Baker Sweet											
Winter Gray (Hogg). L. Syns. Belle Fille, Grauwe Franse Rennett, Prager, Reinette Française, Reinette Grise, Reinette Grise d'Hiver, Reinette Grise Extra, Winter Gray Reinette.		rob	m	ygbru	fcj	y	rsa?			vl	From Hogg
Winter Gray (Rivers). L. Syn. Winter Gray Reinette		ob	s	yru	fmj	w	rsa	g		vl	From Rivers
Winter Gray (Album Pomology). L. Syn. Winter Gray Reinette		r	l	pym						l	From Album de Pomologie
Winter Gray Reinette. D. Syn. of Winter Gray (Hogg)											
Winter Gray Reinette. D. Syn. of Winter Gray (Rivers)											
Winter Gray Reinette. D. Syn. of Winter Gray (Album Pomology)											
Winter Green. W	Ohio	c	l	y			s	vg		ml	
Winter Green. WHyS. Syn. of Poorhouse											
Winter Greening. D. Syn. of Green Cheese											
Winter Grickson. MagofH'46. Syn. of Catline											
Winter Grixon. E. Syn. of Catline											
Winter Harvey. MagofH'47. Syns. Autumn Pippin, Winter Pippin	East	rc	m	gyb	tj	w	psa	g		l	
Winter Hog Island Sweet. D. Syn. of Hog Island Winter											

Winter Horse. JVL. [May be Nickajack.]											Not described.
Winter Horse. D. Syn. of Nickajack											
Winter Janet. W		r	m	rs			sa	g		l	May be Ralls.
Winter Jannetting. D. Syn. of Ralls											
Winter John. A'83											Not described.
Winter King. L. Syn. King's Winter. [Not Tompkins King.]											Do.
Winter King. T. Syn. of Tompkins King											
Winter King. SDB76. Syn. of Yahnke											
Winter Lading. D. Syn. of Lading											
Winter Livland. Gb. Syns. Erdbeerapfel, Gov. list No. 580, Livlandischer Winter, Red Calville.	Rus										Do.
Winter Lowland. A'87. [Probably a syn. of Winter Livland.]											Do.
Winter Maiden Blush. P'91	Pa	ob	l	y	vtj	y	sa	vg			This is Winter Blush of Mr Lyon's index
Winter Maiden's Blush. D. Syn. of Winter Blush. [Of Mr. Lyon's index.]											
Winter Majettin. GenF'33. Syn. of Majettin											
Winter May. D. Syn. of May											
Winter Mouse. GenF'33		r	m	s				g	d	l	
Winter Neverfail. JAY	South	r	m	r	j					l	Probably may be Ralls.
Winter Neverfail. JAY. Syn. of Ralls											
Winter Nonsuch. MoH'63	Ill	ob	l	rs			sa	g		l	
Winter Nonsuch. Cole. Syn. of Red Canada											
Winter Norway. Cat. Syn. of Norway											
Winter O'Porto. Gb. Syn. of Winter Aport											
Winter Paradise. L. Syns. Grandmother, Honey Sweet (of some), Paradise Winter, Paradise Winter Sweet, Wine Sweet, Winter Sweet Paradise.	Pa	rob	l	gyb	fj	w	s	vg	k	l	
Winter Peach. IHH'88. Syns. Peach, Peach of Kentucky, Winter Peach of Kentucky.			ml	y			sa	vg		ml	
Winter Peach. IIIB45. Syn. of Peach											
Winter Peach of Kentucky. BBL. Syn. of Winter Peach											
Winter Pear. Gb. Syns. Gov. list No. 70, Winter Birnapfel	Rus	re	m	yres	fj	y	sa	vg	d	me.?	Hansen gives the season as August. Probably a mistake.
Winter Pearmain. DomEnc. Syns. Autumn Pearmain, Great Pearmain, Green Winter Pearmain, Old Pearmain, Parmain d'Hiver, Pearmain, Pearmain Herefordshire, Pepin Parmain d'Angleterre, Pepin Parmain d'Hiver, Peremenes, Red Pearmain.	Eur	c	m	gb	fej	y	sa	g		l	
Winter Pearmain. D. Syn. of Autumn Pearmain											
Winter Pearmain. W. Syn. of Long Island Pearmain											
Winter Pearmain. Dap. Syn. of Long Red											
Winter Pearmain. Dap. Syn. of McAfee											
Winter Pearmain (erroneously). C. Syn. of Herefordshire											
Winter Pearmain (of some). D. Syn. of Milam											
Winter Pearmain (of some). D. Syn. of McAfee											
Winter Pennock. H. Syn. of Pennock											
Winter Perfection. IHH'92	Ill	c	m	gyrs						l	Described by H. M. Dunlap
Winter Pippin (N. Y.). W	N. Y	ob	l	y			sa			l	
Winter Pippin (Ind.). W	Ind	r	l	y			sa	g		l	
Winter Pippin (Vt.). NEF'50. Syn. Winter Pippin of Vermont	Vt	re	l	gy	t	w	sa ?	g		l	
Winter Pippin (from Mich.). D. Syns. Winter Pippin of Geneva (erroneously), Winter Pippin of Michigan.		ob	l	y			sa	g		l	Possibly identical with Geneva. Downing, p. 189.
Winter Pippin. D. Syn. of Winter Harvey											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
Winter Pippin of Geneva. D. Syn. of Geneva											
Winter Pippin of Geneva (erroneously). W. Syn. of Winter Pippin (from Mich.).											
Winter Pippin of Michigan. IndH'79. Syn. of Winter Pippin (from Mich.)											
Winter Pippin of Vermont. D. Syn. of Winter Pippin (Vt.)											
Winter Pound Royal. D. Syn. of Pound Royal											
Winter Queen. DomEnc. Syns. Fall Queen, Kentucky Queen, Queen Apple of Forsythe, Robertson's Superb, Winter Queening.	Va	robe	l	rs			sa	g	dk	ml	Doubtless same as Buckingham.
Winter Queen. D. Syn. of Buckingham											
Winter Queen (?). Cat. Syn. of Poorhouse											
Winter Queening. GarCal		robl	l	rs				vg	d	l	Possibly identical with Buckingham.
Winter Queening. E. Syn. of Winter Queen [Buckingham (?).]											
Winter Quoning. MoH'67. [Said to be an old English variety.]											Not described.
Winter Rambo. W		r	m	rs			sa	vg		l	
Winter Rambo (of some). JBW&B. Syn. of Domine											
Winter Red. W	Ill	r	m	rs			sa	p		l	This may be Pottinger.
Winter Red. C. Syn. of Wine											
Winter Red Streak (?). D. Syn. of Bradford											
Winter Redstreak. GenF'33. Syn. of Cambusnethan											
Winter Redstreak. D. Syn. of Kentucky Red											
Winter Reinette. D. Syn. Weisse Antillische	Ger	oble	l	yb	fj	y	sa		d	l	From Diel.
Winter Rose. CanExR'96	Ont	ob	l	gr	mj	w	sa	g		l	
Winter Rose. D. Syn. of Nickajack											
Winter Russet. E. Syn. of English Russet											
Winter Russet. D. Syn. of Knobby Russet											
Winter St. Lawrence. A'89. Syns. Mank's Codling, Rambour Baree	Eng	rc	ml	rs	mj	w	sa	vg	d	l	May be Murphy. See A'87, 93; '89, 119.
Winter St. Lawrence. A'87. Syn. of Barnes Stripe. [May be Murphy. See A'89, p.119.]											
Winter St. Lawrence. CanHort'91. Syn. of Bethel											
Winter Seedling. D. Syn. of Wealthy Favorite											
Winter Seeknofurther. D Syn. of Fall Seeknofurther											
Winter Sleeping Beauty. D. Syn. of Sleeper											
Winter Snow. Bul8. Syn. of Ogle											
Winter Spice. IllB45		oble	m				s	g			
Winter Spiceen. IndF'40. [Cultivated by Joshua Lindley.]											Not described.
Winter Strawberry. D	Que	r	ml	yrs	tj	w	sa			ml	From Lowndes.
Winter Strawberry. D. Syn. of Turn off Lane											

Winter Streaked. Gb. Syns. Gov. list No. 260, Polosatka simnaya, Shro. to Ia. No. 33, Simnee polosatoe.	Rus										Not described.
Winter Streifling. (LC)	Rus	rob	l	y			sa	g		m	
Winter Stripe. MHSC'86	Rus		ml	yrs			sa	vg	d	l	Prof. Budd says differs from Winter Streaked.
Winter Striped. Cat											Not described.
Winter Sweet. IllH'74	Wis	ob	l	yrs			s	vg		l	W. C. Flagg gave this as a synonym of Green Russet.
Winter Sweet. E. Syn. of London Sweet											
Winter Sweet. P'94. Syn. of Newport											
Winter Sweet. A'95. Syn. of Wading											
Winter Sweet Bough. D. Syn. of Cann											
Winter Sweeting. DomEnc											Not described.
Winter Sweeting. K. Syn. of Seaver											
Winter Sweet Milwads. W. Syn. of Milwads											
Winter Sweet Paradise. Lin. Syn. of Winter Paradise											
Winter Sweet Pippin. H											Do.
Winter Tart. IndH'72											Do.
Winter Wagener. WVaB75											Do.
Winter White. IllH'69 [Probably White Pearmain.]											Do.
Winter White Calville. K. Syn. of White Calville											
Winter Wine. D. Syn. of Wine											
Winter Winesap. Hort'72. Syn. of Winesap											
Winterwood. P'94	Ill	obl	s	gy	ft	gy	sa	vg		l	
Winterzitron. R. Syn. Winterzitronenapfel											Do.
Winterzitronenapfel. MoH'87. Syn. of Winterzitron											
Winthrop Greening. Cole. Syns. Howe Apple, Lincoln Pippin, Kennebec Seedling, Yellow Flat.	Me	ob	l	gyru	tj	w	rsa	g	dk	me	
Winthrop Pearmain. Cole	Me	ro	l	yrs	j	w	sa			ml	From Maine Pomological Report.
Wisconsin. Cat											Not described.
Wisconsin Chief. MinnExR'90											Do.
Wisconsin Russet. WisB45. Syns. Mathews, Mathews' Russet	Wis		l	grn			sa			vl	
Wisconsin Spy. CH	Wis		m	y				g	d		
Wiseman. L. Syn. Wiseman's Champion Keeper											Do.
Wiseman's Champion Keeper. Cat. Syn. of Wiseman											
Wishford. L. Syn. Dredge's Fair Maid of Wishford	Eng	r	m	yrnrs	fj	y	bs			l	From Hogg.
Wistowchoe. Gb. Syn. of Pendant Ear											
Wismer. R. Syns. Wismer's Dessert, Wisner's Dessert	Can	r	ml	yrs					d	l	Wismer probably correct.
Wismer's Dessert. AmGar'97. Syn. of Wismer											
Wisner. D	N. Y	c	s	grs	tj		psa	g		l	
Wisner's Dessert. IllH'01. Syn. of Wismer											
Wistal (erroneously). Bul8. Syn. of Wetsel											
Witch. L. Syn. Lancaster Witch	Ohio?										Not described.
Witherill's White Sweet. D. Syn. of Wetherill											
Withrow. R. Syn. Withrow's Seedling											Do.
Withrow's Seedling. AmF'58. Syn. of Withrow											
Wochin's Apple. Gb. Syn. of Vochin											
Wolf's Den. T. Syn. of Averill											
Wolf River. Dap	Wis	robc	vl	gyrs	ctj	w	sa	g	km	ml	
Wollaton Pippin. D. Syn. of Court Pendu Plat											
Wolman's Harvest. E. Syn. of Summer Rose											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

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Wolseley. R. Syn. Lord Wolseley	For		l						dk	vl	
Womack. L. Syn. Mary Womack	Ky	ob	m	wrs	ftmj	wy	s	vg	dk	me	
Wonder. W	South	r	l							l	Probably? identical with Hamilton (South).
Wonder (?). D. Syn. of Hamilton (South)											
Wonderlich. L. Syn. Wonderlich's Spice											Not described.
Wonderlich's Spice. MagofH'53. Syn. of Wonderlich											
Wood. MagofH'46. [From Hallowell, Me.]	Me										Do.
Wood (Va.). L. Syn. Wood's Favorite	Va	ob	ml	wyb	fe		sa	vg		ml	A supposed seedling of Maiden Blush.
Woodard. IllH'90	Ill.?		m	r				g		l	Named by Ill. Hort. Society 1890. 69.
Woodburn. L. Syn. Woodburn Spitzenburg	Va	obl		rs			sa			l	
Woodburn Spitzenburg. W. Syn. of Woodburn											
Woodcock. L. Syn. Green Woodcock	Eng	rob	m	yrs	tj	w	bsa			m	From Hogg.
Wood's Favorite. AmF'56. Syn. of Wood (Va.)											
Wood Greening. L. Syns. Coate's Greening, Cooke's Greening, Onstine, Wood's Greening.	N. J.	rob	m	yg	tj	gw	sa	vg		l	
Wood's Greening. C. Syn. of Wood Greening											
Woodhouse. IllH'86											Not described.
Wood's Huntingdon. GenF'33. Syn. of Wick											
Woodland. D	Ill.? South?	ob	m	ygrs	j	y	sa	g		l	
Woodley. R. Syn. Woodley Favorite											Do.
Woodley Favorite. BBL. Syn. of Woodley											
Woodmansee. MoH'86			m	rs				vg		vl	
Woodpecker. D. Syn. of Baldwin											
Woodpile. P'95	Tenn	re	l	ywrs	ftj	y	sa	vg		m	
Woodring. D	Ohio	r	m	y			sa	g		l	
Woodruff. R. Syn. Woodruff's Sweet			l	r			s			m	
Woodruff's Sweet. A'69. Syn. of Woodruff											
Woods Favorite. BBL. [May be Wood (Va.).]											Do.
Woodside. L. Syn. Woodside Cider	Ohio	c	m	rs			sa	g		l	
Woodside Cider. W. Syn. of Woodside											
Woodstock. H									k		Do.
Woodstock. D. Syn. of Dyer											
Woodstock Pippin. GenF'33. Syn. of Blenheim											
Wood Sweet. L. Syns. Hyde's Sweet, Wood's Sweet	Vt	ob	l	wyrs	tj	w	rs	g-vg		m	
Wood's Sweet. D. Syn. of Wood Sweet											
Woodward. L. Syn. Ben Woodward											Do.

Woodward's Pippin. D. Syn. of Ortley											
Wood Winter. R. Syn. Wood's Winter											Do.
Wood's Winter. IllB'45. Syn. of Wood Winter											
Woolforks. W	Ky	re	ml	yg	tj	w	bsa	g	dk	l	
Woolman's Early. T. Syn. of Summer Rose											
Woolman's Harvest. DomEnc. Syn. of Summer Rose											
Woolman's Long. C. Syn. of Ortley											
Woolman's Red Sweet. MagofH'50. Syn. of Woolman Sweet											
Woolman's Striped Harvest. T. Syn. of Summer Rose											
Woolman Sweet. R. Syn. Woolman's Red Sweet											Do.
Woolman White. R. Syn. Woolman's White Sweet											Do.
Woolman's White Sweet. MagofH'50. Syn. of Woolman White											
Woolsey. Cat											Do.
Woolston Red. R. Syn. Woolston's Red Streak				rs							Do.
Woolston's Red Streak. A'52. Syn. of Woolston Red											
Woolston White. R. Syn. Woolston's White Sweet				w			s				Do.
Woolston's White Sweet. A'52. Syn. of Woolston White											
Woolverton. A'56											Do.
Woolverton. CanB'96. Syn. of Louise											
Wootten. TJG&S											Do.
Worcester. L. Syn. Golden Worcester	Eng.?	r	s	yb	f	y			d	l	From Ronalds.
Worcester Pearmain. BBL											Not described.
Worden's Pie Apple. D. Syn. of Sops of Wine											
Worgunok. BBL. [Supposed to be Vorgunok.]											Do.
Worgunok. Cat. Syn. of Vorgunok											
Workaroe. NYExR'92	Rus	e	ml		fj		sa	g		me	
World Beauty. R. Syn. Beauty of the World		obe	l	yr	j			vg		ml	
World King. R. Syn. King of all the World											Do.
World Wonder. L. Syns. Wonder of the World, World's Wonder	South	obe	vl	rs				vg		ml	Probably Nickajack.
World's Wonder. D. Syn. of Nickajack											
World's Wonder. W. Syn. of World Wonder											
Wormsley. L. Syns. Knight's Codlin, Knight's Codling, Wormsley Pippin	Eng	re	m	g	ef	w	sa	g		me	
Wormsley Pippin. GenF'33. Syn. of Wormsley											
Woroneck's. Gb. Syn. of Voronesh Reinette											
Worszt. P'91. Syn. No. 451	Rus	oblob	l	gyrs				g		e	
Worthen. R. Syn. Worthen's Winter Sweet	Ill		ml	w			s	vg		l	
Worthen's Winter Sweet. IllH'78. Syn. of Worthen											
Wotring. MagofH'53											Not described.
Wreston. L. Syn. Wreston's Prolific	Ky										Do.
Wreston's Prolific. W. Syn. of Wreston											
Wright. D. Syns. Wright Apple, Wright's Apple	Vt	rob	m	py	vtj	w	sa	g-vg		m	
Wright Apple. T. Syn. of Wright											
Wright's Apple. W. Syn. of Wright											
Wright Janet. L. Syn. Wright's Janet	Mo.?	rob	ml	yrs	fj	y	bsa	g-vg		vl	
Wright's Janet. W. Syn. of Wright Janet											
Wrightman. CH. Syn. Wrightman's Blush	Wis		l	yb				vg		l	
Wrightman's Blush. IllH'81 Syn. of Wrightman											
Wrights Seedling. SDB'76	Minn	oble	m	y	g	w	sa		k	m	Originated by Shaw, at Minnesota City, Minn., in 1852.
Wrigley. Dap. Syn. of Cooper Market											
Wuerzapfel. R. Syn. Sommergewuerzapfel											Not described.
Wyandotte. Dap. Syn. of McAfee											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Wyandott Sweet. MagofH'53											Not described.
Wycken Pippin. K. Syn. of Wyken											
Wyggers. D. Syns. of Golden Reinette (Eur.)											
Wyken. L. Syns. Arley, Girkin Pippin, Warwickshire Pippin, Wycken Pippin, Wyken Pippin.	Eng	obe	ms	gyb	tj	y	sa		d	ml	From Ronalds.
Wyken Pippin. D. Syn. of Wyken											
Wyker Pippin. D. Syns. of Golden Reinette (Eur.)											
Wyle. R. Syn. Wyle's Seedling											Not described.
Wyle's Seedling. MichB31. Syn. of Wyle											
Wyman. R. Syn. Wyman Pippin											Do.
Wyman Pippin. A'60. Syn. of Wyman											
Wyncoop. R. Syn. Wyncoop Harvest											Do.
Wyncoop Harvest. MagofH'41. Syn. of Wyncoop											
Wythe. Hort'73. Syn. Illinois Pippin	Ill	obe	m	wrs	ftj	w	sa	vg	d	l	Name first published in Horticulturist, 1873, p. 88.
Wythe. D. Syn. of Pittsburg											
Yacht. MagofH'53. Syn. Jagd	Pa	ob	m	yrs	t	w	psa	g		ml	
Yacob. P'92	Pa	rob	l	yrs	tj	yw	rsa	g		vl	
Yadkin. W. Syn. Yadkin Beauty	South	r	l	rs		w	sa	g		me	
Yadkin Beauty. Cat. Syn. of Yadkin											
Yahaula. W. Syn. of Yahoola											
Yahnke. SDB76. Syn. Winter King	Minn	rc	ml	yrcs	j	ws	sa	vg		l	Originated with Frank Yahnke, Winona, Minn in 1873.
Yahoola. H. Hort'58. Syn. Yahaula	Ga	ob	m	yru	j			g		ml	From White's manuscript.
Yakima. P'94	Wash	rc	l	yrcs	fj	y	sa	g	dm	l	May be Baldwin. See A 1899, p. 210.
Yakor. AlaB98											Not described.
Yancy. L. Syn. Yancy's Prize	Va							g			Do.
Yancy's Prize. A'71. Syn. of Yancy											
Yankee Apple. E. Syn. of Pumpkin Sweet											
Yankee Russett. W	Ohio										Do.
Yankee Spy. D. Syns. Dutchess County Sweet, Ox Sweet, Seedsville Sweet		obe	m	yb	mj	y	rs	g	k	m	
Yantamoe. Gb. Syn. of Amber											
Yardley. Dap. Syn. Bucks County Seedling (of some)	Pa	rob	l	gyrs	ctj	w	bsa		km	me	
Yates. D. Syns. Red Warrior, Yates Winter	Ga	obe	s	wyrs	tj	ws	psa	g	dm	vl	
Yates Winter. Cat. Syn. of Yates											
Yazoo. R. Syn. Brown's Yazoo	Miss	robl	vl	rs				g		ml	Described in A 1889, 156
Yearly. R. Syn. Yearly's Winter	Minn										Not described.
Yearly's Winter. MinnExR'90. Syn. of Yearly											

Yearry. TennBX-1. Syn. of Claiborne											
Yeats. MolI'88. Syn. of Stark											
Yellow. L. Syn. Yellow Pippin	Ohio	rob	m	dyb	cj	y	rsa	vg		l	Cultivated by B. O. Curtis, Edgar Co., Ill.
Yellow. Syn. of Wick											
Yellow Anis. Gb. Syns. Anis jeltui, Anis schaltui, Gov. list No. 987, Yellow Anisette.	Rus										Not described.
Yellow Anisette. Gb. Syn. of Yellow Anis											
Yellow Arcad. Gb. Syns. Arkad jeltui, Arkad scholti, Gov. list No. 188, Gov. list No. 327, Jeltui arkad, Scholti Arkad, Yellow Arcadian.	Rus										Do.
Yellow Arcadian. Gb. Syn. of Golden Arkad											
Yellow Arcadian. Gb. Syn. of Yellow Arcad											
Yellow Bell. Cat											Do.
Yellow Belle Fleur. G. Syn. of Yellow Bellflower											
Yellow Bellflower. DomEne. Syns. Belle Fleur, Belle Fleur Yellow, Bellflower, Bellflower Yellow, Bishop's Pippin of Nova Scotia, Lady Washington, Reinette Musque, Warren Pippin, Yellow Belle Fleur.	N. J.	oble	vl	pyb	tje	y	sa	vg	dkm	ml	
Yellow Bough. Cole. Syn. of Bough											
Yellow Butter. MichB31											Do.
Yellow Calville. Gb. Syns. Gov. list No. 142, Kalvil jeltui, Kalville scholti	Rus	ob	m	y			sa	g		e	
Yellow Crank. D. Syn. of Green Cheese											
Yellow Doctor. C		obl	m	y			sa			me	
Yellow English. IllH'99											Do.
Yellow English Crab. W	Eng	r		y			sa				Is this a crab?
Yellow Everlasting. C. Syn. of Everlasting											
Yellow Fenouillet. C. Syn. of Fenouillet Jaune											
Yellow Flat. Dap. Syn. of Kirkbridge											
Yellow Flat. D. Syn. of Winthrop Greening											
Yellow Forest. GarM'85. Syn. Wild Apple	La	rob	ml	y	tj		sa	vg	dc	ml	
Yellow Foster. D	Ohio ?	ob	ms	y	mj	y	sa	g		m	
Yellow German Reinette. GenF'83. Syn. of Golden Reinette											
Yellow Greening. IndH'72											Not described.
Yellow Hart. IllH'71	Ill.?		m	y							Perhaps same as Yellow Heart.
Yellow Harvest. GenF'32. Syn. of Early Harvest											
Yellow Heart. BBL											Doubtless same as Yellow Hart.
Yellow Hop. PFar'60											Not described.
Yellow Horse. W	South	ob	l	y			sa	g		me	Probably identical with Horse.
Yellow Horse. T. Syn. of Horse											
Yellow Hoss. D. Syn. of Horse											
Yellow Ingestrie. NEF'29	Eng	rob	s	y	tj		sa	g	d	m	
Yellow Janette. D. Syn. of Ralls											
Yellow Juice. Gb. Syn. of Yellow Naliv											
Yellow June. D. Syns. Hoover June, White June	South	rob	ms	py	tj	w	bsa	g		e	
Yellow June. T. Syn. of Kirkbridge											
Yellow June. W. Syn. of White Juneating											
Yellow Juneating. DomEne. Syn. of Early Harvest											
Yellow Kief. R. Syns. Kievskoe jeltoe, Shro. to Ia. No. 17, Yellow Kiev	Rus	rob	s	y	jf	w	sa	g		me	The United States Board on Geographic Names authorizes "Kief" as correct.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Yellow Kiev. Gb. Syn. of Yellow Kief											
Yellow Lemon. Gb. Syns. Gov. list No. 577, Limonnoe jeltoe, Limonnoe scholtoe.	Rus										Not described.
Yellow Limbertwig. Cat											Do.
Yellow May. D. Syn. of White Juneating											
Yellow May Pippin. Dap. Syn. of White Juneating											
Yellow Meadow. D	South	ob	l	gy	c	y	sa	g		m	
Yellow Mountaineer. Cat. Syn. of Piney Mountain											
Yellow Naliv. Gb. Syns. Gov. list No. 458, Jeltui Naliv, Nalivnoe jeltui, Scholtinaliw, Shro. to Ia. No. 164, Yellow Juice.	Rus										Do.
Yellow Newtown. D. Syns. Albemarle, Albemarle Pippin, Back Creek, Large Yellow Newtown, Mountain Pippin, Newtown Pippin, Newtown Pippin Yellow, New York Greening, New York Pippin, Virginia Pippin, Yellow Newtown Pippin.	N. Y	rob	ml	gy	fcj		a	vg-b	dkm	vl	Generally known in Virginia as Albemarle
Yellow Newtown Pippin. K. Syn. of Yellow Newtown											
Yellow Pearmain. W	South	c	m	y			sa	g		l	Possibly same as Clark Pearmain. See p. 127.
Yellow Pearmain. D. Syn. of Clark Pearmain											
Yellow Pearmain. T. Syn. of Golden Pearmain											
Yellow Pippin. IllH'81											Not described.
Yellow Pippin. DomEnc. Syn. of Newark Pippin											
Yellow Pippin. D. Syn. of Ortley											
Yellow Pippin. Dap. Syn. of Yellow											
Yellow Prolific. Gb. Syns. Plodovitka jeltaya, Shro. to Ia. No. 131	Rus										Do.
Yellow Pumpkin. R. Syn. Yellow Pumpkin Sweet											Do.
Yellow Pumpkin Sweet. IndH'72. Syn. of Yellow Pumpkin											
Yellow Reinette. BBL											Do.
Yellow Sap. BBL											Do.
Yellow Sibley. IllH'95. Syn. of Sibley											
Yellow Spice. IndH'72											Do.
Yellow Stettin. Gb. Syns. Gelber Stettiner, V. R. S. to Ia. No. 41	Rus										Do.
Yellow Sugar. Gb. Syns. Sacharnoe jeltoe, Shro. to Ia. No. 64	Rus										This is Yellow Sweet in the Gibb list.
Yellow Summer Pearmain. Dap. Syn. of Porter											
Yellow Sweet (Amer.). D. Syn. Yellow Sweeting	Am	r	s	py	t	w	ps	g		m	"A native apple of unknown origin."—Downing.
Yellow Sweet (Rus.). Gb. Syns. Gov. list No. 167, Jeltoe Sladkoe, Scholtoe Sladkoe.	Rus	ob	ml	rs			s	vg		vl	A Russian variety described by Prof. Budd.
Yellow Sweet (Rus.). Gb. Syns. Shro. to Ia. No. 127, Sladkoe jeltoe	Rus										Perhaps differing from the preceding.

Yellow Sweet (Texas). A'99	Tex	ob	l	y				vg		m	
Yellow Sweet (of Green and Hansen). SDB76. Syns. Green Sweet, Green Sweet of Patten.	Rus	rob	m	ygb		w	s	g	d	me	Appears to be distinct from other Yellow Sweets.
Yellow Sweeting. DomEnc. Syn. of Yellow Sweet (Amer.)											
Yellow Sweet June. FDNCo		r	m	y	j		s		dk	e	Doubtless Hightop Sweet.
Yellow Transparent. D. Syns. Gov. list No. 334, Grand Sultan, Russian Transparent, Skvosnoi jeltui, Skwosnoi Sehstoi, Transparent of the Crimea, White Transparent.	Rus	robe	m	py	tj	w	sa	g-vg	dkm	me	
Yellow Vandervere. W	Ohio	r	m	y			sa	g		l	Also a synonym of Vandevere.
Yellow Vandervere. D. Syn. of Vandevere											
Yellow Vandervere. W. Syn. of Vandervere Pippin											
Yellow Winesap. TJG&S											Not described.
Yocomb. L. Syn. Yocomb's	South	ob	l	rs			sa	g		me	
Yocomb's. W. Syn. of Yocomb											
Yoder. D. Syn. of Brimer											
Yopp. A'73. Syn. Yopp's Favorite	Ga	re	l	gyb	ftj	w	sa	g		m	
Yopp's Favorite. D. Syn. of Yopp											
York. D	Mass	re	m	pyb	j	w	sa	g-vg	k	m	
York and Lancaster. GarM'63. Syn. of St. Lawrence											
York Imperial. MagofH'53. Syns. Johnson's Fine Winter, Shepp	Pa	roblob	m	wes	fej	y	sa	g-vg	mk	ml	
York Pippin. D. Syn. of Fall Pippin											
York Pippin. D. Syn. of Golden Pippin											
York Russet. L. Syn. York Russeting		e	l	ru			sa	vg	dk	m	
York Russet. D. Syn. of Cheeseboro											
York Russet. D. Syn. of Pumpkin Russet											
York Russeting. K. Syn. of Cheeseboro											
York Russeting. Lin. Syn. of York Russet											
Yorkshire. L. Syns. Coate's Yorkshire Goose Sauce, Yorkshire Greening.	Eng	ob	l	grsru	fe	gw	bsa	g	k	m	
Yorkshire Goose Sauce. GenF'33. Syn. of Yorkshire											
Yorkshire Greening. GenF'33. Syn. of Yorkshire											
Yorkshire Sweetwater. GenF'32											Do.
York Stripe. Dap	Pa	re	ml	wyrs	mj	w	bsa	g		l	
York Vandaver. MagofH'53. Syn. of York Vandevere											
York Vandevere. R. Syn. York Vandaver											Do.
Yost. MagofH'53	Pa	ob	m	yrsc	tj	y	psa	g		ml	
Young. L. Syns. Irish Russet, Sam Young	Ire	ob	s	yru	jt	g	sa	g		ml	
Young America. A'75	Va		ml	y						e	
Young Late. L. Syn. Young's Late Winter											Do.
Young's Late Winter. Cat. Syn. of Young Late											
Young's Longkeeper. E. Syn. of Easter											
Young's seedling. GenF'33											
Zachary. L. Syn. Zachary Pippin	Me	ob	l-vl	gyrs	ctmj	w	sa			m	
Zachary Pippin. A'73. Syn. of Zachary											
Zakoritnoe. Gb. Syns. Gov. list No. 268, Saccharine, Sakaritnoe	Rus										Do.
Zane. MagofH'53. Syn. Zaen Greening	Va	r	l	gy	t	gw	sa	p		vl	First described by Elliott
Zane Greening. E. Syn. of Zane											
Zane Seedling. H											Not described.
Zansen. R. Syn. Zansen Von Welten	For		m							l	
Zansen Von Welten. WmW. Syn. of Zansen											
Zantar. Gb. Syn. of Amber											
Zantarnoe. Gb. Syn. of Amber											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Zarski Schip. Gb. Syn. of Czar Thorn											
Zawsen Von Welter. IllB45. Syn. of Welter											
Zeb Vance. Cat. [May be a synonym of Vance.]											Not described.
Zecke. Dap. Syn. of McAfee											
Zeiber. A'54. Syn. of Helper											
Zelenka. Gb. Syns. Gov. list No. 967, Greening, Rgl. to Ia. No. 239, Schlonne, Zelenoe.	Rus										Do.
Zelenka polosataya. Gb. Syn. of Green Streaked											
Zelenka sladkaya. Gb. Syn. of Green Sweet (Rus.)											
Zelenoe. Gb. Syn. of Zelenka											
Zerico. MagofH'37											Do.
Zettle's No. 1. MinnHort'96											
Zettle's No. 2. MinnHort'96											
Zettle's No. 3. MinnHort'96											
Zettle's No. 4. MinnHort'96											
Zettle's No. 5. MinnHort'96											
Zettle's No. 6. MinnHort'96											
Zettle's No. 7. MinnHort'96											
Zieber. MagofH'53	Pa	r	ms	yrs			psa	g			
Ziesler. L. Syn. Ziesler's Sweet	Pa	ob		y			s				
Ziesler's Sweet. W. Syn. of Ziesler											
Zimmerman. A'52											Do.
Zitsonnoe Zarskoe. Gb. Syn. of Imperial Citron											
Zoar. P'95. Syn. Zoar Transparent	Ohio	rob	l	wrsc	vjt	y	sa	vg	d	m	
Zoar Benoni. MagofH'53											Do.
Zoar Gilliflower. MagofH'47											Do.
Zoar Greening. D. Syn. Zoar Large Green	Ohio	rc	l	gb	tmj	w	psa	g		m	
Zoar Harvest. MagofH'53											Do.
Zoar Large Green. MagofH'47. Syn. of Zoar Greening											
Zoar Large Winter Sweet. MagofH'47. Syn. of Zoar Winter											
Zoar Nonsuch. MagofH'53											Do.
Zoar Spitzenburg. R. Syn. Zoar White Spitzenberg											Do.
Zoar Stripe. R. Syn. Zoar Striped Fall											Do.
Zoar Striped Fall. MagofH'47. Syn. of Zoar Stripe											
Zoar Transparent. Dap. Syn. of Zoar											
Zoar White Spitzenberg. MagofH'47. Syn. of Zoar Spitzenburg											
Zoar Winter. R. Syn. Zoar Large Winter Sweet											Do.
Zoate Peter Lely. GenF'33. Syn. of Lely											
Zolotareff. Gb. Syns. Gov. list No. 275, Sototoreffka, Zolotarevka, Zolotareff's apple.	Rus	rc	l	gyrs	tj	w	sa	g		me	

Zolotareff's apple. Gb. Syn. of Zolotareff											
Zolotarevka. Gb. Syn. of Zolotareff											
Zolotoi Arkad. Gb. Syn. of Golden Arend											
Zolotoi renet. Gb. Syn. of Golden Reinette											
Zost. MagofH'53											Do.
Zour Bough. D. Syn. of Primate											
Zuccalmaglio. R. Syn. Zuccalmaglio's Reinette		oble	m	gb	fj	w	sa			l	
Zuccalmaglio's Reinette. CanExR'01. Syn. of Zuccalmaglio											
Zurdel. R. Syn. White Zurdel		r	l	gy			sa	g	k	m	
Zurich. L. Syn. Transparent de Zurich			ms	w						me	
Zusoff. Gb. Syns. Gov. list No. 585, Jussow's Winterapfel, Zusow's Winterapfel, Zuzoff, Zuzoff's Winter.	Rus.	re	ml	rs	jf	w	sa	g		m	
Zusow's Winterapfel. Gb. Syn. of Zusoff											
Zuzoff. IIIH'99. Syn. of Zusoff											
Zuzoff's Winter. N. Syn. of Zusoff											
Zweibel Apfel. D. Syn. of Borsdorf											
Zweibel Borsdorfer. IaB90. Syn. of Borsdorf											

The following varieties were introduced from Russia by the United States Department of Agriculture in 1870, and distributed under these numbers. The nomenclature is that of the late Chas. Gibb, in his report to the American Pomological Society, which was published in the volume of Transactions for 1887, page 41.

Gov. list No. 1. Gb. Syn. of Red Astrachan										
Gov. list No. 2. Gb. Syn. of White Summer Calville										
Gov. list No. 4. Gb. Syn. of Luiken										
Gov. list No. 15. Gb. (?) Syn. of Avenarius										
Gov. list No. 44. Gb. Syn. of White Astrachan										
Gov. list No. 60. Gb. Syn. of Red Pine										
Gov. list No. 61. Gb. Syn. of Noble Redstreak										
Gov. list No. 68. Gb. Syn. of Early Champagne										
Gov. list No. 69. Gb. Syn. of Summer Pear										
Gov. list No. 70. Gb. Syn. of Winter Pear										
Gov. list No. 105. Gb. Syn. of Russian Gravenstein										
Gov. list No. 122. Gb. Syn. of Revel Borsdorf										
Gov. list No. 128. Gb. Syn. of Sheepnose										
Gov. list No. 153. Gb. Syn. of Transparent Naliv										
Gov. list No. 157. Gb. Syn. of White Naliv										
Gov. list No. 159. Gb. Syn. of Lemon										
Gov. list No. 161. Gb. Syn. of Longfield										
Gov. list No. 162. Gb. Syn. of Buschbohn										
Gov. list No. 164. Gb. Syn. of Heidorn										
Gov. list No. 166. Gb. Syn. of Summer Aport										
Gov. list No. 167. Gb. Syn. of Yellow Sweet										
Gov. list No. 169. Gb. Syn. of Green Sweet (Rus.)										
Gov. list No. 170. Gb. Syn. of Revel										
Gov. list No. 171. Gb. Syn. of Winter Glass										
Gov. list No. 173. Gb. Syn. of Earliest										
Gov. list No. 174. Gb. Syn. of Little Pipka										
Gov. list No. 176. Gb. Syn. of Red Sided										
Gov. list No. 177. Gb. Syn. of Green Streaked										
Gov. list No. 178. Gb. Syn. of Barloff										

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Gov. list No. 180. Gb. Syn. of Neelovskoe											
Gov. list No. 181. Gb. Syn. of Champagne Pipka											
Gov. list No. 182. Gb. Syn. of Red Summer Calville											
Gov. list No. 183. Gb. Syn. of Burlovka											
Gov. list No. 184. Gb. Syn. of Arabka											
Gov. list No. 185. Gb. Syn. of Anisovka											
Gov. list No. 186. Gb. Syn. of Revel Glass											
Gov. list No. 187. Gb. Syn. of Green Glass											
Gov. list No. 188. Gb. Syn. of Yellow Arcad											
Gov. list No. 190. Gb. Syn. of Tiesenhausen											
Gov. list No. 196. Gb. Syn. of Sweet Streaked											
Gov. list No. 197. Gb. Syn. of Crooked Spike											
Gov. list No. 198. Gb. Syn. of Polumiron											
Gov. list No. 199. Gb. Syn. of Waxen Naliv											
Gov. list No. 200. Gb. Syn. of Rosy Repka											
Gov. list No. 202. Gb. Syn. of Hare Pipka											
Gov. list No. 203. Gb. Syn. of Arcad											
Gov. list No. 204. Gb. Syn. of Rubets											
Gov. list No. 205. Gb. Syn. of Karabovka											
Gov. list No. 206. Gb. Syn. of Czar Thorn											
Gov. list No. 207. Gb. Syn. of Stupka											
Gov. list No. 208. Gb. Syn. of Royal											
Gov. list No. 210. Gb. Syn. of Wine Rubets											
Gov. list No. 212. Gb. Syn. of Barkoff											
Gov. list No. 213. Gb. Syn. of Stepanoff											
Gov. list No. 214. Gb. Syn. of Garden											
Gov. list No. 215. Gb. Syn. of Kustoe											
Gov. list No. 217. Gb. Syn. of Sugar Sweet											
Gov. list No. 218. Gb. Syn. of Vochin											
Gov. list No. 219. Gb. Syn. of White Swan											
Gov. list No. 220. Gb. Syn. of Silken											
Gov. list No. 225. Gb. Syn. of Getman											
Gov. list No. 226. Gb. Syn. of White Rubets											
Gov. list No. 228. Gb. Syn. of Crimean (Vochin)											
Gov. list No. 230. Gb. Syn. of Titovka											
Gov. list No. 231. Gb. Syn. of Golden Arcad											
Gov. list No. 234. Gb. Syn. of Muscatel											
Gov. list No. 236. Gb. Syn. of Antonovka											
Gov. list No. 240. Gb. Syn. of Lejanka											
Gov. list No. 242. Gb. Syn. of Broadcheek											

Gov. list No. 245.	Gb.	Syn. of Borovinka
Gov. list No. 246.	Gb.	Syn. of Prolific
Gov. list No. 247.	Gb.	Syn. of Popoff
Gov. list No. 248.	Gb.	Syn. of Biel
Gov. list No. 252.	Gb.	Syn. of Aport
Gov. list No. 260.	Gb.	Syn. of Winter Streaked
Gov. list No. 261.	Gb.	Syn. of Repka Aport
Gov. list No. 262.	Gb.	Syn. of Charlamoff
Gov. list No. 264.	Gb.	Syn. of Scented
Gov. list No. 265.	Gb.	Syn. of Gorke Pipka
Gov. list No. 266.	Gb.	Syn. of Novgorod Streaked
Gov. list No. 267.	Gb.	Syn. of Pear
Gov. list No. 268.	Gb.	Syn. of Zakoritnoe
Gov. list No. 269.	Gb.	Syn. of Rosy Aport
Gov. list No. 272.	Gb.	Syn. of Little Hat
Gov. list No. 273.	Gb.	Syn. of Autumn Pear
Gov. list No. 274.	Gb.	Syn. of Rosy
Gov. list No. 275.	Gb.	Syn. of Zolotareff
Gov. list No. 276.	Gb.	Syn. of Half Glassy
Gov. list No. 277.	Gb.	Syn. of Vargul
Gov. list No. 278.	Gb.	Syn. of Red Borovinka
Gov. list No. 279.	Gb.	Syn. of Winter Aport
Gov. list No. 282.	Gb.	Syn. of Voronesh Reinette
Gov. list No. 283.	Gb.	Syn. of Slast
Gov. list No. 284.	Gb.	Syn. of Kremer Glass
Gov. list No. 285.	Gb.	Syn. of Ribbed Naliv
Gov. list No. 286.	Gb.	Syn. of Kremer
Gov. list No. 287.	Gb.	Syn. of Riga Transparent
Gov. list No. 288.	Gb.	Syn. of Raspberry
Gov. list No. 290.	Gb.	Syn. of Ukraine
Gov. list No. 295.	Gb.	Syn. of Imperial
Gov. list No. 304.	Gb.	Syn. of Switzer
Gov. list No. 310.	Gb.	Syn. of ——— (Omitted)
Gov. list No. 313.	Gb.	Syn. of Muscatel
Gov. list No. 315.	Gb.	Syn. of Herren
Gov. list No. 316.	Gb.	Syn. of Red Reinette
Gov. list No. 317.	Gb.	Syn. of White Pigeon
Gov. list No. 321.	Gb.	Syn. of Sweet Pipka
Gov. list No. 322.	Gb.	Syn. of Cinnamon
Gov. list No. 323.	Gb.	Syn. of Riepovka
Gov. list No. 324.	Gb.	Syn. of German Calville
Gov. list No. 327.	Gb.	Syn. of Yellow Arcad
Gov. list No. 330.	Gb.	Syn. of Streaked Naliv
Gov. list No. 332.	Gb.	Syn. of Early Prolific
Gov. list No. 333.	Gb.	Syn. of Red Transparent
Gov. list No. 334.	Gb.	Syn. of Yellow Transparent
Gov. list No. 335.	Gb.	Syn. of Green Transparent
Gov. list No. 336.	Gb.	Syn. of White Transparent
Gov. list No. 337.	Gb.	Syn. of Serinkia
Gov. list No. 338.	Gb.	Syn. of Revel Pear
Gov. list No. 339.	Gb.	Syn. of White Reinette
Gov. list No. 340.	Gb.	Syn. of Livland Raspberry

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Gov. list No. 341. Gb. Syn. of Borsdorf											
Gov. list No. 342. Gb. Syn. of Thaler											
Gov. list No. 343. Gb. Syn. of Red Wine											
Gov. list No. 344. Gb. Syn. of Sultan											
Gov. list No. 350. Gb. Syn. of Lapouchoe											
Gov. list No. 351. Gb. Syn. of Prolific Sweeting											
Gov. list No. 352. Gb. Syn. of Resonant											
Gov. list No. 354. Gb. Syn. of Aromatic Spike											
Gov. list No. 355. Gb. Syn. of Autumn Aport											
Gov. list No. 359. Gb. Syn. of Pickle											
Gov. list No. 360. Gb. Syn. of Pound											
Gov. list No. 362. Gb. Syn. of Lead											
Gov. list No. 364. Gb. Syn. of White Vochin											
Gov. list No. 367. Gb. Syn. of Red Streak (Rus.)											
Gov. list No. 368. Gb. Syn. of Sugar Miron											
Gov. list No. 369. Gb. Syn. of Pipka											
Gov. list No. 370. Gb. Syn. of Swan											
Gov. list No. 371. Gb. Syn. of German Skrute											
Gov. list No. 372. Gb. Syn. of Petrovskoe											
Gov. list No. 374. Gb. Syn. of Pendant Ear											
Gov. list No. 375. Gb. Syn. of Cinnamon Pine											
Gov. list No. 377. Gb. Syn. of Yellow Lemon											
Gov. list No. 378. Gb. Syn. of Hibernal											
Gov. list No. 380. Gb. Syn. of Moscow Pear											
Gov. list No. 382. Gb. Syn. of Green Butskaya											
Gov. list No. 385. Gb. Syn. of Bode											
Gov. list No. 387. Gb. Syn. of Good Peasant											
Gov. list No. 393. Gb. Syn. of Imperial Citron											
Gov. list No. 398. Gb. Syn. of Enormous											
Gov. list No. 399. Gb. Syn. of Green Crimean											
Gov. list No. 402. Gb. Syn. of Borsdorf											
Gov. list No. 403. Gb. Syn. of Sweet Anis											
Gov. list No. 406. Gb. Syn. of Sweet Pipka											
Gov. list No. 407. Gb. Syn. of Blackwood											
Gov. list No. 408. Gb. Syn. of General Greig											
Gov. list No. 409. Gb. Syn. of Vochin											
Gov. list No. 410. Gb. Syn. of Little Repka											
Gov. list No. 413. Gb. Syn. of Cross											
Gov. list No. 424. Gb. Syn. of Bergamot											

Gov. list No. 425.	Gb.	Syn. of Painted Anis										
Gov. list No. 426.	Gb.	Syn. of Svinets										
Gov. list No. 427.	Gb.	Syn. of Anissim										
Gov. list No. 429.	Gb.	Syn. of Bosklonoff										
Gov. list No. 430.	Gb.	Syn. of Waxen Aread										
Gov. list No. 433.	Gb.	Syn. of Orloff										
Gov. list No. 437.	Gb.	Syn. of Saxonian?										
Gov. list No. 438.	Gb.	Syn. of Painted										
Gov. list No. 439.	Gb.	Syn. of White Crimean										
Gov. list No. 441.	Gb.	Syn. of Rattle										
Gov. list No. 442.	Gb.	Syn. of Yellow Calville										
Gov. list No. 444.	Gb.	Syn. of Lubsk Reinette										
Gov. list No. 445.	Gb.	Syn. of Romianka										
Gov. list No. 447.	Gb.	Syn. of Kief Reinette										
Gov. list No. 448.	Gb.	Syn. of Cardinal										
Gov. list No. 450.	Gb.	Syn. of Handsome White										
Gov. list No. 451.	Gb.	Syn. of ——— (Omitted)										
Gov. list No. 453.	Gb.	Syn. of Beautiful Aread										
Gov. list No. 455.	Gb.	Syn. of Berry (Rus.)										
Gov. list No. 457.	Gb.	Syn. of Kluevskoe										
Gov. list No. 458.	Gb.	Syn. of Yellow Naliv										
Gov. list No. 461.	Gb.	Syn. of Ribbed										
Gov. list No. 462.	Gb.	Syn. of Green Rubets										
Gov. list No. 463.	Gb.	Syn. of ——— (Omitted)										
Gov. list No. 466.	Gb.	Syn. of Acid Repka										
Gov. list No. 467.	Gb.	Syn. of Flat Miron										
Gov. list No. 468.	Gb.	Syn. of Painted White										
Gov. list No. 469.	Gb.	Syn. of Grandmother										
Gov. list No. 470.	Gb.	Syn. of Lapouchoe										
Gov. list No. 471.	Gb.	Syn. of Prolific Anis										
Gov. list No. 472.	Gb.	Syn. of Ostrokoff										
Gov. list No. 475.	Gb.	Syn. of Shepherd										
Gov. list No. 476.	Gb.	Syn. of Red Aread										
Gov. list No. 477.	Gb.	Syn. of Christmas										
Gov. list No. 478.	Gb.	Syn. of Thin Twig										
Gov. list No. 481.	Gb.	Syn. of Mensk										
Gov. list No. 490.	Gb.	Syn. of Glints										
Gov. list No. 502.	Gb.	Syn. of Rambour Reinette										
Gov. list No. 544.	Gb.	Syn. of Lapouchoe Naliv										
Gov. list No. 548.	Gb.	Syn. of Meadow										
Gov. list No. 551.	Gb.	Syn. of Watermelon										
Gov. list No. 555.	Gb.	Syn. of Red Sweeting										
Gov. list No. 557.	Gb.	Syn. of Revel Streaked										
Gov. list No. 558.	Gb.	Syn. of Early Cinnamon										
Gov. list No. 563.	Gb.	Syn. of Crimean Naliv										
Gov. list No. 565.	Gb.	Syn. of Vorgunok										
Gov. list No. 566.	Gb.	Syn. of Large Transparent										
Gov. list No. 568.	Gb.	Syn. of Melonen										
Gov. list No. 569.	Gb.	Syn. of Rosenhager										
Gov. list No. 575.	Gb.	Syn. of Alabaster										
Gov. list No. 578.	Gb.	Syn. of Leipsic										

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Gov. list No. 579. Gb. Syn. of Summer Livland											
Gov. list No. 580. Gb. Syn. of Winter Livland											
Gov. list No. 584. Gb. Syn. of Erdbeer											
Gov. list No. 585. Gb. Syn. of Zusoff											
Gov. list No. 587. Gb. Syn. of English Pippin											
Gov. list No. 592. Gb. Syn. of Long Arcad											
Gov. list No. 595. Gb. Syn. of Sweet Mensk											
Gov. list No. 597. Gb. Syn. of Sandy Glass											
Gov. list No. 599. Gb. Syn. of Romenskoe											
Gov. list No. 600. Gb. Syn. of Long											
Gov. list No. 864. Gb. Syn. of Smoky Arcad											
Gov. list No. 874. Gb. Syn. of Sweet Borovinka											
Gov. list No. 962. Gb. Syn. of Muscatel Reinette											
Gov. list No. 963. Gb. Syn. of Livland Muscatel											
Gov. list No. 964. Gb. Syn. of Autumn Streaked											
Gov. list No. 965. Gb. Syn. of Sweet Pear											
Gov. list No. 966. Gb. Syn. of Red Black											
Gov. list No. 967. Gb. Syn. of Zelenka											
Gov. list No. 968. Gb. Syn. of Aloe											
Gov. list No. 969. Gb. Syn. of Amber											
Gov. list No. 970. Gb. Syn. of Stranger											
Gov. list No. 971. Gb. Syn. of Basil (the Great)											
Gov. list No. 972. Gb. Syn. of Overflowing											
Gov. list No. 973. Gb. Syn. of ——— (Omitted)											
Gov. list No. 974. Gb. Syn. of Rosumoff											
Gov. list No. 975. Gb. Syn. of Red Titka											
Gov. list No. 976. Gb. Syn. of Lipka											
Gov. list No. 977. Gb. Syn. of ——— (Omitted)											
Gov. list No. 978. Gb. Syn. of Golden White											
Gov. list No. 979. Gb. Syn. of Large Long White											
Gov. list No. 980. Gb. Syn. of White Pelikanoff											
Gov. list No. 981. Gb. Syn. of White Russet											
Gov. list No. 982. Gb. Syn. of White Skrute											
Gov. list No. 983. Gb. Syn. of Transparent Astrachan											
Gov. list No. 984. Gb. Syn. of Kursk Anis											
Gov. list No. 985. Gb. Syn. of Red Anis											
Gov. list No. 986. Gb. Syn. of Green Anis											
Gov. list No. 987. Gb. Syn. of Yellow Anis											
Gov. list No. 988. Gb. Syn. of Pineapple (Rus.)											

The following varieties were sent by Dr. Regel, of St. Petersburg, Russia, to the Iowa Agricultural College. The numbering is that of Mr. Gharles Gibb in his report to the American Pomological Society.

Rgl. to Ia. No. 10. Gb. Syn. of (Omitted.). [Possibly the same as Autumn Streaked.]
Rgl. to Ia. No. 123. Gb. Syn. of Revel Pigeon
Rgl. to Ia. No. 151. Gb. Syn. of Sugar Miron
Rgl. to Ia. No. 170. Gb. Syn. of Revel Glass
Rgl. to Ia. No. 191. Gb. Syn. of Red Petersburg
Rgl. to Ia. No. 239. Gb. Syn. of Zelenka. [May be same as Zelenoe.]
Rgl. to Ia. No. 243. Gb. Syn. of Nicolai
Rgl. to Ia. No. 257. Gb. Syn. of Arabka (Gov. list No. 184)
Rgl. to Ia. No. 277. Gb. Syn. of Lead
Rgl. to Ia. No. 328. Gb. Syn. of Peterhoff
Rgl. to Ia. No. 356. Gb. Syn. of Round Borsdorf
Rgl. to Ia. No. 361. Gb. Syn. of Pointed Pipka
Rgl. to Ia. No. 379. Gb. Syn. of Revel Pear (Gov. list No. 338)
Rgl. to Ia. No. 428. Gb. Syn. of Fonarie
Rgl. to Ia. No. 540. Gb. Syn. of Kalkidon
Rgl. to Ia. No. 934. Gb. Syn. of White Aport
Rgl. to Ia. No. 1227. Gb. Syn. of Gipsey
Rgl. to Ia. No. 1260. Gb. Syn. of Red Raspberry
Rgl. to Ia. No. 1277. Gb. Syn. of Rosy Voronesh

The varieties included in the following list were sent to the Iowa Agricultural College by Dr. Schroeder, of Russia. The numbers are from Mr. Charles Gibb's report to the American Pomological Society.

Shro. to Ia. No. 1. Gb. Syn. of Repolovka
Shro. to Ia. No. 2. Gb. Syn. of Hare Pipka
Shro. to Ia. No. 3. Gb. Syn. of Lead
Shro. to Ia. No. 4. Gb. Syn. of Ostrokoff
Shro. to Ia: No. 5. Gb. Syn. of Royal Table
Shro. to Ia. No. 6. Gb. Syn. of Grandmother
Shro. to Ia. No. 7. Gb. Syn. of Osimoe
Shro. to Ia. No. 8. Gb. Syn. of Sweet Cross
Shro. to Ia. No. 9. Gb. Syn. of English Borovinka
Shro. to Ia. No. 10. Gb. Syn. of Ukraine
Shro. to Ia. No. 11. Gb. Syn. of Romenskoe
Shro. to Ia. No. 12. Gb. Syn. of Vargulek
Shro. to Ia. No. 13. Gb. Syn. of Mottled Anis
Shro. to Ia. No. 14. Gb. Syn. of Anissim
Shro. to Ia. No. 15. Gb. Syn. of Cross
Shro. to Ia. No. 16. Gb. Syn. of Vargul
Shro. to Ia. No. 17. Gb. Syn. of Kruder
Shro. to Ia. No. 18. Gb. Syn. of Anissim
Shro. to Ia. No. 19. Gb. Syn. of Blackwood
Shro. to Ia. No. 20. Gb. Syn. of Kursk Reinette
Shro. to Ia. No. 21. Gb. Syn. of Karabovka
Shro. to Ia. No. 22. Gb. Syn. of Blushed Calville
Shro. to Ia. No. 23. Gb. Syn. of Aport — This and the following one have the same numbers.
Shro. to Ia. No. 23. Gb. Syn. of Aport Voronesh (?)

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Shro. to Ia. No. 24. Gb. Syn. of Sandy Glass											
Shro. to Ia. No. 25. Gb. Syn. of Dansic Pipka											
Shro. to Ia. No. 26. Gb. Syn. of Antonovka											
Shro. to Ia. No. 27. Gb. Syn. of Large Anis											
Shro. to Ia. No. 28. Gb. Syn. of Kluevskoe											
Shro. to Ia. No. 29. Gb. Syn. of Melonen											
Shro. to Ia. No. 30. Gb. Syn. of Ledenets											
Shro. to Ia. No. 31. Gb. Syn. of Good Peasant											
Shro. to Ia. No. 32. Gb. Syn. of Anis											
Shro. to Ia. No. 33. Gb. Syn. of Winter Streaked											
Shro. to Ia. No. 34. Gb. Syn. of ——— (Omitted)											
Shro. to Ia. No. 35. Gb. Syn. of ——— (Omitted)											
Shro. to Ia. No. 36. Gb. Syn. of ——— (Omitted)											
Shro. to Ia. No. 37. Gb. Syn. of White Borodovka											
Shro. to Ia. No. 38. Gb. Syn. of Queen Louise											
Shro. to Ia. No. 39. Gb. Syn. of Polish Cinnamon											
Shro. to Ia. No. 40. Gb. Syn. of White Summer Calville											
Shro. to Ia. No. 41. Gb. Syn. of Lejanka											
Shro. to Ia. No. 42. Gb. Syn. of Bokovoe											
Shro. to Ia. No. 43. Gb. Syn. of Watermelon											
Shro. to Ia. No. 44. Gb. Syn. of Lipin											
Shro. to Ia. No. 45. Gb. Syn. of Royal											
Shro. to Ia. No. 46. Gb. Syn. of ——— (Omitted)											
Shro. to Ia. No. 47. Gb. Syn. of Yellow Kief											
Shro. to Ia. No. 48. Gb. Syn. of Cinnamon Pine											
Shro. to Ia. No. 49. Gb. Syn. of Sweet Mensk											
Shro. to Ia. No. 50. Gb. Syn. of Swan											
Shro. to Ia. No. 51. Gb. Syn. of Avenarius											
Shro. to Ia. No. 52. Gb. Syn. of Riga Translucent											
Shro. to Ia. No. 53. Gb. Syn. of Blackwood											
Shro. to Ia. No. 54. Gb. Syn. of Great Mogul											
Shro. to Ia. No. 55. Gb. Syn. of Red Ruskin											
Shro. to Ia. No. 56. Gb. Syn. of Longfield											
Shro. to Ia. No. 57. Gb. Syn. of ——— (Omitted)											
Shro. to Ia. No. 58. Gb. Syn. of ——— (Omitted)											
Shro. to Ia. No. 59. Gb. Syn. of Repka Arcad											
Shro. to Ia. No. 60. Gb. Syn. of Smoky Arcad											
Shro. to Ia. No. 61. Gb. Syn. of Melonen											
Shro. to Ia. No. 62. Gb. Syn. of Richard											

Shro. to Ia. No. 63.	Gb.	Syn. of Kolomenskoe										
Shro. to Ia. No. 64.	Gb.	Syn. of Yellow Sugar										
Shro. to Ia. No. 65.	Gb.	Syn. of ——— (Omitted)										
Shro. to Ia. No. 66.	Gb.	Syn. of Revel Pigeon										
Shro. to Ia. No. 67.	Gb.	Syn. of Nasiedka										
Shro. to Ia. No. 68.	Gb.	Syn. of Broad Green										
Shro. to Ia. No. 69.	Gb.	Syn. of Early Red										
Shro. to Ia. No. 70.	Gb.	Syn. of German Prolific										
Shro. to Ia. No. 71.	Gb.	Syn. of German Ledenets										
Shro. to Ia. No. 72.	Gb.	Syn. of Sugar Miron										
Shro. to Ia. No. 73.	Gb.	Syn. of Sweet Prolific										
Shro. to Ia. No. 74.	Gb.	Syn. of Green Astrachan										
Shro. to Ia. No. 75.	Gb.	Syn. of Silken										
Shro. to Ia. No. 76.	Gb.	Syn. of ——— (Omitted)										
Shro. to Ia. No. 77.	Gb.	Syn. of Sweet Streaked										
Shro. to Ia. No. 78.	Gb.	Syn. of Avenarius										
Shro. to Ia. No. 79.	Gb.	Syn. of King Stripe										
Shro. to Ia. No. 80.	Gb.	Syn. of Petrovskoe										
Shro. to Ia. No. 81.	Gb.	Syn. of Mensk										
Shro. to Ia. No. 82.	Gb.	Syn. of Blushed Calville										
Shro. to Ia. No. 83.	Gb.	Syn. of Pear										
Shro. to Ia. No. 84.	Gb.	Syn. of Bergadorf										
Shro. to Ia. No. 85.	Gb.	Syn. of Glass										
Shro. to Ia. No. 86.	Gb.	Syn. of Bielgorod										
Shro. to Ia. No. 87.	Gb.	Syn. of Herren										
Shro. to Ia. No. 88.	Gb.	Syn. of Bergamot										
Shro. to Ia. No. 89.	Gb.	Syn. of German Calville										
Shro. to Ia. No. 90.	Gb.	Syn. of Rosy Aport										
Shro. to Ia. No. 91.	Gb.	Syn. of German Skrute										
Shro. to Ia. No. 92.	Gb.	Syn. of Svinets										
Shro. to Ia. No. 93.	Gb.	Syn. of Vinnoe										
Shro. to Ia. No. 94.	Gb.	Syn. of Kalkidon										
Shro. to Ia. No. 95.	Gb.	Syn. of Fonaric										
Shro. to Ia. No. 96.	Gb.	Syn. of Juicy Ribbed										
Shro. to Ia. No. 97.	Gb.	Syn. of Marble										
Shro. to Ia. No. 98.	Gb.	Syn. of Smolensk										
Shro. to Ia. No. 99.	Gb.	Syn. of Long Arcad										
Shro. to Ia. No. 100.	Gb.	Syn. of Putim										
Shro. to Ia. No. 101.	Gb.	Syn. of Cinnamon Pine										
Shro. to Ia. No. 102.	Gb.	Syn. of Multicolor										
Shro. to Ia. No. 103.	Gb.	Syn. of Striped Calville										
Shro. to Ia. No. 104.	Gb.	Syn. of Silken										
Shro. to Ia. No. 105.	Gb.	Syn. of Charlamoff										
Shro. to Ia. No. 106.	Gb.	Syn. of Potainoe										
Shro. to Ia. No. 107.	Gb.	Syn. of Serinkia										
Shro. to Ia. No. 108.	Gb.	Syn. of Sweet Aport										
Shro. to Ia. No. 109.	Gb.	Syn. of Amber										
Shro. to Ia. No. 110.	Gb.	Syn. of Translucent										
Shro. to Ia. No. 111.	Gb.	Syn. of Cinnamon Anis										
Shro. to Ia. No. 112.	Gb.	Syn. of Champagne										
Shro. to Ia. No. 113.	Gb.	Syn. of Raspberry										

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Shro. to Ia. No. 114. Gb. Syn. of Stepanoff											
Shro. to Ia. No. 115. Gb. Syn. of Early Translucent											
Shro. to Ia. No. 116. Gb. Syn. of Heidorn											
Shro. to Ia. No. 117. Gb. Syn. of —— (Omitted)											
Shro. to Ia. No. 118. Gb. Syn. of —— (Omitted)											
Shro. to Ia. No. 119. Gb. Syn. of —— (Omitted)											
Shro. to Ia. No. 120. Gb. Syn. of Rshev Miron											
Shro. to Ia. No. 121. Gb. Syn. of Poniavinskoe											
Shro. to Ia. No. 122. Gb. Syn. of Beresina											
Shro. to Ia. No. 123. Gb. Syn. of Polish Prolific											
Shro. to Ia. No. 124. Gb. Syn. of Champagne Pipka											
Shro. to Ia. No. 125. Gb. Syn. of Striped Naliv											
Shro. to Ia. No. 126. Gb. Syn. of Early Grandmother											
Shro. to Ia. No. 127. Gb. Syn. of Yellow Sweet											
Shro. to Ia. No. 128. Gb. Syn. of Lemon											
Shro. to Ia. No. 129. Gb. Syn. of Autumn Aport											
Shro. to Ia. No. 130. Gb. Syn. of Blushed Calville											
Shro. to Ia. No. 131. Gb. Syn. of Yellow Prolific											
Shro. to Ia. No. 132. Gb. Syn. of Prolific											
Shro. to Ia. No. 133. Gb. Syn. of White Naliv											
Shro. to Ia. No. 134. Gb. Syn. of Titovka											
Shro. to Ia. No. 135. Gb. Syn. of Russian Gravenstein											
Shro. to Ia. No. 136. Gb. Syn. of Scented White											
Shro. to Ia. No. 137. Gb. Syn. of Repka Aport											
Shro. to Ia. No. 138. Gb. Syn. of Borovinka											
Shro. to Ia. No. 139. Gb. Syn. of Repka											
Shro. to Ia. No. 140. Gb. Syn. of Czar Thorn											
Shro. to Ia. No. 141. Gb. Syn. of Tashkin											
Shro. to Ia. No. 142. Gb. Syn. of Red Sided											
Shro. to Ia. No. 143. Gb. Syn. of Painted Arcad											
Shro. to Ia. No. 144. Gb. Syn. of Marmalade											
Shro. to Ia. No. 145. Gb. Syn. of Early Stripe											
Shro. to Ia. No. 146. Gb. Syn. of Large Prolific											
Shro. to Ia. No. 147. Gb. Syn. of Thaler											
Shro. to Ia. No. 148. Gb. Syn. of Rubets											
Shro. to Ia. No. 149. Gb. Syn. of Revel Glass											
Shro. to Ia. No. 150. Gb. Syn. of Visotskoe											
Shro. to Ia. No. 151. Gb. Syn. of Romanoff											
Shro. to Ia. No. 152. Gb. Syn. of —— (Omitted)											

Shro. to Ia. No. 153.	Gb.	Syn. of Imperator									
Shro. to Ia. No. 154.	Gb.	Syn. of Red Sided									
Shro. to Ia. No. 155.	Gb.	Syn. of Arabka									
Shro. to Ia. No. 156.	Gb.	Syn. of Red Naliv									
Shro. to Ia. No. 157.	Gb.	Syn. of Broad Green									
Shro. to Ia. No. 158.	Gb.	Syn. of Autumn Streaked									
Shro. to Ia. No. 159.	Gb.	Syn. of Crooked Spike									
Shro. to Ia. No. 160.	Gb.	Syn. of Waxen									
Shro. to Ia. No. 161.	Gb.	Syn. of Christmas									
Shro. to Ia. No. 162.	Gb.	Syn. of ——— (Omitted)									
Shro. to Ia. No. 163.	Gb.	Syn. of Red Miron									
Shro. to Ia. No. 164.	Gb.	Syn. of Yellow Naliv									

The following varieties were received by the Iowa Agricultural College from various Russian sources. They are arranged in numbers and nomenclature according to Mr. Charles Gibb's report to the American Pomological Society.

V. R. S. to Ia. No. 1.	Gb.	Syn. of Early Pipka									
V. R. S. to Ia. No. 2.	Gb.	Syn. of Voronesh Arcad									
V. R. S. to Ia. No. 3.	Gb.	Syn. of White Sweet									
V. R. S. to Ia. No. 4.	Gb.	Syn. of Vinnoe									
V. R. S. to Ia. No. 5.	Gb.	Syn. of White Rubets									
V. R. S. to Ia. No. 6.	Gb.	Syn. of ——— (Omitted)									
V. R. S. to Ia. No. 7.	Gb.	Syn. of Ivory									
V. R. S. to Ia. No. 8.	Gb.	Syn. of Flat Voronesh									
V. R. S. to Ia. No. 9.	Gb.	Syn. of Voronesh Cinnamon									
V. R. S. to Ia. No. 10.	Gb.	Syn. of Golden Reinette (Rus.)									
V. R. S. to Ia. No. 11.	Gb.	Syn. of Rosy									
V. R. S. to Ia. No. 12.	Gb.	Syn. of Pyriform									
V. R. S. to Ia. No. 13.	Gb.	Syn. of ——— (Omitted)									
V. R. S. to Ia. No. 14.	Gb.	Syn. of ——— (Omitted)									
V. R. S. to Ia. No. 15.	Gb.	Syn. of Shepherd									
V. R. S. to Ia. No. 16.	Gb.	Syn. of Bogdanoff									
V. R. S. to Ia. No. 17.	Gb.	Syn. of Bogdanoff Glass									
V. R. S. to Ia. No. 18.	Gb.	Syn. of Crimea									
V. R. S. to Ia. No. 19.	Gb.	Syn. of Russian Calville									
V. R. S. to Ia. No. 20.	Gb.	Syn. of Persian									
V. R. S. to Ia. No. 21.	Gb.	Syn. of Skrute									
V. R. S. to Ia. No. 22.	Gb.	Syn. of Neumeister									
V. R. S. to Ia. No. 23.	Gb.	Syn. of ——— (Omitted)									
V. R. S. to Ia. No. 24.	Gb.	Syn. of English Pippin. [Identical with Longfield.]									
V. R. S. to Ia. No. 25.	Gb.	Syn. of Livland Muscatel									
V. R. S. to Ia. No. 26.	Gb.	Syn. of Citronen									
V. R. S. to Ia. No. 27.	Gb.	Syn. of Citronat									
V. R. S. to Ia. No. 28.	Gb.	Syn. of Noble Redstreak									
V. R. S. to Ia. No. 29.	Gb.	Syn. of Alfriston									
V. R. S. to Ia. No. 30.	Gb.	Syn. of ——— (Omitted)									
V. R. S. to Ia. No. 31.	Gb.	Syn. of Batullen									
V. R. S. to Ia. No. 32.	Gb.	Syn. of Boiken									
V. R. S. to Ia. No. 33.	Gb.	Syn. of Mueller Spitz									

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh.		Flavor.	Quality.	Use.	Season.	Remarks.
					Texture.	Color.					
V. R. S. to Ia. No. 34. Gb. Syn. of Baumann											
V. R. S. to Ia. No. 35. Gb. Syn. of Grosser Bohn											
V. R. S. to Ia. No. 36. Gb. Syn. of Geflammter											
V. R. S. to Ia. No. 37. Gb. Syn. of ——— (Omitted)											
V. R. S. to Ia. No. 38. Gb. Syn. of Red Jungfern											
V. R. S. to Ia. No. 39. Gb. Syn. of Possart											
V. R. S. to Ia. No. 40. Gb. Syn. of Landsburg											
V. R. S. to Ia. No. 41. Gb. Syn. of Yellow Stettin											
V. R. S. to Ia. No. 42. Gb. Syn. of ——— (Omitted)											
V. R. S. to Ia. No. 43. Gb. Syn. of Red Pigeon											
V. R. S. to Ia. No. 44. Gb. Syn. of Red Serinkia											
V. R. S. to Ia. No. 45. Gb. Syn. of Nitchner Strawberry											
V. R. S. to Ia. No. 46. Gb. Syn. of Eiser											
V. R. S. to Ia. No. 47. Gb Syn. of Hare Head											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Admirable. L. Syn. Small's Admirable											Not described.
Aiken's Striped Winter. Syn. of Akin											
Aiken's Winter. Hort'72. Syn. of Akin											
Aker's Green Winter. Cat. Syn. of Green Aker											
Aker's Striped Winter. Cat. Syn. of Striped Aker											
Akin. L. Syns. Aiken's Striped Winter, Aiken's Winter, Akin's Winter	Minn	rob	ms	yb	je	yw	pa	g	k	l	
Akin's Winter. D. Syn. of Akin											
Alabama. R. Syn. Alabama Hybrid											Do.
Alabama Hybrid. JVL. Syn. of Alabama											
Alaska. IllH'90. Syn. Kenyon	Iowa		l	y							
Albion. Cat	Ill										Do.
Alpha. Cat	Mo										Do.
Amber. MagofH'43	Eur	c	s	y			sa	g		m	May prove to be Yellow.
Amber Crab. D. Syn. of Yellow											
Ampla. BBL											Not described.
Andrews. R. Syn. Dr. Andrew's No. 4	Ill							vg	dk		
Angular. RNY'70											Do.
Anoka. Cat	Ill										Do.
Astracan. Hort'51. Syns. Evergreen Apple, Evergreen Striped	Eng	c	s	rs			a		k	m	
Astrachan. D		re	m	y			a	g	k	e	
Atropurpurea. BBL											Do.
Aucubifolia. IllB45											Do.
August. (LC)	Minn										Do.
Aurantiaca. A'99	Rus	rob	ms	yrs							
Autumn Cone. Cat. Syn. of Cone											
Baccatus. R. Syn. Baccatus Crab			s	yb				g			
Baccatus Crab. IllB45. Syn. of Baccatus											
Bailey. L. Syn. Bailey's Crimson Crab	N. Y	re	l	ybe			sa			m	
Bailey's Crimson Crab. A'71. Syn. of Bailey											
Ball. L. Syn. Ball's Winter	Vt										Do.
Ball's Winter. Cat. Syn. of Ball											
Barbarie. BBL											Do.
Barr. R. Syn. Barr's Hybrid Winter											Do.
Barr's Hybrid Winter. MinnExR'90. Syn. of Barr											
Barr Hybrid. R. Syn. Barr's Yellow Hybrid											Do.
Barr's Yellow Hybrid. MinnExR'90. Syn. of Barr Hybrid											
Barr Yellow. R. Syn. Barr's Yellow Siberian											Do.
Barr's Yellow Siberian. MinnExR'90. Syn. of Barr Yellow											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Bawl. R. Syn. Bawl's Winter											Not described.
Bawl's Winter. A'73. Syn. of Bawl. [Probably Ball.]											
Beach. Bul6	Vt	r	l	wy				g	k	vl	
Beach Sweet. R. Syn. Beach's Sweet, Beech's Sweet			vl	rc			s	vg			
Beach's Sweet. JNCo. Syn. of Beach Sweet											
Beauty. L. Syn. Beauty Queen											Do.
Beauty Queen. Cat. Syn. of Beauty											
Becher's Large Red. Hort'72. Syn. of Beecher Red											
Bechtel. PJB. Syn. Double Flowering			vs								Do.
Beecher. A'71. Syn. Beecher's Sweet	Am	rl	m	y			s	vg	k	m	
Beecher Red. R. Syns. Becher's Large Red, Beecher's Red	Minn	ob	l	dr	fj		sa	vg	k	l	Perhaps first described in Hort'72.
Beecher's Red. IllH'91. Syn. of Beecher Red											
Beecher's Sweet. RNY'70. Syn. of Beecher											
Beech's Sweet. A'89. Syn. of Beach Sweet											
Beeler. R. Syn. Red Beeler's. [Reported to A'97, 141, by J. M. Samuels, of Ky.]											Not described.
Berry. A'71	Minn		s								Do.
Bitter Sweet. L. Syn. Siberian Bitter Sweet	Eng		s	y							
Black. L. Syn. Black Siberian											Do.
Black Siberian. Cat. Syn. of Black											
Blanc Molett. BBL											Do.
Blood Red. NYExR'96	Minn	ob	m	gyr	j	y	sa	g		ml	
Blushing Maid. NEF'69			l					g		m	
Bola. Cat	Mo										Do.
Boone. IaB90	Iowa		l	yb	fj				k	l	
Bouck. R. Syn. Bouck's Red Winter. [May possibly be an apple.]											Do.
Bouck's Red Winter. Hort'72. Syn. of Bouck											
Bowman. CanExR'88											Do.
Briar Sweet. JW&S. Syn. of Brier											
Brier. A'71. Syns. Briar Sweet, Brier's Sweet, Brier's Sweet Crab	Wis	rc	ml	rs			s	vg	dk		
Brier's Sweet. B. Syn. of Brier											
Brier's Sweet Crab. Syn. of Brier											
Brown. BBCo. Syn. Brown's Transcendent	Ill		vl	y					k	vl	
Brown's Transcendent. Cat. Syn. of Brown											
Bryant. AmGar'91. Syn. Bryant Favorite											Do.
Bryant Favorite. AmGar'91. Syn. of Bryant											
Byers. L. Syn. Byers' Beauty	Mich	obl	m	rs			a	g	k	m	

Byers' Beauty. A'75. Syn. of Byers											
Byers Sweet. R. Syn. Byers' Sweet							s				Do.
Byers' Sweet. A'87. Syn. of Byers Sweet											
Calville. A'99. Syn. Pyrus Cerasifera	Eur	robl	l	r					k		
Captain Reins. A'73. Syn. of Reins											
Carpenter. L. Syn. Carpenter's Seedling											Do.
Carpenter's Seedling. Cat. Syn. of Carpenter											
Cerasiformis (crab baccata). A'99. Syn. Chinese Apple	Rus	robl	s	yr					k		
Cerise. BBL											Do.
Champagne. A'67			m	r					e	l	
Chandler. Cat											Do.
Charles. CanH'03	Ont	r	m	y	cj	y	sa	g	k	m	
Charles Downing. IaH'38	Iowa	obl	l	br				vg		l	
Chase. L. Syn. Chase's Winter Sweet		rob	m	yrb	fj	y	s			l	
Chase Blush. L. Syn. Chase's Blush, Jelly	Me		vl					vg	k		
Chase's Blush. JBW&B. Syn. of Chase Blush											
Chase's Jelly. Cat. Syn. of Jelly											
Chase's Winter Sweet. Syn. of Chase											
Cherry. Lin. Syn. Cherry Apple		ro	s	yb	cj		pa	g	k	m	
Cherry Apple. Hort'51. Syn. of Cherry											
Chicago. RNY'69	Ill	obl	s	y	c		sa			vl	
Chickasaw. Cat											Do.
Chinese. F. [A double flowering variety.]											Do.
Chinese Apple (crab baccata). A'99. Syn. of Cerasiformis											
Chlorocarpa. A'99	Eur	r		gr							
Chokecherry. FHC			l						k		
Clark. L. Syn. Clark's Beauty			m	y			sa			e	
Clark's Beauty. A'73. Syn. of Clark											
Cleveland. A'73. Syn. Cleveland Yellow			vl	y			sa		k	e	
Cleveland Yellow. A'73. Syn. of Cleveland											
Cluster. L. Syn. Queen's Choice											Do.
Coerulescens. BBL											Do
Col. Wilder. Cat. Syn. of Wilder											
Compton. R. Syn. Compton Greening			ml	gy	j				k	l	
Compton Greening. A'73. Syn. of Compton											
Concentrated. IndH'85											Do.
Cone. L. Syn. Autumn Cone											Do.
Conical. RNY'70	Am	c	m	rs			sa	vg	dm	e	
Conocarpa. A'99	Eur	c		gr							
Coral. RNY'69	Ill	obc	s	y			sa			vl	
Coral Beauty. IaH'88	Iowa		l	dr				g		m	
Cordell. Hort'72. [This may be an apple. See Hort. '72, 244.]											Do.
Costata. A'99	Rus	rob	ml	r							
Crab, Manning's Red. Lin. Syn. of Manning											
Craine. Cat. [May be same as Crane.]	Mo										Do.
Crampton. R. Syn. Crampton No. 3											Do.
Crampton No. 3. SDB50. Syn. of Crampton											
Cranberry. Cat											Do,
Crane. L. Syn. Crane's Choice Cluster. [May be identical with Craine.]											Do.
Crane's Choice Cluster. Cat. Syn. of Crane											
Currant. Hort'51		rob	vs	rs							Mainly ornamental.
Custard. IaH'88	Iowa		l	y				g	ke	m	
Dartmouth. B	N. H		ml	y					ke		

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Dartt. Syn. Dartt's Hybrid	Minn	rc	l	c		y	sa	g	k	l	Originated at Owatonna, by E. H. S. Dartt.
Dartt's Hybrid. Syn. of Dartt											
D'Avrolles. BBL											Not described.
De Never. Hort'72	Minn. ?										Do.
Denzl. Cat											Do.
Dr. Andrews No. 4. IllH'70. Syn. of Andrews											
Doubleflowering. Hort'51. Syns. Double Flowering Apple, Double Flowering Chinese Crab.	China?	r	s	y			a	p		m	Mainly ornamental
Double Flowering. Cat. Syn. of Bechtel											
Double Flowering Apple. D. Syn. of Doubleflowering											
Double Flowering Chinese Crab. K. Syn. of Doubleflowering											
Double White. D. Syn. Double White Siberian Crab		r		wy							
Double White Siberian Crab. Hort'51. Syn. of Double White											
Dudley. A'73			m	y						l	
Duplin. L. Syn. Pride of Duplin											Not described.
Early Red. Cat											Do.
Early Strawberry. A'85. Syn. of Strawberry											
Edulis. A'99	Rus	robl	ml	yr					k		
Elgin. L. Syns. Geneva, Lady Elgin, Marengo Siberian No. 4	Ill	rob	l	wyrb	ftj	w	sa	vg	dk	vl	Probably identical with Geneva.
Empire. Hort'72	Minn. ?										Not described.
Ent. R. Syn. Ent's Green. [A wild crab of S. Dakota.]	S. D										Do.
Ent's Green. SDB65. Syn. of Ent											
Ent Yellow. R. Syn. Ent's Yellow											Do.
Ent's Yellow. SDB65. Syn. of Ent Yellow											
Erranda. Cat											Do.
Estellene. Cat											Do.
Eureka. RNY'70. Syn. Maiden's Blush		obl	l	y			sa	g-vg	d	l	
Evergreen Apple. D. Syn. of Astracan											
Evergreen Striped. C. Syn. of Astrachan											
Everlasting. WisB45											Do.
Excelsior. AHortA'70	Minn		ml	rs				vg		m	
Faribault. NDB49	Minn										Do.
Fancy Red. Cat											Do.
Fancy Yellow. Cat											Do.
Fastigiata. BBL											Do.
Fay. L. Syns. Fay's Joe, Fay's Joy	Ill	ob	ml	yrs		w	a	g			Said to be a hybrid.

Fay Gem. R. Syn. Fay's Gem	N. J. ?							b			Not described.
Fay's Gem. P'91. Syn. of Fay Gem											
Fay's Joe. A'71. Syn. of Fay											
Fay's Joy. Cat. Syn. of Fay											
First Settler. Hort'72	Minn. ?										From Stockton, Minn. Perhaps a crab.
Flava. BBL											Not described.
Flavescens. BBL											Do.
Florence. A'87	Minn	ob	ml	rs			a	vg	k	m	Originated by Peter M. Gideon.
Fluke. R. Syn. Fluke's (wild crab)	Iowa										Not described.
Fluke's (wild crab). A'89. Syn. of Fluke											
Fondulac. Syn. Fondulac Beauty. [Probably a crab, a hybrid]	Minn. ?										Do.
Fondulac Beauty. Hort'72. Syn. of Fondulac											
Forbes. A'99											Do.
Foxley. K	Eng	rob	m	y	cj	y	sa				
Fragrant. D. Syn. Fragrant Flowered Siberian Crab		ob	s	g				p			Probably a native.
Fragrant Flowered Siberian Crab. Hort'51. Syn. of Fragrant											
Frequin. R. Syn. of Frequin Rouge											Not described.
Frequin Rouge. BBL. Syn. of Frequin.											
Galena. A'71	Iowa										Do.
General Grant. AHortA'70. Syn. of Grant											
Geneva. L. Syns. Geneva Gem, Lady Elgin. [Probably identical with Elgin.]											
Geneva. Dap. Syn. of Elgin											
Geneva Gem. Cat. Syn. of Geneva											
Genuina. A'99	Rus	r	vs	yp							
Georgia Red. RNY'69											Do.
German. Hort'72. [From J. P. Buckner, Waukesha, Wis.]	Wis. ?										Do.
Gibb. A'85. Syn. Gibb's Golden	Wis	rob	vl	y	fj	y	sa			e	
Gibb's Golden. Cat. Syn. of Gibb											
Gideon. IndH'85	Minn		ml	y			sa	vg		l	
Gideon No. 2. NYB84											
Gideon No. 3. NYExR'95											
Gideon No. 6. A'87. Syn. of Mary											
Gideon's No. 25. SDB26											
Gideon Sweet. DelExR'95	Minn										Do.
Glover. L. Syn. Glover's Early	Am										Do.
Glover's Early. A'75. Syn. of Glover											
Gold Drop. A'73			vl	y	cj		r	vg		l	
Golden. D. Syn. Golden Beauty		rob	l	y	mj	w	ba			m	
Golden (Wis.?). Hort'72. [From J. P. Buckner, Waukesha, Wis.]	Wis. ?										Do.
Golden Beauty. Lin. Syn. of Golden											
Golden Beauty. CNC. Syn. of Yellow											
Golden Beauty of Paradise. JBW&B. Syn. of Paradise											
Golden Meehan. Cat. Syn. of Meehan											
Goodwine. R. Syn. Goodwine's Cider	Ill		ml	grs			a		e		
Goodwine's Cider. ADF&S. Syn. of Goodwine											
Gracie. (LC)	Minn										Do.
Grant. L. Syn. General Grant	Minn	rob	l	rs			sa			l	
Green Aker. L. Syn. Aker's Green Winter										vl	Do.
Greenwood. SDB26. Syn. Dartt's Greenwood	Minn		m	yr			a	g	k	m	
Grise. R. Syn. Grise Dieppois											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Grise Dieppois. BBL. Syn. of Grise											
Hagner. R. Syn. Hagner's Winter	Wis	r	l	dr	fj	gy	bsa	g		vl	
Hagner's Winter. AHortA'70. Syn. of Hagner											
Hall. R. Syn. Hall's Imperial											Not described.
Hall's Imperial. ColB17. Syn. of Hall											
Hamilton. SDB65	Iowa										Do.
Hampton. L. Syns. Hampton's New Siberian Crab, Hampton's Siberian Crab.	Ohio	c	l	yrs							
Hampton's New Siberian Crab. Hort'54. Syn. of Hampton											
Hampton's Siberian Crab. D. Syn. of Hampton											
Harwell. Cat											Do.
Hasker. R. Syn. Hasker Blush											Do.
Hasker Blush. MichB31. Syn. of Hasker											
Hayden. MeExR'93											Do.
Hayes. L. Syn. President Hayes			ml					vg		ml	
Hedge. MinnExR'90											Do.
Heikes. MoH'80											Do.
Hesper. R. Syn. Hesper Blush		rc	l	yb			sa	g	d	m	
Hesper Blush. AHortA'70. Syn. of Hesper											
Hesper Rose. IndH'89											Do.
Hibernal. Cat											Do.
Homestead. MinnExR'90											Do.
Honey Sweet. RNY'70											
Hooper. R. Syn. Hooper's Blush											Do.
Hooper's Blush. A'71. Syn. of Hooper											
Howard. L. Syn. Howard's Sweet											Do.
Howard's Sweet. Cat. Syn. of Howard											
Howland. Cat											Do.
Hudson. R. Syn. Hudson River			l	yrs				vg			
Hudson River. CAG. Syn. of Hudson											
Hugo. MoH'92	Mo	oblc	l				a		k		
Hutcheson's Sweet. A'75. Syn. of Hutchinson											
Hutchinson. L. Syns. Hutcheson's Sweet, Hutchinson's Winter Sweet		rob	m	y		yw	s				
Hutchinson's Winter Sweet. AHortA'70. Syn. of Hutchinson											
Hyslop. D. Syn. Hyslop's		rc	l	dr		y	sa	g	kc	m	
Hyslop's. F. Syn. of Hyslop											
Imperial. Cat											Do.
Intermedia. SDB65	Eur	rob	m	yr							

Iowa. JNCo. Syn. of Lowe											
Isham. R. Syn. Isham Winter											Do.
Isham Winter. MinnExR'90. Syn. of Isham											
Island Gem. Bul8	Vt	r	ml	r				vg	dk	m	
Itaska. Cat											Do.
IXL. AHortA'70. Syn. IXL Orange		obl	vl	y	fj		sa	vg	d	l	
IXL Orange. J&R. Syn. of IXL											
January. BBL	Minn										Do.
Jelly. MichB118. [Originated with P. M. Gideon.]	Minn										Do.
Jelly. L. Syn. Chase's Jelly											Do.
Jelly. JBW&B. Syn. of Chase Blush											
Jersey. Cat											Do.
Jones. R. Syn. Jones' Cider	N. C										Do.
Jones' Cider. NCB149. Syn. of Jones											
Judah. MHSC'84		obl	m	dr							
Jumbo. Bul8	Vt	obl	vl	yr				vg-b	dkm	l	
Kaida. BBL. Syn. Malus Kaida											Do.
Kentucky. R. Syn. Kentucky Red			m	r					c	ml	Probably an apple
Kentucky Red. JIN. Syn. of Kentucky											
Kenyon. Cat. Syn. of Alaska											
Key. L. Syn. Key Red											Not described.
Key Red. Cat. Syn. of Key											
Kishwaukee. Hort'69	Ill									vl	Do.
Ladies' Favorite. NEF'69. Syn. of Lady Favorite											
Lady. D	Eur	rob	s	rru	mj	y	sa	g	k	l	
Lady Crab. IllB45. Syn. of Elgin											
Lady Elgin. Dap. Syn. of Elgin											
Lady Elgin. A'71. Syn. of Geneva. [Elgin probably correct.]											
Lady Favorite. L. Syn. Ladies' Favorite				y			sa	vg			
Ladyfinger. AmGar'91	Kans	obl	l	yr	tj	y	a	vg		ml	
Lake. A'81. Syn. Lake Winter	Wis	r	vl	y			sa		k	vl	
Lake Winter. B. Syn. of Lake											
Lamertine. Hort'72	Minn										Not described Probably a crab.
Lanier. R. Syn. Lanier's											Not described.
Lanier's. SCExR'98. Syn. of Lanier											
Large Red. Lin. Syns. Large Red Siberian Crab, Large Siberian Crab		r	vl	yr						ml	
Large Red Siberian Crab. D. Syn. of Large Red											
Large Scarlet. Lin		r	l	y			sa		k	m	
Large Siberian Crab. Hort'51. Syn. of Large Red											
Large Winter. L. Syn. Mammoth Winter											Do.
Large Yellow. W. Syn. Large Yellow Siberian Crab		r	l	y			a	g	k	m	
Large Yellow Siberian. Cat. Syn. of Yellow Siberian											
Large Yellow Siberian Crab. D. Syn. of Large Yellow											
Late Winter. Cat										vl	Do.
Laura. JWK			l	r				g			
Lemon. Cat	Iowa										Do.
Leslie. R. Syn. Leslie's Sweet											Do.
Leslie's Sweet. CanExR'01. Syn. of Leslie											
Letson. R. Syn. Letson Cowless											Do.
Letson Cowless. BBL. Syn. of Letson											
Lewelling. BBL. [Perhaps same as Oregon.]											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Lewelling. OreB34. Syn. of Oregon											
Lexington. IllH'01				br			a	g		l	
Looker. R. Syn. Looker's Winter			m							vl	
Looker's Winter. JNCo. Syn. of Looker											
Lou. AmGar'99	Minn										Not described.
Louis. AmGar'91. Syn. Louis Favorite	Minn	r	m	yrs	tj	yws	a	vg-b		m	
Louis Favorite. AmGar'91. Syn. of Louis											
Lowe. JNCo. Syn. Iowa			l	gb	cj		sa			l	
Lutea. A'99	Rus.	r	vs	yr							
Lyman. R. Syn. Lyman's Prolific	Minn	rc	l	yrs	f	y	sa		k	m	Originated with H. M. Lyman, Excelsior, Minn.
Lyman's Prolific. NDB49. Syn. of Lyman											
Mackie. L. Syn. Mackie's Beauty Siberian	N. Y.	rob	l	y			sa			m	
Mackie's Beauty Siberian. RNY'70. Syn. of Mackie											
Macrocarpa. A'99	Eur.	rob	ml	gyr							
Maiden Blush. L. Syn. Maiden's Blush		ob	s	pyb		yw	msa			l	
Maiden's Blush. AHort'70. Syn. of Eureka											
Maiden's Blush. D. Syn. of Maiden Blush											
Malakoff. A'75											Do.
Malus Kaida. E&B. Syn. of Kaida											
Malus Maxima. KanExR'89. Syn. of Maxima											
Malus Striata. E&B. Syn. of Kaida											
Mammoth Cluster. Cat											Do.
Mammoth White. L. Syn. Mammoth White Winter											Do.
Mammoth White Winter. Cat. Syn. of Mammoth White											
Mammoth Winter. Cat. Syn. of Large Winter											
Manning. L. Syn. Crab Manning's Red		ob	s	rs			sa	v-gb	d	l	
Marengo. Hort'68. Syn. Marengo Winter	Ill	rob	l	yrb	cj	yw	sa	g	dm	vl	Origin, Marengo, Ill.
Marengo Siberian No. 4. Dap. Syn. of Elgin											
Marengo Winter. Hort'68. Syn. of Marengo											
Market. IaH'88	Iowa		ml	pyb				g		e	
Martha. IllH'93	Minn	ob	ml	y				vg	dkc		
Martin. R. Syn. Martin Fessard											Not described.
Martin Fessard. BBL. Syn. of Martin											
Mary. MinnB83. Syn. Gideon No. 6	Minn	r	l	pr	f	w	a		m		Originated with Peter M. Gideon, Excelsior, Minn.
Mathews. A'89. Syn. Matthews	Iowa										Not described.
Mathilda. JNCo	Minn		m	ygb	c		a		c	ml	

Matthews. BBL. Syn. of Mathews											
Maxima. R. Syn. Malus Maxima											Do.
Meader. L. Syns. Meader's Red Winter, Meader's Winter, Mead's Winter		rob	m	yrb	jtc	y	ra	g	ke	vl	
Meader's Red Winter. AHortA'70. Syn. of Meader											
Meader Russet. R. Syn. Meader's Russet											Do.
Meader's Russet. A'75. Syn. of Meader Russet											
Meader's Winter. AHortA'70. Syn. of Meader											
Mead's Winter. IllH'96. Syn. of Meader. [Probably an error.]											
Medo. Hort'72. [From S. Bates & Son, Stockton, Minn.]	Minn.?										Do.
Meehan. L. Syn. Golden Meehan											Do.
Menesay. Cat											Do.
Mercer. BBL											Do.
Microcarpa. A'99	Eur	robl	s	r							
Milton. IllH'88											Do.
Minneapolis. R. Syn. Pride of Minneapolis	Minn		ml	y					c	ml	
Minnesota. Hort'72. Syn. Minnesota Prince	Am	obl	l	y			sa	vg	km	l	P. M. Gideon in Hort. '72, 244, calls this an apple.
Minnesota Prince. Hort'72. Syn. of Minnesota											
Minshall. GenF'33											Not described.
Missouri. R. Syn. Missouri Pippin											Do.
Missouri Pippin. Cat. Syn. of Missouri											
Montreal. L. Syns. Montreal Beauty, Montreal Waxen	Am	rob	l	yrs	f	y	ra	g	k	ml	
Montreal Beauty. Lin. Syn. of Montreal											
Montreal Pink. A'73			l	rs			sa			e	
Montreal Waxen. A'75. Syn. of Montreal											
Morfelt. MB&Co			l								Do.
Nichols. Cat											Do.
North Carolina. K&S											Do.
Northfield. (LC). Syn. Northfield Beauty	Vt	rob	l	rs			sa	g	k	me	
Northfield Beauty. IllH'72. Syn. of Northfield											
North Star. MoH'86	Minn	rob	s	y			sa	g		l	
No. 1 New. (LC). [Origin, Minn.]											
No. 2 New. (LC). [Origin, Minn.]											
Obconoidea. A'99	Rus	rc	ms	yr							
Oblong. Hort'51. Syns. Oblong Fruited Siberian Crab, Oblong Siberian Crab, Texan Red, Texas Red.		oble	m	wyrs							
Oblonga. A'99	Rus	robl	vs	r							
Oblong Fruited Siberian Crab. D. Syn. of Oblong											
Oblong Siberian Crab. B. Syn. of Oblong											
October. N	Minn		l	y			n		k		
Orange. AHortA'70		rob	m	y		yw	psa	g	k	l	
Oregon. OreB34. Syn. Lewelling											Do.
Orion. A'89	Eng	obl	l	rs			sa	g	km	l	
Oviformis. SDB65	Eur	rc		yr							
Paradise. L. Syn. Golden Beauty of Paradise		obl	l	y				g		l	Said to be a native, *Pyrus coronaria.*
Parkville. IllH'00			vl								A native, *Pyrus coronaria.*
Passe Reine. R. Syn. Passe Reine des Pommes											Not described.
Passe Reine des Pommes. BBL. Syn. of Passe Reine											
Patten. L. Syn. Patten's Crimson	Iowa										Do.
Patten's Crimson. Cat. Syn. of Patten											
Paul. L. Syn. Paul's Imperial				yr	ft	y		g			

Catalogue of known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Paul's Imperial. E&B. Syn. of Paul											
Peach. JBW&B			vl	ybr				vg			
Pearce. R. Syn. Pearce's											Not described.
Pearce's. MinnB3. Syn. of Pearce											
Pearl. Cat											Do.
Peerless. Cat											Do.
Peffer. Cat	Wis.?										Do.
Pennsylvania. IllH'75											Do.
Perfection. IaH'88											Do.
Peter. N	Minn	rob	m	rs			sa	vg		l	
Phillips. A'99											Do.
Pickett. R. Syn. Pickett's			l	br			sa			ml	
Pickett's. JNCo. Syn. of Pickett											
Pieta. R. Syn. Pieta Striata		rob	ml	rs			sa			l	
Pieta Striata. E&B. Syn. of Pieta											
Pioneer. Hort'72. [P. M. Gideon mentions this in Hort'72, 244, as an apple.]	Minn.?										Do.
Plumb. R. Syn. Plumb's Choice. [From J. C. Plumb, Milton, Wis.]	Wis.?										Do.
Plumb's Choice. Hort'72. Syn. of Plumb											
Plumb's No. 1. Hort'69											
Plumb's No. 2. Hort'69											
Polance. R. Syn. Polance Mollet											Do.
Polance Mollet. BBL. Syn. of Polance											
Powers. W. Syns. Powers' Large, Powers Large Red	N. Y	rob	l	wyrs			a	g	k	ml	
Powers' Large. D. Syn. of Powers											
Powers Large Red. A'87. Syn. of Powers											
Powers Red. CanExR'01. [Perhaps same as Powers.]											Do.
Praecox. A'99	Rus		vs	p							
Prairie. R. Syn. Pride of the Prairie	Minn			gy				g-vg			
President Hayes. Cat. Syn. of Hayes											
Pride of Duplin. Cat. Syn. of Duplin											
Pride of Minneapolis. RNY'70. Syn. of Minneapolis											
Pride of the Prairie. RNY'70. Syn. of Prairie											
Priestley. R. Syn. Priestley's Sweeting											Do.
Priestley's Sweeting. MagofH'41. Syn. of Priestley											
Pringle. Bul8. Syn. Pringle Sweet	Can	robl	m	rs			s	vg	dkm	m	
Pringle Sweet. Bul8. Syn. of Pringle											
Purple Siberian. L. Syn. Purple Siberian Crab	Eur	ob	s	pub	e		a	g		m	

Purple Siberian Crab. Hort'51. Syn. of Purple Siberian											
Pyramid. A'73			s	y				vg		m	
Pyrus Cerasifera. SDB65. Syn. of Calville											
Pyrus Coronaria. HB&T. Syn. of Sweet Scented											
Quaker. MichB169		rob	m	y			sa	g		l	
Quaker Beauty. RNY'70											Do.
Queen. Bul8. Syn. Queen Choice		r	m	r				vg	km	l	
Queen Choice. Bul8. Syn. of Queen											
Queen's Choice. Cat. Syn. of Cluster. [Possibly identical with Queen.]											
Queen's Choice. MHSC'84. Syn. of Montreal											
Rebel. IllH'95. [Said to be small and worthless.]											Do.
Red. T. Syn. Siberian Crab, Small Red Siberian Crab	Eur	ob	s	r			sa	g		m	
Red. L. Syns. Red Siberian Crab, Small Red Crab	Eur	rob	ms	yr			sa	g	km	m	
Red (Buler's). A'97. Syn. of Buler											
Red Anis. Cat											Do.
Red Bark. MinnExR'90											Do.
Red Lake. A'87		r	l				sa	g		vl	
Red Siberian Crab. IndF'40. Syn. of Red											
Red Warrior. SBro. Syn. of Yates. [Possibly an apple.]											
Reins. R. Syn. Captain Reins			m	gy			a			e	
Richardson. R. Syn. Richardson's Scarlet											Do.
Richardson's Scarlet. Cat. Syn. of Richardson											
Richland. L. Syns. Richland Sweet, Richland Winter Sweet	Wis						s	vg		vl	
Richland Sweet. IllH'96. Syn. of Richland											
Richland Winter Sweet. A'99. Syn. of Richland											
Ringo. E&B											Do.
Rose of Stanstead. NEF'69. Syn. of Stanstead											
Rottot. MHSC'84	Can	c	m	dr			ma	g			
Rouen. L. Syns. Rouen Transparent Crab, Transparent de Rouen		ob	s	ryb		yw	a			m	
Rouen Transparent Crab. Hort'51. Syn. of Rouen											
Royal Charlotte. GarM'59. Syn. of Charlotte											
Russet. L. Syn. Sweet Russet	Am	rc	l	yru			s	vg	d	m	
Rutland. R. Syn. Rutland Beauty		m						g			
Rutland Beauty. FHC. Syn. of Rutland											
Saint Paul. R. Syn. St. Paul	Minn.?	rc		rs	j	y	bsa			l	
St. Paul. IllH'70. Syn. of Saint Paul											
Sanguinea. A'99	Rus	rob		r							
Sarnia. IaB90	Ont		vl		f		p	vg	k	vl	
Scarlet Gem. Cat											Do.
Scotchman. R. Syn. Scotchman's Choice			l	gyru			a			m	
Scotchman's Choice. A'73. Syn. of Scotchman											
Scott. R. Syn. Scott's											Do.
Scott's. SCExR'98. Syn. of Scott											
September. IndH'90	Minn	oblob	l	rs			sa	vg			
Shields. IllH'89	Wis		l	rs							
Showy. Hort'51		rc	s	y				p			
Siberian. F									k		Do.
Siberian Crab. C. Syn. of Red											
Siberian August. Cat. Syn. Fourth of July. [May be a crab.]											Do.
Siberian Bitter Sweet. GenF'33. Syn. of Bitter Sweet											
Siberian Harvey. K	Eng	r	s	y			s		c	ml	
Siberian Large Yellow. BBL											Do.

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Siberian Red. Cat											Not described.
Siberian Yellow. Cat											Do.
Simmons											Do.
Small's Admirable. Cat. Syn. of Admirable											
Small Red Crab. Lin. Syn. of Red											
Small Red Siberian Crab. T. Syn. of Red											
Snyder. P'92	Wis	obc	l	yrs	fj	y	sa	vg		m	
Solon. SDB65											Do.
Soulard Crab. IllH'68	Mo	ob	l	y			a		c		Claimed to be a native. *Pyrus coronaria.*
Soulard Hybrid. A'89	Iowa		ml				a			ml	Possibly distinct from the preceding.
Spitzenburg. A. Syn. Spitzenberg Crab	Am		m	y				vg			
Spitzenberg Crab. CAG. Syn. of Spitzenburg											
Stanley. CanExR'89											Not described.
Stanstead. L. Syn. Rose of Stanstead	Can	obl	ml	r	j		sr	vg-b	k	l	
Stayman. JWK			l	r				g			
Stella. JWK			l					vg			
Stewart. R. Syn. Stewart's Sweet											Do.
Stewart's Sweet. RNY'70. Syn. of Stewart											
Stockton											Do.
Stoughton. L. Syn. Stoughton's Sweet											Do.
Stoughton's Sweet. Cat. Syn. of Stoughton											
Strawberry. A'85. Syn. Early Strawberry	Am	r	m	rs			sa	g	k	e	
Striata. A'99. Syn. Malus Striata	Eur	robl	m	yrs							
Striped Aker. L. Syn. Aker's Striped Winter	N. Y									vl	
Striped. L. Syn. Striped Siberian Crab		r	m	yrs							
Striped Siberian Crab. Hort'57. Syn. of Striped											
Suaveolens. A'99	Eur			r							
Sugar. Cat											Do.
Summer Rose. AHortA'70	Minn	robl	l	gb	t	gw	sa	g		e	
Summer Sweet Russet. WAW&C. Syn. of Sweet Russet											
Sweet. A'73			m	r			s		c		
Sweet Russet. A'85. Syn. Summer Sweet Russet	Wis		vl	ru				vg		vl	
Sweet Russet. A. Syn. of Russet											
Sweet Scented. HB&T. Syn. Pyrus Coronaria			m	g							Do.
Sweet Spitzenburg. Cat											Do.
Sylvan. A'87. Syn. Sylvan Sweet Crab	Wis	rob	l	yb	tj	y	s		c	mf	
Sylvan Sweet Crab. A'71. Syn. of Sylvan											

Talford. L. Syn. Talford's Sweet. [Telfer possibly correct.]	Iowa										Do.
Talford's Sweet. Cat. Syn. of Talford											
Tallula. BBL											Do.
Taylor. R. Syn. Taylor's Seedling			l	wb							
Taylor's Seedling. FHC. Syn. of Taylor											
Telfer. L. Syn. Telfer Sweet. [Possibly same as Talford.]											Do.
Telfer Sweet. A'85. Syn. of Telfer											
Terry. R. Syn. Terry's Cider	Iowa										Do.
Terry's Cider. IaH'88. Syn. of Terry											
Terry Golden. R. Syn. Terry's Golden	Iowa		l	y				vg		m	
Terry's Golden. IaH'88. Syn. of Terry Golden											
Terry's No. 1. Cat.											
Terry Red. L. Syn. Terry's Red Winter	Iowa									l	Do.
Terry's Red Winter. Cat. Syn. of Terry Red											
Terry Rose. L. Syn. Terry's Rose	Iowa										Do.
Terry's Rose. Cat. Syn. of Terry Rose											
Tetofski. CLW	Rus.			wes	j		a			e	
Texan Red. IllB45. Syn. of Oblong											
Texas Red. TexB16. Syn. of Oblong											
Tonka. JNCo	Minn.?			r			sa				
Transcendent. Lin	Am	roble	ml	gyeb	c	y	sa	g	km	me	
Transparent. R. Syn. Transparent Sweet											Do.
Transparent de Rouen. IllB45. Syn. of Rouen											
Transparent Sweet. MagofH'41. Syn. of Transparent											
Triumphant. IllB45		r	l	r						m	
Tuttle. R. Syn. Tuttle's Sweet	Wis.	r	vl	yrs		gy	bs	g	dk	m	
Tuttle's Sweet. AHortA'70. Syn. of Tuttle											
Union. IllB45. Syn. Union Crab			ml								Do.
Union Crab. IllB45. Syn. of Union											
Valley. A'73			l	rsru			sa			m	
Van Wyck. B. Syns. Van Wyck's Siberian, Van Wyck's Sweet	N. Y	re	l	wb	fmj	w	s	g		m	
Van Wyck's Siberian. Dap. Syn. of Van Wyck											
Van Wyck's Sweet. AHortA'70. Syn. of Van Wyck											
Vermont Beauty. IllB45. Syn. of Large Yellow											
Victory. A'73				yrs						m	
Virginia. IllH'89		ob	m		ctj	yw	sa	g	km		
Walter. R. Syn. Walter's Sweet											Do.
Walter's Sweet. AHG. Syn. of Walter											
Warfel. D	Pa	ob	m	yrs							
Waugh. A'95. [A doubtful crab.]											Do.
Waxen. CAG											Do.
Welcome. CanExR'89											Do.
Wheeler. R. Syn. Wheeler's Scarlet	Can.		m	e					k		
Wheeler's Scarlet. MHSC'84. Syn. of Wheeler											
White. A'67. Syns. White Winter, White Winter Sweet	Minn.?	rob	m	gyb	cmj	yw	a			vl	
White Arctic. JB											Do.
White Honey. JAY			s	yw			s		e		
White Winter. AHortA'70. Syn of White											
White Winter Sweet. Hort'72. Syn. of White											
Whiting. EON		obl	vl	yrs				vg			
Whitney. B. Syns. Whitney's Crab, Whitney No. 20	Ill	re	l	yrs			sa	g	k	ml	
Whitney's Crab. T. Syn. of Whitney											
Whitney's No. 14. AHortA'70											

Catalogue of the known varieties of apples referred to in American publications from 1804 to 1904—Continued.

SIBERIAN AND OTHER CRABS—Continued.

Name of apple.	Origin.	Form.	Size.	Color.	Flesh. Texture.	Flesh. Color.	Flavor.	Quality.	Use.	Season.	Remarks.
Whitney No. 20. AHortA'70. Syn. of Whitney											
Whitney's No. 24. AHortA'70											
Whitney Winter. R. Syn. Whitney's Winter	Ill	ob	m	gyr	fj	w	ba	g	dk	vl	Probably same as Whitney.
Whitney's Winter. AHortA'70. Syn. of Whitney Winter											
Wick. R. Syn. Wick's Everlasting. [Probably a crab.]											Not described.
Wick's Everlasting. Hort'72. Syn. of Wick											
Wild Crab. MinnExR'90											Do.
Wilder. L. Syn. Col. Wilder	Iowa										Do.
Winona. R. Syn. Winona Chief. [May be an apple.]											Do.
Winona Chief. Hort'72. Syn. of Winona											
Winshall. R. Syn. Winshall Crab											Do.
Winshall Crab. MagofH'36. Syn. of Winshall											
Winter. MinnExR'90											Do.
Winter Gem. Hort'69	Ill						a			vl	
Winter Golden. L. Syn. Winter Golden Sweet	Wis	ob	l	y			s			l	
Winter Golden Sweet. MoH'86. Syn. of Winter Golden											
Winter King. Cat											Do.
Winter No. 2. RNY'69											
Winter Pear. BBL											Do.
Winter Sweet. JVL											Do.
Winthrop. RNY'69											
Wisconsin. Hort'72. Syn. Wisconsin Sweet Mammoth	Wis										Do.
Wisconsin Seedling No. 1. AHortA'70											
Wisconsin Seedling No. 3. AHortA'70											
Wisconsin Sweet Mammoth. Cat. Syn. of Wisconsin											
Wood. MinnExR'90. Syn. Woods											Do.
Woods. MoH82. Syn. of Wood											
Woodward. R. Syn. Woodward's Winter											Do.
Woodward's Winter. Hort'72. Syn. of Woodward											
Woodward's No. 6. Hort'72											
Xanthocarpa. SDB65	Eur	robl	m	y							
Yates. TVM. Syn. Red Warrior			vl	drs	fj	y	sa		de	l	Black Warrior is a synonym of Warrior apple.
Yellow. Lin. Syns. Amber Crab, Golden Beauty, Yellow Siberian Crab		r	s	y			a	g	k	me	
Yellow Arctic. Cat											Not described.
Yellow Siberian. D. Syns. Amber, Large Yellow Siberian	Eur	r	s	y			a	g	k	m	
Yellow Siberian Crab. NEF'26. Syn. of Yellow											
Young America. W&TSCo			l	r	fj			vg	d		

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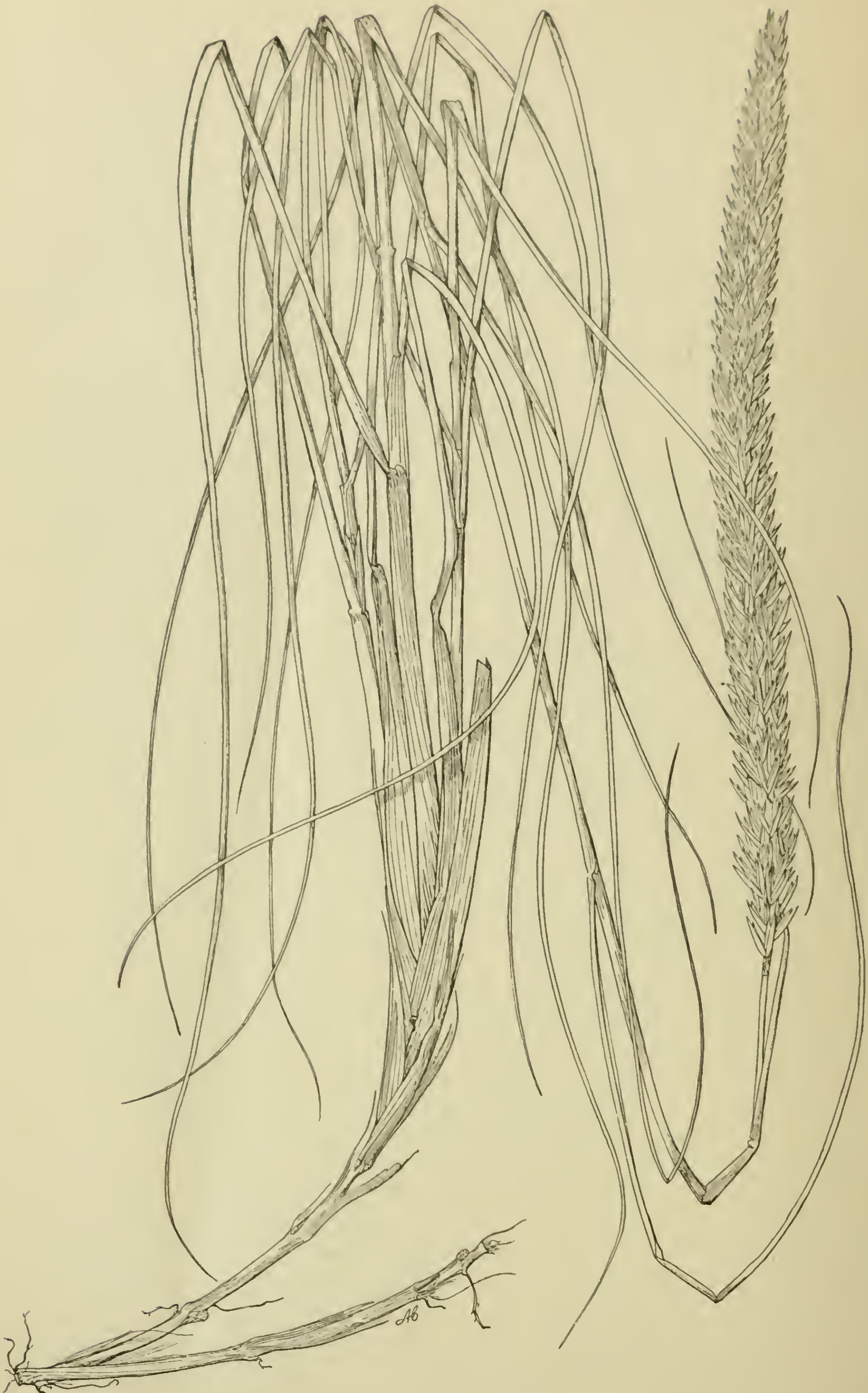

BEACH GRASS (AMMOPHILA ARENARIA LINK).

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 57.

B. T. GALLOWAY, *Chief of Bureau.*

METHODS USED

FOR

CONTROLLING AND RECLAIMING SAND DUNES.

BY

A. S. HITCHCOCK,

Assistant Agrostologist, in Charge of Cooperative Experiments.

GRASS AND FORAGE PLANT INVESTIGATIONS.

Issued March 10, 1904.

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BUREAU OF PLANT INDUSTRY.

BEVERLY T. GALLOWAY, *Chief of Bureau.*

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., January 7, 1904.

Sir: I have the honor to transmit herewith a paper on "Methods Used for Controlling and Reclaiming Sand Dunes," and respectfully recommend that it be published as Bulletin No. 57 of the series of this Bureau.

This paper was prepared by Mr. A. S. Hitchcock, Assistant Agrostologist, in Charge of Cooperative Experiments, Grass and Forage Plant Investigations, and has been submitted by the Agrostologist with a view to publication.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

On the Atlantic and Pacific coasts, on the shores of the Great Lakes, and at numerous places inland, there are areas of sandy land, for the most part originally covered by vegetation, but now denuded of plant growth through the shortsighted policy which has so often prevailed in this country of utilizing everything in sight without reference to the future. The Department of Agriculture is frequently called upon for advice concerning the proper methods of controlling this sand and preventing it from drifting. In some cases cultivated fields have been invaded and railroad tracks covered. The sand has even invaded cities, covering up houses and filling the streets, and much valuable property has thus been destroyed.

Much work has been done in controlling shifting sand dunes in Europe during the past century, and methods have been developed whereby it is possible to control the sand and in many cases to cover it again with vegetation. On account of the importance of the subject, Prof. A. S. Hitchcock, of this office, was sent to Europe recently to study the methods there used in this work. In the autumn of 1902 he visited the Netherlands, Denmark, Germany, and France for this purpose. An outline of the methods that have been successfully employed in those countries is given in this bulletin, together with some other information of general interest concerning the subject of sand dunes.

W. J. Spillman,
Agrostologist.

Office of the Agrostologist,
Washington, D. C., December 16, 1903.

1

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

B. P. I.—92. G. F. P. I.—102

METHODS USED FOR CONTROLLING AND RECLAIMING SAND DUNES.

INTRODUCTION.

The sand-dune areas of Europe are of especial interest because they present conditions similar to those found in the United States and because it is there that the methods of reclamation were first applied and later most successfully developed.

In order to investigate the methods used and determine to what extent they might be applied in this country, the writer visited several regions in Europe where the conditions and methods may be considered representative—the Netherlands, Denmark, the southwest coast of France, and the Kurische Nehrung on the northeast coast of Germany. In Prussia much work has been done along the coasts of the Baltic and North seas, but this is so well described in Gerhardt's[a] admirable book upon the dunes of Germany that other points than the ones mentioned were not visited.

There are other localities of minor importance where dunes occur and where efforts toward reclamation have been made, but it was not learned that the methods used differed essentially from those investigated. Lack of time prevented visits to certain other interesting interior regions, such as the Banat plain of southern Hungary, the north shore of the Black Sea, and Russian Turkestan. The last two regions are of importance because of the efforts put forth by the railroads to prevent the enroachment upon their right of way by shifting dunes.

FORMATION OF SAND DUNES.

Sand hills or dunes usually occur along a sandy seacoast. The sand is constantly washed up by the waves and when dry is readily carried inland by the wind. On a rocky or marshy coast this does not occur.

[a] Paul Gerhardt, Handbuch des deutschen Dünenbaues, Berlin, 1900. This is a very complete and detailed account of the sand dunes of Germany, including geology, flora, formation, reclamation, and historical notes, and is the most elaborate work of this nature thus far published. The writer is indebted to this work for the text figures used in this bulletin. Mr. Gerhardt was superintendent of the Königsberg district (Regierungs und Baurat) and was later advanced to the charge of the entire work at Berlin.

Under the action of the wind the sand accumulates in ridges or hills of irregular contour and extent, depending upon the force and direction of the prevailing winds. It is not intended here to go into the details of dune formation, a subject which has been elaborated in Gerhardt's book and also in numerous lesser works. Suffice it to say that ordinarily a dune passes through a rather definite series of changes. It is formed near the beach and travels back toward the interior. A typical wandering dune presents a gradual slope toward the wind and an abrupt slope on the lee side. The wind forces the sand up the slope and it falls over the edge. The hill or ridge then travels in the direction of the prevailing wind at a rate depending on the force and constancy of the latter. Such a hill is called a wandering dune. As the dune recedes from the coast a new one may form at the beach.

Upon the wandering or active dunes the sand is shifting to such an extent that vegetation does not establish itself. Consequently such dunes are bare. During wet periods seeds may germinate, but sooner or later the flying sand destroys the plants either by cutting them off as by a sand blast or by burying or uncovering them. However, as the action of the wind becomes less forcible at a distance from the strand, vegetation is at last able to become established and resist the enfeebled sand blast. A wandering dune is thus gradually converted into a fixed dune, which, if left to itself, finally becomes forested.

Similar dunes are often formed along the larger rivers or on interior sandy wastes such as are found in the central portions of the Netherlands and Denmark. It not infrequently happens that a fixed dune becomes converted into a wandering dune. This occurs through the removal of the vegetation, either by natural means or as the result of man's carelessness. The result in the first case is usually brought about by changed conditions, such as the direction of the wind, whereby the vegetation dies in certain spots and "blowouts" are formed. Such cavities or blowouts gradually enlarge as the surrounding vegetation is undermined and the result may be the birth of a wandering dune. But from an economic standpoint by far the greatest harm has come from the removal of forests from fixed dunes. The Kurische Nehrung in Prussia and the coast dunes of the Netherlands were at one time covered with forest and gave no trouble. Other cases are known where dunes held permanently by a covering of grass have been converted into wandering dunes by the pasturing of cattle upon them, thus cutting up the sod.

Sand dunes of any considerable extent are rarely found along the seacoast in warmer regions, because the long growing season is more favorable to vegetation. The forest, or at least a scrubby growth of shrubs, usually comes down close to the high-water mark. The severe winter storms of the high latitudes are chiefly responsible for the great dune areas of the north.

In many cases the wandering dunes encroach upon arable land, upon forest, upon valuable property such as railroads and buildings, or upon rivers, harbors, or other water ways. This usually indicates that there has been a recent change of conditions resulting in the formation of active dunes. Seaside resorts upon sandy beaches are often seriously damaged by the formation of dunes and blowouts upon various portions of the property.

In addition to the trouble arising from the encroachment of sand at points where it does damage, it should be understood that there are large areas of sandy land consisting of dunes in various stages of fixation, interspersed with portions of level and sometimes arable land. These level spots represent portions where the wind has swept away the sand down to moist soil, which usually has a definite relation to the water level. Such areas of dunes may include many square miles and are useless for agricultural purposes. It is thus seen that the fixation of dunes may be for two purposes—to protect property in the lee or to convert a useless area of waste land into a productive forest.

ACTION OF THE WIND UPON DRIFTING SAND.

When the wind sweeps over a free surface of drifting sand it acts about equally throughout; but an obstruction of any kind, such as a log or a bunch of grass, at once modifies the action of the wind. A solid object increases the force of the wind around the sides, and hence the sand is excavated. In the lee of the object the sand will accumulate. If two such obstructions are near together a channel is formed between them and once formed deepens with astonishing rapidity. The carrying power of the wind increases much more rapidly than the increase in the velocity.[a] Consequently, any increase in the velocity is immediately noticeable in the increased erosive power. The erosive power of the wind is not identical with the carrying power, for in the first case the wind overcomes cohesion and in the second case it overcomes weight. If the velocity of the wind decreases, the sand previously held in suspension is deposited.

If a solid fence is placed upon the sand at right angles to the wind

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[a] Theoretically the transporting power of the wind varies as the sixth power of the velocity—that is, if the velocity is doubled the carrying power is 64 times as great. It is clear that the force exerted by the wind upon a fixed surface increases as the square of the velocity, for if the velocity of the wind is doubled there will be twice as much air striking the surface with twice the velocity. Furthermore, if the velocity remains the same the force exerted increases with the surface—that is, with the square of the diameter. The moving power then varies as the product of the square of the velocity and the square of the diameter. But the force or work done, which is the same as the weight of the object transported, varies with the cube of the diameter; or, putting it all in terms of velocity, the force varies as the sixth power of the velocity.

the sand is excavated in front (fig. 1). The wind, unable to proceed, is divided into currents in all directions. Those going downward scoop out the sand, thus forming a drift a short distance in front. This increases until its height equals that of the fence, when the wind, no longer meeting with the obstruction, allows sand to be deposited

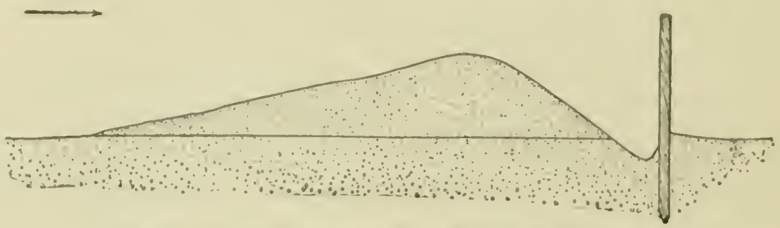

FIG. 1.—Drifting sand as affected by a solid fence.

in this channel, and it fills up, covering the fence. Similarly at the ends of the fence the wind currents are increased and the sand is scooped out. If the fence is raised so as to allow a space beneath, the sand is rapidly scooped out below. The same result occurs beneath buildings, trestles, or other works which allow a space beneath,

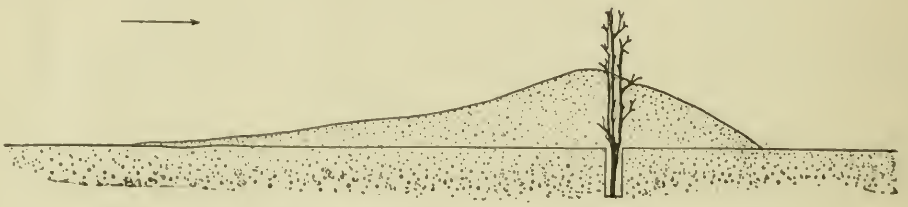

FIG. 2.—Drifting sand as affected by an open, inflexible obstruction.

through which the wind rushes with increased force. If, however, the obstruction is not solid, but more or less open, as a pile of brush or a bunch of grass, the action is entirely different. The wind passes through the obstruction, but with decreased velocity; hence, sand is deposited within the obstruction. No excavation takes place in front

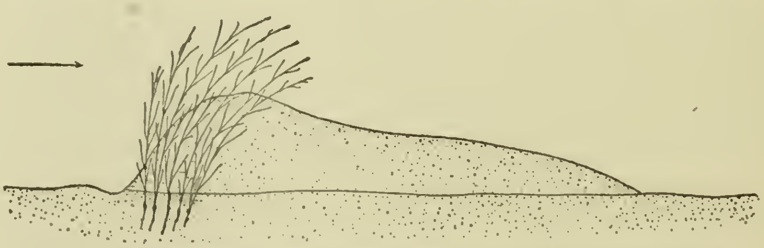

FIG. 3.—Drifting sand as affected by an open, flexible obstruction.

or around the sides. If the obstruction is stiff and inflexible like a sand fence, the sand is deposited on both sides (fig. 2), the windward slope being gradual and the lee slope more abrupt. If the obstruction is flexible like a bunch of grass, most of the sand is deposited in the lee (fig. 3). Of course there are all gradations between the two classes, and various circumstances may modify the usual action.

It may be further stated that when the wind is blowing up an incline, the surface velocity increases with the steepness. A small object is easily blown uphill. But when the wind blows down a slope, eddies form which usually produce a current uphill at the surface. Thus it happens that while small bodies can be blown uphill easily it is not often that they are blown downhill, but must fall from their own weight when the slope is steep. The fact that the velocity of the wind at the surface on the windward side of a dune increases with the slope results in producing a normal incline, which represents a balancing of forces. Usually this incline is quite gradual compared with the lee side of the dune, where the slope is the greatest at which the sand will remain in place—about 30°.

Sand can be removed from one place to another farther on by placing a suitable obstruction above, with a space between it and the surface of the sand, which will increase the wind velocity at this point. Sand may be filled in at any point by interposing an open obstruction, such as brush or a sand hedge, or by planting grass. The practical application will be referred to farther on.

ARTIFICIAL FIXATION OF DUNES.

The fixation is most permanent when the dunes are covered with forest; hence, forestation is the ultimate aim wherever possible. But there is a narrow strip of territory just back of the strand where trees will not grow on account of the exposure to the severe winds and the action of the ocean spray. The width of this strip depends upon local conditions and may vary from one to several rods. The force of the wind is influenced by the character of the coast. Experience soon demonstrates how near to the strand a forest may be produced.

When the work of fixation is completed there will be a forest over the greater part, but a strip along the coast remains which must be permanently held in place by some other method, usually by the planting of grass. When the forest is once established it is cared for and preserved according to the usual methods of forestry. Usually it is impossible to establish a forest directly upon the sand dunes either by sowing the seed or setting out young trees, because the drifting sand cuts the leaves and bark or uncovers or buries the young plants. Sowing the seed has been tried several times, but there remain of this work only a few scattered patches of trees in protected places. It is therefore necessary to hold the sand in place by some kind of a covering until the trees can obtain a start, when they form a covering themselves.

The work of fixation is thus divided into two rather distinct stages: (1) Preliminary; holding the sand in place. (2) Permanent; establishing a forest. Upon the coast strip the work does not proceed beyond the first stage, but the maintenance of the covering in a satisfactory condition requires constant care.

BINDING THE SAND.

There are many methods which have been employed at various times, but those now in successful use on a large scale may be considered under three heads: (1) Transplanting sand-binding plants upon the dunes, sufficiently thick to form a living cover; (2) covering the entire surface with some inert material which prevents the wind from reaching the sand, and (3) covering the surface with a network of brush fence which, while not preventing the wind from reaching the sand, lessens its velocity and prevents drifting. It may be remarked that numerous experiments have demonstrated the futility of sowing the seeds of any plant directly upon the unprotected surface of the bare sand.

These methods, as they have been finally elaborated, will now be described. For the historical development and the description of special methods to meet unusual conditions, the reader is referred to Gerhardt's book previously mentioned.

BINDING BY MEANS OF GRASSES.

Various plants for binding the sand have been tried, but none have been found so successful as grasses. Willow cuttings have been employed in a few cases, but their use has not proved satisfactory. Of the grasses the species used almost exclusively is beach grass (*Ammophila arenaria* Link), shown in Plate I, frontispiece. A kind of wild rye (*Elymus arenarius* L.) has been used occasionally. Beach grass grows naturally on the dunes all along the north Atlantic coasts of both Europe and America as far south as Morocco and North Carolina. It grows in clumps to the height of one to three feet and spreads by means of extensively creeping underground stems or rhizomes.

An important character of beach grass is that it grows with most luxuriance where the sand is drifting. In quiet sand it persists for a few years but gradually dies out. The drifting sand seems to supply the conditions for continued rejuvenation of the growth as the sprouts force their way up through the accumulating sand.

Transplanting.—Beach grass may be transplanted in the autumn or spring; in the autumn from the time it is mature, which may be as early as September, until the ground freezes, and in the spring from the time the ground thaws until growth starts. The grass is usually transplanted in the autumn, because at this time the requisite labor is more easily obtained, and furthermore it is then easier to pick out the individuals that are at the right stage of growth. It is best to choose moist or foggy weather, as the plants are more certain to grow, the danger of desiccation is less, the sand being damp it is more easily manipulated, and the work can be performed much more comfortably, as the flying sand seriously interferes with planting during dry weather.

The plants chosen for transplanting should be two years old and have at the base one or two nodes. The roots spring from these nodes; consequently at least one node must be present. More than two are not necessary and would be a waste of material, though they do no other harm than to interfere with planting in proportion to their number. One-year-old plants are not strong enough and have not developed the nodes sufficiently for transplanting. Plants more than two years old are proportionately lacking in vitality and do not throw out roots with sufficient vigor. With some experience laborers are able to distinguish at sight plants of the right age. If the grass is growing in loose sand and has not been covered deeply, it may be pulled up by hand. But usually it is necessary to cut the rhizomes below the surface of the sand, after which the plants can be easily pulled up. The method of procedure is for the workman to seize a suitable clump of the grass with the left hand and with a spade held in the right hand strike into the sand in such a manner as to cut off the rhizomes below having one to three nodes at the lower end (Pl. VII, fig. 1). The bunch is then pulled up and placed in a pile or under the left arm. When a bundle has accumulated, it is tied up and is ready for use. The spade used is a light tool specially made for the purpose, with a sharp edge or point and a short handle. Sometimes an ordinary spade, such as is used in digging, is put to this service.

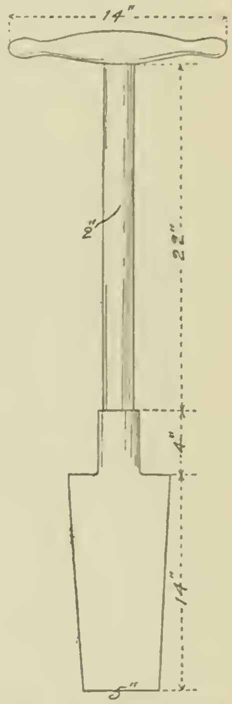

Fig. 1.—Spade used for planting beach grass.

If the grass for transplanting is taken from the dunes that are to be fixed, care should be taken not to remove too much from one place and allow the wind to make a blowout. It should be chosen from places where the grass is growing too thickly. The arrangements should be such that the grass can be planted soon after being dug or the roots may dry out too much. For the same reason it is best to dig the plants near the place where they are to be set out, thus reducing the distance of transportation.

The grass may be set out in various ways, but the method which seems to be most satisfactory is as follows: The planting is done by two persons working together. One prepares the holes and the other inserts the grass. The holes are made with a spade specially constructed, as shown in the illustration (fig. 4). The blade is rather heavy and has a sharp edge below. The operator lifts the spade by the cross bar or handle with both hands, and allows it to drop into the sand mostly by its own weight. He moves the handle back and forth once or twice, or until the blade has been worked down through the sand to the required depth. This makes a V-shaped opening in the sand 8 to 12 inches deep. The sand must be moist enough to retain its position or this method can not be used. The second worker now takes a portion of grass sufficient for one planting and places it in the hole, flattening out the bunch properly. The first worker puts the spade in the sand just behind the bunch, pushes the sand up tightly against the grass, and the operation is completed (fig. 5). The grass can be set out quite rapidly in this manner (Pl. VII, fig. 2).

Arrangement of the plantation.—If the dunes are already partially covered with beach grass, it may be necessary to plant only here and there in the bare places to prevent excavation by the wind or the formation of blowouts. If the sand is bare or covered with only a scattering growth, it is necessary to plant systematically. The most common method is to set the plants in rows. In Germany they are set in squares, the quadrat system, which will be described under methods used in the Kurische Nehrung. When the grass is set in rows, the bunches are placed so that they alternate in adjacent rows. Ordinarily the rows are fairly straight and perpendicular to the prevailing direction of the wind. In an extended area, where there is a succession of dunes and depressions, the rows may follow the contour lines. Rows in the direction of the wind should be avoided, as a channel will be formed between. In broken dune areas the plantings are made between the dunes and along their slopes, but leaving the tops bare (Pl. IV, fig. 1).

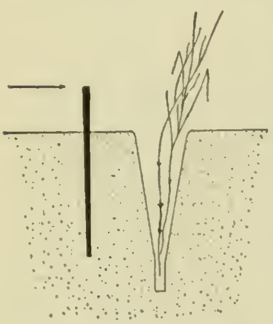

FIG. 5.—Method used in planting beach grass.

Usually there is no preparation of the dunes in the way of leveling or filling, as it is found more economical to allow the wind to do this work. The idea is to accumulate sand in the channels and hollows and allow the wind to blow off the tops of the hills. To aid in leveling the high places the grass is removed from these so that the wind can have free access. No planting may be necessary in the low places where the sand has been blown off down to moisture, as such situations support considerable vegetation. The planting is begun at the base of the slopes and proceeds toward the top, as it is the lower portions that are eroded the most rapidly, for the reasons stated when discussing wind velocity.

The thickness of the planting depends upon local conditions. If it is necessary to accumulate sand rapidly, as in filling a channel, the grass is planted in large bunches placed closely together; but where the sand is easily accumulated, the grass is set thinly to prevent its being covered. Under average conditions the rows are 15 to 18 inches apart and the plants about a foot apart in the row. The amount of grass in a bunch is about what can be easily taken in the hand and may consist of four or five stalks.

Formation of the barrier dune.—The grass planting previously described applies particularly to the large dune areas near the coast,

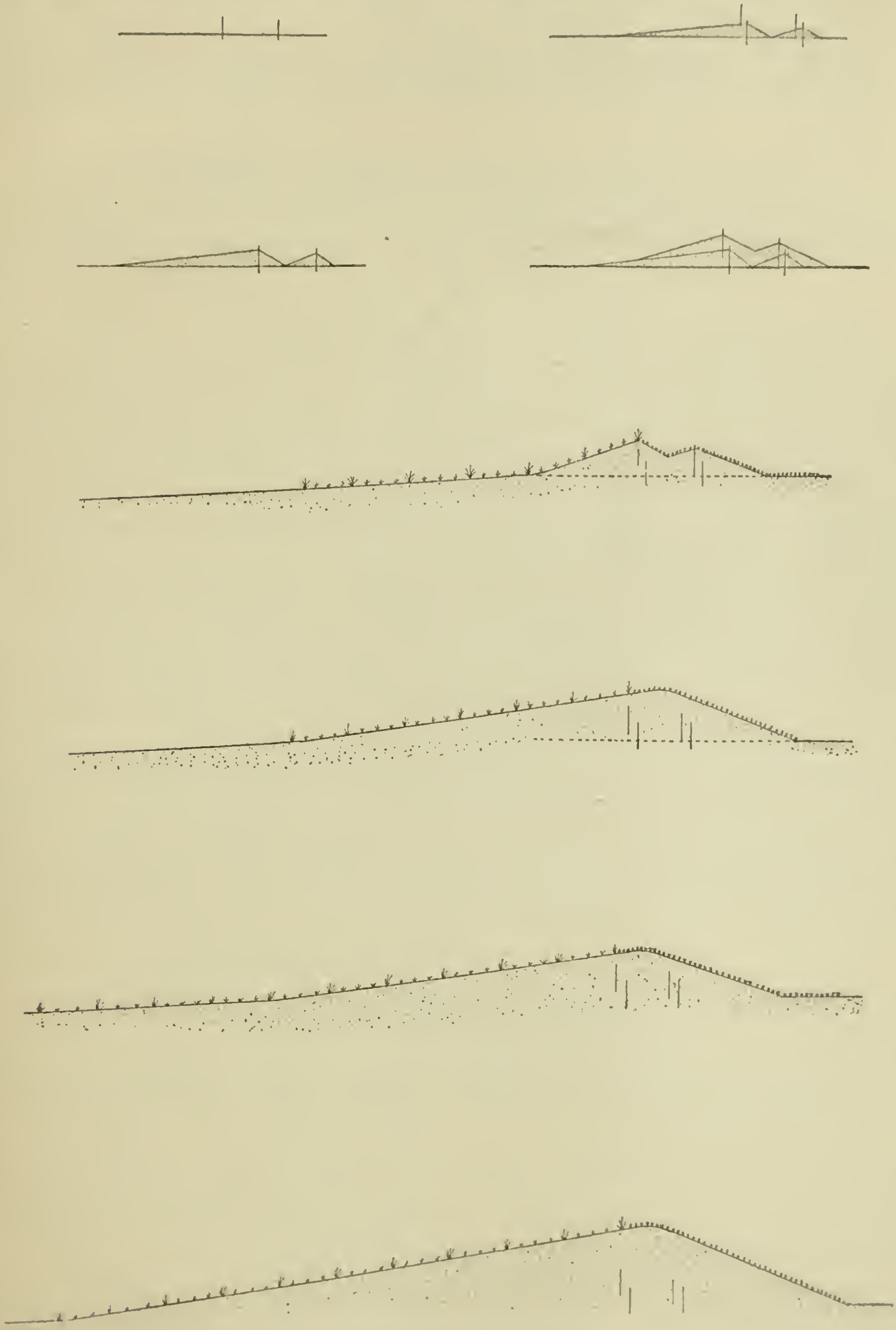

FIG. 6.—Diagram showing in cross section the successive steps taken in forming a barrier dune. The strand is at the left.

where this process is preparatory to the planting of trees. The function of the grass has been fulfilled when the forest is established.

As stated in an earlier paragraph, there is a strip of sand along the coast just back of the strand which presents conditions unfavorable to forest growth. Here it is necessary to hold the sand in place permanently by means of the grass. To do this requires constant supervision. Through various causes bare spaces are likely to occur which must be replanted to prevent the formation of blowouts. Sometimes the bunches must be thinned, as the presence of two large adjacent bunches may cause the wind to draw through between them and form a channel.

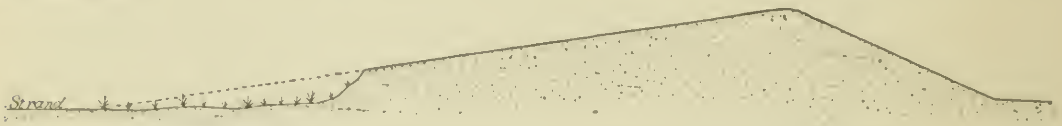

FIG. 7.—Repairing a small breach in a barrier dune by planting grass.

On the Kurische Nehrung in Prussia and along the southwest coast of France it has been found advisable to form an artificial protecting dune extending all along the sea in front of the forest (Pl. VI, fig. 1). This dune is produced by accumulating the sand rapidly so as to form a long ridge (fig. 6). For this purpose brush fences, which consist of rows of brush or rough branches driven into the sand firmly but rising above the surface about 30 inches, are used. The tops should be on a level. Two such rows are placed about 6 feet apart. These fences allow the wind to pass through, but reduce its velocity, and hence sand is deposited within and on both sides. When the sand has reached the top of the fences, a second pair is placed above. When a ridge has been formed, beach grass is planted in rows parallel to the crest. At first, plantings are made along the slopes and a short distance in front toward the strand. As the sand accumulates, the grass is planted farther to the windward. Finally the protecting dune assumes a comparatively permanent form, with a long slope to windward (toward

FIG. 8.—Repairing a larger breach by means of sand fences. The diagram represents a cross section of a dune with two rows of sand fence parallel to the dune and cross rows extending from the outer row to the broken face.

the sea) of 4 to 5 degrees, or about 1:9, and a steep slope on the lee side of about 1:2 (Pl. V, fig. 1). As a matter of fact, the windward slope is often much steeper—as much as 1:6 or even 1:4.

In practice this protecting dune must be established upon an area more or less broken by dunes of irregular shape. The ground line for the ridge is laid out to follow the coast in a general way, but to avoid all sharp bends or indentations of the shore line. The hollows and channels are filled up to the desired height, while the peaks and any small dunes lying in front are denuded of grass so that they are ultimately removed by the wind. Such a ridge protects the forest or arable land lying in the lee, but requires constant supervision to keep it in repair. The danger is from encroachment of the sea during storms, especially in winter. A single severe storm may break through and destroy several rods of well-built dune. Such a breach must be repaired as soon as possible, or the wind will still further erode the unprotected sand and enlarge the opening. These breaks are best filled in by means of sand fences (figs. 7 and 8 and Pl. IV, fig. 2).

It may be mentioned here that reclamation of sand dunes on a large scale is carried on in Europe by the general governments, as private individuals lack the necessary unity of purpose. This will be touched upon under the head of the particular regions visited.

BINDING BY MEANS OF HEATHER.

As stated previously, it is necessary to hold the sand in place while a forest is being established. Near the seacoast this is usually done by planting the beach grass, which is found growing wild upon the dunes. There are, however, vast stretches of inland dunes where beach grass does not grow, and the cost of transportation renders this method less economical than others. When fixing the sand is but preliminary to planting trees the method used depends upon the relative cost. Along the coast, where the fixation is permanent, the planting of beach grass is the only method which meets the requirements, and hence it is used even when it becomes necessary to import the plants.

For a temporary covering any cheap inert material which meets the condition, such as brush, straw, or sawdust, may be used, but by far the most satisfactory material in northern Europe is the heather (*Calluna vulgaris* Salisb.). As it is a common plant in the sand-dune regions this method is used in the central portion of the Netherlands and in the interior regions of Denmark (Pl. III, fig. 2). The heather can be used also in areas near the seacoast, as in western Denmark.

Laying the heather.—The heather is cut off with scythes, spread over the surface, and held in place by a little sand. The scythe used for mowing is short and somewhat resembles American brush scythes. The heather is then tied in bundles and carried to the place where it is to be used. Sometimes it may be necessary to transport the bundles some distance, as the heather grows usually only in the low places between the dunes, or at least it is here that it grows in sufficient luxuriance to be cut profitably. Since the heather is not planted, it is not necessary to use it immediately after gathering, as in the case of the grass. The plants are spread out flat upon the surface, overlapping each other in the rows, and are held in place by being partially covered with sand. The surface is not prepared, except that small inequalities are leveled so that the wind can not get beneath the layers of heather (Pl. II, fig. 1).

The heather is also used in road making. The roads through the dunes are laid out and graded in the usual manner, after which heather is laid thickly in courses upon the surface, thus preventing the wheels of vehicles from sinking into the sand (Pl. II, fig. 2).

BINDING WITH SAND HEDGES.

Sand hedges are used for binding when other methods are not practicable, or where the sand is drifting with especial force, or where it is desired to accumulate sand with rapidity. In general this method involves the use of some inert material, like brush or rows of stakes or reeds, which projects above the surface of the sand and reduces the velocity of the wind without causing deflecting currents, which erode the sand. The entire surface of the sand is not covered, but the action of the wind is hindered sufficiently so that the sand present remains in place and additions from the strand or from neighboring unprotected areas are accumulated (Pl. IX, figs. 1 and 2).

The sand fences or hedges are made from brush obtained in the forest. The branches are cut into pieces from 18 inches to 2 feet long, with sharp ends. The ends are sharpened by the slanting stroke which severs the stick. The side twigs are cut off roughly. These stakes are driven into the ground in rows, or, still better, in squares, thus catching the sand from all directions. The stakes project above the surface about a foot and should be on a line at the top, parallel with the general plane of the dune surface. The size of the squares depends on the tendency to drift, and varies from 9 to 12 feet. The rows should be at right angles to the direction of the prevailing wind. On dunes near the shore the rows should run parallel to this, with the short rows perpendicular. In covering a surface the long rows are first placed and the squares made by inserting crossrows between. The stakes should be close enough together in the rows so that the average width of the space is about equal to the average diameter of the stakes. The size of the stakes varies from half an inch to 2 inches (Pl. IX, fig. 1).

The common reed of Europe is utilized in the same manner. It is cut into the proper lengths and the pieces are set out in rows by about the same methods used in grass planting (Pl. IX, fig. 2).

As previously stated, sand fences are used to repair breaks in protecting dunes, to fill channels previous to planting grass, or wherever it is necessary to accumulate sand. In these cases it may be advantageous to have the fences higher than when they are intended primarily to bind the sand. Sand fences are sometimes used along the base of dunes near the strand, where grass will not grow on account of occasional high tides (Pl. VIII, fig. 1).

In place of sand fences heather or brush placed in rows or squares and held in place by a little sand thrown over one edge is sometimes used.

FORESTATION.

The processes previously described are as a rule only preparatory to establishing a forest. When the dunes are covered with trees they are permanently fixed, and the trees being cared for according to the usual regulations pertaining to forest management become a source of revenue to the Government. It appears that most of the large and troublesome dune areas along the coast were at one time covered with forest, notably Holland and the Kurische Nehrung, but through lack of foresight these areas were denuded of forest and ere long were converted into wastes of drifting sand. Some attempts were made in the early part of the last century to reforest these areas by sowing the seed of forest trees. These trials all resulted in failure, although there are here and there in protected situations small and stunted groves which survived. It has been proved that the only satisfactory method of establishing a forest in the northern dune areas is by setting out young trees, after the sand has been fixed by one of the methods described in previous paragraphs. In Gascony on the southwest coast of France, however, the forest has been successfully established from seed under conditions which will be described when speaking of the methods used in that country.

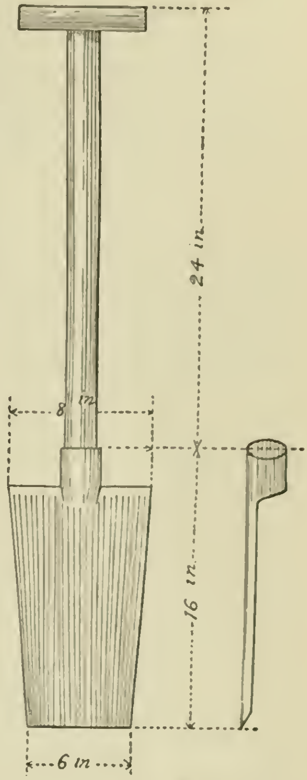

FIG. 9.—Spade used in Prussia for transplanting young trees.

The trees used are mostly conifers, the species depending upon the locality. In the Netherlands *Pinus austriaca* and *P. laricio* are most successful on the coast and *P. sylvestris* on the interior dunes; in Denmark *Pinus montana* on the coast and *Picea excelsa* (preceded by *Pinus montana*) on the interior "heide;" *Pinus sylvestris* and *P. montana* on the Kurische Nehrung; and *Pinus maritima* in Gascony. Deciduous trees, such as birches, alders, and oaks, are used along the roads and serve as fire guards.

The seedlings are raised in nurseries located at convenient points near the area to be planted. These nurseries are often surrounded by wire netting to keep out rabbits and other harmful animals, and may also be protected from the wind by wind-breaks of reeds or cut branches of pine.

The young trees are transplanted when one or two years old (fig. 9). The growth is often quite slow at first and the young forest needs much attention. Some of the trees die and these must be replaced. But on the whole these operations have been very successful, and now there are several areas of forest that are producing an income to the Government.

FIXATION AS OBSERVED IN EUROPE.

For the purpose of observing the details of the European processes of dune reclamation as actually practiced, the Netherlands, Denmark, Germany, and France were visited. Below are given the details of the methods used in the countries mentioned, which may be taken as fairly typical of the work throughout Europe.

THE NETHERLANDS.

Through the kindness of the American minister at The Hague, Mr. Newel, and Mr. Van Marez Oijens, the minister of the department of waterworks, a detailed examination of the dunes near Alkmaar and in the vicinity of Barneveld was made.

COASTAL DUNES.

A line of dunes extends all along the coast of the provinces of North Holland and South Holland. These are two of the richest provinces in the Kingdom, and it becomes of great importance to prevent the encroachment upon the agricultural lands which lie just back of the coast. The dunes were visited in company with Mr. Van Dissel, who has charge of this portion of the work, and who explained the details of the methods used at that point. The particular portion of the dunes visited was near the little town of Schoorl. The land to be reclaimed was the property of the General Government. At an earlier period this region was covered with forest trees, but these were cut off to be used for fuel and other purposes. The result was disastrous. The covering of vegetation was broken through, allowing the wind access to the sand, and finally the whole area was converted into a series of shifting dunes. About forty years ago an attempt was made to reforest these dunes by sowing the seed of pines. These seeds seem to have germinated quite readily, but the seedlings were unable to withstand the severe conditions, and now all that remain to show for the work are a few isolated groves in protected places. The Government has now planned an extensive system of reclamation which in time will convert all of this waste into a productive forest.

The preliminary fixation is done by planting beach grass, as indicated in a previous paragraph. (See Pl. VII, fig. 1.) In this region there is no inert covering that can be economically used, but beach grass grows abundantly all along the coast. As it is easier to obtain the necessary labor in the autumn, the planting takes place at this season rather than the spring. Furthermore, it is easier in the autumn for unskilled laborers to choose grass of the proper age for planting, as in the spring the portion above ground is dried and brown, thus making it difficult to distinguish between the shoots of different ages. Care is taken to gather grass for planting from places where it is growing thickly, so as not to rob the sand of its covering to an injurious extent. In gathering the grass a short-handled spade is used. The little bunches are tied in bundles of 72, this being a convenient armful and also a convenient number for calculation, six dozen. The planting is done by two persons working together, as already described. Sometimes the sand is pressed back upon the transplanted grass by means of the foot instead of the first worker using the spade. While a handful is more than necessary, experience has shown that some of the grass fails to grow. Even though it does not grow, the dead grass acts as a barrier to the sand for some time, at least one year. The grass is planted in rows about 40 centimeters (16 inches) apart and 30 centimeters apart in the row, the bunches in successive rows alternating. If the sand is not entirely bare, the bunches are planted here and there where they are needed. Ordinarily no attempt is made to level or alter the ground and in many places steep hillsides are planted. However, there are cases where the land is somewhat prepared, especially by leveling sharp points that rise above the general surface. In the region visited there is no protecting dune along the strand, and such a method of protection seems not to have been used in Holland.

After the sand has been planted to grass to prevent its drifting, the trees are set out. The young trees are grown in nurseries from seed planted usually in April. Trees are set out when one or two years old in spring or fall, according to conditions. Several species have been tried, such as *Abies balsamea* Mill., *Pinus austriaca* Link, *P. laricio* Poir., *P. maritima* Lam., *P. rigida* Mill., *P. sylvestris* L., *Quercus pedunculata* Ehrh., *Q. rubra* L., and *Robinia pseudacacia* L.

It has been found that the species best adapted for exposed situations are *Pinus austriaca* and *P. laricio*. Some other pines, especially *P. sylvestris*, are good for the more sheltered places.

The cost of setting the grass is 50 to 75 guilders[a] per hectare, and the total cost of reforesting is about 150 guilders per hectare (about $22 per acre). It must be remembered, however, that labor, the most important item of expense, costs much less than in the United States.

INTERIOR DUNES.

In company with Mr. Jager-Gerlings, an interior dune area in the Province of Gelderland, east of the town of Barneveld, was next visited. This is known as heath land because heath or heather (*Calluna vulgaris*) is abundant here. The Government has purchased a quantity of this waste land and proposes to convert it into forest. The land is sterile and the country almost uninhabited.

Here the preliminary fixation is by means of covering the sand with layers of cut heather. The heather is cut with a short, thick scythe

[a] A guilder, gulden, or florin is worth about 40 cents in American money. A hectare is equal to 2.471 acres.

with a straight handle, tied in bundles about 1 meter in circumference, and carried to the place of use in carts or wagons The hills are covered with the layers of heather described in the first part of this article (Pl. II, fig 1).

The region consists of dunes more or less bare and shifting, alternating with lower moist areas where there is a covering of vegetation, mostly heather. These low areas are sufficiently moist to keep the sand from drifting. Experience has shown that over much of this area trees do not thrive when set out in holes, as is customary. This seems to be due to the lack of air in the soil. It has therefore been found necessary to spade up the soil before the trees are planted. This is done by digging up the soil to a depth of 0.56 meter (about 22 inches). It is unnecessary to spade up the soil over the entire surface, the digging being confined to strips 1.2 meters wide, with an unspaded space of 0.8 meter lying between.

The trees are planted in rows, one near each margin of the spaded strip and 0.75 to 0.80 meter apart. Heather is laid between the rows to hold the sand. On the hills where the heather has been laid the trees may be planted in holes among the heather. The planting takes place in autumn or spring, but it is customary to plant the hills in the fall, leaving the low places till spring, when it is drier (Pl. II, fig. 1; Pl. III, fig. 1).

After the planting it is necessary to watch the growth of the trees and to stir the ground around them in proportion to their needs. If the growth is poor and the trees remain stunted the ground is stirred with a stout four-tined rake. If the soil is moved too much the trees may make too vigorous a growth and the wood will not ripen sufficiently in the fall.

The tree best suited to the greater part of this region is the common pine or, as it is called in America, the Scotch pine (*Pinus sylvestris*). It was stated that the trees from Scottish seed grew better than those from Norway seed.

On the more sterile portions of the area better results are obtained from *Pinus rigida* and *P. divaricata* Gord. (*P. banksiana* Lam.). The black or Austrian pine (*Pinus austriaca*) does not succeed well, its growth being too slow. *Pinus laricio* promises well.

About one-fourth of 1 per cent of the trees die from various causes, and these it is necessary to replace. Various insects prey upon the trees. In this connection it is noteworthy that bird houses are placed at intervals in the forest to attract birds that devour harmful insects or their larvæ. A bird called the "birkhuhn" nips off the young buds. Rabbits and other small animals gnaw the bark. A root fungus (*Agaricus melleus*) kills many individuals. These are replaced by choke-cherry (*Prunus virginiana*).

The cost of the work per hectare at this point is approximately as follows:

	Guilders.
Cutting and tying the heather	1.1
Transporting the heather	1.5
Spreading the heather	16
Spading the ground	57
Planting the trees	25

This makes the total cost about 100 guilders per hectare, or about $16 per acre.

The different parts of the plantation are reached by means of roads placed at convenient distances. There is usually a strip of deciduous trees, mostly of birches, planted along these roads as a protection in case of fire, since conifers burn with ease, while the birches do not. In passing through the higher dunes, it is necessary to have the roads curve between them in order that the wind may not sweep through and cause serious erosion.

DENMARK.

Through the kindness of Prof. Eugene Warming, director of the botanical garden at Copenhagen, letters of introduction to the dune inspectors at Aar and Skagen were obtained. Dune areas extend all along the coast of western and northern Denmark, but these two points were selected as being typical of the entire region.

OXBÖL.

The first point visited was in the southwestern part of Denmark in the Province of Ribe. Mr. R. P. F. Bang, the inspector of this district, lives at Aar, near Oxböl, which is reached via Esbjerg and Varde. The method used here for fixing the sand and planting trees is similar to that used in Holland; the conditions are also very similar. The region consists of a series of sand dunes, with low places interspersed, and extends some distance back from the coast. There has been no attempt in this region to form a barrier dune. As the heather grows abundantly throughout most of the dune region this plant is used for the purpose of fixation except near the coast. The young forest consists for the most part of *Pinus montana* and *Picea alba*. In addition, Mr. Bang has experimented with *Picea sitchensis* and *P. nordmanniana*, both of which promise success. *Pinus austriaca* is injured by the cold winters, and *Picea excelsa* does not successfully withstand severe winds. On certain portions, where the soil is comparatively rich, *Picea pectinata* succeeds.

About fifty years ago an attempt was made to establish a forest in this region, and in certain isolated and protected places portions of this forest are now in evidence. The trees, according to the situation, may be 3 to 15 feet high, but for the most part present a very stunted growth.

The heather is laid at any time of the year when it can be most conveniently done.[a] Near the coast, where beach grass is used, the planting takes place as in Holland except that on account of the broken nature of the country and the strong winds it is found that the bunches of grass must be smaller, consisting only of one or two pieces. The pines are planted when they are 3 years old and the spruces at 4 years. The plantation showed a very marked difference in the condition of the trees, depending on the richness of the soil and the exposure. The stunting of the trees is very noticeable in the native forest near the coast. The trees nearest the coast are small and scrubby, and for some distance inland they bear very few branches on the windward side, therefore appearing very lopsided. The entire cost of laying the heather, planting and raising the trees, is 300 crowns per hectare,[b] or about $32 per acre. The usual compensation for planting the grass is about 8 cents per square rod, the work being done at a fixed price (4 öre) per 4 square meters.

SKAGEN.

The investigation of the dunes around Skagen at the north end of Denmark was made in company with the inspector, Mr. C. F. Dahlerup. The whole peninsula above Frederikshavn is one vast sand area consisting mostly of dunes. Between the dunes are more or less extended areas of flat land where the soil contains more humus. These lower portions can be used for grass and to a limited extent for other crops, but they must be fertilized and limed. For this purpose kainit and Thomas slag are used, and lupines are grown to supply nitrogen. The distance to the ground water determines the availability of the soil for crops, the most favorable distance being about 18 inches. If the ground water lies lower than this the soil is too dry and if above this it is too wet for cultivation. The land around Skagen and for about two miles south is owned privately, but a large area south of this is owned by the Government. The latter is carrying on a system of reclamation upon this area, and also upon some of the land owned privately. Upon the private land the cost is divided as follows: One-half is paid by the General Government, one-sixth by the province, one-sixth by the township, and one-sixth by the owner.

The preliminary fixation is by means of beach grass planted in October or November. Although in the more quiet portions of the dune the beach grass lives only from five to ten years, yet as it gradually dies out its place is taken by various native plants which serve to

[a] The methods used in planting have been described in Tidskrift for Skoving, 12, Om de Nord-og vestjydske Klitters Beplantning.

[b] A crown equals 26.8 cents in American money.

hold the sand effectively. Heather also lasts about the same time, but the native plants tend to take its place as it disintegrates. One of the common plants found as a native covering is reindeer moss. *Salix repens*, one of the willows, is an excellent plant for holding the sand, but thus far there has been no success in its artificial propagation. On the large areas of beach-grass plantations the rows follow the contour lines and the planting extends from the base toward the apex of the hills, but the tops of the dunes are not planted. The cost of planting and gathering the grass is about the same here as around Oxböl. It is customary to hire one workman at a fixed price per square yard, and this man provides the necessary helpers.

The trees used here upon the plantation are mostly *Pinus montana* and *Picea alba*. *Picea sitchensis* has been used to some extent and seems to do well, especially in wet places, but it has not yet been sufficiently tested. *Picea alba* withstands wind but will not endure drought. The seed of the trees is planted in seed beds in May. The following spring, when the seedlings are one year old, they are transplanted to the nursery rows by an ingenious machine. It was said that by means of this machine 1,000 plants could be transplanted at a cost of about 6 cents. The trees are finally set out upon the dunes when they are three years old. Besides the conifers mentioned, oak (*Quercus sessiliflora*) and birch are employed as fire guards. It is interesting to note that the heather comes in naturally in the birch plantations, but does not appear in the oak plantations. Alder is planted on low places for the purpose of enriching the land, the nodules upon the roots having the same function as those upon the roots of legumes. Mr. Dahlerup stated that there are in all about thirty-five plantations in Denmark along the west coast of Jutland, one of the largest being this one at Skagen. Concerning the interior plantations in the "heide" region, he said that the preliminary fixation is by means of heather, while the young forest is composed of *Pinus montana* and *Picea excelsa*. The latter is the best tree for the purpose, but it can not be grown successfully directly upon the heather land. It is therefore necessary to plant first *Pinus montana*. This kills the heather and *Picea excelsa* can be made to grow in the shade of the pine. Although *Pinus montana* can be successfully grown, it is inferior to *Picea excelsa* so far as its usefulness for timber purposes is concerned.

GERMANY.

The most extensive work to be found in Europe in the reclamation of sand-dune areas has been done along the north coast of Germany. The coast of the North Sea, and especially the North and East Friesian Islands, are continually subjected to the erosive action of wind and water, which requires not only extensive work in the protection and reclamation of dunes but much in the way of mechanical obstruction.

The coast and harbors are protected in various ways by masonry and piles. Sand-dune works also extend in various places all along the coast of the Baltic Sea, which, however, are fully described in Gerhardt's book, previously mentioned. Therefore, for the purpose of inspecting the methods which are typical of the whole coast, a visit was made to only one of the important sand-dune regions of Germany—the Kurische Nehrung in northeastern Prussia.

This is one of the most wonderful sand spits in the world, consisting of a narrow peninsula which extends northward from the region of Kranz for about 60 miles. To the west lies the open ocean of the Baltic Sea and to the east the bay called the Kurisches Haff. The opening to the bay lies just to the north of this sand spit. On the opposite shore is located the somewhat important town of Memel, and there are three or four towns or villages situated in various places along the peninsula. The strip of land is quite narrow, varying from 1 to 5 miles in width. At one time this peninsula was covered with forests, but later the trees were removed and the region was soon converted into a series of shifting dunes. Besides the necessity for protecting the villages and arable land upon the peninsula it is necessary to prevent the increased encroachment of the sand upon the harbor to the east. For these reasons the Government undertook the reclamation of the whole peninsula.

So much attention is given to this region in Gerhardt's work that it is unnecessary to do more than note a few points in which the methods differ from those used in the Netherlands and in Denmark. In the first place, a long barrier dune, the entire length of the peninsula on the west side, has been produced. This is kept in repair by means of beach grass and the necessary sand fences. The beach grass is planted upon this dune in a much more exact and methodical manner than that seen elsewhere. The surface is first carefully laid off with a line in squares called "quadrats," and the plants are placed with almost mathematical precision. The forest consists for the most part of *Pinus montana*. In the vicinity of Rossitten there are several large wandering dunes which have not been planted. These dunes are indeed hills, being from 200 to 300 feet in height. As the general course of these shifting dunes is from the west toward the east, they will finally disappear in the waters of the Kurisches Haff. For this reason it has been thought inexpedient to make plantations upon them except where it has been necessary to protect villages and other valuable property.

Through the kindness of Prof. Christian Luerssen, who gave a letter of introduction to the dune inspector of this region, the venerable Mr. Epha, a veteran in the service of sand reclamation, every pains was taken to render the inspection of the dunes easy and satisfactory. The success of the work in this region is impressive. The conditions are certainly as adverse as on any of the dune areas along the European coast; yet the vast sandy waste has been converted into a productive forest, which, with a comparatively small amount of attention, can be protected from further encroachment of the ocean.

The cost of holding the sand by planting grass upon the wandering dunes of the Kurische Nehrung is said by Gerhardt to be from 170 to 220 marks[a] per hectare, or $17 to $22 per acre. This includes gathering the grass, transporting it to the plantation, and the setting The gathering costs from 2 to 2.50 marks, while the transportation costs about 2 marks per 100 bundles for distances not exceeding 3 miles and about 3 marks where the distance is 3 to 5 miles. Planting is usually done by the day, the wages paid being 1.30 to 1.80 marks for men and from 1 to 1.20 marks for women. The laborers are mostly women (Pl. VII, fig. 2). According to circumstances the cost of planting 100 bundles may be 3 to 8 marks. Where the grass to be used is obtained in the vicinity by thinning the dense bunches the total cost of planting may be 5 to 10 marks per 100 bundles.

The cost of the brush fences, where this method is used, is about 0.20 mark (5 cents) per running meter. This includes gathering the brush, preparing the stakes, and setting the fence. As the material is obtained from the waste brush in the neighborhood, no charge is estimated for this. The amount of material is at the rate of 0.05 cubic meter per running meter. At this rate one cord of the prepared brush is sufficient to set about 80 yards of fence.

The cost of establishing a forest is given by Gerhardt as 1,200 marks per hectare ($120 per acre). This is the average of ten years' experience upon the Kurische Nehrung and includes items as follows:

	Cost per hectare.	Cost per acre.
	Marks.	*Dollars.*
Fixation of the shifting sand by means of sand or reed hedges	700	70.00
Fertilizer	300	30.00
Preparation of the holes for planting	50	5.00
Planting the young trees, 400 to the hectare	125	12.50
Miscellaneous expenses	25	2.50
Total	1,200	120.00

FRANCE.

The most important dune region in France is that along the southwestern coast from the vicinity of Bordeaux to the Spanish line. Through the courtesy of Mr. Poisson, a botanist in the Jardin des Plantes, a letter of introduction to Mr. Émile Durègne, a civil engineer living in Bordeaux, who has been over the greater part of the dunes

[a] A German mark is equal to 23.8 cents in American money.

in his capacity as surveyor, was provided. Mr. Durègne is very familiar with the whole region and with the methods which have been used to reclaim it, and has published some important papers upon the subject. The particular region visited was a few miles south of Arcachon. This is a part of the general dune system extending from the mouth of the Gironde River to Bayonne. Before this land was reclaimed a considerable portion lying back of the dunes was unfit for agriculture, as it consisted of alternating sand hills and marshes. Since the reclamation the conditions have so changed that the population has very materially increased. A barrier dune, similar to the one found in the Kurische Nehrung, extends all along the coast (Pl. VI, fig. 1). This is held in place in the same manner; that is, by means of beach grass and brush fences. The most marked difference in the method of reclamation is in the fact that a forest was established by sowing the seed. The seed of *Pinus maritima* is sown on the sand in October or November or in the spring during March and April, and the whole is then covered with brush or conifers. The seed soon germinates, and, protected temporarily by the brush, grows into a forest.

The total cost of covering the area with forest, including the planting of the trees and the covering of the land, is about 320 francs per hectare, or about $26 per acre. The grass for planting the barrier dune is dug up by means of a small mattock, and is set with a conical instrument having a horizontal handle. The grass is planted in rows parallel to the course of the dune. Breaches are repaired by means of sand fences (Pl. IV, fig. 2), usually by placing two lines of fence about 6 meters apart and extending above the surface of the sand 60 or 70 centimeters. As soon as these are covered a second line of fence is placed on top. The fence which was used in establishing the original barrier dune was placed about 2 meters high. Where ravines are to be filled with sand it is common to use these fences in a network of squares. Some portions of this protecting dune reach the extraordinary height of 200 feet or even more. There is evidence to show that in former times some of these dunes had encroached upon the inland forest, killed the trees, and then passed over them, as stumps are to be found on the windward side along the shore (Pl. V, fig. 2).

Mr. J. Poisson[a] has described the method used upon the dunes of the Coubre, a peninsula which lies just north of the mouth of the river Gironde. The seed of *Pinus maritima* was sown at the rate of about 5½ pounds to the acre, mixed with one-half pound each of furze, broom, and beach grass. The total cost of covering 2,100 hectares was 766.142 francs, or about $29 per acre.

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[a] Sur la fixation des dunes dans l'ouest et dans le nord de la France. Extrait des Comptes Rendus de l'Association Française pour l'Avancement des Sciences. Paris, 1900.

Mr. John Gifford, who has examined the dune region of the Landes, gives an account[a] of the methods used in the original work of reclamation, which is here appended:

A littoral dune was constructed straight along the shore from the mouth of the Gironde to Bayonne. This dune is the secret of all success in the fixation of shifting sand. It is simply a bank of sand of certain dimensions, with a certain slope suited to the condition of affairs. This protective, or littoral, dune is formed as follows: A double fence is constructed of brush, or of palisades driven in the sand. This stops the sand which comes from the ocean. Soon a ridge of sand forms, equal in height to the fence. A double fence is used, as it gives breadth to the dune and stops the sand which blows through the fence on the ocean side. As soon as a ridge of sand is formed as high as the fence, the old fence is pulled up or a new one built on top, and so on until a dune of the height desired is formed artificially. The proper height of a protective dune is 33 feet. It should slope 25 degrees toward the sea, and may be 60 degrees[b] on the land side. The dune must be at least 300 feet from high-water mark. After the dune has reached the proper size, it is kept in shape by the sea marram (*Psamma arenaria*).[c] This peculiar plant, called gourbet in France, is exclusively used for fixing the sand on the littoral dune. It has long, much-divided rhizomes, and will grow well only when covered with fresh sand. The dune must always be kept in shape. If sand accumulates in any one spot in undue amount, a draft is formed, which may end in a breach of the littoral dune. "Gardes cantonniers" are stationed along the dune to watch it closely, and here and there on this long, straight sand bank groups of men and women may be seen digging up the gourbet in places where it is too thick and planting it where needed. Constantly the dune is watched and mended; the forest, villages, and fields in its lee are dependent upon it, and it in turn is dependent upon the humble but persistent gourbet.

After the formation of the littoral dune comes the work of planting in its lee. The surface of the sand is covered with brush arranged like the slates on a roof, with a shovelful of sand here and there to hold it down. Then the seeds of *Pinus maritima* are sown, with seeds of other plants to shade the young pines, and seeds to attract insectivorous birds. The pines usually come up well and grow quickly, although close to the littoral dune they are gnarled and stunted by the salt winds. Thus the sands are fixed, and, although the forests do not yield a good interest in cash, they are of incalculable value to a large proportion of the people of Gascony; in fact, indirectly, to the whole of France. Fire lanes have been constructed across the dunes, and, thanks to the watchfulness of the guards and the rigid enforcement of laws, fires are almost impossible.

Very little cutting is done in these forests, the revenue coming mainly from the resin industry. Owing to a lack of roads and insufficient means of transportation on these dunes, only the most valuable timber is marketed, after being tapped for resin. If it is desirable to remove a tree, it is bled to death before being cut. All other trees are tapped very carefully, and are in no way injured by the process. In fact, bled timber is considered superior to unbled in France. The Hague method of orcharding is used, a system which does not injure the tree, but gives a resin of better quality and more abundant turpentine. Another article, however, could be written on the French method of turpentine orcharding.

Other industries have started, the people have improved, and the country is more fruitful and beautiful, so that through the agency of trees a new province has been practically added to France.

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[a] The Control and Fixation of Shifting Sands. In the Engineering Magazine, January, 1898.

[b] There is some error here in the angles given for the slope. The windward slope is from 4 degrees to 14 degrees, and the lee slope about 30 degrees.

[c] Another name for beach grass (*Ammophila arenaria*).

SUMMARY.

Extensive and systematic work is done by various governments in Europe for the purpose of reclaiming waste dune areas. The object may be to convert this waste into a productive forest, or to prevent the encroachment of the sand upon valuable property.

The sand is first held in place by some inert covering or a plantation of grass, and afterwards a forest is established by transplanting young trees.

Trees will not grow in the immediate vicinity of the ocean; hence a narrow strip along the coast must be permanently held in place by means of a sand-binding grass.

The best grass for this purpose is beach grass (*Ammophila arenaria*), which grows naturally along the sandy seashores of the North Atlantic coast. The same species grows along the shores of the Great Lakes and on the Atlantic coast of the United States as far south as North Carolina.

The grass is transplanted in rows or squares in autumn or spring. Satisfactory results can not be produced by sowing the seed of this or of other plants directly upon the unprotected sand.

Where heather grows in sufficient abundance this is cut and laid upon the surface of the sand.

The third important method for preventing drifting is the use of sand fences. These consist of rows of rough stakes or pieces of brush driven into the sand and projecting above the surface from 1 to 3 feet. For holding the sand the shorter stakes are placed in squares of 9 to 12 feet, forming a network. For accumulating sand in hollows or repairing breaches in a protecting dune the high fences may be used. Solid fences are not used.

The drifting of the sand having been prevented by one of the above methods, young trees are set out to form the permanent covering of forest. In northern Europe no satisfactory results have been obtained in establishing a forest by sowing the seed, but in southwestern France a forest was produced by sowing the seed of *Pinus maritima* upon the sand and covering it with brush.

The trees used are: In the Netherlands, *Pinus austriaca* and *P. laricio* near the coast, *P. sylvestris* on the interior dunes; Denmark, *Pinus montana* near the coast and *Picea excelsa* (preceded by *Pinus montana*) on interior heath land; Germany, *Pinus montana;* France, *Pinus maritima.*

On the Kurische Nehrung and in other parts of Prussia, and in Gascony, a long barrier dune has been formed artificially to protect the land lying back of it. This is kept in repair by planting beach grass and by the use of sand fences when necessary.

PLATES.

35

DESCRIPTION OF PLATES.

PLATE I. *Frontispiece.* Beach grass (*Ammophila arenaria* Link). Drawing from herbarium specimen.

PLATE II. Fig. 1.—Inland dunes near Barneveld, the Netherlands. In the background the dunes have been covered with heather to prevent drifting and afterwards set out with *Pinus sylvestris*. In the foreground the pines have been planted without a covering of heather, as the sand is here moist enough to prevent its drifting. Fig. 2.—Inland dunes near Barneveld, the Netherlands, showing road in process of construction through the plantations. In the background the dunes are covered with heather. In the foreground is the road, the sand being ridged up with ditches at each side. Upon the sand is placed heather in a thick layer. This prevents the wheels of vehicles from sinking into the loose sand.

PLATE III. Fig. 1.—Inland dunes near Barneveld, the Netherlands, showing a plantation of *Pinus sylvestris* on a covering of heather. The sand is first covered with a layer of cut heather to prevent its drifting. Fig. 2.—Unreclaimed sand dunes near Alkmaar, the Netherlands. In the foreground is a low area partially covered with heather. In the interior such areas furnish the heather, which is cut and laid upon the surface of the sand to prevent its drifting.

PLATE IV. Fig. 1.—Plantation of beach grass upon the dunes near Oxböl, Denmark. This shows how the plantations are made along the lower places and part way up the slopes of the dunes, the tops remaining unplanted. The grass will be planted somewhat higher on the slopes as opportunity permits, but the tops will be denuded of grass to facilitate the removal of the sand by the wind. Fig. 2.—Barrier or protecting dune south of Arcachon, France. To the left beach grass has been planted in rows parallel to the beach. In the center is a sand fence, placed to repair a breach, which is now nearly covered with sand. To the extreme right is the forest in the lee of the dune.

PLATE V. Fig. 1.—Lee slope of a portion of the barrier dune south of Arcachon, France. Since the dune has been fixed on the windward slope, the advance of the sand inland has been very slow, as shown by young trees growing along the slope. Fig. 2.—Unreclaimed sand dunes south of Arcachon, France. The stumps are the remains of a forest which has been covered and again uncovered by an advancing dune.

PLATE VI. Fig 1.—General view of the barrier dune south of Arcachon, France. This dune stretches along the coast from Arcachon to Bayonne, about 75 miles, and protects the forest of *Pinus maritima* in its lee at the right. The ocean is seen at the left. This dune was formed artificially with the help of sand fences and beach grass and is now held in position by the same means. [From a photograph by Mr. É. Durègne.] Fig. 2.—Unreclaimed sand dunes south of Arcachon, France. The sand is drifting badly at this point Here and there a small hillock is held in place by a bunch of beach grass.

PLATE VII. Fig. 1.—Laborers digging beach grass near Alkmaar, in the Netherlands. The instrument used for this purpose here is a spade with a rounded point. The grass is obtained upon the dunes where it is growing naturally, by thinning out the bunches. In the background may be seen the unreclaimed dunes partially covered with vegetation. Fig. 2.—Laborers setting out beach grass upon the barrier dune at Rossitten, on the Kurische Nehrung. At the right is the overseer. The grass is set in squares or "quadrats." The position of the rows is determined quite accurately by stretching a line between two poles, one of which appears in the illustration. One laborer makes the holes with a planting spade, while another sets the grass. At the left may be seen a bundle of the grass ready to be set.

PLATE VIII. Fig. 1.—Protecting the base of a barrier dune by means of two rows of sand fences. Storms had eaten away the face of the dune and the fences are placed to accumulate sand, after which grass will be planted. [From a cut in Gerhardt's Dünenbau.] Fig. 2.—Protecting a road through the dunes, on the Frische Nehrung, Prussia. The road is curved and the slope is held by covering with a layer of reeds and placing poles upon these. [From a cut in Gerhardt's Dünenbau.]

PLATE IX. Fig. 1.—Shifting dunes held by sand fences on the Kurische Nehrung, Prussia. The fences are of brush placed in squares. Nearer the strand the brush is in rows parallel to the beach. [From a cut in Gerhardt's Dünenbau.] Fig. 2.—Shifting dunes held by means of sand fences of reeds, on the Kurische Nehrung, Prussia. Next to the strand the reeds are placed in rows parallel to the beach. Farther up on the dunes they are placed in squares. A roadway passes through at this point. [From a cut in Gerhardt's Dünenbau.]

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FIG. 1.—DUNES HELD BY COVERING OF HEATHER.

FIG. 2.—MAKING A ROAD IN THE DUNES.

FIG. 1.—PINE PLANTATIONS IN COVERING OF HEATHER.

FIG. 2.—HEATHER AMONG THE DUNES.

FIG. 1.—BEACH GRASS PLANTATION ALONG BASE OF DUNES.

FIG. 2.—BEACH GRASS AND SAND FENCE ON BARRIER DUNE.

FIG. 1.—LEE SLOPE OF BARRIER DUNE.

FIG. 2.—REMAINS OF ONCE BURIED FOREST.

FIG. 1.—GENERAL VIEW OF BARRIER DUNE.

FIG. 2.—UNRECLAIMED SHIFTING DUNE.

FIG. 1.—DIGGING BEACH GRASS FOR PLANTING.

FIG. 2.—TRANSPLANTING BEACH GRASS.

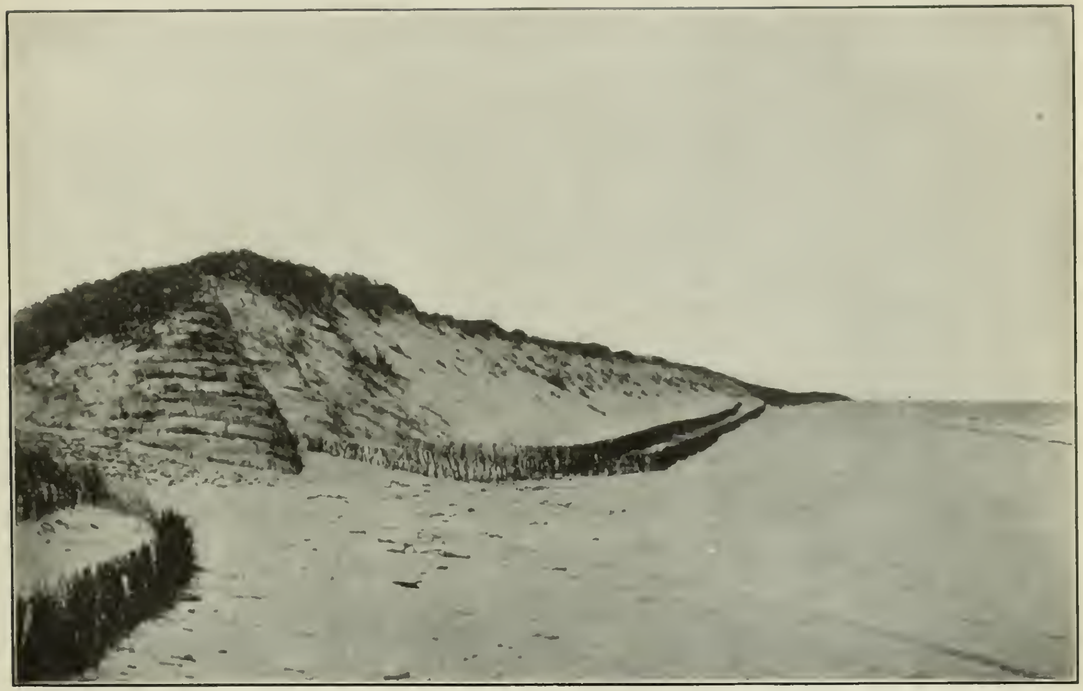

FIG. 1.—SAND FENCES PROTECTING BASE OF DUNE.

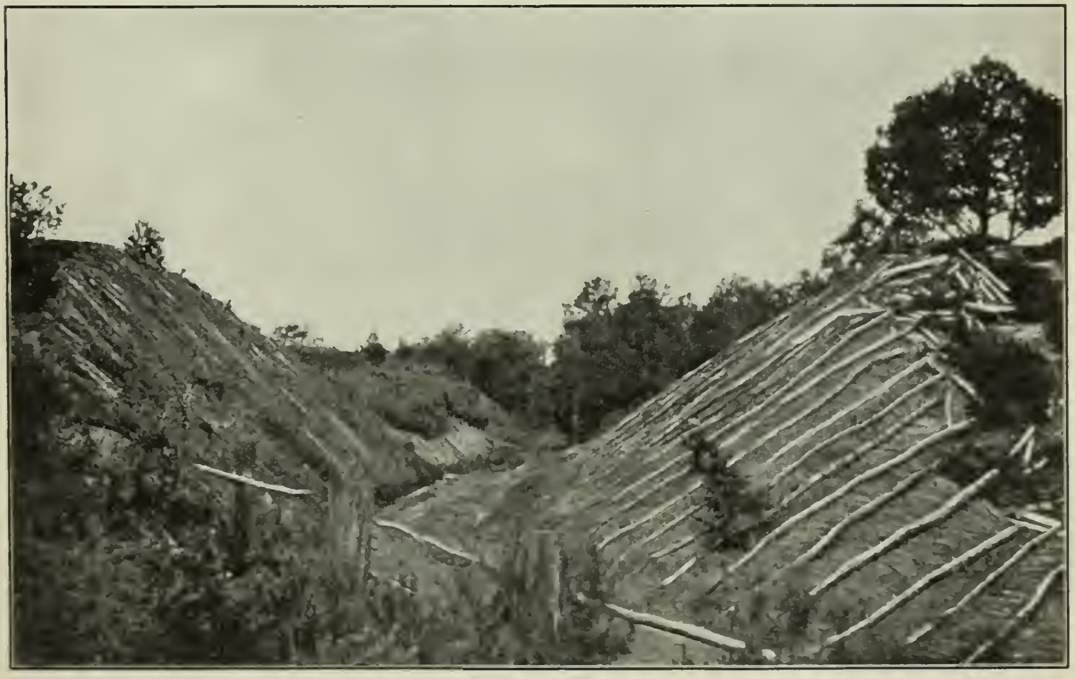

FIG. 2.—PROTECTING A ROAD THROUGH THE DUNES.

FIG. 1.—SHIFTING DUNES HELD BY BRUSH FENCES.

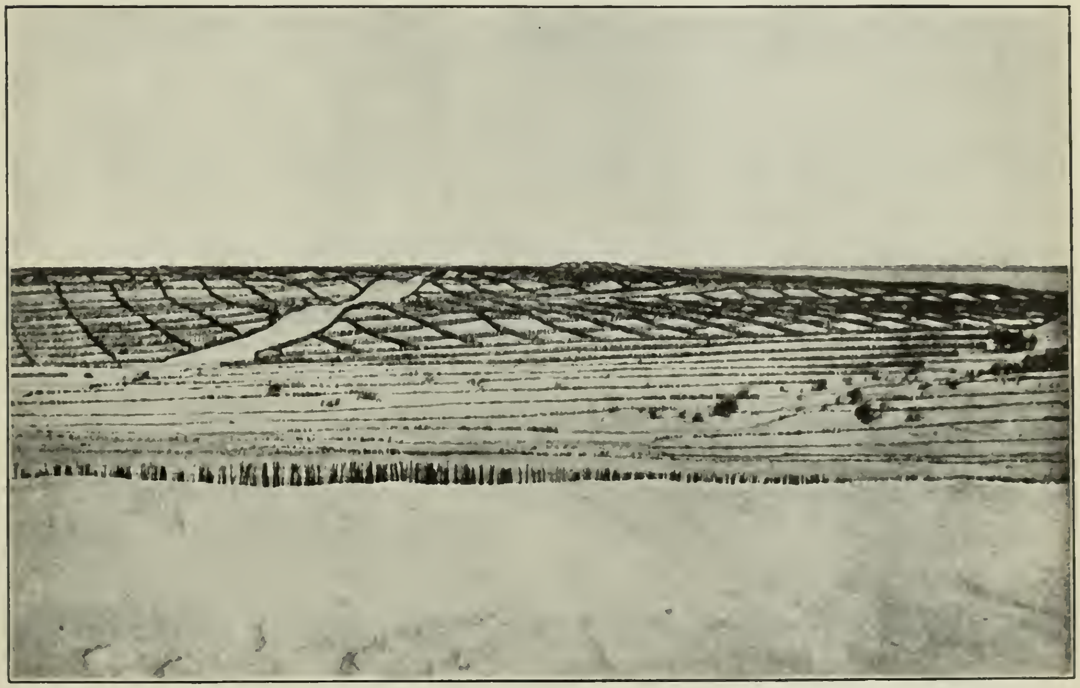

FIG. 2.—SHIFTING DUNE HELD BY REED FENCES.

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B. T. GALLOWAY, *Chief of Bureau.*

THE

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BY

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3

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., March 26, 1904.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 58 of the series of this Bureau the accompanying technical paper entitled "The Vitality and Germination of Seeds."

This paper was prepared by J. W. T. Duvel, Assistant in the Seed Laboratory, and has been submitted by the Botanist with a view to publication.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

5

PREFACE.

Because of variation in the amount and quality of each year's crop it is frequently necessary for seedsmen to carry over large quantities of seeds from one year to another. Such seeds often lose their ability to germinate, and either are a loss to the seedsman or, if they are marketed, cause still more serious losses to those who plant them. Since 1899 Mr. Duvel has been engaged in a general investigation of the causes affecting the vitality of seeds, with special reference to the conditions under which they are stored commercially. This investigation was begun in 1899 under the Dexter M. Ferry Botanical Fellowship at the University of Michigan, and since September 1, 1902, it has been continued by the United States Department of Agriculture. An account of the whole study is presented herewith.

The general method pursued has been to store seeds experimentally under all sorts of conditions, and afterward to ascertain the exact percentage of germination. It is now possible to speak with precision of the extent of damage caused by careless methods of storage, to express in actual figures the greater liability of seeds to loss of vitality under the warm humid conditions existing in the South Atlantic and Gulf States than under colder and drier conditions, and to demonstrate the utility of storing seeds, when they must be kept in a humid climate, in moisture-proof packages. A further investigation, i. e., of the extent to which vitality may be preserved by means of commercial cold storage, is now in progress.

FREDERICK V. COVILLE,
Botanist.

OFFICE OF BOTANICAL INVESTIGATIONS AND EXPERIMENTS,
Washington, D. C., December 5, 1903.

CONTENTS.

ILLUSTRATIONS.

TEXT FIGURES.

THE VITALITY AND GERMINATION OF SEEDS.

INTRODUCTION.

It has long been known that the conditions under which plants are grown and the degree of maturity at the time of harvesting are factors which play an important part in the life of seeds. But, granting that seeds are of strong vitality at the time of harvesting, there remain to be considered the methods of gathering and curing, the water content of the seed at the time of storing, the methods of storage, the humidity and temperature of the surrounding atmosphere, the composition of the seed, the nature of the seed coats, activities within the cells, and numerous other factors which play important parts in the life of the seed.

The conditions necessary for the successful germination of a seed of good vitality and the chemical transformations accompanying these early stages of development have received considerable attention from numerous investigators. These changes and conditions are fairly well understood for many of our common seeds. However, several important facts still remain unexplained, and our knowledge will not be complete until each and every species has been carefully studied.

On the other hand, the conditions influencing the vitality of seeds as commercially handled are but little understood and have been almost wholly neglected in research work. Likewise, but little attention has been given to the complex chemical and physical changes which take place in mature seed during the slow process of devitalization. It was in order to determine some of these factors that the work described in these pages was begun, and the results are thus of considerable practical value as well as of scientific importance. The present paper treats chiefly of the conditions influencing the vitality and germination of seeds when subjected to such methods of treatment as are generally met with in the ordinary handling of seed. Particular attention has been given to the effect of climate, moisture, and temperature on vitality, supplemented with a discussion of the changes taking place in mature seeds, especially the respiratory activities and the part played by enzymes.

The results of the above experiments have suggested improved methods of storing and shipping seeds so as to prolong their vitality and also to secure the production of more vigorous seedlings.

The work for the present paper was begun in 1899 at the University of Michigan and was continued for three consecutive years while the writer held the Dexter M. Ferry Botanical Fellowship in that institution. During this time the investigation was under the direction of Prof. V. M. Spalding, Ph.D., and Dr. F. C. Newcombe, who showed great interest in it and gave valuable suggestions as the work progressed, at the same time placing the facilities of the laboratory and of the library at the disposal of the writer. Since September 1, 1902, the work has been continued in the Seed Laboratory of the U. S. Department of Agriculture. Valuable assistance in storing seeds was rendered by Prof. C. W. Burkett, at Durham, N. H.; Mr. E. E. Smith, Wagoner, Ind. T.; Prof. W. R. Dodson, Baton Rouge, La.; Prof. F. S. Earle, Auburn, Ala.; Zimmer Brothers, Mobile, Ala.; Prof. H. H. Hume, Lake City, Fla., and Prof. Charles B. Scott, San Juan, Porto Rico.

MATERIALS AND METHODS.

SEEDS.

For these experiments thirteen different samples of seeds were used, being so selected as to include representatives of ten different families and twelve genera and species, as follows:

Poaceæ—*Zea mays*, sweet corn (two samples).

Liliaceæ—*Allium cepa* L., onion.

Brassicaceæ—*Brassica oleracea* L., cabbage; *Raphanus sativus* L., radish.

Apiaceæ—*Daucus carota* L., carrot.

Fabaceæ—*Pisum sativum* L., pea; *Phaseolus vulgaris* L., bean.

Violaceæ—*Viola tricolor* L., pansy.

Polemoniaceæ—*Phlox drummondii* Hook, phlox.

Solanaceæ—*Lycopersicon lycopersicum* (L.) Karst., tomato.

Cucurbitaceæ—*Citrullus citrullus* (L.) Karst., watermelon.

Asteraceæ—*Lactuca sativa* L., lettuce.

It will thus be seen that the seeds used cover a wide range as to family characteristics, as well as size, structure, and composition of seed. Likewise they are all from plants of the garden or field that have undergone a high degree of cultivation, thus enabling the seeds to withstand more or less variation as to conditions of vitality and growth.

All seeds used throughout these experiments were provided by D. M. Ferry & Co., of Detroit, Mich., and the seed furnished was of strong vitality and of known age and origin. The corn "A" (Minnesota Sweet), onion (Yellow Danvers), pea (D. M. Ferry Extra Early), bean (Yellow Kidney, Six Weeks), tomato (Dwarf Champion), and the watermelon (Sweet Mountain) were grown in Michigan. The corn "B" (Minnesota Sweet), was grown in Nebraska, the cabbage (Winningstedt), in Washington, and the lettuce (Black-Seeded Simpson), in California, while the radish (Early Scarlet Turnip-Rooted), carrot (Chantenay), pansy (mixed), and *Phlox drummondii* (mixed) were grown in France. The seed was all of the harvest of 1899 and was received at the botanical laboratory of the University of Michigan on January 27, 1900.

On January 30, 1900, germination tests were made, showing the vitality of the seeds to be as follows:

Vitality of seeds tested January 30, 1900.

Kind of seed.	Percentage of germination.	Kind of seed.	Percentage of germination.
Bean	100	Pansy	69.5
Cabbage	93	Pea	97
Carrot	83.5	Phlox	78
Corn, sweet, "A"	94	Radish	81
Corn, sweet, "B"	88	Tomato	98
Lettuce	87.5	Watermelon	99
Onion	98		

GERMINATION TESTS AND APPARATUS.

In the preliminary work several methods of testing were tried, but as none proved as serviceable as the "Geneva tester," this apparatus was adopted for all subsequent tests as recorded in the following pages. The detailed construction of this tester need not be described, for it is simple and quite familiar to all. However, some modifications were made in the preparation of the apparatus, and some precautions taken in the manipulation, which have proved to be of much value. The brass wires originally and ordinarily used to support the folds of cloth were replaced by glass rods of 6 to 7 mm. diameter. Rods of this size are much heavier than is necessary to support the folds of cloth, but the chief advantage in having rods of large diameter is that in case of the germination of large seeds the folds can be drawn near together at the top and still have sufficient space within the fold for the seeds. On the other hand, in the germination of small seeds that require considerable quantities of air, the folds can be closed at the top by bringing the rods together, thus insuring more uniform conditions throughout the fold and at the same time leaving sufficient space above the seeds for an abundant supply of air. The chief advantage in substituting glass rods for brass wires is in removing the possible source of injury resulting from the poisonous action of the dissolved copper.

Another error frequently, if not always, made in using such a tester is in allowing the ends of the cloths, or sometimes the bottoms of the folds, to dip into water in the pan. This should never be permitted, for in that way seeds are kept too moist, especially near the ends of the folds. Likewise such methods give an opportunity for the transmission of dissolved copper and a resulting injury to the seeds. For this same reason the strips of cloth should be made sufficiently narrow not to come into contact with the sides of the pan.

Much better results are obtained if the seeds, before being placed in the germinator, are soaked in water for several hours, the length of time depending on the power of absorption of the seeds. In these experiments the seeds were always soaked in distilled water for twelve or fifteen hours before transferring them to the germinator. This preliminary soaking gives a more speedy germination, which is always advantageous, especially in making comparative germination tests. In order to supply the requisite amount of moisture for subsequent growth, the cloths were first uniformly and completely wet with distilled water; moreover much care was taken to see that there was only a very small quantity of water in the bottom of the pan. In case of seeds that germinate readily, such as cabbage, lettuce, and onion, it is necessary that all surface water be removed from the bottom of the germinator if good results are desired. The pan then being covered with a glass plate, it is seldom necessary to increase the amount of moisture, for seeds when once soaked need only to be kept slightly moist and not wet, as must necessarily be true if the ends of the cloths or bottoms of the folds dip into the water. After soaking, the water in the seeds and cloths is ample for the completion of most germination tests. However, in an occasional test the seeds may become slightly dry, which happens when the cover is kept off the pan for a considerable time while counting germinated seeds. In such cases the remedy is to pour a small quantity of water in the bottom of the pan, or in extreme cases to moisten the folds with a fine spray.

If the above modifications be adopted and the necessary precautions taken, many of the objections frequently made to the Geneva tester will be removed and the difficulties will be overcome; at least it is a most excellent method of testing seeds where comparative results are especially desired. It must also be borne in mind that the Canton flannel (which is generally used in making the pockets) should always be of the best grade and should never be used a second time without being thoroughly cleaned and sterilized.

In selecting samples for germination the impurities and the immature seeds were first removed. The samples for test were then made up of the remaining large and small seed. For the most part 200 seeds were taken for a test, but with the larger seeds—corn, pea, bean, and watermelon—100 seeds were usually used. In all cases where any irregularity was apparent, tests were repeated. The controls are based on the results of several duplicate tests.

All germination tests were made in a dark room where the temperature could be comparatively well regulated and was maintained nearly constant throughout most tests. Germinated seeds were removed daily during early stages of the tests and a complete record of the number germinating each day was kept. This is of value in seed testing, because the germinative energy of a seed tells much as to its vitality. If seeds have a high vitality, the germinative energy will be very strong, i. e., germination will take place rapidly, giving rise to strong and vigorous seedlings; but if the seeds are of very low vitality, there will be a corresponding retardation in germination, giving rise to weak seedlings, i. e., showing a low germinative energy. In most cases throughout this work only the final percentages of germination are tabulated.

EFFECT OF CLIMATIC CONDITIONS ON THE VITALITY OF SEEDS.

It has long since been known that seeds under ordinary conditions lose their power of germination after the lapse of a few years, or in some cases within a few weeks or months. Many investigators have also learned that the rapidity with which seeds lose their vitality, when stored under ordinary conditions, varies greatly with the section of the country in which such seeds are kept. This loss in vitality is especially marked in the case of seeds stored in places of relatively high humidity. The rapid deterioration of seeds in localities having a humid atmosphere has become a source of much embarrassment to seedsmen, for they have experienced many difficulties in shipping seed to such places. This is especially marked in the case of seeds sent to growers or dealers in the vicinity of the Gulf of Mexico. Gardeners and planters in that part of the United States are continually complaining about the nonviable seeds sent out by seedsmen. Some growers have learned how to guard against this difficulty to a certain extent. Zimmer Brothers, of Mobile, Ala., wrote, on February 28, 1900, concerning this matter, as follows:

> During thirty years' experience in market gardening, we have learned that seeds of many hardy plants will not keep in our climate, and when ordering we so time our order that we can plant the seeds as soon as received. If such be impossible, we are very careful to keep the original package unopened until conditions are favorable for planting. If we find it necessary to keep seeds of hardy plants for some months, we put them up on arrival in dry bottles, put on top a bit of cotton saturated with chloroform and cork tightly. We have kept, in that way, cauliflower seed satisfactorily for twelve months. At the shore seeds keep very badly; one-half mile back they do much better. As a rule seeds of tender plants give but little trouble.

As far as has been ascertained, no definite experiments have been made with these points in view, and especially with the idea of determining the cause or causes of this deterioration of vital energy. In order to obtain reliable data on these points, a series of experiments was undertaken in February, 1900, to determine how seeds are affected when distributed to different parts of the United States and submitted to the free influence of various climates. Likewise at the various points where tests were made the seeds were subjected to different treatments.

The places selected for these tests were San Juan, P. R., Lake City, Fla., Mobile, Ala., Auburn, Ala., Baton Rouge, La., Wagoner, Ind. T., Durham, N. H., and Ann Arbor, Mich.

A sample of each species of seed was put up separately in double manila coin envelopes and in closely corked bottles. Duplicate sets of each series were then subjected at each of the above-named places to the following conditions:

Trade conditions.—Conditions similar to those in which seeds are kept when offered for sale by retail dealers, the seed being more or less exposed to meteorological changes and subjected to natural variations in temperature and humidity. For the most part the seeds were in rooms that were never heated.

Dry rooms.—Rooms in the interior of buildings which were artificially heated during cold weather, and where the quantity of moisture was relatively small and the temperature comparatively constant.

Basements.—Rooms where the temperature was comparatively low and uniform, and the relative humidity of the surrounding air was much higher than in "trade conditions" and "dry rooms."

These conditions varied in the different places at which tests were made, and a more detailed description will be given when the results of the germination tests are discussed.

For the first part of this paper, treating of the influence of climate on vitality, none of the seeds need to be considered save those prepared in paper packages and kept under trade conditions, these coming more nearly under the direct action of the surrounding atmosphere. A sample of each kind of seed was put up in a manila (No. 2) coin envelope, and each of these packages was then inserted in a second (No. 3) coin envelope. Duplicate samples of every kind of seed were sent to the various testing places, where they were subjected to trade conditions. At San Juan the packages of seeds were kept in an open room, being subjected to the full action of the atmosphere but protected from the direct rays of the sun and from rain. At Lake City the packages were kept in a one-story frame building which was not artificially heated and the doors of which were open the greater portion of the time. At Mobile the packages of seeds were stored in a comparatively open attic of a private dwelling. At Auburn the seeds were stored in a greenhouse office, with the doors frequently standing open. At Baton Rouge the packages were kept on a shelf in a grocery store, the doors of which were closed only during the night. At Wagoner the conditions were very similar to those of Baton Rouge, save that the packages of seeds were kept in a drug store. At Durham the seeds were kept over a door at the entrance of one of the college buildings. This door opens into a hall which communicates with the offices, chemical laboratory, and the basement. At Ann Arbor the seeds were stored in the botanical laboratory, with slightly varying conditions, they being near a window which was frequently open during the summer, and at irregular intervals during the early part of the summer the packages were placed in the window so as to receive the direct rays of the sun. The seeds stored at Ann Arbor served partially as controls for those sent to the various other places, and, in addition to the last-named series, seeds from the original packages, as received from D. M. Ferry & Co., were kept in a dry and comparatively cool closet on the fourth floor of the botanical laboratory. These seeds served as checks for the complete set of experiments, and are designated throughout this paper as "Control."

The samples were sent out to the above-named places in February, 1900. The first complete set was returned in June, or early July, of that year. The second complete set was allowed to remain throughout the entire summer, and was returned in October and early November of the same year. The average time of treatment for the two series of experiments was 128 and 251 days respectively. When the seeds were returned, germination tests were made as soon as possible. The length of time that the seeds were in the various places and the vitality as shown by the germination tests are given in Tables I and II. In both tables the columns from left to right, beginning with Mobile, Ala., are in the order of the degree to which the seeds were injured.

TABLE I.—*Effect of climate on vitality, as shown by percentage of germination—first test.*

Kind of seed.	Control.	Mobile, Ala., Feb. 17 to July 7. 140 days.	San Juan, P. R., Feb. 9 to June 20. 129 days.	Baton Rouge, La., Feb. 17 to June 18. 121 days.	Wagoner, Ind. T., Feb. 17 to June 23. 126 days.	Lake City, Fla., Feb. 9 to June 18. 129 days.	Durham, N. H., Feb. 17 to July 14. 147 days.	Auburn, Ala., Feb. 17 to May 30. 102 days.	Ann Arbor, Mich.
Corn, sweet, "A"	95.9	80.0	96.0	96.0	96.0	94.0	100.0	96.0	100.0
Corn, sweet, "B"	89.3	48.0	72.0	80.0	70.0	86.0	89.3	88.0	92.0
Onion	95.8	7.0	84.5	90.0	93.5	95.0	96.5	96.0	95.0
Cabbage	92.7	61.5	82.0	88.5	83.5	89.5	93.0	91.0	96.0
Radish	83.6	58.5	64.0	77.5	77.5	79.0	80.6	75.5	82.5
Carrot	83.3	59.0	71.5	74.3	81.5	76.5	78.0	84.5	76.0
Pea	95.3	69.2	94.0	94.0	98.0	96.0	98.0	93.3	90.0
Bean	98.7	58.0	100.0	96.0	96.0	98.0	100.0	98.0	98.0
Pansy	63.0	3.0	20.0	28.5	48.5	44.5	55.5	57.5	53.5
Phlox drummondii	69.0	0.5	23.5	47.5	50.5	41.5	67.0	61.5	67.0
Tomato	95.5	90.0	94.0	91.5	96.5	94.0	94.5	95.0	89.0
Watermelon	98.3	98.0	96.0	100.0	98.0	98.0	98.0	94.0	100.0
Lettuce	81.6	63.0	79.0	82.5	78.0	87.0	82.0	86.5	82.0
Average of all seeds	87.79	53.59	75.12	80.48	82.12	83.00	85.57	85.70	86.23

From Table I it will be seen that the loss of vitality in the case of seeds stored at Mobile was much greater than in those stored at any of the other places. The greatest loss in the samples tested was in the phlox, where the germination was only 0.5 per cent, or a loss in vitality of 99.3 per cent as compared with the control. These results were closely followed by a loss in vitality of 95.9 and 92.7 per cent for the pansy and onion seed, respectively. The percentages of germination in the other cases, except the "B" sweet corn, pea, and bean, were sufficient to have produced a fair stand, i. e., if we consider that far too many seeds are usually sown. But a decrease in the percentage of germination means seeds of a low germinative energy. Even though the final percentage of germination be up to standard, the retardation may be of vital importance. A very good example of the retardation in germination is shown in the tests of the watermelon seeds. In the control sample 94 per cent of the seed germinated in 47½ hours, while the seed returned from Mobile showed, during the same time, a germination of only 12 per cent; yet the difference in the final germination was only 0.3 per cent in favor of the control. Likewise the seed returned from San Juan germinated only 20 per cent in 47½ hours, the final germination being 96 per cent or only 2.3 per cent lower than the control.

Many similar cases might be mentioned in which the final percentages of germination, as shown by the first set of tests given in Table I, represent a loss such as might be justly considered well within the limits of normal variation. However, that all of the samples of seed were injured as a result of the unfavorable climatic conditions is shown in the second set of tests set forth in Table II. In the latter case the seeds remained in the various places nearly twice as long as those used for the first test.

TABLE II.—*Effect of climate on vitality as shown by percentage of germination—second test.*

Kind of seed.	Control.	Mobile, Ala., Feb. 17 to Nov. 6. 262 days.	Baton Rouge, La., Feb. 17 to Oct. 22. 247 days.	Durham, N. H., Feb. 17 to Oct. 26. 251 days.	Auburn, Ala., Feb. 17 to Nov. 19. 275 days.	Lake City, Fla., Feb. 9 to Oct. 1. 231 days.	Wagoner, Ind. T., Feb. 17 to Oct. 13. 238 days.	San Juan, P. R., Feb. 9 to June 20. 129 days.	Ann Arbor, Mich.
Corn, sweet, "A"	94.5	20.0	88.0	96.0	88.0	92.0	90.0	92.0	98.0
Corn, sweet, "B"	88.5	12.0	51.2	82.0	62.0	77.0	78.0	78.0	80.0
Onion	97.0	0.0	0.5	0.0	12.0	16.5	24.5	50.0	97.5
Cabbage	92.4	17.0	25.5	12.0	61.5	63.5	70.5	76.2	91.0
Radish	78.8	51.0	55.5	59.5	63.0	58.5	60.5	62.0	77.5
Carrot	82.0	8.5	25.0	2.0	36.0	43.5	49.0	48.5	86.0
Pea	95.7	44.0	80.0	94.0	97.9	86.5	80.0	98.0	98.0
Bean	98.7	0.0	60.0	78.0	56.0	84.0	82.0	96.0	100.0
Pansy	53.0	0.0	0.0	0.0	2.0	1.5	7.5	6.5	46.5
Phlox drummondii	53.9	0.0	0.0	0.5	1.0	2.5	5.5	11.5	40.0
Tomato	97.5	79.5	96.0	87.0	94.0	94.0	94.0	96.5	98.0
Watermelon	99.0	64.0	92.0	82.0	86.0	92.0	94.0	88.0	96.0
Lettuce	92.3	20.0	84.5	88.5	86.0	85.0	82.0	83.5	92.5
Average of all seeds	86.77	24.31	50.86	52.42	57.34	61.27	62.11	68.21	84.58

Even though the columns in both Tables I and II are arranged in the order of the loss in vitality as shown by the averages of the various places, it will at once be seen that the relative degree of injury did not remain the same throughout the experiment. This is probably best explained by a variation in the climatic influences. It is evident that in some of the places where seeds were stored the effects were more deleterious during the time between the first and second tests than they were during the first period of storage of 128 days. The results given in Table II are of the greater value in showing the relative merits of the different localities as places for storing seeds, extending as they do over a longer period of time.

As a result of the second series of tests it was found that the average percentage of germination of all of the samples of seed that were stored in trade conditions at Mobile for 262 days was only 24.31 per cent. This is equivalent to a loss in vitality of 71.98 per cent as compared with the average percentage of germination of the control samples, the average germination of the controls being 86.77 per cent. The pansy, phlox, onion, and beans stored at Mobile wholly lost their power of germination. The tomato seed, which proved to be the most resistant to unfavorable conditions, gave a germination of 79.5 per cent, or a loss in vitality of 18.46 per cent, as compared with the control sample, which germinated 97.5 per cent. The degree of deterioration in the seeds stored at the other places was much less marked than for those stored at Mobile. The loss in vitality was only 41.39 per cent in the seeds returned from Baton Rouge. The results from the seeds which were stored at Durham, Auburn, Lake City, Wagoner, and San Juan differed but little from those from Baton Rouge. The relative losses in vitality are in the order given. The seeds kept in the packages which were stored under trade conditions in the laboratory at the University of Michigan showed a loss in vitality of only 2.52 per cent as compared with the control, the seeds of which were stored in a cool, dry closet on the fourth floor of the botanical laboratory. Ordinarily a loss of 2.52 per cent would be considered as a normal variation due to sampling and testing, and such was probably true in these two sets, with the exception of the greater deterioration of the phlox, pansy, and "B" sweet corn, which were undoubtedly injured by the unfavorable trade conditions, as repeated tests have shown.

From Table II it will also be seen that the "A" sweet corn, peas, tomato, and watermelon, with the exception of those returned from Mobile, show a fair percentage of germination. In some cases the final percentages of germination were even higher than the controls; but, as previously stated, the final germination is not always a good criterion for the determination of vitality, it being necessary to consider the germinative energy as a basis for comparison. In order to show this more fully some of the detailed results are herewith given in Table III. These results show to a good advantage the degree to which germination has been retarded.

TABLE III. *Retardation in germination due to injury caused by unfavorable climatic conditions.*

Place where seeds were kept.	Corn "A."		Peas.		Watermelon.		Tomato.		
	Germination at end of 64 hours.	Final germination.	Germination at end of 40 hours.	Final germination.	Germination at end of 84 hours.	Final germination.	Germination at end of 83 hours.	Germination at end of 107 hours.	Final germination.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Control	84.3	94.5	79.6	95.7	98.0	99.0	78.0	92.7	97.5
Mobile, Ala	4.0	20.0	[a]21.0	41.0	0.0	61.0	1.5	12.5	79.5
San Juan, P. R	64.0	92.0	60.0	98.0	12.0	88.0	38.5	78.0	96.5
Baton Rouge, La	50.0	88.0	36.0	80.0	0.0	92.0	9.0	56.0	96.0
Wagoner, Ind. T	64.0	90.0	36.0	80.0	2.0	94.0	40.0	81.5	94.0
Lake City, Fla	68.0	92.0	50.0	86.0	0.0	92.0	16.5	65.0	94.0
Durham, N. H	86.0	96.0	54.0	94.0	0.0	82.0	0.5	5.5	87.0
Auburn, Ala	80.0	88.0	[a]93.7	97.9	22.0	86.0	59.0	75.5	94.0
Ann Arbor, Mich	82.0	98.0	82.0	98.0	91.0	96.0	75.5	91.0	98.5

[a] After 62 hours.

In order that the results of Tables I and II may be more readily and fully comprehended, it has been deemed advisable to summarize them in another table. For this purpose the average percentages of germination of all of the different samples of seed have been determined for each of the different places. From these average percentages of germination the deterioration in vitality, as shown by both the first and second tests as given in Tables I and II, have been calculated, the germination of the controls serving as a basis for comparison. These results furnish more trustworthy data as to the relative merits of the different localities as places for storing seeds. Likewise the percentages of deterioration between the time of the first and the second tests are shown in Table IV.

TABLE IV.—*Average percentages of germination of all seeds kept at the various places, their deviations from the controls, and the increased percentages of loss in the second series of tests.*

Place of storage.	Average germination of all seeds used in experiments.		Deterioration in vitality as compared with controls.		Deterioration in vitality between first and second tests.
	First test.	Second test.	First test.	Second test.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Control	87.79	86.77	....	....	1.16
Mobile, Ala	53.59	24.31	38.95	71.98	54.64
San Juan, P. R	75.12	68.21 [a]45.18	14.31	21.39 [a]47.93	9.20 [a]39.86
Baton Rouge, La	80.48	50.86	8.32	41.39	36.81
Durham, N. H	85.57	52.42	2.52	39.58	38.74
Auburn, Ala	85.70	57.34	2.38	33.91	33.10
Lake City, Fla	83.00	61.27	5.45	29.38	26.18
Wagoner, Ind. T	82.12	62.11	6.45	28.41	24.37
Ann Arbor, Mich	86.23	84.58	1.77	2.52	1.91

[a] Calculated results.

In Table IV the results are arranged in the order of the loss in vitality as shown by the second tests. However, a few words of explanation will be necessary, especially concerning the loss at San Juan. In the first place, the seeds were kept at San Juan only 131 days[a] during the early part of the summer, while during the most critical period, June 20 to November 6, they were in the botanical laboratory of the University of Michigan. Those marked Mobile, Ala., were, during the entire time, 262 days, under the influence of the warm, moist climate of the Gulf of Mexico. The seeds kept at other places can well be compared with those from Mobile, the time being approximately the same. The average loss as shown by the second tests was 3.35 times greater than the loss in the first test, which by calculation would bring San Juan next below Mobile, with a loss of vital energy in the seeds equal to 47.93 per cent. But more data are necessary before such a gradation of injurious climatic influences can be established.

Table IV, however, brings out another interesting point, as shown by comparing the results of the first and second tests at San Juan and Mobile. In the first test the loss in vitality of the seeds from Mobile was 38.95 per cent, while the seeds returned from San Juan showed a loss of only 14.31 per cent as compared with 71.98 and 21.39 per cent, respectively, as shown in Table II. The degree to which the seeds were injured while they were stored in San Juan was such that they continued to deteriorate much more rapidly than the control sample. This deterioration was most marked in the case of the pansy seed, the germination of the first test being 20 per cent and that of the second test only 6.5 per cent, showing a loss in vitality of 68.2 per cent and 87.7 per cent, respectively. Thus when seeds are once placed in conditions unfavorable for the preservation of their vitality for a sufficient length of time to cause some injury, this injury will always be manifest and cause a premature death of the seeds even though they afterwards be removed to more favorable conditions.

Seeds of strong vitality can withstand greater changes in conditions than seeds of low vitality without any marked deterioration. Throughout these experiments a wide difference has been observed between the "A" sweet corn and the "B" sweet corn. The original tests made January 30, 1900, at the time the seeds were received, showed a germination of 94 per cent for the "A" sample and 88 per cent for the "B" sample of corn. The control tests, made in November, 1900, showed a germination 0.5 per cent higher in each case; but the average loss in vitality of the two samples of seed kept at the various places was 12.17 per cent for the "A" sample and 26.10 per cent for the "B" sample. As with the pansy and the phlox these samples showed that

[a] The number of days here given for San Juan is not absolutely correct. The time was reckoned from the date the seeds were sent from the laboratory until they were received in return.

the stronger the vitality of the original sample of seed the more harsh treatment can be undergone without being injured. Strong vitality implies long life as well as vigorous seedlings.

Another very important factor to be considered in the handling of seeds is the relative resistance of seeds of various species to adverse conditions. Certain seeds under one set of conditions may retain their vitality exceedingly well, while seeds of other species of plants under identical conditions may be killed in a comparatively short time. For this reason no general rule can be laid down for the preservation of seeds. Table V shows the varying degrees of deterioration of the different species of seeds used in the experiments.

TABLE V. —*Different degrees of deterioration of various kinds of seeds.*

Kind of seed.	First test.			Second test.		
	Germination of control.	Average germination from the various places.	Deterioration in vitality as compared with the control samples.	Germination of control.	Average germination from the various places.	Deterioration in vitality as compared with the control samples.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Tomato	95.5	93.06	2.55	97.5	92.43	5.20
Pea	95.3	91.56	3.92	95.7	84.80	11.39
Corn, sweet, "A"	95.9	94.75	1.20	94.5	83.00	12.17
Watermelon	98.3	97.75	.57	99.0	86.62	12.51
Lettuce	81.6	80.00	1.96	92.3	77.75	15.77
Radish	83.6	74.38	11.02	78.8	60.93	22.67
Corn, sweet, "B"	89.3	78.16	12.47	88.5	65.40	26.10
Bean	98.7	93.00	5.76	98.7	69.50	29.58
Cabbage	92.7	86.00	7.22	92.4	52.15	43.56
Carrot	83.3	75.16	9.77	82.0	37.81	53.89
Onion	95.8	82.18	15.26	97.0	25.12	74.10
Pansy	63.0	38.87	38.33	53.0	8.00	84.90
Phlox drummondii	69.0	44.87	34.97	53.9	7.62	85.85

In the above table the list of seeds is arranged in the order of their power to withstand the action of diverse climatic conditions, as shown by the results of the second test, given in Table II. Tomato seeds were found to be the most resistant, the control sample germinating 97.5 per cent. The average germination of the samples of tomato seed kept at the various places was 92.43 per cent, or a loss in vitality of only 5.20 per cent. The seed showing the next least injury was the peas, with a deterioration of 11.39 per cent. The phlox, which was the most affected by the unfavorable conditions, germinated only 7.62 per cent, thus showing a loss in vitality of 85.85 per cent.

It is also interesting to note that the order, as shown by the second series of tests, is quite different from that of the first. This lack of uniformity increases the difficulties that must be overcome before the causes of the loss of vitality in seeds can be fully comprehended. Were all seeds affected in the same way when subjected to identical conditions, the order should have remained the same throughout, but the wide variation in atmospheric changes affects different seeds so very differently that no uniformity of results can be secured. For example, the conditions prevailing from February until June were much more disastrous to the vitality of the tomato and pea than to the "A" sweet corn, watermelon, and lettuce, while the conditions existing from June to November were more injurious to the "A" sweet corn, watermelon, and lettuce. An examination of the table will show other results of a similar nature. During the earlier stages of devitalization seeds undergo a gradual deterioration in vitality, but after reaching a certain stage in their decline there is a comparatively sudden falling off, and seeds, except perhaps a few of the most persistent, soon cease to show any power of germination. Such factors as these must be taken into account in determining the relative length of time that different kinds of seed will retain their vitality. But as yet sufficient information is lacking in order to make any trustworthy attempt to classify seeds in respect to their viable periods when subjected to different conditions. Numerous experiments are now under way, with the hope of furnishing a basis for such a classification.

In order to obtain more data as to the influence of climate upon vitality additional samples of seed were sent to Mobile and Baton Rouge, where they were stored under the same trade conditions as for the former experiment. For these tests only cabbage, lettuce, and onion seeds, put up in envelopes, as for the previous tests, were used. The different packages of seed, placed in paper boxes from which they were not removed, were sent from the laboratory on May 20, 1901, and were returned November 26, 1901, the total time of storage being 190 days. The results of these tests are shown in Table VI, and are even more striking than those of the former tests shown in Tables I and II.

TABLE VI.—*Relative merits of Mobile, Ala., Baton Rouge, La., and Ann Arbor, Mich., as places for storing seeds.*

[Period, 190 days.]

Seeds subjected to "Trade conditions."	Cabbage.			Lettuce.			Onion.			
	Percentage of seeds germinated at the end of—			Percentage of seeds germinated at the end of—			Percentage of seeds germinated at the end of—			
	36 hours.	60 hours.	14 days.	36 hours.	60 hours.	11 days.	60 hours.	84 hours.	108 hours.	14 days.
Mobile, Ala........	0.0	0.0	8.5	0.0	11.0	64.0	0.0	0.0	0.0	0.0
Baton Rouge, La ..	0.0	0.0	22.5	2.5	35.5	74.0	0.0	0.0	0.0	0.0
Ann Arbor, Mich..	10.0	64.5	86.5	67.0	82.5	96.5	3.0	10.0	43.0	93.0

Table VI shows quite clearly the deleterious action of the warm, moist climate of the Gulf of Mexico on the life of seeds. The onion seed which was stored at Mobile and Baton Rouge did not germinate, while seed from the same lot stored at Ann Arbor germinated 93 per cent. The cabbage seed was injured nearly as much as the onion, the sample from Mobile germinating only 8.5 per cent. The conditions at Baton Rouge were slightly more favorable to the preservation of vitality. The cabbage seed stored at the latter place germinated 22.5 per cent, while a like sample of seed stored at Ann Arbor germinated 86.5 per cent. The lettuce was much more resistant than either the cabbage or the onion seed, but here, too, the injury was quite marked, especially as shown by the retardation in germination. The conditions at Mobile were also the most disastrous for the lettuce seed. During the first 36 hours that the tests were in the germinating chamber none of the lettuce seed from Mobile germinated, while the seed from the corresponding sample from Ann Arbor germinated 67 per cent. The final percentages of germination were 64 and 96.5 per cent, respectively, for the seed from Mobile and Ann Arbor, showing a loss in vitality of 33.68 per cent in the seed stored at Mobile. Here it will be seen, as in Table V, that the onion seed was most sensitive and the lettuce seed most resistant to the unfavorable conditions. In the first tests shown in Table V the average loss in vitality of the lettuce, cabbage, and onion was 15.77, 43.56, and 74.10 per cent, respectively, while for the last tests, as shown in the foregoing table, the losses in vitality of similar samples of seed kept at Mobile were 33.68, 91.29, and 100 per cent, respectively. The ratio is practically the same in both cases, the loss in the cabbage seed being 2.7 times greater than that of the lettuce.

The foregoing data are sufficient to indicate that climatic influences play a very important part in the life of seeds, and that the degree of injury varies greatly in different places and likewise in different seeds. Some seeds were practically worthless after an exposure of four or five months in such places as Mobile, Baton Rouge, or San Juan, as shown in Table I. After longer exposures, six or nine months, similar results were obtained from all of the places to which seeds were sent. Many of the seeds were killed, as shown in Table II. The conditions at Mobile were fatal to all of the seeds; that is, the seeds were worthless so far as the gardener is concerned.

CAUSES OF THE LOSSES IN VITALITY IN DIFFERENT CLIMATES.

Having shown that seeds lose their vitality much sooner in some localities than in others, the question naturally arises, "Why this loss in vitality?" Unfortunately only two of the places where seeds were stored, Mobile and San Juan, have Weather Bureau stations which are equipped for making complete observations of the meteorological conditions. It has been observed, however, that there is a very close relationship between the precipitation and the loss in vitality in seeds; that is to say, in a measure the loss in vitality is directly proportional to the amount of rainfall. This deterioration is more apparent as the temperature increases, but the injury due to the increase in temperature is dependent on the amount of moisture present.

The following table has been compiled in order to show the ratio between the loss in vitality and the precipitation and temperature. The loss in vitality, as given in the second column of Table VII, represents the average losses in percentages, calculated from the results of the germination tests of the 13 different samples of seeds, as shown in Table II.[a]

The third column shows the annual precipitation in inches. The annual precipitation has been taken, because in some instances heavy rainfalls occurred just previous to the time that the seeds were put into storage. Then, too, the annual precipitation furnishes more accurate data for a basis of comparison. The mean temperatures, as given in column 4, are not the mean annual temperatures, but the averages covering the time during which the seeds were stored. The mean annual temperatures were not taken, chiefly for the reason that the critical period, in so far as temperature is concerned, is during the summer months.

TABLE VII.—*Ratio between vitality, precipitation, and temperature.*[b]

Place where seeds were stored.	Average loss in vitality of the 13 different samples of seeds.	Annual precipitation.	Temperature.	
			Mean Fahr.	Maximum Fahr.
	Per cent.	*Inches.*	*Degrees.*	*Degrees.*
Mobile, Ala	71.98	91.18	71.4	96.0
Baton Rouge, La	41.39	66.37	72.2	98.0
Durham, N. H	39.58	48.20	52.3	98.0
Auburn, Ala	33.91	62.61	64.4	98.0
Lake City, Fla	29.38	49.76	73.3	103.0
Wagoner, Ind. T	28.41	42.40	67.1	107.0
Ann Arbor, Mich	2.52	28.58	49.12	98.0

[a] These seeds were sent out in February, 1900, and were returned to the botanical laboratory and tested in October and November, 1900. The average time that the seeds were kept at the various places was 252 days.

[b] The results of the San Juan tests have been omitted from this table because, as has been previously stated, all of the seeds were returned from San Juan on June 20, 1900, when the first tests were made. The second series of tests was made in October, 1900. During the time intervening between the first and second tests the San Juan samples were kept in the botanical laboratory at the University of Michigan.

According to the table the seeds kept at Mobile suffered the greatest loss in vitality. However, it is quite probable that the greatest loss would have been from the seeds stored at San Juan had the time of storage been the same for the two places, so that the results of the San Juan tests could have been included in the table. This conclusion is based on the following facts: Normally, the number of rainy days at San Juan far exceeds those at Mobile. In 1900 there were 211 days on which rain fell in San Juan, while the records for Mobile show only 116. Likewise the average temperature of the dew-point for San Juan was 71° F. and only 59° F. for Mobile, which, when expressed in terms of absolute moisture, gives 8.240 and 5.555 grains of water per cubic foot at the time of saturation. On the other hand, the relative humidity of San Juan was 78.5 per cent, or slightly lower than that of Mobile, the latter having a relative humidity of 80.5 per cent. However, the mean annual temperatures were 77.6° and 71.4° F., respectively, hence a mean absolute humidity of 7.099 grains of aqueous vapor for San Juan and only 6.718 grains per cubic foot for Mobile.

From the foregoing table it will be seen that precipitation is a factor of much greater importance than temperature. In order to show the real value which the amount of precipitation furnishes as a basis for judging the length of time that seeds will retain their vitality when stored in localities having a marked difference in the amount of rainfall, the results set forth in the above table are represented diagrammatically as follows:

Effect of precipitation on vitality.

Place.	Percentage of loss in vitality.	Inches of precipitation.
Mobile	71.98	91.18
Baton Rouge	41.39	66.37
Durham	39.58	48.20
Auburn	33.91	62.61
Lake City	29.38	49.76
Wagoner	28.41	42.40
Ann Arbor	2.52	28.58

A discrepancy is very marked for Durham, N. H., which may be partially explained by considering again the conditions under which the seeds were stored. It will be remembered that these samples of seeds were stored in a hall which opened directly into a chemical laboratory. It is quite probable that the low percentages of germination were due to the injurious action of gases emanating from the laboratory. Of these gases, ammonia probably played a very important part, as it is well known that seeds are very readily injured when subjected to the action of ammonia.

It is to be understood that the above comparisons are somewhat indefinite. If the amount of rainfall were equally distributed throughout the year a definite ratio could, in all probability, be established; but in the majority of places there are alternating wet and dry seasons, which make such a comparison very difficult and unsatisfactory. Yet for ordinary considerations it is sufficient to say that seeds will retain their vitality much better in places having a small amount of rainfall. For more exact comparison other factors must be taken into account, especially the relative humidity, mean temperature, and temperature of the dew-point, which ultimately resolves itself into the absolute amount of moisture present in the atmosphere.

EFFECT OF MOISTURE AND TEMPERATURE UPON VITALITY.

From the foregoing experiments it is quite evident that moisture plays an important part in bringing about the premature death of seeds and that the detrimental action of moisture is more marked as the temperature increases. Formerly the general consensus of opinion has been to make this statement in the reverse order—that is, that temperature exerts a very harmful action on seeds if much moisture be present. For comparatively high temperatures the latter statement would probably suffice—at least it is not misleading, and in a certain measure it is true; but at the lowest known temperatures, as well as at ordinary temperatures, moisture is the controlling factor, and in order to be consistent it should likewise be so considered for higher temperatures—that is, within reasonable limits.

That temperature is only of secondary importance is brought out in the results obtained by a number of investigators. It has been well established by Sachs,[a] Haberlandt,[b] Just,[c] Krasan,[d] Isidore-Pierre,[e] Jodin,[f], Dixon,[g] and others that most seeds, if dry, are capable of germination after being subjected to relatively high temperatures for periods of short duration. The maximum for most seeds is a temperature of 100° C. for one hour; but if the seeds contain comparatively large quantities of moisture they are killed at much lower temperatures. It has been reported that lettuce seed will lose its vitality in two weeks in some of the tropical climates where moisture is abundant. Dixon has shown that if lettuce seed be dry it will not all be killed until the temperature has been raised to 114° C.

In case of low temperatures the factor of moisture is of less importance, yet even under such conditions the moisture must not be excessive or the injury will be quite apparent. But if seeds are well dried it can safely be said that they will not be killed as a result of short exposures to the lowest temperatures which have thus far been produced. Our knowledge of the resistance of seeds to extremely low temperatures is based on the experiments of Edwards and Colin,[h] Wartmann,[i] C. De Candolle and Pictet,[j] Dewar and McKendrick,[k] Pictet,[l] C. De Candolle,[m] Brown and Escombe,[n] Selby,[o] and Thiselton-

[a] Handbuch d. Exp. Phys. d. Pflanzen, Leipzig, 1865, p. 66.

[b] Pflanzenbau I, 1875, pp. 109–117; Abs. in Bot. Jahresbr., 1875, p. 777.

[c] Bot. Zeit., 33, Jahrg. 1875, p. 52; Cohn's Beiträge zur Biol. der Pflanzen, 1877, **2**: 311–348.

[d] Sitzungsbr. d. Wiener Akad. d. Wiss., 1873, **48**: 195–208. I. Abth.

[e] Ann. Agron., 1876, **2**: 177–181; Abs. in Bot. Jahresbr., 1876, II. Abth., **4**: 880.

[f] Compt. Rend., 1899, **129**: 893–894.

[g] Nature, 1901, **64**: 256–257; notes from the Botanical School of Trinity College, Dublin, August, 1902, pp. 176–186.

[h] Ann. sci. nat. bot., ser. 2, 1834, **1**: 257–270.

[i] Arch. d. sci. phys. et nat., Genève, 1860, **8**: 277–279; ibid., ser. 3, 1881, **5**: 340–344.

[j] Ibid., ser. 3, 1879, **2**: 629–632; ibid., ser. 3, 1884, **11**: 325–327.

[k] Proc. Roy. Inst., 1892, **12**: 699.

[l] Arch. d. sci. phys. et nat., Genève, ser. 4, 1893, **30**: 293–314.

[m] Ibid., ser. 4, 1895, **33**: 497–512.

[n] Proc. Roy. Soc., 1897–8, **62**: 160–165.

[o] Bul. Torr. Bot. Club., 1901, **28**: 675–679.

Dyer.[a] In the experiments of the last-named investigator seeds were subjected to the temperature of liquid hydrogen (−250° to −252° C.) for six hours, and when tested for vitality the germination was perfect and complete.[b]

Much more might be said on the effect of high and low temperatures on vitality. But for the commercial handling of seeds the extremes of temperature are of secondary importance and need not be further discussed at this time. In the present work the purpose has been to show the effect of moisture on the vitality of seeds when subjected to such temperatures as are usually met with in the storing of seeds.

SEEDS PACKED IN ICE.

On February 6, 1900, samples of each of thirteen kinds of seed were put up in duplicate, both in manila coin envelopes and in small bottles. The bottles were closed with carefully selected cork stoppers. These two sets of duplicate samples were then divided into two lots. Each lot contained one of each of the packages and one of each of the bottles of seeds. The samples thus prepared were carefully packed with excelsior in wooden boxes, the boxes being then wrapped with heavy manila paper. In one of the boxes was also placed a Sixes' self-registering thermometer, so that the minimum temperature could be ascertained.

These boxes were stored in a large ice house near Ann Arbor, being securely packed in with the ice at the time the house was being filled. The first box was taken out with the ice on June 12, 1900, after a lapse of 126 days. The thermometer in this box registered a minimum of −3.6° C. It is safe to assume that this temperature was uniform, at least up to within a few days of the time when the seeds were taken out. Unfortunately, absence from the university at this particular time delayed an examination of the seeds until June 20. During the eight intervening days the box of seeds was kept in the laboratory and there many of the seeds in the packages molded, so that they were unfit for germination tests. In fact, the results of the tests from the packages are of little value within themselves; but in comparison with the vitality tests of the seeds kept in the bottles some important facts are brought out, and it has been deemed advisable to tabulate these results with those of the second series.

The second box of seeds was packed approximately in the center of a large ice house (100 by 60 by 20 feet) and was taken out with the ice on July 21, 1900, after having been 167 days in cold storage. The

[a] Proc. Roy. Soc., 1899, 65: 361–368.

[b] *Brassica alba* (oily), *Pisum sativum* (nitrogenous), *Cucurbita pepo* (oily), *Triticum sativum* (farinaceous), and *Hordeum vulgare* (farinaceous).

box was brought directly to the laboratory and the seeds were examined at once. Those contained in the paper packages had absorbed a considerable quantity of moisture and were much softened. In all of the packages except those containing the onion and watermelon seeds some mold had developed; but in the seeds used for the germination tests care was taken to avoid using those that showed any trace of a mycelium, thereby reducing the injury due to fungous growth to a minimum, even though subsequent experiments have shown that such injury is practically negligible.

An interesting point concerning the germination of some of the seeds at this low temperature may be stated in this connection. Eight of the peas, or 4 per cent, had already germinated, the radicles varying in length from 1 to 2.5 cm., thus corroborating Uloth's results in germinating peas at or slightly below the temperature of melting ice.[a]

TABLE VIII.—*The vitality of seeds kept in an ice house in envelopes and bottles, and likewise the vitality of the controls.*

Kind of seed.	First test, after 126 days.					Second test, after 167 days.				
	Germination.			Difference between envelope and control samples.	Difference between envelope and bottled samples.	Germination.			Difference between envelope and control samples.	Difference between envelope and bottled samples.
	Control.	Envelope.	Bottle.			Control.	Envelope.	Bottle.		
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Corn "A"	96.0	36.0	94.0	60.0	58.0	92.0	86.0	96.0	6.0	10.0
Corn "B"	90.0	60.0	96.0	30.0	36.0	92.0	74.0	94.0	18.0	20.0
Onion	95.0	92.5	96.5	2.5	4.0	95.0	94.5	95.0	0.5	0.5
Cabbage	93.5	89.0	94.0	4.5	5.0	92.0	90.0	94.0	2.0	4.0
Radish	88.5	....	81.5	....	....	80.5	74.0	89.0	6.5	15.0
Carrot	79.5	....	80.0	....	....	73.5	52.0	75.5	21.5	23.5
Pea	92.0	....	88.0	....	....	94.7	90.0	96.0	4.7	6.0
Bean	100.0	....	100.0	....	....	100.0	0.0	98.0	100.0	98.0
Pansy	52.5	5.0	65.5	47.5	60.5	52.0	2.5	65.5	49.5	63.0
Phlox	74.0	....	[a]16.5	....	....	54.0	11.0	68.5	43.0	57.5
Tomato	95.5	73.0	93.5	22.5	20.5	96.5	51.5	96.0	45.0	44.5
Watermelon	98.0	90.0	100.0	8.0	10.0	100.0	96.0	100.0	4.0	4.0
Lettuce	80.0	....	66.0	....	....	81.5	66.0	71.0	15.5	5.0
Average	87.3	63.6	87.9	25.0	27.7	84.9	62.1	87.6	24.3	27.0

[a] In making up the averages the result of the germination of the phlox was omitted because a subsequent examination showed that the bottle containing this sample of seed was broken at the bottom, thus admitting sufficient moisture to destroy vitality, as is borne out by the second test.

The above table shows, as previously stated, that the results of the first tests are incomplete and not very satisfactory, owing to the fact that the germination tests were unavoidably delayed for eight days after the seeds were taken from the ice house; but with the second set

[a] Flora, 1875, pp. 266–268.

of samples the counts for the vitality tests were begun within an hour from the time the seeds were removed from the ice house. Thus, the conclusions for these experiments must be drawn chiefly from the second series of tests. However, comparisons will be made with the first where such seem justifiable.

It will at once be seen that the seeds which were in paper packages gave a much lower percentage of germination than either the control samples or those kept in bottles. The average germination of the controls was 84.9 per cent, and the average germination of the seeds kept in bottles was 87.6 per cent, while only 62.1 per cent of the seeds kept in paper packages germinated. This is equivalent to a loss in vitality of 24.3 and 27 per cent, respectively, as compared with the vitality of the control samples and the samples from the bottles. The results of the first tests are practically the same, save that the differences between the control and the bottle samples are less marked. In the second case the average vitality of the seeds kept in envelopes was much reduced by the complete failure to germinate in the case of the beans, which are most susceptible to the deleterious action of moisture at the given low temperature.

One of the most important points brought out by these experiments is the result obtained with onion, cabbage, and watermelon seeds. In both the first and the second tests the germination varied but little throughout. However, in all cases the seeds in the paper packages were slightly injured by the action of the moisture. This factor is of much importance, especially in the case of the onion seed, which, when kept in a moist atmosphere at normal temperatures, soon loses its vitality, but when maintained at temperatures slightly below freezing it becomes very resistant to the action of moisture. The beans, on the other hand, were all killed, although they are ordinarily much more hardy than onion seed. It is quite probable, however, that the death of the beans may be attributed to the reduction in temperature. Containing as they do large quantities of starch, they absorb more water than less starchy or more oily seeds. This factor, together with the large embryo, renders them much more susceptible to the injurious action of freezing temperatures.

Another important feature brought out by these experiments was the better germination of the seeds which had been stored in bottles in the ice house. The average germination of these samples was 2.7 per cent higher than that of the control. In a measure this may be included within the limits of variation; but when it is considered that all of the bottle samples except the beans, tomato, and lettuce showed a vitality equal to or greater than the control, it can hardly be considered as a normal variation, especially since only the lettuce gave any marked variation in favor of the control. Likewise, the average percentages of the first series of tests show a slight increase in favor of the seeds kept in the bottles, though the increase is not so well marked and is less uniform than in those of the second series.

Aside from the final germination there is still another factor that must be taken into consideration as bearing evidence of the advantage of keeping seeds at low temperatures, provided that they are kept dry. All of the samples that were stored in the ice house in bottles showed a marked acceleration in germination. It is quite evident that the respiratory activities and accompanying chemical transformations were much reduced by the reduction in temperature, and the vital energy was thus conserved; but when the conditions were favorable for germination the greater amount of reserve energy in these seeds gave rise to a more vigorous activity within the cells and a corresponding acceleration in germination.

Numerous other experiments showing the effect of moisture on the vitality of seeds were made. In contrast to those just given, the injurious action of moisture at higher temperatures, yet temperatures well within the limits of those ordinarily met with in the handling of seeds, will be next considered.

EFFECT OF MOISTURE ON VITALITY AT HIGHER TEMPERATURES.

This set of experiments was undertaken particularly to furnish conditions somewhat similar to those existing in the States bordering on the Gulf of Mexico, or, in fact, all places having a relatively high degree of humidity and a temperature ranging from 30° to 37° C. (86° to 98.6° F.) during the summer months. In order to secure the desired degrees of temperature two incubators were utilized, one being maintained at a temperature varying from 30° to 32° C., the other from 36° to 37° C. The thermo-regulators were so adjusted as to admit of a possible variation of nearly two degrees in each case.

Beans, cabbage, carrot, lettuce, and onion were used for these tests. In each of the incubators the seeds were subjected to four different methods of treatment: 1. In a moist atmosphere, in free communication with the outside air. 2. In a moist atmosphere, but not in contact with fresh air, the seeds being in sealed bottles of 250 cc. capacity. 3. In a dry atmosphere, in free communication with the outside air. 4. Air-dried seeds in sealed bottles.

In order to obtain the conditions requisite for the first method of treatment, an apparatus was used as shown in figure 1. The seeds were put up in small packages and then placed in a 250 cc. bottle. The bottle containing the packages of seeds was placed within a specimen jar which was partially filled with water. This jar was then closed with a large cork stopper which carried two glass tubes, each of 1 cm. bore. These tubes extended 25 cm. above the top of the jar and out through the opening in the top of the incubator. The primary object of the tubes was to prevent any water vapor from escaping within the incubator and thereby doing damage to the seeds that were to be kept dry in the same incubator. For the same reason the cork in the jar was well coated with paraffin. Approximately the same volume of water was maintained in the jar throughout the experiment, more water being added through tube *a*, as occasion demanded, to replace the loss by evaporation. The chief advantage in having two tubes was the comparative ease with which the air within could be displaced by a fresh supply by forcing a current of fresh air through one or the other of the tubes.

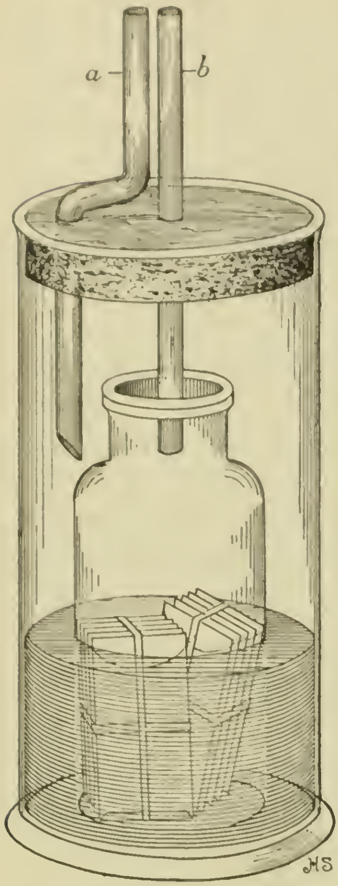

FIG. 1.—Apparatus used to determine the effect of moisture and temperature on the vitality of seeds in communication with free air.

Two such preparations were made, one being left in the oven maintained at a temperature varying from 30° to 32° C., the other in the oven maintained at a temperature varying from 36° to 37° C. In both cases the bottles contained five packages of each of the five samples of seed, thus making provisions for testing at different intervals.

In order to supply the conditions for the second method of treatment, similar packages from the same samples of seeds were put into 8-ounce bottles, which were then kept for five days in a moist chamber. The increase in weight due to the absorption of water within the five days was as follows: Beans, 3.03 per cent; cabbage, 8.09 per cent; carrot, 8.26 per cent; lettuce, 7.45 per cent, and onion 8.43 per cent. This increase, with the water already present in the air-dried seeds, gave a water content of 13.23 per cent for the beans, 13.99 per cent for the cabbage, 13.60 per cent for the carrot, 12.45 per cent for the lettuce, and 14.84 per cent for the onion.

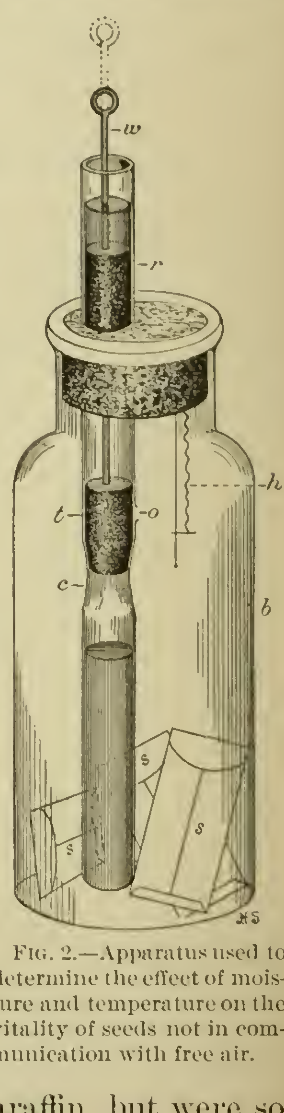

FIG. 2.—Apparatus used to determine the effect of moisture and temperature on the vitality of seeds not in communication with free air.

The bottles were then corked and sealed with paraffin, but were so constructed that the relative humidity of the inclosed air could be increased without the admission of more free air. The detailed construction of this apparatus is shown in fig. 2.[a]

The seeds continued to absorb moisture to a limited extent. In order that the inclosed air might be maintained at approximately the same degree of saturation, a crude hygroscope was attached on the inside of each bottle. These hygroscopes were made from awns of *Stipa capillata* L., the tip of the awns being removed and a short piece of fine copper wire used as an indicator. These hygroscopes were suspended from the under side of the cork, as shown at *h*, and by the side of each was suspended a fine fiber of silk, which, being carried around by the indicator, recorded the number of turns made by the awn.

Five such preparations were made for each of the two sets, so as to furnish seeds for a series of tests. One set was kept at a temperature of 30° to 32° C., the other at 36° to 37° C. The seed from one of the bottles, at each of the temperatures, was weighed after eighty-one days, at the time the germination tests were made. These weighings showed that at the lower temperatures the average increase in weight for all the seeds was 8.6 per cent, and at the higher temperatures, 6.3 per cent. The increase in the case of the beans was quite marked at this time, being 13.3 per cent for those maintained at a temperature ranging from 30° to 32° C., and 9.8 per cent for those maintained at 36° to 37° C.

The third set of conditions consisted simply of packages of the air-dried seeds kept in open boxes in each of the incubators. This series of tests was made especially for the purpose of determining the effect of dry heat on the vitality of seeds when maintained at the temperatures above given for some considerable time.

For the fourth series small packages of the seeds were put into 2-ounce bottles, which were then corked and sealed with paraffin. Five of these bottles were kept in each of the ovens and germination tests were made at irregular intervals. The results of these tests furnish a

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[a] The wide-mouth bottle (*b*) contains the packages of seed (*s*). Through an opening in the cork is inserted a short piece of soft glass tubing, being first fused at the lower end and having a slight constriction drawn at *c*. At a distance of 1 cm. above the constriction is blown a small opening, as shown at *o*. A short piece of heavy rubber tubing (*t*), cemented on a piece of heavy brass wire (*w*), serves as a stopper. This stopper, which must fit closely within the glass tube, is operated by means of the heavy wire. When drawn up, the water in the tube may give off aqueous vapor, which can escape through the small opening (*o*) into the bottle. When sufficient moisture is present the supply is shut off by pushing the stopper down firmly against the constriction. The stopper must be well coated with vaseline to prevent its sticking to the sides of the glass tube. To make the apparatus more secure against the entrance of fresh air, a second piece of rubber tubing (*r*) is placed in the upper part of the glass tube, the top of which is then filled with oil.

basis for comparing the relative merits of keeping seeds in open vessels and in sealed bottles.

Table IX will show the effect of the various methods of treatment on the vitality of the seeds.

TABLE IX.—*Vitality of seeds when subjected to the action of a dry and a moist atmosphere, both when exposed to free air and when confined in glass bottles, at relatively high temperatures.* [a]

Kind of seed.	Beginning of experiment.	End of experiment and date of germination tests.	Duration of experiment.	Vitality of seeds when kept in a moist atmosphere.				Vitality of seeds when kept in a dry atmosphere.				Germination of control samples.
				In open bottles, at temperatures varying from—		In sealed bottles, at temperatures varying from—		In open boxes, at temperatures varying from—		In sealed bottles, at temperatures varying from—		
				30° to 32°.	36° to 37°.	30° to 32°.	36° to 37°.	30° to 32°.	36° to 37°.	30° to 32°.	36° to 37°.	
			Days.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
Bean	Mar. 4	Apr. 4	31	100.0	100.0	78.0	41.0	86.0	84.0	98.0	98.0	94.0
Do	...do....	May 12	69	97.5	0.0	75.0	0.0	100.0	90.0	92.5	95.0	98.7
Do	...do....	May 24	81	94.0	......	0.0	0.0	98.0	90.0	98.0	100.0	98.0
Do	...do....	July 22	140	2.3	......	0.0	0.0	100.0	94.0	98.0	96.0	99.4
Cabbage	...do....	Apr. 4	31	87.8	90.5	73.0	72.5	86.5	84.0	83.5	86.9	91.0
Do	...do....	May 12	69	71.6	0.0	30.0	0.0	67.5	87.9	79.0	78.5	83.0
Do	...do....	May 24	81	80.0	......	1.0	0.0	89.0	92.0	92.5	92.0	92.5
Do	...do....	July 22	140	0.0	......	0.0	0.0	84.0	83.0	88.5	86.7	93.1
Carrot	...do....	Apr. 4	31	83.5	77.5	54.5	29.5	84.5	88.0	89.5	89.0	92.5
Do	...do....	May 12	69	69.5	0.0	22.5	0.5	82.0	85.0	83.5	82.5	78.0
Do	...do....	May 24	81	48.0	......	2.5	0.0	44.5	50.0	50.0	48.0	64.5
Do	...do....	July 22	140	0.5	......	0.5	0.0	81.0	81.2	78.5	83.1	83.4
Lettuce	...do....	Apr. 4	31	92.5	90.5	78.0	58.0	91.0	86.5	91.5	90.0	90.0
Do	...do....	May 12	69	38.0	0.0	41.5	2.0	42.0	38.5	38.5	51.5	31.5
Do	...do....	May 24	81	55.5	......	1.0	0.0	65.0	58.5	62.5	67.0	53.5
Do	...do....	July 22	140	0.0	......	1.5	0.0	82.0	87.0	81.5	88.0	79.9
Onion	...do....	Apr. 4	31	95.5	89.0	64.5	45.0	95.5	93.0	96.0	97.5	96.0
Do	...do....	May 12	69	68.0	0.0	2.5	0.0	97.0	95.0	97.5	93.0	98.5
Do	...do....	May 24	81	59.5	......	0.0	0.0	95.5	94.0	99.0	95.0	96.5
Do	...do....	July 22	140	0.0	......	0.0	0.0	90.0	92.0	97.5	94.7	95.4

[a] A study of the table will show that the lettuce and carrot seed germinated very poorly at the end of 69 and 81 days. This, however, was not due to any inherent quality of the seed, but to an excessive temperature at the time the tests were made. Both of these seeds require a comparatively low temperature for their successful germination, lettuce germinating best at 20° C., and carrot at an alternating temperature of from 20° to 30° C.

The amount of moisture absorbed or expelled under the different methods of treatment has an important bearing on the duration of vitality and will be considered briefly at this time. Only the general results will be discussed in this connection, inasmuch as later experiments, carried out in a similar manner, show the detailed results to much better advantage. Nevertheless, it requires only a glance at the above table to show the marked difference in the germinative power of seeds which have been stored in moist and in dry conditions. The seeds which were exposed in a moist atmosphere to the higher temperatures (36° to 37° C.) were killed much earlier than those subjected to the moist atmosphere at the lower temperatures—30° to 32° C.—in both the open and the closed bottles.

A weighing at the end of 31 days showed that the average increase in weight of the seeds kept in the open, moist chamber, due to the absorption of moisture, was 6 per cent at a temperature of 30° to 32° C., and 5 per cent at a temperature of 36° to 37° C. For the seeds kept in the oven, maintained at the temperature of 30° to 32° C., another weighing was made at the end of 134 days, at which time the average increase in the water content had risen to 8.67 per cent. Unfortunately the seeds from the second oven, maintained at the higher temperature, had become badly molded in 69 days, so that only the one weighing was made.

Vitality tests made at this time, 69 days, showed that all of the seeds from the open, moist chamber, at the higher temperatures, had been previously killed as a result of the drastic treatment; consequently no future germination tests were made. Those maintained at the lower temperatures were almost entirely free from mold at the expiration of the experiment, only an occasional seed showing any trace of fungous growth. Nevertheless, germination tests showed that the vitality had been destroyed in the cabbage, lettuce, and onion. Beans and carrot were most resistant, the former having germinated 2.3 per cent and the latter 0.5 per cent. All of the seeds had become very much softened. The beans and the lettuce had changed very materially in color, the beans (Early Kidney Wax Six Weeks) having become much darker and the lettuce (Black-Seeded Simpson) almost a lemon color.

With the seeds constituting the second series, i. e., *in a moist atmosphere but in sealed bottles*, the injury was much more severe. Here, as with the open chambers, the seeds subjected to the higher temperatures were killed first, even though the amount of moisture actually absorbed was less, as was also true with the other series. A weighing made at the end of 81 days gave an increase of 8.6 per cent for those from the oven maintained at a temperature of 30° to 32° C., and 6.3 per cent at the higher temperature. Likewise, in this series, the seeds had become very much softened and a very disagreeable odor had developed as a result of the putrefaction of their nitrogenous constituents. A close examination made at the end of 81 days revealed slight traces of fungous growth, but there is no reason to believe that these played any part in the destruction of vitality. However, in making counts for germination tests all molded seeds were carefully discarded.

The results of the germination tests showed that the vitality of the seeds kept at the lower temperatures had been practically destroyed at this time. The beans and onions failed to germinate, while the cabbage, carrot, and lettuce germinated only 1, 2.5, and 1 per cent, respectively.

During the succeeding 60 days much mold had developed, and at the expiration of the experiment, 140 days, only the carrot and the lettuce gave any indications of vitality. It is especially interesting to note with what rapidity the deterioration took place between the sixty-ninth and the eighty-first days, showing that when vitality reaches a certain point in its decline there follows a comparatively sudden death. This same fact is also shown in the case of those seeds in this same series kept at the higher temperature. After 31 days' treatment they all failed to germinate, except 0.5 per cent in carrot and 2 per cent in lettuce seeds.

In the two series of experiments just considered there was an increase in water content as a result of the humidity of the air in which the seeds were kept. But the third series, *open and dry*, presents quite another factor. A weighing made at the end of 30 days showed that there had been an average loss of 2.5 per cent for the lower temperatures and 3.5 per cent for higher temperatures. After this time the weight remained nearly constant. Subsequent experiments, which will be considered later, also show that the water capable of being expelled at any given atmospheric temperature is driven off in a comparatively short time. In case of seeds this condition is practically completed in eight or ten days when maintained at temperatures as above given. This extra drying of the seed causes a greater contraction of the seed coats, and in a number of cases a corresponding retardation in the rapidity with which germination takes place. The retardation in the germinative activity is dependent on the increased difficulty with which the seeds absorb water, and in many cases has an important bearing on the vitality tests.

The fourth and last series, in which the air-dried seeds were sealed in bottles and subjected to the temperatures at which the two ovens were maintained, gave still another very different set of conditions. Here there was also an increase in weight, due probably to some process of oxidation, but the increase was very slight. The average increase from those kept at either of the temperatures was less than one-half of one per cent.

Seeds, if well matured and thoroughly air-dried, are not injured when kept at temperatures below 37° C., whether they be kept in free communication with fresh air, or in sealed bottles, or tubes. In the experiments under discussion the average percentage of germination was slightly higher in the case of the seeds which had been stored in the sealed bottles. The mean percentage of germination for the seeds which had been exposed to the open air at a temperature of 30° to 32° C. was 83.05 per cent. Those from the sealed bottles kept at the same temperature germinated 84.82 per cent. At the higher temperatures—36° to 37° C.—the mean germination of the seeds from the open and the closed bottles was 82.68 and 85.62 per cent, respectively. The control sample germinated 85.45 per cent. That 37° C. is about the maximum temperature at which air-dried seeds can be stored without injury is shown by the following experiments.

Preparations similar to those above mentioned were used, and after being subjected to a temperature of 37° C. for 219 days, there was no appreciable loss in vitality, except the deterioration of 4 per cent in the case of the cabbage seed that was kept in an open bottle, and 6.3 per cent in the seed from a closed bottle.[a] But by increasing the temperature, during an additional period of 68 days, from 37° C. to a maximum of 44° C., the injury was much more marked, especially in the closed bottles. In the open bottles the vitality of the cabbage was lowered from 91.3 per cent to 77 per cent, representing a loss in vitality of 15.66 per cent. The onion seed fell from 95.7 per cent to 87 per cent when kept in an open bottle, and to 61 per cent when kept in a closed bottle. The beans showed no apparent injury in either case, except that they became very dry; consequently there was a retardation in germination as a result of the slow absorption of water.

The greater loss in vitality of the seeds kept in the bottles was the direct result of the higher humidity of the air immediately surrounding the seed, and not because there was a deficiency in the supply of fresh air, as might be readily assumed. In the open receptacles the additional amount of free water expelled, as a result of the increase in temperature, was allowed to escape, while in the sealed bottles it only gave rise to a relatively moist atmosphere, and consequently to a premature death of some of the seeds. If seeds are to be so confined, they should be previously dried at a temperature at which they are to be stored.

All of these seeds had become very dry and brittle. The odor of the air confined within the sealed bottles had become very unpleasant; likewise there was a marked change in the color of the seed coats of the inclosed seeds.

SUMMARY.

Most seeds if kept dry are not injured by prolonged exposures to temperatures below 37° C. (98.6° F.), it being immaterial whether they are in open or in sealed bottles.

If the temperature be increased above 37° C., vitality is seriously reduced.

If seeds are kept in a moist atmosphere, a temperature even as high as 30° C. (86° F.) works much injury in a comparatively short period. The degree of injury rapidly increases as the temperature rises.

Provided the degree of saturation is the same, the deleterious effect of moisture is fully as great in open as in closed bottles.

[a] Only cabbage, onion, and beans were used for this experiment, the carrot and the lettuce seed being omitted.

THE EFFECT OF DEFINITE QUANTITIES OF MOISTURE ON THE VITALITY OF SEEDS WHEN THEY ARE KEPT WITHIN CERTAIN KNOWN LIMITS OF TEMPERATURE.

The results of the experiments just discussed furnish a fair criterion by which to judge the vitality of seeds when influenced by temperature and moisture. It was still necessary to determine the effect of definite quantities of moisture on the vitality of seeds when they are submitted to temperatures well within the limits of that which may be encountered in commercial transactions.

On December 19, 1900, preparations were made to determine these factors. Seeds of cabbage, lettuce, onion, tomato, and peas were used for these experiments, which continued for 70 or 72 days. All of this seed was of the harvest of 1899 and had been in the laboratory during the eleven months immediately preceding the setting up of the experiments, being thus thoroughly air-dried. The amount of moisture present in the seeds at this time, as indicated by drying at 100° C., was as follows: Cabbage, 5.90 per cent; lettuce, 5 per cent; onion, 6.41 per cent; tomato, 4.71 per cent, and peas, 8.44 per cent.

The preparations were made as follows:

(*a*) Air-dried seeds were placed in bottles of 125 cc. capacity. The bottles were closed with cotton plugs in order to protect the seeds from dust while permitting a free circulation of air. This set served largely as a check.

(*b*) Air-dried seeds were carefully weighed and then put into 125 cc. bottles, closed with firm corks, and sealed with paraffin.

(*c*, *d*, *e*, and *f*) These samples were also carefully weighed and sealed in bottles as *b*, but in the different series of bottles there was first introduced 0.5, 1, 2, and 3 cc. of water which had been previously absorbed by small strips of filter paper.

(*g*) The seeds constituting this series were first dried for 30 days at a temperature of from 30° to 32° C. and then put up in bottles which were sealed with paraffin. The loss in weight as a result of the drying was as follows: Cabbage, 2.41 per cent; lettuce, 2.59 per cent; tomato, 2.71 per cent, and onion, 3.47 per cent, leaving a water content of only 3.49 per cent, 2.41 per cent, 2 per cent, and 2.94 per cent, respectively. (Peas were not included in this series.)

One of each of the above preparations was then subjected to different degrees of temperature as follows:

(1) Outdoor conditions, protected from rain and snow, but freely subject to all changes in temperature and humidity. The temperature during the time of the experiment, December 19, 1900, to February 28, 1901, varied from a minimum of −21.6° C. to a maximum of 8.9° C.

(2) In a fruit cellar having a comparatively low and uniform temperature ranging from 10° to 13° C.

(3) In the "dark room" of the botanical laboratory, which was quite dry and maintained at a temperature of 20° to 22° C.

(4) In the herbarium room on the fourth floor of the botanical laboratory. The air here was very dry and the mean temperature about the same as for No. 3, but with a much wider variation, reaching at times a maximum of 30° and a minumum of 10° C.

(5) In an incubator maintained at 30° to 32° C.

(6) In an incubator maintained at 37° to 40° C.

It will be observed that all of the preparations, except Nos. 1 and 4, were kept at temperatures which were quite uniform. The increase or decrease in the weight was determined at the expiration of 70 or 72 days by again carefully weighing the seed, after which germination tests were made. The results of the germination tests and the gain or loss in weight are given in Table X.

TABLE X.—*Relation of moisture and temperature to vitality.*

Laboratory numbers.	Place where seeds were stored.	Extremes of temperature to which seeds were subjected.	Amount of water put into each bottle.	Cabbage.			Lettuce.			Onion.				Tomato.			Peas.		
				Percentage of increase in weight while seeds were inclosed in bottles.	Percentage of germination. At the end of 36 hours.	Percentage of germination. Final.	Percentage of increase in weight while seeds were inclosed in bottles.	Percentage of germination. At the end of 36 hours.	Percentage of germination. Final.	Percentage of increase in weight while seeds were inclosed in bottles.	Percentage of germination. At the end of 77 hours.	Percentage of germination. At the end of 120 hours.	Percentage of germination. Final.	Percentage of increase or decrease in weight while seeds were inclosed in bottles.	Percentage of germination. At the end of 72 hours.	Percentage of germination. Final.	Percentage of increase or decrease in weight while seeds were inclosed in bottles.	Percentage of germination. At the end of 60 hours.	Percentage of germination. Final.
		Degrees C.	*cc.*																
Control..	Botanical laboratory....	....	......	....	57.3	92.8	....	80.7	92.0	....	29.5	89.5	91.8	....	73.0	97.7	....	90.0	92.0
1534......	Outdoors..............	−21.6– 8.9	(*a*)	....	56.0	91.5	....	79.5	92.0	....	26.0	90.0	97.0	....	72.5	97.0	....	90.0	98.0
1535......	Fruit cellar..............	10 −13	(*a*)	....	56.5	89.5	....	81.5	94.0	....	18.5	83.0	94.5	....	77.5	96.5	....	96.0	98.0
1536......	Dark room..............	20 −22	(*a*)	....	58.0	89.5	....	82.5	92.5	....	23.0	89.0	96.0	....	70.5	97.0	....	78.0	92.0
1537......	Herbarium room........	10 −30	(*a*)	....	63.0	94.0	....	83.5	93.0	....	24.5	88.5	98.0	....	71.5	94.0	....	87.2	89.1
1538......	Incubator..............	30 −32	(*a*)	....	55.0	93.5	....	82.0	90.5	....	23.0	85.5	97.5	....	72.0	97.0	....	76.0	86.0
1539......	Incubator..............	37 −40	(*a*)	....	54.0	89.0	....	83.0	92.5	....	16.5	77.5	95.5	....	67.5	92.5	....	64.0	72.0
1528......	Outdoors..............	−21.6– 8.9	(*b*)	0.06	57.5	89.0	None.	76.5	91.5	0.13	35.0	92.5	98.5	0.12	71.0	95.5	−0.16	90.0	96.0
1529......	Fruit cellar..............	10 −13	(*b*)	0.08	61.0	90.0	0.18	80.0	93.5	0.54	26.5	87.5	95.0	0.22	74.0	94.5	−0.20	86.0	94.0
1530......	Dark room..............	20 −22	(*b*)	0.11	52.0	91.0	0.26	79.5	94.0	0.35	27.0	87.5	99.0	0.03	68.5	93.5	−0.28	86.0	90.0
1531......	Herbarium room........	10 −30	(*b*)	0.16	58.0	90.5	0.16	81.5	90.5	0.35	27.0	84.0	95.5	0.27	74.5	96.5	−0.25	98.0	100.0
1532......	Incubator..............	30 −32	(*b*)	0.17	50.0	91.5	0.13	79.0	91.5	0.45	18.5	77.0	93.5	0.14	60.5	92.5	−0.74	88.0	92.0
1533......	Incubator..............	37 −40	(*b*)	0.05	25.0	88.0	0.11	68.5	91.0	0.24	2.5	59.5	96.0	None.	47.0	93.0	−0.32	94.0	100.0
1522......	Outdoors..............	−21.6– 8.9	0.5	1.47	66.0	90.0	1.89	77.0	92.0	3.13	33.0	86.5	97.5	2.14	82.5	96.0	1.31	90.0	94.0
1523......	Fruit cellar..............	10 −13	0.5	1.54	62.0	92.5	1.44	79.0	91.0	2.81	23.5	84.0	96.0	1.60	63.5	98.5	1.31	88.0	92.0
1524......	Dark room..............	20 −22	0.5	1.38	59.0	90.5	1.41	83.5	93.0	3.02	27.0	86.0	98.0	1.96	80.5	95.0	1.48	96.0	96.0
1525......	Herbarium room........	10 −30	0.5	1.02	54.5	94.5	1.04	83.0	93.0	2.47	19.5	87.5	99.5	1.40	76.5	94.0	1.38	94.0	98.0
1526......	Incubator..............	30 −32	0.5	1.43	26.5	86.5	1.44	72.5	87.5	2.96	3.5	62.5	93.0	1.86	65.0	91.0	1.68	88.0	96.0
1527......	Incubator..............	37 −40	0.5	1.26	0.0	82.5	1.20	27.0	85.0	2.65	0.0	10.5	51.0	1.38	32.0	89.0	1.43	66.0	88.0
1504......	Outdoors..............	−21.6– 8.9	1.0	3.04	70.0	95.0	3.34	81.0	94.5	5.49	24.0	85.0	96.5	3.16	83.0	92.5	2.96	94.0	94.0
1505......	Fruit cellar..............	10 −13	1.0	2.79	53.5	88.5	3.03	78.0	93.5	5.22	24.5	88.5	96.0	3.40	84.0	96.0	3.24	94.0	96.0
1506......	Dark room..............	20 −22	1.0	2.82	51.5	91.5	2.75	78.0	90.5	4.57	19.5	84.5	97.0	3.23	81.0	95.0	3.49	98.0	98.0
1507......	Herbarium room........	10 −30	1.0	2.41	60.0	92.0	2.39	77.5	89.5	4.12	11.5	81.0	94.0	2.75	76.5	95.5	3.35	100.0	100.0
1508......	Incubator..............	30 −32	1.0	2.66	5.5	81.5	2.24	53.0	86.5	3.72	0.0	19.5	53.0	2.48	59.0	92.0	3.01	80.0	90.0
1509......	Incubator..............	37 −40	1.0	2.35	0.0	11.0	2.33	0.0	55.0	3.91	0.0	0.0	0.0	2.70	1.0	67.5	3.29	38.0	80.0
1510......	Outdoors..............	−21.6– 8.9	2.0	5.08	60.0	93.0	5.34	83.5	96.5	7.89	24.0	88.5	97.5	5.36	83.0	93.0	6.74	92.0	98.0
1511......	Fruit cellar..............	10 −13	2.0	5.08	62.5	92.0	5.22	83.0	90.0	7.47	25.0	87.0	97.0	5.47	84.5	93.5	7.02	96.0	96.0
1512......	Dark room..............	20 −22	2.0	5.19	27.5	90.5	4.71	74.5	90.0	6.73	4.5	47.0	76.0	4.60	75.5	93.5	4.57	90.0	96.0

1513......	Herbarium room........	10 -30	2.0	5.36	26.5	86.0	4.85	72.5	91.0	7.14	8.5	64.0	85.5	5.12	84.5	98.5	7.17	98.0	100.0
1514......	Incubator	30 -32	2.0	5.71	0.0	3.5	5.19	0.0	34.0	9.31	0.0	0.0	0.0	5.00	18.5	77.5	7.50	30.0	54.0
1515......	Incubator	37 -40	2.0	4.62	0.0	0.0	4.81	0.0	0.0	6.59	0.0	0.0	0.0	4.60	0.0	2.0	6.92	0.0	0.0
1516......	Outdoors	−21.6– 8.9	3.0	7.50	52.0	92.0	7.02	79.5	95.0	10.38	13.0	80.0	91.0	6.50	70.5	92.0	11.22	96.0	96.0
1517......	Fruit cellar..............	10 -13	3.0	7.50	52.5	89.0	6.80	84.5	94.0	9.54	18.0	82.5	94.5	6.77	80.5	95.0	9.73	100.0	100.0
1518......	Dark room	20 -22	3.0	6.67	22.0	83.5	6.73	54.0	80.5	9.78	4.5	22.0	37.5	6.70	71.5	94.0	10.86	88.0	88.0
1519......	Herbarium room........	10 -30	3.0	7.59	16.0	77.5	6.96	59.5	78.0	8.90	0.5	8.5	17.5	6.26	67.5	93.5	11.18	88.0	88.0
1520......	Incubator	30 -32	3.0	7.51	0.0	0.0	7.20	0.0	0.0	9.37	0.0	0.0	0.0	6.18	5.0	64.5	10.79	0.0	4.0
1521......	Incubator	37 -40	3.0	6.89	0.0	0.0	6.43	0.0	0.0	9.25	0.0	0.0	0.0	5.18	0.0	0.0	10.72	0.0	0.0
1540......	Outdoors	−21.6– 8.9	(*c*)	0.33	57.5	88.5	0.28	79.0	93.5	0.22	28.0	91.5	99.5	0.23	73.5	92.5	....	....	....
1541......	Fruit cellar..............	10 -13	(*c*)	0.10	52.5	92.0	None.	78.0	89.5	None.	32.0	91.5	99.5	0.20	75.0	99.0	....	....	....
1542......	Dark room	20 -22	(*c*)	0.18	63.5	92.0	0.27	81.5	90.0	0.06	29.5	90.0	96.5	0.03	74.5	96.0	....	....	....
1543......	Herbarium room........	10 -30	(*c*)	0.02	50.0	90.5	0.02	84.5	95.5	0.04	25.0	88.5	97.0	0.08	68.0	97.5	....	....	....
1544......	Incubator	30 -32	(*c*)	None.	60.0	89.0	0.02	79.5	92.0	None.	29.0	83.5	95.5	−0.24	69.5	95.5	....	....	....
1545......	Incubator	37 -40	(*c*)	None.	50.0	91.0	None.	74.5	89.5	0.11	21.5	86.0	97.0	−0.02	67.5	95.5	....	....	....
1546......	Herbarium room........	10 -30	(*c*)	0.60	58.5	93.0	0.58	84.0	92.5	0.89	25.0	83.0	97.0	1.56	78.0	94.5	....	....	....

a These bottles were simply closed with a cotton plug. *b* Air-dried seeds. *c* Dried 30 days at 30° to 32° C. and then kept in open bottles until tests were made 40 days later.

The foregoing table, showing the conditions under which the seeds were kept, has been made quite complete. Aside from the final percentages of germination, the percentages of germination after a definite number of hours have likewise been given, the latter being better expressed as germinative energy. The germinative energy, as has been previously stated, is an important factor in determining the potential energy of a seed. This is quite clearly shown in many of the germination tests recorded in the above table. The preliminary results show a marked contrast as a result of the different kinds of treatment, while the final results reveal nothing more than the regular degree of variation usually met with in testing seeds. Of the five species of seeds, the onion has yielded the most striking variations in the earlier stages of germination. Take, for example, No. 1535, the sample that was kept in an open bottle in the fruit cellar. The moisture absorbed was sufficient to cause a chemical transformation, which injured the vitality of the seed and consequently caused a retardation in germination. No. 1539, the onion seed from the incubator maintained at a temperature of 37° to 40° C., germinated only 16.5 per cent in 77 hours, while the final percentage of germination was 95.5 per cent. Onion seeds Nos. 1532 and 1533 germinated in 77 hours 18.5 and 2.5 per cent respectively, while the final germination of the former was 93.5 per cent and of the latter 96 per cent. All of these tests gave final percentages of germination somewhat higher than the mean of the control samples. But the germination was considerably retarded, the control samples having germinated 29.5 per cent during the first 77 hours. These retardations in germination must be due to a lowering of vitality, as a more careful study of the table will show, and not to any excessive drying that may have taken place during the time of treatment. Numerous other examples are to be found in the table, some even more striking than those mentioned, but it is not deemed necessary that they all be pointed out and discussed here.

The table also shows the results of the various weighings made of all of the different samples which were kept in closed bottles. With but very few exceptions there was an increase in weight, which increase was quite marked in all cases where free water was introduced. The air-dried seeds that were sealed in bottles without the introduction of free water all increased slightly in weight, with the exception of the peas, which showed a slight decrease in weight. It has been observed that the absolute loss in the weight of the peas was slightly greater than the total gain in the four other samples of seed. This, however, is not of sufficient uniformity throughout to fully justify the conclusion that cabbage, lettuce, onion, and tomato seed have a greater affinity for water than peas, and that the former robbed the latter of a portion of their water content. Yet a portion of the increased weight of the cabbage, lettuce, onion, and tomato seed is probably best accounted for in that way. On the other hand, it is quite probable that a portion of the increase in weight was due to the results of intramolecular transformations and to the coexistent respiratory activities of the seed. The means of making these determinations are far from easy. Van Tieghem and G. Bonnier have shown[a] that seeds kept in sealed tubes in atmospheric air increased in weight during two years, but the increase was very small. In their experiments the peas which were in sealed tubes increased $\frac{1}{796}$ of their original weight. A corresponding sample kept in the open air increased $\frac{1}{72}$ of its original weight.

Nos. 1540 to 1545 in Table X show an increased weight in seeds when sealed in bottles for 70 days. These seeds were previously dried for 30 days at a temperature of 30° to 32° C. Disregarding the increase in weights as above given and the factors to which such increase may be attributed, it is quite evident that in all cases where water was added the increase in weight was due chiefly to the absorption of the water. The absolute increase was approximately the same as the weight of the water added.

The amount of water absorbed by different seeds varies greatly under identical conditions, depending largely upon the nature of the seed coats and the composition of the seed. The average increase in weight of the seeds used in these experiments was as follows: Onion, 6.27 per cent; pea, 5.51 per cent; cabbage, 4.12 per cent; lettuce, 3.99 per cent; tomato, 3.99 per cent. The loss in vitality of the corresponding samples was 28, 12, 23.7, 18.5, and 14.7 per cent, respectively. The relationship here is quite close, the amount of water absorbed being roughly proportional to the loss in vitality. The peas, however, afford an exception to this general statement. But it must be remembered that peas require a much larger percentage of moisture to start germination and are likewise capable of undergoing much wider variations than the other seeds in question. However, before a definite ratio can be established between the absorption of water and the loss in vitality, many other factors must be taken into consideration, such as the composition, water content, and duration of vitality of the seed under natural conditions.

Another interesting factor is shown in No. 1546 of Table X. These seeds were dried for 30 days at a temperature of 30° to 32° C., after which they were kept in an open bottle in the laboratory for 40 days. During the 30 days' drying the cabbage lost 2.41 per cent, lettuce 2.59 per cent, tomato 2.71 per cent, and the onion 3.47 per cent of moisture. These same seeds when exposed to the free air of the laboratory for 40 days never regained their original weight, the increase being as follows: Cabbage, 0.6 per cent; lettuce, 0.58 per cent; tomato, 1.56 per cent; onion, 0.89 per cent. The average quantity of water expelled was 2.79

[a] Bul. Soc. bot. France, **29**: 25–29, 149–153, 1882.

per cent in 30 days, while the average increase in weight during the 40 days was only 0.91 per cent. These results show that if seeds are once carefully and thoroughly dried, they will remain so; that is, if kept in a comparatively dry room. This is an important factor in the preservation of vitality, as is borne out in the results of the germination tests. Later experiments were made with very similar results, and an analogous method of treatment promises to be of much value as a preliminary handling of seeds. It is not definitely known to what this stronger vitality is due, whether it be simply to the effect of the drying or to some process of chemical transformation which makes the seeds more viable. These results are now under consideration and will be reported at some future time.

The table also shows in a very striking degree the decrease in the number of germinable seeds with an increase in the moisture and temperature. The amount of moisture absorbed by the seeds, with a limited amount present in the bottles, was inversely proportional to the temperature. At the higher temperatures the inclosed air held a larger portion as water vapor; however, there was a greater deterioration in vitality. Where the seeds were kept outdoors at the low temperatures (−21.6° to 8.9° C.) of the winter months, no injury was apparent except where 3 cc. of water was added, and then only the onion seed was affected. This sample of seed had absorbed a quantity of water equal to 10.38 per cent of the original weight, which together with the original water content (6.41 per cent of the original sample) made 17.88 per cent of moisture in the seed. Practically the same results were obtained with the seeds kept in a fruit cellar at a temperature of 10° to 13° C. The samples of this series, in the open bottles, were also injured, as has been pointed out. With the samples that were stored in the dark room and in the herbarium room, the injury was more marked as a result of the higher temperature; but even here the seeds in the bottles which contained 0.5 cc. of free water deteriorated very little. The injury was confined to the onion seed, which showed a slight retardation in germination. Where 1 cc., 2 cc., and 3 cc. of water were added, vitality in some instances was likewise remarkably well preserved. The lettuce, tomato, and peas gave no indications of any deterioration save in the bottles containing 3 cc. of water. Here the lettuce and peas were permanently injured, while the tomato seeds suffered only sufficiently to cause a delay in the rapidity with which they germinated. The cabbage seed was retarded with 2 cc. and a lowering of the final percentage of germination with 3 cc. of water. The onion seed, being very sensitive to these unfavorable conditions, deteriorated very greatly, being practically worthless where 3 cc. of water were added. A brief study of the table will readily show that many seeds were killed at the still higher temperatures of 30° to 32° C. and 37° to 40° C. The onion seed was slightly injured even where no water was added. However, a temperature of 40° C. is sufficient to injure many seeds, even though the liberated water be permitted to escape, as is shown in the tests of the onion, No. 1539 of the table. The greatest injury when air-dried seeds are sealed in bottles and then subjected to a higher temperature is due to the increased humidity of the confined air, as a result of the water liberated from the seeds.

At first glance some of the conditions given in the above table may seem to be extreme and far beyond any normal conditions that would be encountered in the ordinary handling of seeds. This may seem to be especially true with the seeds kept in the bottles with 3 cc. of water where the additional amount of moisture absorbed gave rise, in some of the seeds, to a water content of approximately 20 per cent. Yet this need not be thought of as an exception, for such extreme cases are often encountered in the commercial handling of seeds. During the process of curing even more drastic treatment is not infrequently met with. Pieters and Brown[a] have shown that the common methods employed in the harvesting and curing of *Poa pratensis* L. were such that the interior of the ricks reached a temperature of 130° to 140° F. (54.4° to 60° C.) in less than sixteen hours, at which temperature the vitality of the seed is greatly damaged and frequently entirely destroyed. The interior of one rick reached a temperature of 148° F. (64.4° C.) in twenty hours, and the vitality had decreased from 91 per cent to 3 per cent, as shown by the germination of samples taken simultaneously from the top and from the inside of the same rick.

On the other hand, the extreme cases need not be considered. Take, for example, the onion seed that was sealed in a bottle with 1 cc. of water and maintained at a temperature of 37° to 40° C. The increase in weight due to the water absorbed was 3.91 per cent, thus giving a moisture content of 11.2 per cent and a complete destruction of vitality. The cabbage seed, kept in the same bottle, had absorbed a quantity of water equivalent to 2.35 per cent of its original weight, which, with the 5.90 per cent contained in the original sample, gave 8.25 per cent of water. This sample of seed germinated only 11 per cent, having thus no economic value. In neither of these samples was the amount of water present in the seeds greater than that ordinarily found in commercial samples. Moreover, the temperature was much below that frequently met with in places where seeds are offered for sale and likewise well within the limits of the maximum temperature of our summer months, especially in the Southern States. Take, by way of comparison, the maximum temperatures of some of the places at which seeds were stored to determine the effect of climate on vitality, as shown in another part of this paper. During

[a] Bulletin 19, Bureau of Plant Industry, U. S. Department of Agriculture, 1902.

the summer of 1900 the maximum temperature at Wagoner, Ind. T., was 107° F. (41.1° C.), while that of Lake City, Fla., was 103° F. (39.5° C.). If these points are kept in mind, it is not at all surprising to find that seeds lose their vitality within a few weeks or months in warm, moist climates.

In order to make the above facts more clear the preceding table has been summarized and is presented in the following condensed form, showing the relation of the water content of the seed to vitality:

TABLE XI.—*Marked deterioration in vitality with an increase in the quantity of the water content of seeds.*

How preparations were made.	Amount of water introduced into the bottles.	Average increase in weight as a result of the greater water content.	Average moisture in seeds at the time germination tests were made.	Average germination.
	cc.	*Per cent.*	*Per cent.*	*Per cent.*
Control sample			6.07	93.3
Closed bottles, sealed with paraffin	Water expelled.	0.06	[a] 2.77	[a] 93.9
Do	None.	.08	6.55	94.0
Do	0.5	1.75	8.31	91.7
Do	1.0	3.24	9.91	83.3
Do	2.0	5.91	12.75	67.5
Do	3.0	8.13	15.10	58.6

[a] Peas not included in this set.

Numerous other results of a similar character might be cited, but it hardly seems necessary at this time, since there can be no doubt that moisture is the prime factor in causing the premature destruction of vitality in seeds in the usual conditions of storage. Why they lose their vitality as a result of the unfavorable conditions is quite a different question, and has to do with the very complex composition of the seed.

A COMPARISON OF METHODS OF STORING AND SHIPPING SEEDS IN ORDER TO PROTECT THEM FROM MOISTURE AND CONSEQUENTLY TO INSURE A BETTER PRESERVATION OF VITALITY.

SUGGESTIONS OF EARLIER INVESTIGATORS.

As early as 1832, Aug. Pyr. De Candolle[a] wrote a chapter on the conservation of seeds, in which he said that if seeds be protected from moisture, heat, and oxygen, which are necessary for germination, their vitality will be much prolonged; moreover, that if seeds are buried sufficiently deep in the soil, so that they are protected at all times from the very great influence of oxygen and moisture, their vitality will be preserved for a much longer period.

[a] Physiologie Végétale, Paris, 1832, Tome II, p. 618.

Giglioli[a] goes so far as to say:

> There is no reason for denying the possibility of the retention of vitality in seeds preserved during many centuries, such as the Mummy wheat and seeds from Pompeii and Herculaneum, provided that these seeds have been preserved from the beginning in conditions unfavorable to chemical change. * * * The original dryness of the seeds and their preservation from moisture or moist air must be the very first conditions for a latent secular vitality.

Some of the earliest suggestions for storing seeds in quantity were made by Clément and Fazy-Pasteur, and were reported by Aug. Pyr. De Candolle in his Physiologie Végétale. Clément suggested the use of large cast-iron receptacles, made impervious to air and water, the well-dried seeds to be poured in through an opening at the top, after which the opening should be hermetically sealed and the seeds withdrawn through an iron pipe and stopcock at the bottom of the tank. The scheme of Fazy-Pasteur was to store seeds in wooden boxes well covered with tar. This method was especially applicable to small quantities of seeds, and was used to a limited extent at that time, but, so far as has been ascertained, it has long since been discarded. The keeping of seeds in large iron tanks, as suggested by Clément, has never been practiced to any extent. It seems quite possible, however, that the present "tank" grain elevator, now so universally used, might readily be modified in such a way as to make the method suggested by Clément quite practicable.

THE NECESSITY FOR THOROUGHLY CURING AND DRYING SEEDS.

In addition to being well matured and carefully harvested, seeds should be thoroughly cured and dried before being put into the storage bins. Much better results would be obtained if such seeds were artificially dried for several days in a current of dry air at a temperature not to exceed 35° C. With this method of drying, from 2 to 4 per cent of the moisture usually present in air-dried seeds is expelled. The accompanying contraction of the seed coats makes them more impervious to the action of moisture, and consequently the seeds are better prepared for storing and shipping. Experiments made with cabbage, lettuce, onion, and tomato seeds gave results as follows: The average loss in weight of the air-dried seeds, after an additional drying of 30 days at a temperature of 30° to 32° C. was 2.79 per cent. Yet these same seeds, when kept for 40 days in the laboratory, reabsorbed only an average of 0.91 per cent of moisture. Like quantities from the original sample gave only the slight variations ordinarily met with, due to the humidity of the atmosphere. Thus seeds, when once carefully and thoroughly dried, will not regain their original weight, provided they be kept in a dry room.

[a] Nature, 1895, **52**: 544–545.

CHARACTER OF THE SEED WAREHOUSE OR STORAGE ROOM.

Another important factor in the storing of seeds is the character of the seed warehouse or storage room. The first point to be considered is dryness. Such houses should be kept as dry as possible, which can be accomplished either by means of artificial heat or by the use of strong drying agents, or better still, by both. True, if the seed warehouse be located in a section having a dry climate, this difficulty is at once largely overcome. But in many cases such a location is impracticable or even impossible, and other means must be resorted to. As a matter of fact, most large seed warehouses are not heated and a great loss in vitality inevitably follows; but each seedsman must determine for himself whether or not this loss is sufficiently great to justify the expense of heating such a storage room.

Experiments carried on during the progress of this work have shown some very marked differences in favor of seeds stored in rooms artificially heated. The averages of the thirteen samples of seeds from the eight places at which they were stored show a difference in the loss of vitality of 9.87 per cent. Those kept in rooms that were artificially heated during a greater portion of the time deteriorated 25.91 per cent, while those stored in rooms not so heated deteriorated 35.78 per cent. The loss here given for seeds stored in dry rooms is greater than such conditions warrant, owing to the very unfavorable conditions at Mobile, Ala., and Baton Rouge, La. At Lake City, Fla., the relative percentages of deterioration were 29.42 and 16.27 for the unheated and heated rooms, respectively; at Auburn, Ala., 33.90 and 10.34 per cent, and at Durham, N. H., 39.58 and 3.57 per cent, respectively. Unfortunately these experiments were not made with this definite point in view, and the results are not entirely satisfactory, as no records were made of the temperatures and humidities.

THE VALUE OF GOOD SEED TO THE MARKET GARDENER.

This work was undertaken chiefly for the purpose of finding some improved methods of shipping and storing seeds in small packages, wherein their vitality might be better preserved. The rapid deterioration in vitality causes great losses to gardeners living in districts where the climatic conditions bring about the premature destruction of vitality in seeds. In many cases the seeds are practically worthless or altogether fail to germinate after a few weeks' exposure. The loss in such cases is not in the greater quantity of seed required, but the retardation or complete failure of the germination often means delay, making the difference between success and failure in the desired crop. Seed of low vitality is even worse than dead seed. With the latter the difficulty is soon discovered, while with the former, although the seed will germinate, the seedlings are not sufficiently vigorous to develop into strong and healthy plants. True, most enterprising gardeners usually have vitality tests made immediately preparatory to planting, but this is not always convenient, and they rely on the results of tests made at some earlier date. In such cases it quite frequently happens that they accept the results of tests made several weeks earlier. With many seeds this will suffice, yet there are many others that will deteriorate very materially within a few weeks or even within a few days in such unfavorable climates as exist, for example, near the Gulf of Mexico. In a letter dated January 15, 1903, Mr. J. Steckler, of New Orleans, La., wrote as follows concerning the vitality of seeds:

> Some seeds are not worth being planted after being here three months. This is especially true of cauliflower seed. We have made repeated tests and this seed after remaining here 90 days was worthless and had to be thrown away.

SHIPPING SEEDS IN CHARCOAL, MOSS, ETC.

Bornemann[a] made some experiments with seeds of *Victoria regia* and *Euryale ferox*, in which he found that when packed in powdered charcoal they soon lost their vitality, but when packed in powdered chalk slightly better results were obtained. On the other hand, Dammer[b] recommends powdered charcoal as a method of packing for seeds that lose their vitality during shipment, especially the seeds of palms and a number of the conifers.

Charcoal is undoubtedly much better than moist earth or moss, which are frequently used, the latter affording abundant opportunities for the development of molds and bacteria during transit. Some such method as moist charcoal is necessary in case of seeds which lose their vitality on becoming dry. Numerous other reports have been published from time to time concerning the shipping of seeds of aquatic plants, as well as those of low vitality, but they need not be discussed further at this time.

NATURE OF THE EXPERIMENTS.

Aside from some popular accounts and miscellaneous suggestions, but little has been done toward finding improved methods of shipping and storing seeds of our common plants of the garden and field. Accordingly, in February, 1900, a series of experiments was undertaken to determine some of these factors, in which three questions were considered: (1) How may small quantities of seeds be put up so as to retain a maximum germinative energy for the greatest length of time? (2) What immediate external conditions are best suited for the longevity of seeds? (3) What part do climatic conditions play in affecting the life of seeds?

[a] Gartenflora, 35. Jahrg., 1886, pp. 532–534.

[b] Ztschr. trop. Landw., Bd. I, 1897, No. 2.

In order to answer the first question, duplicate samples of the various kinds of seeds were put up in double manila coin envelopes, as described on page 14. Likewise, duplicate samples were put up in small bottles, the bottles being closed with good cork stoppers. Some of the bottles were filled with seed, while others were only partly full. In some cases there was a surplus air space five times as great as the volume of the inclosed seeds. This space, however, had no bearing on the vitality of the seeds as far as could be determined.

In order to determine what immediate external conditions play an important part in the destruction of vitality, samples of seed, prepared as above described, were stored in different places.[a] At each place they were subjected to three different conditions of storage, which, for convenience, have been designated as "trade conditions," "dry room," and "basement," as described on page 14. In addition to these three methods of storage, numerous other conditions were tried in and near the laboratory; such as in incubators at increased temperatures and with varying degrees of moisture, in cold storage, in greenhouses, and in various gases, in vacuo, in liquids, etc.

The third question, "What part do climatic conditions play in affecting the life of seeds?" has been answered for the most part in a discussion on the effect of climate on vitality, page 13. In fact, the seeds in the envelopes kept under trade conditions were the same in both cases, being used here simply as a means for comparing the vitality of seeds when stored in paper packages and in bottles, as well as to show the relative merits of trade conditions, dry rooms, and basements as storage places for seeds.

DISPOSITION OF THE SAMPLES.[b]

A more definite description of the treatment given the seeds in the various places may be summed up as follows:

San Juan, P. R.—The seeds were sent to San Juan on February 9, 1900, and were returned on June 20, 1900, after a lapse of 131 days.[c] At San Juan the seeds were stored under trade conditions only, and the various packages were not removed from the original box in which they were sent. While in San Juan the box containing the seeds was kept in a room well exposed to climatic influences, being protected only from the direct rays of the sun and from rain.

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[a] San Juan, P. R.; Lake City, Fla.; Mobile, Ala.; Auburn, Ala.; Baton Rouge, La.; Wagoner, Ind. T.; Durham, N. H., and Ann Arbor, Mich.

[b] The places of storage represented by trade conditions have already been described for each of the localities, but it seems advisable to rewrite the descriptions here so that they may be more readily compared with the dry room and basement conditions.

[c] The exact time that the seeds remained at San Juan was much less than 131 days, the time of transportation being included, as has been done for the other places.

Lake City, Fla.—The seeds were sent to Lake City on February 9, 1900. The first complete set was returned on June 18, after 129 days. The second complete set was returned October 1, after 234 days. The "trade conditions" at Lake City were supplied by keeping the seeds in a small, one-story frame building, the doors of which were open the greater part of the time. This building was not heated, and the seeds were stored approximately 5 feet from the ground. "Dry room" conditions were those of a storage room on the fourth floor of the main building of the Florida Agricultural College. The third set was kept in a small bulletin room in the basement of the same building.

Mobile, Ala.—The seeds were sent to Mobile on February 17, 1900. One set was received in return on July 7, after 180 days. The other set was received on November 6, after 262 days. The "trade conditions" in this case consisted of a comparatively open attic in a one-story frame dwelling. The set in a "dry room" was kept in a kitchen on a shelf 5 feet from the floor, and not more than 6 feet distant from the stove. Here they were subjected to the action of artificial heat throughout the entire period.[a] The seeds under "basement" conditions were kept in a small cellar, which during the season of 1900 was very moist.

Auburn, Ala.—The seeds were sent to Auburn on February 17, 1900. The first complete set was received in return on May 30, the second on November 19 of the same year, or after 102 and 275 days, respectively. "Trade conditions" consisted of an office room connected with a greenhouse, with the doors frequently standing open; "dry room" conditions were obtained in the culture room of the biological laboratory on the third floor of the main building of the Alabama Polytechnic Institute, "basement" conditions being found in the basement of the same building, a comparatively cool situation, yet with a relatively high degree of humidity.

Baton Rouge, La.—The seeds were sent to Baton Rouge on February 17, 1900. On June 18 the first complete set was received in return. The second set remained until October 22, making the time of absence 121 days for the first and 247 for the second set. "Trade conditions" at Baton Rouge were furnished by keeping the seeds throughout the entire time of the experiment on shelves in a grocery store, the doors of which were not closed except at night. These conditions were thus identical with those to which seeds are subjected when placed on sale in small stores. The "dry room" was a class room on the second floor in one of the college buildings. A storeroom in the basement of a private residence, having two sides walled with brick, furnished "basement" conditions.

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[a] Presumably these were in a dry place, but further evidence showed that the presumption was erroneous. The vapors arising while cooking was being done on the stove gave rise to conditions very detrimental to a prolonged life of the seeds.

Wagoner, Ind. T.—The seeds were sent to Wagoner on February 17, 1900. The first series was received in return on June 23, after 126 days; the second set was returned after 238 days, on October 13, 1900. The sets for "trade conditions" were kept in a drug store, on a counter near an open door. The "dry room" was a sleeping room on the first floor of the same building, while "basement" conditions were supplied by keeping the seeds in a large depository vault in a bank.

Durham, N. H.—The two sets of seeds were sent to Durham on February 17, 1900, and were returned on July 14 and October 20, after 117 and 231 days, respectively. The seeds under "trade conditions" were kept over a door at the entrance of one of the college buildings. The door opened into a hall, which led into office rooms, the chemical laboratory, and the basement. An office room on the first floor of the same building supplied "dry room" conditions. The seeds were located well toward the top of the room, which was heated with steam and remained quite dry at all times. The "basement" conditions were found in a storage room in one corner of the basement of the same building.

Ann Arbor, Mich.—The set of samples placed under "trade conditions" was kept in the botanical laboratory, being moved about from time to time in order to supply the necessary variations to an herbarium room, to an open window, and to an attic. From February 18, 1900, until May 12, 1900, the set of seeds under "dry room" conditions was stored in a furnace room. The seeds were only a few feet from the furnace and were always quite dry and warm: The maximum temperature recorded was 43° C., with a mean of 38° during cold weather, and of 30° C. during milder weather. On May 12 this set of seeds was transferred to the herbarium room on the fourth floor of the botanical laboratory, where they remained until vitality tests were made. "Basement" conditions were found in a fruit cellar, having two outside walls and a temperature fluctuating between 10° and 13° C.

These packages and bottles were all securely packed in new cedar boxes from which they were not removed until after their return to the laboratory.

RESULTS OF THE GERMINATION TESTS.

After receipt of the seeds, germination tests were made as rapidly as possible, the results of which are given in the tabulations which follow. Likewise, in each case is shown the vitality of the control sample. Furthermore, a summary of each table is given, showing the average percentages of germination of the seed from the various places for the first and second tests, respectively. From these results the average percentage of loss in vitality has been calculated, reckoning the germination of the control sample as a standard. It is thus a very simple matter to compare the relative merits of the different methods of storing and the rôle they play in promoting the longevity of seeds.

TABLE XII.—*Percentage of germination of beans subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 98.7 per cent; second test, 98.7 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	98	98	98	98	86	98
Do	Second	234	84	98	96	98	0	100
Auburn, Ala	First	102	98	97.5	100	100	97.9	97.5
Do	Second	275	56	98	94	98	66	100
Mobile, Ala	First	140	58	96	82	100	0	100
Do	Second	262	0	90	0	98	....	98
Baton Rouge, La	First	121	96	100	92	100	54	98
Do	Second	247	60	96	28	100	0	98
San Juan, P. R	First	131	100	100	....	....	....	....
Do	Second	....	96	98	....	....	....	....
Wagoner, Ind. T	First	126	96	96	98	100	100	98
Do	Second	238	82	100	....	100	84	98
Durham, N. H	First	147	100	100	100	98	100	100
Do	Second	251	78	96	98	96	92	98
Ann Arbor, Mich	First	....	98	84	98	84	98	92
Do	Second	....	100	100	100	91.5	92	100
Average percentage of germination.	First	128	93	96.44	95.43	97.14	66.99	97.64
	Second	251	69.50	97	69.33	97.36	55.66	98.86
Average percentage of gain or loss in vitality.	First	128	5.78	2.29	3.31	1.58	32.13	1.06
	Second	251	29.59	1.72	29.76	1.36	43.61	+0.10

The beans at Mobile were seriously affected under all conditions except when put up in bottles and thus protected from the moist atmosphere. Those kept in bottles under "trade conditions" deteriorated to 90 per cent, but the result of the first test of the same series indicates that some moisture passed through the cork and that the seeds were injured in that way.

At Baton Rouge the beans retained their vitality somewhat better; but even here all those from the envelopes were practically worthless after 247 days, for beans that germinate only 60 per cent are of no value for planting.

The "trade conditions" at Auburn, Ala., and Durham, N. H., were also very unfavorable to the prolonged vitality of the beans. At Wagoner, Ind. T., San Juan, P. R., and Lake City, Fla., there was a marked deterioration, yet not sufficiently great during the time given to render them worthless for planting. However, it is quite evident that beans subjected to such conditions of storage would not be fit for planting the second season.

A summary of the table shows that the vitality of the beans when kept in bottles and subjected to either of the three conditions was not interfered with. The averages show a variation of less than 2 per cent. With those kept in paper packages the results were quite different, the advantage being slightly in favor of the "trade conditions." The loss in vitality was 29.59, 29.76, and 43.61 per cent, respectively, for "trade conditions," "dry rooms," and "basements."

TABLE XIII.—*Percentage of germination of peas subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 95.3 per cent; second test, 95.7 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	96	97.9	94	94	96	98
Do	Second	234	86	98	92	92	6	98
Auburn, Ala	First	102	93.3	94	87.8	97.8	93.9	94
Do	Second	275	97.9	94	90	96	86	98
Mobile, Ala	First	140	69.2	92	88	96	10.2	98
Do	Second	262	44	100	42	96	....	98
Baton Rouge, La	First	121	94	92	94	90	90	98
Do	Second	247	80	88	70	98	0	98
San Juan, P. R	First	131	94	100	....	....	....	....
Do	Second	....	98	98	....	....	....	....
Wagoner, Ind. T	First	126	98	90	96	92	90	88
Do	Second	238	80	92	....	96	88	92
Durham, N. H	First	147	98	94	100	98	94	98
Do	Second	251	94	98	94.7	96	98	90
Ann Arbor, Mich	First	....	90	94	94	72	96	94
Do	Second	....	98	94	94	92	86	100
Average percentage of germination.	First	128	91.56	94.24	93.4	91.41	81.44	95.43
	Second	251	84.74	95.25	80.45	95.14	60.66	96.28
Average percentage of gain or loss in vitality.	First	128	3.92	1.12	1.99	4.08	14.55	+0.14
	Second	251	11.45	0.47	15.94	0.58	36.62	+0.60

The peas retained their vitality much better than the beans. However, the greatest loss in both peas and beans was in the envelopes at Mobile and Baton Rouge. Some of the samples from the envelopes germinated fully as well or even better than the control, but the general averages of the second tests for all of the localities show a loss of 11.45 per cent in "trade conditions," 15.94 per cent in "dry rooms," and 36.63 per cent in "basements." The beans under identical conditions lost 29.59, 29.76, and 43.61 per cent, respectively.

The seeds kept in bottles deviated but very little from the standard of the control.

TABLE XIV.—*Percentage of germination of cabbage subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 92.7 per cent; second test, 92.4 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	89.5	92.5	89.5	94	86.5	90.5
Do	Second	234	63.5	89.5	81.5	89.5	14.5	94.5
Auburn, Ala	First	102	91	90.5	89.5	81	92	91
Do	Second	275	61.5	90	90	89	60	85.5
Mobile, Ala	First	140	64.5	93.5	58.5	96	58.5	92.5
Do	Second	262	17	87.5	5	95	....	94
Baton Rouge, La	First	121	88.5	93	90.5	91	79.5	94
Do	Second	247	25.5	90.5	11.5	86	0.5	90.5
San Juan, P. R	First	131	82	95.5	....	....	....	....
Do	Second	....	76.2	89	....	....	....	....
Wagoner, Ind. T	First	126	83.5	93	94	95.5	88.5	97.5
Do	Second	238	70.5	91.5	....	92.5	76.5	89
Durham, N. H	First	147	93	97.5	89	96	95.5	94.5
Do	Second	251	12	92.5	93	95.5	92.5	96.5
Ann Arbor, Mich	First	....	96	92	94	90.5	89.5	94.5
Do	Second	....	91	94	88	82	76	95.5
Average percentage of germination.	First	128	86	93.47	86.43	92	84.29	93.5
	Second	251	52.15	90.56	61.5	89.93	53.33	92.21
Average percentage of gain or loss in vitality.	First	128	7.23	+0.83	6.77	0.86	9.07	+0.86
	Second	251	43.56	1.94	33.44	2.67	42.29	0.22

Table XIV shows that the cabbage, like the peas, was injured to a less degree at Mobile and Baton Rouge than the beans, but even the cabbage seed kept in the paper packages in these cities were all but killed. The average degree of injury, however, was greater in the cabbage than in the beans. In a majority of cases there was more or less deterioration in the case of this seed kept in the envelopes. Aside from those already mentioned, the trade conditions at Durham, N. H., and the basement at Lake City, Fla., should be expressly noted.

The seeds kept in the bottles deviated but little from the control, while those kept in paper packages germinated only 52.15, 61.50, and 53.33 per cent for the trade conditions, dry room, and basement—equivalent to a loss in vitality of 43.56, 33.44, and 42.29 per cent, respectively.

TABLE XV.—*Percentage of germination of radish subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 83.6 per cent; second test, 78.8 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination. Trade conditions. Envelopes.	Trade conditions. Bottles.	Dry rooms. Envelopes.	Dry rooms. Bottles.	Basements. Envelopes.	Basements. Bottles.
Lake City, Fla	First	129	79	78.5	84.5	75	66	83
Do	Second	234	58.5	64	67.5	71.5	48.5	67
Auburn, Ala	First	102	75.5	85	85.5	80.5	86.5	85.5
Do	Second	275	63	72.5	66	73.5	60.5	76.5
Mobile, Ala	First	110	58.5	81	56.5	81	75	76
Do	Second	262	51	71.5	49	70	....	72
Baton Rouge, La	First	121	77.5	85.5	73.5	78.5	61.5	78.5
Do	Second	247	55.5	69.5	49.5	71.5	51.5	75
San Juan, P. R.	First	131	64	81.5	....	....	....	....
Do	Second	....	62	73.5	....	....	....	....
Wagoner, Ind. T	First	126	77.5	80.5	79	84	80.5	86.5
Do	Second	238	60.5	75.5	....	77	63	70.5
Durham, N. H	First	117	80.6	75.5	76.5	85	81	74
Do	Second	251	59.5	81.5	71.5	85	68	79
Ann Arbor, Mich	First	....	82.5	85	82.5	79.5	78	82.9
Do	Second	....	77.5	80.5	79.5	57.5	62.5	78.5
Average percentage of germination.	First	128	74.39	81.56	76.86	80.5	75.5	80.91
	Second	251	60.94	73.56	64.33	72.71	59	74.07
Average percentage of loss in vitality.	First	128	11.02	2.44	8.07	3.71	9.67	3.22
	Second	251	22.67	6.65	18.37	7.73	25.13	6

The results of the tests of the radish seed are very similar to those of the cabbage; the latter, however, showed a greater loss in vitality. As shown by the second tests, the average percentages of deterioration of the cabbage seed which was kept in the envelopes were as follows: Trade conditions, 43.56 per cent; dry room, 33.44 per cent; basement, 42.29 per cent, while the loss in vitality of the radish was only 22.67, 18.37, and 25.13 per cent, respectively.

TABLE XVI.—*Percentage of germination of carrot subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 83.3 per cent; second test, 82 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	76.5	83	78	78.5	73	77.5
Do	Second	234	43.5	80.5	67.5	78.5	3	84.5
Auburn, Ala	First	102	84.5	82	83	86	86.5	86.5
Do	Second	275	36	76.5	72.5	76.5	47.5	82.5
Mobile, Ala	First	140	59	87.5	51.5	83.5	20.5	87
Do	Second	262	8.5	86	.5	69	....	78
Baton Rouge, La	First	121	74.3	82.3	75.1	86.8	57.3	82.3
Do	Second	247	25	72.5	16.5	52.5	0	39
San Juan, P. R	First	131	71.5	82.5	....	....	....	....
Do	Second	....	48.5	86.5	....	....	....	....
Wagoner, Ind. T	First	126	81.5	82	77.5	81	77.5	87.5
Do	Second	238	49	81.5	....	81	45.5	84
Durham, N. H	First	147	78	82.5	84	85.5	83.5	82.5
Do	Second	251	2	85.5	87.5	85.5	72	87.5
Ann Arbor, Mich	First	....	76	79	83	75.5	78	83.5
Do	Second	....	86	78	78.5	80	58.5	71
Average percentage of germination.	First	128	75.16	82.6	76.01	82.4	68.04	83.83
	Second	251	37.31	80.87	53.83	74.71	37.75	75.21
Average percentage of gain or loss in vitality.	First	128	9.72	0.84	8.75	1.08	18.32	+0.63
	Second	251	54.5	1.38	34.35	8.89	53.96	9.5

Table XVI shows results very similar to those of Table XV, except that the carrot was affected slightly more than the cabbage. There was also a greater falling off in the case of the seeds kept in the bottles in dry rooms and basements. The reason for this is not very clear. Apparently it was due to some local conditions, inasmuch as it was confined chiefly to the bottles kept at Mobile and Baton Rouge. The average results of the germination tests of the seeds kept in packages are quite low for the carrots. Seed from trade conditions germinated 37.31 per cent, from basements 37.67 per cent, and from dry rooms 53.83 per cent, with a loss in vitality of 54.5, 54.06, and 34.36 per cent, respectively. Under similar conditions the cabbage lost in vitality 43.56, 42.28, and 33.45 per cent, respectively.

TABLE XVII.—*Percentage of germination of "A" sweet corn subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 92.7 per cent; second test, 92.4 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	94	96	94	92	88	98
Do	Second	234	92	100	96	90	54.5	100
Auburn, Ala	First	102	96	98	94	98	100	92
Do	Second	275	88	98	94	90	80	100
Mobile, Ala	First	140	80	100	80	96	94.1	96
Do	Second	262	20	96	26	100	....	96
Baton Rouge, La	First	121	96	94	96	88	86	100
Do	Second	247	88	96	88	96	14	100
San Juan, P. R	First	131	96	94	....	....	....	....
Do	Second	....	92	94	....	....	....	....
Wagoner, Ind. T	First	126	96	98	94	96	96	96
Do	Second	238	90	96	....	96	92	94
Durham, N. H	First	147	100	92	95.9	90	100	96
Do	Second	251	96	96	96	96	100	98
Ann Arbor, Mich	First	....	100	86	94	89	100	96
Do	Second	....	98	98	100	96	92	98
Average percentage of germination.	First	128	94.75	94.75	92.56	94.14	94.87	96.29
	Second	251	83	96.75	83.33	94.86	72.08	98
Average percentage of gain or loss in vitality.	First	128	+2.21	+2.21	0.15	+0.01	+2.34	+3.87
	Second	251	10.11	+4.71	9.81	+2.66	22	+6.06

TABLE XVIII.—*Percentage of germination of "B" sweet corn subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 89.3 per cent; second test, 88.5 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	86	60	90	38	76	46
Do	Second	234	77.1	2	64	0	30	0
Auburn, Ala	First	102	88	92	86	86	86	84
Do	Second	275	62	56	82	38	82	89.6
Mobile, Ala	First	140	48	81.2	60	87.5	75	86
Do	Second	262	12	52	16	54	....	76
Baton Rouge, La	First	121	80	82	84	94	64	88
Do	Second	247	54.2	36	66	46	4.5	61.2
San Juan, P. R	First	131	72	72	....	....	....	....
Do	Second	....	78	71.7	....	....	....	....
Wagoner, Ind. T	First	126	70	82	90	88	84	84
Do	Second	238	78	76	....	88	88	76
Durham, N. H	First	147	89.3	69.5	84.2	83.6	80	80
Do	Second	251	82	91.8	84	88	76	88
Ann Arbor, Mich	First	....	92	88	88	48	88	96
Do	Second	....	80	92	86	22	82	88
Average percentage of germination.	First	128	78.16	78.31	83.17	75.01	79	80.55
	Second	251	65.41	59.70	66.33	48	60.41	68.40
Average percentage of loss in vitality.	First	128	12.47	12.31	6.87	16	11.54	9.80
	Second	251	26.09	32.55	25.06	45.76	31.74	22.71

Tables XVII and XVIII have been considered together, since both have to do with the same variety of sweet corn. The difference in the quality of these two samples was quite marked when the seed was received. Germination tests were made January 30, 1900, and showed 94 per cent for the "A" and 88 per cent for the "B" corn. In November, 1900, samples of seed from the same original packages were tested, giving a germination of 92.4 per cent and 88.5 per cent for the "A" and "B" samples, respectively, as shown in the controls of the above tables. Thus, when two grades of corn are subjected to favorable conditions of storage, both are well preserved; but when subjected to unfavorable conditions, the one of poorer quality is much more susceptible to injury. The "A" sample which was stored in envelopes in trade conditions lost 10.11 per cent, as compared with 26.9 per cent for the "B" sample. The "A" sample which was stored in dry rooms lost only 9.81 per cent, while the "B" sample lost 25.06 per cent. In basements, the "A" sample lost 23 per cent and the "B" sample 31.74 per cent. In both samples the corn in the packages stored in the basement at Mobile was so badly molded at the time the second tests were made that they have been omitted from the table.

The most interesting feature in comparing the results of these two samples is found in the seed which was stored in the bottles. The average results of the "A" samples show a much higher percentage of germination for those from the bottles than the control, while the averages for the "B" sample were much lower than the corresponding controls. The average germination of the "B" sample from the bottles was 59.7 per cent for the trade conditions, 48 per cent for dry rooms, and 68.4 per cent for basements, or a loss in vitality of 32.55, 45.76, and 22.71 per cent, respectively. This difference was due to two causes, first, a difference in the quality of the seed at the beginning of the experiment, and, secondly, the larger amount of water in the second sample, "B." The greater quantity of water present in the seed gave rise to a more humid atmosphere after the seeds were put into the bottles, especially when subjected to higher temperatures than those in which the seeds had been previously stored. This is an important factor always to be borne in mind when seeds are put up in closed receptacles; they must be well dried if vitality is to be preserved.

TABLE XIX.—*Percentage of germination of lettuce subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 81.6 per cent; second test, 92.3 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	87	84	81	76.5	68	77
Do	Second	234	85	92	92.5	90	43.5	95.5
Auburn, Ala	First	102	86.5	85.5	88.5	84.5	84.5	88.5
Do	Second	275	86	90.5	90.5	91	83.5	90
Mobile, Ala	First	140	63	78	58	87.5	1.5	83
Do	Second	262	20	88.5	31	90.5	....	91.5
Baton Rouge, La	First	121	82.5	81.5	79	78.5	70.5	76
Do	Second	247	84.5	93.5	74.5	87.5	.5	92.5
San Juan, P. R	First	131	79	87.5	....	....	....	....
Do	Second	....	83.5	89	....	....	....	....
Wagoner, Ind. T	First	126	78	76	80	82	81	76.5
Do	Second	238	82	92.5	....	91	87.5	89
Durham, N. H	First	117	82.5	80.25	83.25	77.5	80	75.2
Do	Second	251	88.5	93	92	93	90.5	90.5
Ann Arbor, Mich	First	....	82	68.5	81.5	81.5	78.5	72
Do	Second	....	92.5	90	89.5	90.5	88	91.5
Average percentage of germination.	First	128	80.06	80.15	79.18	81.14	66.28	78.31
	Second	251	77.75	91.12	78.33	90.93	65.58	90.78
Average percentage of loss in vitality.	First	128	1.89	1.77	2.97	.56	18.78	4.03
	Second	251	15.76	1.29	15.14	1.49	28.95	1.65

The lettuce has shown no very marked deviation from the controls, save the seeds from the packages kept at Mobile, and those which were stored in basements in envelopes at Baton Rouge and Lake City. The average results of the second series of tests show a similar loss in vitality of all of the seeds from the envelopes. The samples of seed from the bottles germinated practically as well as the controls. The results of the first series of tests are not entirely satisfactory, none of the tests having gone to standard. The low germination of the lettuce in this series was due to inability to properly control the temperature in the germinating pans. The proper temperature for the successful germination of lettuce seed is 20° C., while in this first series the germination tests were unavoidably made at 26° to 27.5° C. Nevertheless, this seeming objection is of little consequence, since all of the results are directly comparable with the control.

TABLE XX.—*Percentage of germination of onion subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 95.8 per cent; second test, 97 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	95	95	95.5	95	80	97.5
Do	Second	234	16.5	95.5	79	96	0	97.0
Auburn, Ala	First	102	96	96.5	96	98.5	97	97.5
Do	Second	275	12	96	96	98	23.5	99
Mobile, Ala	First	140	7	94.5	11.5	96.5	75.5	99
Do	Second	262	0	94.5	0	96.5	[a]0	97.5
Baton Rouge, La	First	121	90	93	94	93.5	35	96.5
Do	Second	217	0.5	97.5	0	65	0	48.5
San Juan, P. R	First	131	81.5	98	....	....	....	....
Do	Second	....	50	96.5	....	....	....	....
Wagoner, Ind. T	First	126	93.5	97.5	95.5	97	96	94.5
Do	Second	238	24.5	95	....	97.5	34	97.5
Durham, N. H	First	147	96.5	96	94.5	96	93	94.5
Do	Second	251	0	97.5	96	97	94	98
Ann Arbor, Mich	First	....	95	96	99.5	97	93	97
Do	Second	....	97.5	97.5	95	96.5	47	98
Average percentage of germination.	First	128	82.19	95.81	83.79	96.21	81.36	96.64
	Second	251	25.12	96.25	61	92.36	33.08	90.86
Average percentage of gain or loss in vitality.	First	128	14.20	+0.01	12.53	+0.43	15.07	+0.87
	Second	251	74.11	1.20	37.12	4.80	65.90	6.33

[a] This test has not been included in making up the averages inasmuch as the seeds were badly molded when put in test.

The onion seeds which were stored in the envelopes were very seriously affected in many of the places. Those from the basement at Lake City, from all of the conditions at Mobile, and from the dry room and basement at Baton Rouge were entirely killed. The seed from trade conditions at Baton Rouge germinated only 0.5 per cent. In many other cases the samples from the envelopes had become practically worthless. In only two instances was there any loss in vitality where the seeds were stored in bottles, viz, the second tests from the dry rooms and basement at Baton Rouge. These two tests have lowered the average results quite materially. If they were not included the averages would be raised to 96.91 and 97.90 per cent, respectively, instead of 92.36 and 90.86 per cent, as given in the table. The average percentages of germination of the seeds from the envelopes were very low in the second test, and were as follows: Trade conditions, 25.12 per cent; dry rooms, 61 per cent, and basements, 33.8 per cent. This represents a loss in vitality of 74.11, 37.12, and 65.9 per cent, respectively.

Onion seed is relatively short lived, and very easily affected by unfavorable external conditions. For this reason onion seed should be handled with the greatest care if vitality is to be preserved for a maximum period. This may be done successfully by keeping the *dry* seed in well-corked bottles, or in any good moisture-proof package.

TABLE XXI.—*Percentage of germination of pansy subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 63 per cent; second test, 53 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	44.5	63	45	58.5	10.5	62.5
Do	Second	234	1.5	54	22.5	47	0	57.5
Auburn, Ala	First	102	57.5	68	66.5	62	60	59.5
Do	Second	275	2	20.5	28	27.5	0	33.5
Mobile, Ala	First	140	3	57.5	2	61	1	59
Do	Second	262	0	20.5	0	25.5	....	2.5
Baton Rouge, La	First	121	28.5	53	38	41	4.5	54
Do	Second	247	0	34	0	17	0	2.5
San Juan, P. R	First	131	20	60.5	....	....	....	....
Do	Second	....	6.5	58.5	....	....	....	....
Wagoner, Ind. T	First	126	48.5	61.5	50.5	62.5	46	59
Do	Second	238	7.5	65	....	59.5	8.5	52.5
Durham, N. H	First	147	55.5	66.5	49.5	63.5	49	63.5
Do	Second	251	0	60.5	44	60.5	36.5	60
Ann Arbor, Mich	First	....	53.5	51	59.5	40	50	53
Do	Second	....	46.5	45	52	48.5	3.5	60.5
Average percentage of germination.	First	128	38.87	60.12	44.43	55.93	31.57	58.64
	Second	251	8	44.75	24.41	40.80	8.08	38.43
Average percentage of loss in vitality.	First	128	38.3	4.57	29.48	11.23	49.89	6.92
	Second	251	84.91	15.60	53.97	23.02	84.76	27.49

TABLE XXII.—*Percentage of germination of phlox drummondii subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 69 per cent; second test, 53.9 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	41.5	78	62	62	20.5	77.5
Do	Second	234	2.5	57	6	25.5	0	63
Auburn, Ala	First	102	61.5	72.5	62	63	65.5	67.5
Do	Second	275	1	56.5	13.5	59	1	65
Mobile, Ala	First	140	0.5	55	0.5	74.5	0.5	58.5
Do	Second	262	0	51.5	0	58.5	....	48.5
Baton Rouge, La	First	121	47.5	62.5	43.5	58.5	2	70.5
Do	Second	247	0	58	0	58.5	0	61.5
San Juan, P. R	First	131	23.5	65	....	....	....	....
Do	Second	....	11.5	61.5	....	....	....	....
Wagoner, Ind. T	First	126	50.5	73.5	61	70	65	75
Do	Second	238	5.5	66	....	57	9.5	47.5
Durham, N. H	First	147	67	74	62.5	45.5	69.5	71.5
Do	Second	251	0.5	62.5	33	30.5	45.5	70
Ann Arbor, Mich	First	....	67	66	75.5	69.5	64.5	72
Do	Second	....	40	54	55	58.5	10.5	61
Average percentage of germination.	First	128	44.87	68.31	52.76	63.28	41.07	70.35
	Second	251	7.62	58.37	17.91	49.64	11.08	59.5
Average percentage of gain or loss in vitality.	First	128	34.97	1	23.54	8.29	40.49	+ 2.01
	Second	251	85.86	+8.27	66.78	7.91	79.45	+10.39

Pansy and phlox have been considered together, since their behavior was almost the same. Both of the controls deteriorated to a considerable degree during the 123 days which elapsed between the time of the first and the second test, pansy losing 15.87 per cent and phlox 21.88 per cent. In both cases the mean loss in vitality of the seeds in the envelopes was very great. The results of the second tests show a loss of 84.91 per cent for pansy, and 85.86 per cent for phlox where stored under trade conditions. In dry rooms there was a mean loss of 53.57 per cent for pansy and 66.78 per cent for phlox, and in basements a loss of 84.76 per cent for the pansy and 79.45 per cent for the phlox. These results are obtained by considering the second test of the control as a standard, the depreciation of the control being disregarded. Some samples were dead and many more were of no economic value. It is especially interesting to note how quickly the seeds died at Mobile, Ala., there being only a few germinable seeds at the end of 140 days.

The behavior of the seeds in the bottles was more or less variable. Some of the pansy seeds showed a higher vitality than the control, but the averages were somewhat lower, the mean loss ranging from 15.60 per cent under trade conditions to 27.49 per cent in basements, while with the phlox the means for trade conditions and for basements were higher than the control by 8.27 and 10.39 per cent, respectively.

TABLE XXIII.—*Percentages of germination of tomato subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 95.5 per cent; second test, 97.5 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	91	91	91	95.5	88.5	91
Do	Second	231	91	98	91	97.5	77	97.5
Auburn, Ala	First	102	95	91.5	93.5	97.5	96	94.5
Do	Second	275	94	98.5	97	91.5	98	96.5
Mobile, Ala	First	140	90	94.5	91.5	96.5	61.5	93.5
Do	Second	262	79.5	97.5	87	95.5	19.5	98
Baton Rouge, La	First	121	91.5	95	91	95	83.5	95
Do	Second	247	96	96.5	93	98	39.5	96
San Juan, P. R	First	131	94	94.5	....	....	....	....
Do	Second	....	96.5	94.5	....	....	....	....
Wagoner, Ind. T	First	126	96.5	97	98	96.5	98.5	96
Do	Second	147	94	98	....	97.5	98.5	93.5
Durham, N. H	First	147	94.5	95	97	94	97.5	96.5
Do	Second	251	87	98	97	99	97.5	97
Ann Arbor, Mich	First	....	89	94	93	91.5	89	92.5
Do	Second	....	98.5	98	98	97.5	95	98
Average percentage of germination.	First	128	93.06	94.81	84	95.21	88.21	94.57
	Second	251	92.44	97.31	94.33	97.07	84.25	97.21
Average percentage of loss in vitality.	First	128	2.56	0.72	1.57	0.30	7.64	0.98
	Second	251	5.20	0.20	3.29	0.44	13.63	0.30

The tomato seed, as shown in Tables V and XXV, was the most resistant to the unfavorable conditions of storage. The seed in the bottles was not injured at any of the places. The lowest germination was 91.5 per cent from the seed kept in a dry room at Ann Arbor, Mich. The seed in the envelopes gave a much wider variation, falling quite low in some of the samples which were stored in the basements. The average losses in vitality for the entire series of the second set of seeds which were kept in envelopes were as follows: Trade conditions, 5.20 per cent; dry rooms, 3.29 per cent; basements, 13.63 per cent. The average percentage of germination of the seed which was kept in the bottles differed from the control less than one-half of 1 per cent.

TABLE XXIV.—*Percentage of germination of watermelon subjected to various conditions of storage in different localities.*

[Germination of control sample: First test, 95.5 per cent; second test, 99 per cent.]

Place of storage.	Order of tests.	Number of days in storage.	Percentage of germination.					
			Trade conditions.		Dry rooms.		Basements.	
			Envelopes.	Bottles.	Envelopes.	Bottles.	Envelopes.	Bottles.
Lake City, Fla	First	129	98	98	96	98	98	100
Do	Second	234	92	96.2	86	98	70	94
Auburn, Ala	First	102	94	94	96	98	99	100
Do	Second	275	86	100	98	98	94	96
Mobile Ala	First	140	98	98	98	100	80	100
Do	Second	262	64	96	68	96	0	100
Baton Rouge, La	First	121	100	98	96	100	98	98
Do	Second	247	92	98	86	100	20	100
San Juan, P. R.	First	131	96	100	....	....	....	....
Do	Second	....	88	100	....	....	....	....
Wagoner, Ind. T.	First	126	98	98	98	100	96	98
Do	Second	238	94	98	....	96	88	98
Durham, N. H	First	147	98	98	100	98	98	96
Do	Second	251	82	96	98	92	94.1	98
Ann Arbor, Mich	First	....	100	100	94	94	98	96
Do	Second	....	96	100	96	92	100	96
Average percentage of germination.	First	128	97.75	98	96.86	98.29	95.29	98.29
	Second	251	86.75	98.02	88.67	96	77.70	97.43
Average pecentage of loss in vitality.	First	128	0.56	0.31	1.47	0.01	3.06	0.01
	Second	251	12.37	0.99	10.44	3.03	21.52	1.59

What has been said of the tomato seed is practically true for the watermelon, save that there was a greater loss in vitality in the latter, when seeds were kept in envelopes. The average percentage of germination of the second tests was 86.75 per cent for trade conditions; 88.67 per cent for dry rooms; and 77.7 per cent for basements, or a loss in vitality of 12.37, 10.44 and 21.52 per cent, respectively, as compared with the vitality of the control sample, which germinated 99 per cent.

An examination of the foregoing set of tables will show that in most cases the deterioration was comparatively slight during the first 128 days. Yet even during this short period the losses in vitality were very marked in some of the more critical localities, particularly at Mobile. However, the greatest loss, as shown by the germination tests, was during the 123 days immediately following.

While seeds, like other living things, are capable of withstanding quite unfavorable conditions for a considerable time without showing any appreciable deterioration in vitality, still the forces destroying vitality are at work. When the turning point is once reached and can be detected by germination tests, the decline is more noticeable and death soon follows.

The preceding tables show that the loss in vitality was very different in the different places. The conditions at Mobile, Ala., proved to be the most injurious, while those at Ann Arbor, Mich., were the most conducive to longevity. These results, however, are given in another part of this paper dealing with the effect of climate on the vitality of seeds. The results are tabulated on pages 18 and 23 and represented diagrammatically on page 24, so that any further discussion at this time is unnecessary.

Likewise each table has been summarized, giving the average percentages of germination and the average percentages of the loss in vitality of each sample of seed for both the first and second tests. These averages include those of the three conditions of storage—trade conditions, dry rooms, and basements—in both envelopes and bottles.

Naturally, the results of the second tests are of the greater importance, and, in order that the results may be readily compared and more critically examined, they have been collected and tabulated herewith:

TABLE XXV.—*Average percentage of germination and average percentages of loss in vitality of the different kinds of seeds when kept under different conditions.*

Kind of seed.	Germination of control sample.	Trade conditions.				Dry rooms.				Basements.			
		Envelopes.		Bottles.		Envelopes.		Bottles.		Envelopes.		Bottles.	
		Germination.	Loss in vitality.	Germination.	Loss in vitality.	Germination.	Loss in vitality.	Germination.	Loss in vitality.	Germination.	Loss in vitality.	Germination.	Loss in vitality.
Tomato	97.5	92.44	5.20	97.31	0.20	94.33	3.29	97.07	0.44	84.25	13.63	97.21	0.30
Sweet corn, "A"	92.4	83	10.11	96.75	+4.71	83.33	9.81	91.86	+2.66	73.08	22	98	+ 6.06
Peas	95.7	84.74	11.45	95.25	.47	80.45	15.94	95.14	.58	60.66	36.62	96.28	+.60
Watermelon	99	86.75	12.37	98.02	.99	88.67	10.44	96	3.03	77.70	21.52	97.43	1.59
Lettuce	92.3	77.75	15.76	91.12	1.29	78.33	15.14	90.93	1.49	65.58	28.95	90.78	1.65
Radish	78.8	60.94	22.67	73.56	6.65	64.33	18.37	72.71	7.73	59	25.13	71.07	6
Sweet corn, "B"	88.5	65.41	26.09	59.70	32.55	66.33	25.06	48	45.76	60.41	31.74	68.40	22.71
Bean	98.7	69.50	29.59	97	1.72	69.33	29.76	97.36	1.36	55.66	43.61	98.86	+.10
Cabbage	92.4	52.15	43.56	90.56	1.94	61.50	33.44	89.93	2.67	53.33	42.29	92.21	.22
Carrot	82	37.31	54.50	80.87	1.38	53.83	34.35	74.71	8.89	37.75	53.96	75.21	9.50
Onion	97	25.12	71.11	96.25	1.20	61	37.12	92.36	4.80	38.08	65.90	90.86	6.33
Pansy	53	8	81.91	44.75	15.60	21.41	53.97	40.80	23.02	8.08	84.76	38.43	27.49
Phlox	53.9	7.62	85.86	58.37	+8.27	17.91	66.78	49.61	7.91	11.08	79.45	59.50	+10.39
Average loss in vitality	......	......	36.63	......	3.92	......	21.19	......	8.08	......	42.28	......	4.51

In comparing the average results shown in Table XXV, it will be seen that different seeds behave very differently under practically identical conditions. The list of seeds has been arranged according to their loss of vitality as represented by those kept in envelopes under trade conditions, as shown in the fourth column. The tomato seed gave a loss in vitality of 5.20 per cent, being the most resistant to the unfavorable climatic conditions. Phlox, on the other hand, germinated only 7.62 per cent, representing a loss in vitality of 85.86 per cent.

Likewise the same seeds behave very differently under slightly different conditions, as will be seen by comparing the percentages of deterioration in the case of seeds kept in envelopes under trade conditions, in dry rooms, and in basements. In dry rooms the order, except the peas, is the same as for trade conditions. The loss of vitality in the seeds stored in the dry rooms was uniformly less than for those stored under trade conditions, excepting for the peas and beans; but in the series from the basements there was great irregularity. The loss in vitality for the most part was uniformly greater than under trade conditions or in dry rooms save in the last five—cabbage, carrot, onion, pansy, and phlox—where the loss was less in the case of those kept in the basements. This indicates that these five species of seed are less susceptible to the evil effects of a moist atmosphere when the temperature is relatively low.

The relative value of these three conditions for storing seeds in paper packets is best obtained by a comparison of the general averages. The average losses in vitaliy for the thirteen different samples of seed which were kept at the eight different stations were as follows: Trade conditions, 36.63 per cent; dry rooms, 21.19 per cent; basements, 42.28 per cent. From these results it is quite clear that seeds put up in paper packages will retain their vitality much better if kept in dry, artificially heated rooms than if they are subjected to trade conditions or stored in basements.

But another comparison needs yet to be made, and is the most important of the series, i. e., the vitality of seeds when kept in closely corked bottles. In the majority of cases there was but little deviation from the control samples, and many of the samples germinated even better where the seeds were kept in bottles. The "A" sweet corn offers the best illustration of the increased germination. At the same time the "B" sample of sweet corn was very much injured. Here are two samples of the same variety of corn behaving very differently when kept in bottles. This difference in vitality is directly attributed to the greater quantity of water in sample "B," showing the necessity of thoroughly drying seeds if they are to be put up in closed vessels. A comparison of the general averages of the bottle samples and of those kept in envelopes indicates that the former is far superior to the latter as a method for preserving the vitality of seeds. Under trade conditions the loss in vitality was 36.63 per cent in envelopes and

3.93 per cent in bottles; in dry rooms, 21.19 per cent in envelopes and 8.08 per cent in bottles; in basements, 42.28 per cent in envelopes and 4.51 per cent in bottles.

The necessary precautions to be taken, if seeds are to be stored in bottles, are (1) a well-dried sample, preferably artificially dried seed, and (2) a cool place for storing, at least a place in which the temperature will not be higher than the temperature at which the seeds were originally dried.

If the above precautions are taken at least two beneficial results will follow: First, protection against moisture, which is of considerable importance, as many seeds are soon destroyed in that way when kept in paper packages. Secondly, vitality will be preserved for a longer period and consequently there will be a more vigorous germination, a better growth of seedlings, and a greater uniformity in the resulting crop.

Having thus shown that seeds retain their vitality in warm, moist climates much better when kept in bottles than when kept in paper packages, the necessity of finding a more suitable method for sending small quantities of seed to such places at once presents itself.

EXPERIMENTS IN KEEPING AND SHIPPING SEEDS IN SPECIAL PACKAGES.

At present the greatest disadvantages in sending out seeds in bottles are the inconvenience and expense involved by this method of putting up seeds. The increased cost of bottles, as compared with the paper packets now so universally employed, the additional labor and expense necessary to put up the seeds, the greater cost in handling and packing the bottles to insure against losses by breakage, and the increased cost of transportation, are all matters of vital importance. Seedsmen claim that the existing conditions of the trade will not admit of their raising the price of seeds sufficiently high to justify the increased expense of glass containers. Although to the seedsmen the preservation or the prolongation of vitality is an important factor, yet the demand is for an inexpensive and at the same time a neat and serviceable package.

Accordingly, duplicate samples of the following-named seeds were put up in special packages, one set being sent to Mobile, Ala., and the other kept at Ann Arbor, Mich. The seeds used for these experiments were beans, peas, cabbage, lettuce, onion, pansy, and phlox.[a]

[a]The lettuce, onion, pansy, and phlox were from the same bulk samples of seeds as those used in the earlier experiments; but the beans, peas, and cabbage used for these tests were from samples received at the laboratory on February 4, 1901. However, the latter three were from the same general stock of seed, differing from those used in experiments already given only in that they were stored during the interval in the warehouse of D. M. Ferry & Co., Detroit, Mich., instead of in the botanical laboratory at the university.

All of these samples were first dried for ten days in an incubator maintained at a temperature of from 30° to 32° C. The amount of moisture in the samples before and after drying, as well as the moisture expelled during the drying process, was as follows:

Moisture test of seeds in special packages.

Kind of seed.	Moisture in air-dried samples.	Moisture remaining.	Moisture liberated.
	Per cent.	*Per cent.*	*Per cent.*
Beans	10.32	4.90	5.42
Peas	9.70	6.00	3.70
Cabbage	4.89	3.47	1.42
Lettuce	5.33	3.80	1.53
Onion	6.48	4.47	2.01
Pansy	4.82	3.13	1.69
Phlox	5.82	4.30	1.52

These well-dried seeds were then put up in seven different kinds of packages:

(1) Double coin envelopes, of much the same quality as those in which seeds are commonly sold.

(2) Bottles of 120 cc. capacity, closed with firm cork stoppers.

(3) Bottles of 120 cc. capacity, corked and sealed with paraffin.

(4) Tin cans having closely fitting lids, the whole being then carefully dipped in paraffin.

(5) Double coin envelopes, as for No. 1, the packets being then dipped in melted paraffin.

(6) Double coin envelopes, the inner one paraffined, the outer envelope being used simply to protect the paraffin and to facilitate ease of handling.

(7) Double coin envelopes, with both the inner and the outer coated with paraffin.

On February 15, 1901, one of each of the above preparations was sent to Mobile, Ala., and stored in a cellar approximately 400 feet back from the bay. After the lapse of 108 days, i. e., on June 3, these samples were received in return, at which time germination tests were made.

The other complete set, retained in the botanical laboratory at Ann Arbor, was subjected to a very moist atmosphere. The samples were kept in a damp chamber made by taking two battery jars of different sizes, the smaller containing the seeds being placed within the larger, which was lined with filter paper and then partially filled with water. The whole was covered with a glass plate, and the atmosphere within was always on the verge of saturation.

A third and an extreme set of conditions was established by keeping some of the paraffined packages immersed in water for twenty-seven days. At the end of that time (March 14) the seeds were tested for germination, as were also those from the unprotected envelopes in the moist chamber. The seeds that were kept under water in the paraffined packages germinated readily and normally, showing no deterioration in vitality; but the seeds from the packages not paraffined, which were kept in the moist chamber, had been injured to an appreciable extent, there being a marked retardation in the germination of all of the species of seed. The cabbage at the end of thirty-six hours had germinated only 11 per cent, as compared with 57.5 per cent for seed from the immersed paraffined package. The relative merits of the two conditions as affecting onion seed may be expressed by a germination of 13.5 per cent and 39 per cent, respectively, after sixty-one and one-half hours. Not only was there a marked retardation, but likewise a reduction in the final percentage of germination, with the single exception of the cabbage. These results can be more carefully studied in Table XXVI.

Germination tests were made of all of the other samples on June 3, 1901, the date when the seeds were returned from Mobile. At this time the seeds in the unprotected envelopes in the moist chamber were so badly molded that no germination tests were made. The samples from Mobile, which were directly comparable with the above, except that they had been stored in a basement, were greatly injured. The beans had deteriorated to 88 per cent, the onion to 27 per cent, the pansy to 8 per cent, while the phlox was dead. However, seed of the other species—cabbage, lettuce, and peas—gave final percentages of germination varying but little from the control, but the slowing down in the rapidity of germination was sufficiently marked to show a corresponding loss in vitality.

With the samples which were put up in bottles, tin cans, and paraffined packages the results were quite different from those given above. In no case was there any marked deviation beyond that which might be justly attributed to ordinary variation, except in the phlox from a tin can which had been stored in the moist chamber in the laboratory. This sample of phlox germinated only 3.5 per cent. Unfortunately, both the pansy and the phlox seeds used for these experiments were not very satisfactory. These samples were at this time nearly two years old and consequently of a low vitality. The tabulated results of the foregoing experiment follow.

TABLE XXVI.—*Vitality of seeds preserved in different kinds of packages.*

Treatment of samples.	Duration of experiment.	Percentage of germination.							
		Beans.	Cabbage.	Lettuce.	Onions.	Peas.	Pansy.	Phlox.	Averages.
	Days.								
Control		94.0	90.2	89.5	97.5	90.0	37.7	42.5	77.34
Ann Arbor, Mich., moist chamber:									
Envelopes	27	80.0	91.0	76.5	90.0	88.0	25.0	0.0	64.35
Bottle, corked	108	98.0	91.5	91.0	93.5	94.0	36.0	31.0	76.43
Bottle, paraffined	108	97.5	93.5	90.5	95.5	90.0	39.5	39.0	77.93
Tin can, paraffined	108	96.0	87.0	90.0	93.0	90.0	35.0	3.5	70.63
Two envelopes, outer paraffined	108	98.0	91.5	91.5	97.0	92.0	33.5	27.5	75.85
Two envelopes, inner paraffined	108	98.0	94.0	89.0	93.0	88.0	21.0	47.0	76.14
Two envelopes, both paraffined	108	96.0	90.5	86.5	95.5	92.0	23.0	38.5	71.57
Two envelopes, both paraffined and immersed in water	27	100.0	88.5	88.5	94.5	90.0	34.5	30.5	75.21
Mobile, Ala., basement:									
Envelopes	108	88.0	86.0	88.0	27.0	96.0	8.0	0.0	56.14
Bottle, corked	108	98.0	91.0	90.5	95.5	84.0	34.5	32.5	75.14
Bottle, paraffined	108	98.0	90.5	92.5	95.5	92.0	31.5	41.5	78.21
Tin can, paraffined	108	96.0	88.0	95.0	96.0	88.0	26.0	23.0	73.14
Two envelopes, outer paraffined	108	94.0	90.5	89.0	95.5	92.0	29.5	34.0	74.73
Two envelopes, inner paraffined	108	96.0	92.0	88.0	90.0	98.0	33.0	38.0	76.43
Two envelopes, both paraffined	108	100.0	92.0	89.5	88.5	90.0	25.5	33.5	74.14

Subsequent experiments were made, using envelopes of different qualities, as well as varying the treatment of the packages. Samples of cabbage, lettuce, and onion seed were put up as follows:

(*a*) The regular seedsmen's envelope, made of a heavy grade of manila paper.

(*b*) Envelopes made of a medium quality of waterproof paper.

(*c*) Envelopes made of a thin parchment paper.

(*d*) Envelopes made of the same quality of parchment paper as for the preceding series, but paraffined previous to being filled with seed. The packages were then sealed by redipping the open ends.

(*e*) Envelopes of parchment paper, as for the two preceding series, except that the envelopes were first filled with seed, sealed, and then the entire package was dipped in paraffin at a temperature of from 55° to 60° C.

Samples of all of these packages were then stored under trade conditions and in dry rooms in Ann Arbor, Baton Rouge, and Mobile. The exact conditions of storage in the different places were the same as described on pages 49 and 50.

The samples were put up on May 20, 1901. The period of storage ended on November 26, having continued 190 days. Unfortunately, no special precautions were taken to dry the seeds. They were simply air-dried samples; hence they contained a quantity of moisture sufficiently large to give rise to an increased relative humidity of the confined air in the paraffined packages. This increased humidity was accompanied by a greater activity within the cells, and consequently by a greater deterioration of vital force. For this reason the results are not as definite as the conditions warrant. Nevertheless, some important facts were brought out by the experiments which justify their being discussed and tabulated (in part) at this time.

TABLE XXVII.—*Vitality of seed preserved in paraffined packages.*

Kind of seed.	Trade conditions, seeds put up in—			Dry room, seeds put up in—		
	Paraffined envelopes.	Parchment envelopes, then dipped in paraffin, at 50° to 60° C.	Seedsmen's packages.	Paraffined envelopes.	Parchment envelopes, then dipped in paraffin, at 50° to 60° C.	Seedsmen's packages.
Cabbage:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Ann Arbor, Mich	91	90	86.5	90.5	85.5	86.5
Mobile, Ala	30.5	57.5	8.5	38	50.5	5
Baton Rouge, La	70	63	22.5	73.5	79.5	35.5
Lettuce:						
Ann Arbor, Mich	89.5	89.5	96.5	91.5	90	93
Mobile, Ala	80	75	64	78	78.5	61.5
Baton Rouge, La	81.5	77.5	74	82	73.5	72.5
Onion:						
Ann Arbor, Mich	91	90	93	91.5	89	89
Mobile, Ala	0	4	0	0	4.5	0
Baton Rouge, La	1	20	0	5	40	0
Average	59.39	62.94	49.44	61.11	65.66	49.22

In the first place, the injury resulting from the effect of the climatic influences is quite well marked in the above table. The conditions at Mobile and Baton Rouge were much more detrimental to the life of the seeds than were the conditions at Ann Arbor. Secondly, the differences in the preservation of vitality of those seeds stored under trade conditions and of those kept in dry rooms were much less marked than they were in earlier experiments. This is probably accounted for by the marked difference in the two seasons. The summer of 1900 was extremely wet in the South, especially at Mobile, while the summer of 1901 was exceptionally dry. Concerning the conditions Zimmer Brothers wrote on November 26, 1901, as follows:

> We do not think you will find much difference in the two packages. The season this year has been very dry, with no rain since the big August storm; in fact, we do not remember such a dry season in thirty years.

Although the season was exceptionally dry at Baton Rouge and Mobile, the loss in vitality was very great in comparison with the loss at Ann Arbor, demonstrating very clearly that climatic influences play a very important part in the storage of seeds.

This table shows the relative resisting powers of lettuce, cabbage, and onion seed, the lettuce being most resistant and the onion least resistant, as shown in a preceding table. However, the chief purpose of this series of experiments was to demonstrate the relative value of different packages as a means of putting up seeds.

In Table XXVII it will be observed that the results obtained from the waterproof and parchment paper envelopes have been omitted. These omissions have been made because the results were practically identical with those of the ordinary seedsmen's packets; but the comparisons to be made between the ordinary paper packets and the paraffined packages are worthy of consideration. The envelopes that were paraffined after being filled with seed gave the best results. This difference, however, was due not to the special treatment but to the higher melting point of the paraffin. The average percentages of germination of the three samples of seed kept under trade conditions in the three localities were 59.39 per cent for the envelopes previously paraffined, 62.94 per cent for the envelopes dipped in paraffin after being filled with seed, and 49.44 per cent for the seedsmen's envelopes. In dry rooms the results were 61.11, 65.66, and 49.22 per cent, respectively. These averages were somewhat higher than the true conditions of Baton Rouge and Mobile warrant, as the results of the germination tests from all of the packages retained at Ann Arbor showed but little variation. Taking the three samples of seed which were stored under trade conditions in Mobile, the average percentage of germination was 24.2 for the seed from the nonparaffined package and 45.5 per cent for the seed from the paraffined package, showing a loss in vitality of 77.3 and 49.5 per cent, respectively, considering the germination of the Ann Arbor sample as a standard. At Baton Rouge the results were slightly better; the average percentages of germination were 32.2 for the seeds from the nonparaffined and 53.5 per cent for the seeds from the paraffined packages, representing a loss in vitality of 65 and 40.5 per cent, respectively. While in either case the loss was very great, still the advantages of the paraffined packages are worthy of consideration for the reason that a prolongation of life for only a few weeks is frequently of the greatest importance, particularly in districts where much fall planting is done.

In this connection may be given the results of some other tests, which really were a part of this same experiment, but included only onion seed. This seed was put up in seedsmen's envelopes and in paraffined envelopes like those previously described. In addition, seed was also put up in small bottles, which were corked. These packages were kept in a small box within a suit case carried on two trips across the Atlantic and on a tour through Central Europe, thus subjecting them to very variable conditions. Germination tests gave the following results: Seed from the ordinary packages, 77 per cent; paraffined envelopes, 90 per cent; bottles, 91 per cent.

To test more thoroughly the keeping qualities of seeds in paraffined packages and in bottles, another series of experiments was begun on December 20, 1901. For these tests only cabbage and onion seeds were used, but each with three different degrees of moisture: (1) Seed from the original packages, i. e., air-dried samples, the cabbage having a water content of 5.80 per cent, and the onion 6.48 per cent. (2) Air-dried samples were exposed in a moist atmosphere under a bell jar for two days, during which time the cabbage absorbed 1.83 per cent of water and the onion 2.41 per cent, thus raising the water content to 7.63 and 8.89 per cent, respectively. (3) Air-dried seeds which were dried in an incubator for eight days at a temperature varying from 27° C. to 39° C. During this interval 2.05 per cent of water was expelled from the cabbage and 3.11 per cent from the onion seed, leaving a water content of only 3.75 per cent in the former and 3.37 per cent in the latter.

Each of the samples, treated as just described, was put up in three different kinds of packages: (1) Seedsmen's regular seed envelopes. (2) Similar envelopes which were parafined, after being filled with seed, at a temperature of from 70° to 75° C. The melting point of the paraffin was 53° C. (3) In bottles which were closed with firm cork stoppers.

One of each of the above packages was then stored at Mobile under trade conditions and in a basement; likewise at Ann Arbor in the herbarium room of the botanical laboratory, in a greenhouse, and in an incubator maintained at 40° C. The duration of this experiment was 131 days, from December 20, 1901, to April 30, 1902. The results of the germination tests are given in Table XXVIII. Two percentages have been given for the control sample, one for Ann Arbor and the other for Mobile. This was necessary since the two series were tested at different times and comparisons can not be made interchangeably between the two.

TABLE XXVIII.—*Vitality of cabbage and onion seed as preserved in various kinds of packages and subjected to different conditions of storage.*

[Germination of control samples—Ann Arbor: Cabbage, 81.7 per cent; onion, 74 per cent. Mobile: Cabbage, 88 per cent; onion, 84.5 per cent.]

Kind of seed and package.	Special treatment of package.	Percentage of water content of seed.	Percentage of germination.					
			Ann Arbor, Mich.				Mobile, Ala.	
			Botanical laboratory.	Trade conditions.	Greenhouse.	Incubator at 40° C.	Trade conditions.	Basement.
Cabbage:								
Envelope	None	5.80	81.0	81.0	68.0	72.5	60.0	10.0
Do	Paraffin	5.80	80.0	79.0	85.5	62.0	87.5	52.5
Bottle	Corked	5.80	79.5	85.0	85.0	68.5	84.0	84.0
Envelope	None	7.63	85.5	80.5	65.5	71.5	61.5	15.5
Do	Paraffin	7.63	80.5	82.0	83.5	69.5	86.5	46.5
Bottle	Corked	7.63	80.5	85.0	86.5	48.0	82.0	91.5
Envelope	None	3.75	76.0	85.5	67.0	73.0	61.0	9.0
Do	Paraffin	3.75	86.0	84.0	76.0	71.0	82.5	78.0
Bottle	Corked	3.75	83.0	84.0	71.0	64.5	82.5	85.0

TABLE XXVIII.—*Vitality of cabbage and onion seed as preserved in various kinds of packages and subjected to different kinds of storage*—Continued.

Kind of seed and package.	Special treatment of package.	Percentage of water content of seed.	Percentage of germination. Ann Arbor, Mich. Botanical laboratory.	Ann Arbor, Mich. Trade conditions.	Ann Arbor, Mich. Greenhouse.	Ann Arbor, Mich. Incubator at 40° C.	Mobile, Ala. Trade conditions.	Mobile, Ala. Basement.
Onion:								
Envelope	None	6.48	78.5	69.5	3.5	47.0	19.5	10.0
Do	Paraffin	6.48	76.5	66.5	67.0	4.5	83.0	27.0
Bottle	Corked	6.48	73.5	71.5	60.0	61.0	86.0	82.5
Envelope	None	8.89	71.5	60.0	11.5	28.0	21.0	2.5
Do	Paraffin	8.89	71.5	66.0	56.0	9.0	71.5	21.0
Bottle	Corked	8.89	78.0	68.0	67.5	3.0	77.5	78.5
Envelope	None	3.37	61.5	63.5	8.5	? 6.0	17.0	6.0
Do	Paraffin	3.37	75.5	72.5	58.0	? 9.0	77.0	60.5
Bottle	Corked	3.37	76.5	71.0	77.0	59.5	84.5	81.5

Many of the points brought out by this table are very similar to those of the preceding one, yet the differences are sufficiently marked to justify its being given in this connection. The seeds stored in the botanical laboratory and those subjected to trade conditions at Ann Arbor have germinated practically the same, the cabbage slightly favoring trade conditions and the onion being better preserved in the laboratory. But a comparison of the trade conditions at Ann Arbor and Mobile in the unprotected packages shows the same wide variation that has been already pointed out.

The advantage of drying is not very clearly brought out in this table; in many cases there seems to have been a slight injury as a result of the high temperature at which the drying was done. Unavoidably the temperature at that time reached 39° C., which, as has already been stated, is slightly above the maximum to which seeds can be subjected for any considerable time without injury. The injury due to heat is very evident in the samples stored in the incubator maintained at 40° C., this injury being more apparent with the increased moisture, especially in the paraffined package and in the bottle. However, on the whole the percentages of germination are higher for the dried seed than for the seed which had absorbed an additional quantity of moisture; and, indeed, the comparison should properly be made with these two, for seeds as they are usually stored contain even higher percentages of moisture than either the cabbage or lettuce after they had absorbed the additional amount of water.

But the chief purpose of the present experiments was to determine the relative advantages of envelopes, paraffined packages, and bottles as methods of putting up seed in order that vitality might be preserved for a longer time. This comparison is best made by considering the vitality of the seed stored in the greenhouse at Ann Arbor and under trade conditions at Mobile. It will be readily seen that the vitality of the seed from the unprotected packages was greatly reduced, while those from the paraffined envelopes and from the bottles germinated nearly as well as the controls. These differences are better represented diagrammatically, as follows:

Diagram representing the percentages of germination of cabbage seed when treated as described.

Kind of package.	Special treatment of package.	Percentage of water content of seeds.	Ann Arbor, Mich., greenhouse.	Mobile, Ala., trade conditions.
Envelope	....	5.80	73.3	60
Do	Paraffined	5.80	92.1	87.5
Bottle...........	Corked	5.80	91.5	84
Envelope	....	7.63	70.5	64.5
Do	Paraffined	7.63	89.9	86.5
Bottle...........	Corked	7.63	93.1	82
Envelope	....	3.75	72.1	64
Do	Paraffined	3.75	81.8	82.5
Bottle...........	Corked	3.75	79.7	82.5
Control sample .	Original package.	5.80	88	88

Diagram representing the percentages of germination of onion seed when treated as described.

Kind of package.	Special treatment of package.	Percentage of water content of seeds.	Ann Arbor, Mich., greenhouse.	Mobile, Ala., trade conditions.
Envelope	....	6.48	4	19.5
Do	Paraffined	6.48	76.6	83
Bottle...........	Corked	6.48	68.6	86
Envelope	....	8.89	13.2	21
Do	Paraffined	8.89	64	74.5
Bottle...........	Corked	8.89	77.3	77.5
Envelope	....	3.37	9.7	17
Do	Paraffined	3.37	66.3	77
Bottle...........	Corked	3.37	88	84.5
Control sample..	Original package.	6.48	84.5	84.5

The percentages for Ann Arbor shown in the graphic representations are not the same as those given in the foregoing table. In the diagram they are directly comparable with the results from the Mobile series, all being based on the vitality of the controls, as shown by the tests made at that time, the standard being 88 per cent for the cabbage and 84.5 per cent for the onion.

A discussion here hardly seems necessary, as there can be no doubt that seeds retain their vitality much better in moist climates if protected from the action of the atmosphere. This may be accomplished by dipping the packages in paraffin or by putting the seed in bottles. Disregarding the expense, bottles surpass paraffined envelopes as a means for the preservation of vitality, and also in the ease with which the seed can be put up. The results are more certain if care is exercised in selecting good corks.

RESPIRATION OF SEEDS.

From a practical point of view it has been conclusively shown that moisture is the controlling factor in seed life. Seeds stored in a humid atmosphere soon lose their vitality, but if carefully dried and protected from moisture life is greatly prolonged.

The question at once presents itself: In what way does the presence of increased quantities of moisture cause a premature death of the seed, or why is vitality prolonged if the water content of the seed be reduced?

In a measure, the answer to this question is *respiration*. Seeds as we commonly know them absorb oxygen and give off carbon dioxid; that is, respire.[a] During their respiratory activities the energy stored within the seed is readily evolved, the vital processes are destroyed, and life becomes extinct. The intensity with which respiration takes place is largely dependent upon the humidity of the surrounding atmosphere, which ultimately resolves itself into the amount of water in the seed. The respiratory activity is directly proportional to the quantity of moisture absorbed by the seed up to a certain point, attaining its maximum during the process of germination. It has been found that a decrease in the water content results in a corresponding diminution in the intensity of respiration and consequently in a prolongation of the life of the seed as such.

Bonnier and Mangin[b] were the first to show that respiration in living plants increases with an increase in the humidity in the surrounding air. As this is true for growing plants, it is even more marked in stored seeds. Maquenne[c] suggested that a reduction in moisture is accompanied by a reduction in respiration, but at that time no experiments had been made to show that such was actually the case.

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[a] Kolkwitz (Ber. d. deutsch. Bot. Ges., **19**: 285–287, 1901) reports respiration in recently ground seeds.

[b] Ann. sc. nat. bot., ser. 7, **2**: 365–380, 1885.

[c] Ann. Agron., **26**: 321–332, 1900.

In 1832, Aug. Pyr. De Candolle wrote in the second volume of his Physiologie Végétale that the vitality of seeds would be prolonged if they were buried sufficiently deep in the soil to protect them from oxygen (or air) and moisture. Unfortunately, De Candolle did not discover the true cause of this prolonged life, for nowhere did he make any reference to respiration. Nevertheless his general conclusions were properly drawn. De Candolle also stated that light accelerates evaporation in seeds and thus causes a premature death. Here, however, his results were wrongfully interpreted. These conclusions are applicable only in case of seeds that die if allowed to become dry. The real effect of light is to cause a slightly accelerated respiration and consequently a greater deterioration in vitality. Jodin[a] states that light accelerates respiration to a marked degree. His experiments were with peas which contained 10 to 12 per cent of moisture. Two samples of peas were placed, each under a bell jar, over mercury. One sample was kept in the light and the other in the dark. At the end of 4 years 6 months and 14 days an analysis of the confined air from the sample kept in the light gave the following results:

Peas, 3.452 grams, in air, in light:	Per cent.
Oxygen	19.1
Nitrogen	78.6
Carbon dioxid	1.2

At the end of 4 years 7 months and 14 days an analysis of a sample of air taken from the other chamber was as follows:

Peas, 3.580 grams, in air, in dark:	Per cent.
Oxygen	20.8
Nitrogen	79.1
Carbon dioxid	.1

The 3.452 grams of peas that were subjected to the influence of the action of light had absorbed, in the given time, 2.4 cc. of oxygen and produced 1.8 cc. of carbon dioxid. The seed kept in the dark showed but little signs of respiratory activity. Germination tests of the former showed the peas to be dead, while five peas from the sample kept in the dark germinated perfectly.

While there is no question that light exerts some influence on respiration, still the above results do not furnish sufficient data to establish the fact that respiration practically ceases in the absence of light. In fact, experiments have shown that respiration is also quite marked in case of seeds stored in the dark, and the difference is very slight if the same temperature be maintained.

Van Tieghem and Bonnier, in their "Recherches sur la vie latente des graines,"[b] demonstrated that 7.976 grams of peas, sealed, in air,

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[a] Ann. Agron., **23**: 433–471, 1897.

[b] Bul. Soc. bot. France, **29**: 25–29, 1882.

in a tube, respired quite freely. After the lapse of two years an analysis of the confined air gave the following results:

	Per cent.
Oxygen	14.44
Nitrogen	81.74
Carbon dioxid	3.82

These same seeds germinated 45 per cent and had increased $\frac{1}{790}$ of their original weight.

In the experiments of the writer it was found that 40.1150 grams of air-dried beans liberated 7.7 cc. of carbon dioxid in 370 days. The concentration of the carbon dioxid in the flask at the time the gas was drawn for analysis was 1.54 per cent. This sample of seed germinated 97 per cent, and there was only a very slight retardation in germination, which indicated that the vitality had not been materially reduced. During this time there was a slight decrease in the weight of the seed—0.19 per cent. At the same time two check bottles were set up, one containing 40.1184 grams of beans known to be dead, and the other bottle containing nothing except air. Analyses of the air from these two bottles gave the same results as samples of air drawn from the laboratory. These preparations were kept in subdued light throughout the experiment.

That respiration may take place in the dark, that it is very intense if much moisture be present, and that intensive respiration is accompanied by a rapid loss in vitality is shown by the following experiments. On April 3, 1900, samples of beans, cabbage, carrot, lettuce, and onion were sealed, each in bottles of 250 cc. capacity, and were stored in a dark room which was maintained at a temperature of from 20° to 25° C. These samples were first carefully weighed and then placed in a damp chamber for 175 hours, so that an additional quantity of moisture could be absorbed.

Control samples of air-dried seeds were also kept in sealed bottles and subjected to the same subsequent treatment. After the lapse of one year analyses of the confined gases and germination tests of the seeds were made, the results of which are given with the general details.

Beans.—Of beans, 24.9994 grams absorbed 4.70 per cent of water while in the damp chamber. The respiration during the year was equivalent to 2.5 cc. of carbon dioxid. The loss in weight was only 0.05 per cent, but the vitality had fallen from 100 to 86 per cent, as shown by the control.

Cabbage.—Of cabbage seed, 10 grams, with an additional 9.79 per cent of water, were used for this test. During the year this sample of cabbage seed had given off 24 cc. of carbon dioxid, an equivalent of 2.4 cc. of carbon dioxid per gram of seed per year. The control sample germinated 89 per cent, but this seed was dead.

Carrot.—Of carrot seed, 10 grams were allowed to absorb during 175 hours an additional 10.25 per cent of water. In one year 27 cc. of carbon dioxid were produced, giving a concentration of carbon dioxid of nearly 12 per cent. The deterioration in vitality was from 84 to 0 per cent, as compared with the control.

Lettuce.—Of air-dried lettuce seed, 10 grams were allowed to absorb an additional 8.87 per cent of water. During the experiment 19.5 cc. of carbon dioxid were formed, an equivalent of approximately 10 per cent of the original volume of the inclosed air. These seeds were all killed. The control sample germinated 94 per cent.

Onion.—Of air-dried onion seed, 10 grams were allowed to absorb an additional 10.11 per cent of water. The seed gave off 26.5 cc. of carbon dioxid during the experiment and deteriorated in vitality from 97 to 0 per cent.

A bottle containing 4 cc. of water was also sealed at the same time and served as a check for the other analyses. A sample of air taken from this bottle gave the same results as the original air sample.

It is a matter of much regret that no analyses could be made of the air from the bottles which contained the check samples. These bottles contained the same weight of air-dried seeds as was used for the experiments. Unfortunately the seals on these bottles had become dry and admitted of an exchange of gases, so that the results were not reliable.

Another series of experiments consisted in keeping onion seeds in sealed bottles for 1 year and 13 days, with the following results:

(*a*) Fifty grams of air-dried seed were sealed, in air, in a bottle of 500 cc. capacity. There was an increase in the weight of the seeds of 0.1091 gram—slightly more than 0.2 per cent. An analysis of the inclosed gas gave:

	Per cent.
Oxygen	12.27
Nitrogen	85.87
Carbon dioxid	1.86

(*b*) Fifty grams of air-dried seed were sealed, in air, in a 500 cc. bottle, with 4 cc. of water in a small test tube at the bottom of the bottle. Nearly all of the water was absorbed by the seeds, there being an increase in weight of 3.6475 grams, or 7.3 per cent. The composition of the inclosed air was:

	Per cent.
Oxygen	None
Nitrogen	86.65
Carbon dioxid	13.35

The oxygen had all been consumed and the seeds were all dead.

(*c*) Fifty grams of onion seed were sealed in a 500 cc. bottle, in a mixture of illuminating gas and air. The increase in weight was only 0.04 per cent. An analysis of the inclosed gas was as follows:

	Per cent.
Oxygen	3.23
Carbon dioxid	1.21
Methane and nitrogen	95.96

(*d*) Another 50-gram sample of onion seed, belonging to a different series, was sealed in a bottle of 300 cc. capacity, and showed the following composition of the inclosed air:

	Per cent.
Oxygen	8.02
Nitrogen	85.17
Carbon dioxid	6.81

In only one case was there any deterioration in vitality, namely, where the large quantity of moisture was present. The other samples germinated normally. The seed kept in the illuminating gas germinated even better than the control.

In all of the bottles there was a marked decrease in pressure, showing that the volume of oxygen absorbed was much greater than the volume of the carbon dioxid given off.

During respiration certain chemical changes must be taking place which exert a marked influence on the vitality of seeds. What these changes are is a question yet to be solved. The protoplasts of the individual cells gradually but surely become disorganized. C. De Candolle[a] takes the view, in discussing the experiments of Van Tieghem and Bonnier, that during respiration life is simply subdued. But the period of subdued activity, he says, is comparatively short, for respiration soon ceases and life becomes wholly latent. As a result of his own experiments in storing seeds at low temperatures he concludes that seeds cease to respire and become completely inert; in which case they can suffer any degree of reduction in temperature without being killed. The killing of the seeds experimented with (lobelia) he attributes to the fact that the protoplasm had not become inert, but simply subdued, and the seeds were thus affected by the low temperature.

As a result of later experiments C. De Candolle,[b] in keeping some seeds under mercury to exclude air, concludes that "seeds can continue to subsist in a condition of complete vital inertia, from which they recover whenever the conditions of the surrounding medium permits their 'energids,' or living masses of their cells, to respire and assimilate." He compares the protoplasm in latent life to an explosive mixture, having the faculty of reviving whenever the conditions are favorable. This comparison seems rather an unfortunate one; yet, within a certain measure it is probably true.

[a] Revue Scientifique, ser. 4, **4**: 321–326, 1895.
[b] Pop. Sci. Monthly, **51**: 106–111, 1897.

It is now quite generally accepted that respiration is not absolutely necessary for the maintenance of seed life, notwithstanding the fact that Gray contended that seeds would die of suffocation if air were excluded.[a] The experiments of Giglioli[b] in keeping seeds of *Medicago sativa* immersed in various liquids for approximately sixteen years, after which many responded to germination tests, has done much toward demonstrating the fact that seeds can live for a considerable time in conditions prohibiting respiration.

Kochs[c] succeeded in keeping seeds for many months in the vacuum of a Geissler tube without being able to detect the presence of any carbon dioxid, and consequently he concluded that there was no gas given off by intramolecular respiration.

Romanes[d] kept various seeds in vacuum in glass tubes for 15 months and the seeds were not killed. However, his vitality tests can not be considered as entirely satisfactory. In the first place, the number of seeds used (ten) was too small; secondly, the variations in the results, even in the controls, indicate that the samples were not of very good quality.

In the experiments of the writer cabbage and onion seed were kept in a vacuum over sulphuric acid for 182 days. During this time all of the free water had been extracted from the seed. When again connected with a vacuum gauge the dial showed that there was not the slightest change in pressure, and that consequently no evolution of gases had taken place. The cabbage germinated 75 per cent and the onion 73 per cent as compared with 81 and 74 per cent, respectively, for the controls.

The results of the various experiments above given demonstrate quite fully that the vitality of seeds, as we commonly know them, is not interfered with if they are kept in conditions prohibiting respiration. Brown and Escombe[e] hold that all chemical action ceases at temperatures of liquid air. They accordingly conclude that "any considerable internal chemical changes in the protoplasts are rendered impossible at temperatures of -180° to -190° C., and that we must consequently regard the protoplasm in resting seeds as existing in an absolutely inert state, devoid of any trace of metabolic activity and yet conserving the potentiality of life * * * And since at such low temperatures metabolic activity is inconceivable an immortality of the individual protoplasts is conceivable providing that the low temperatures be maintained."

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[a] Amer. Jour. of Sci., 3d series, **24**: 297, 1882.
[b] Nature, **52**: 544, 1895.
[c] Biol. Centrbl., **10**: 673–686, 1890.
[d] Proc. Roy. Soc., **54**: 335–337, 1893.
[e] Ibid., **62**: 160–165, 1897–98.

Giglioli[a] arrived at practically the same conclusions when he said:

It is a common notion that life, or capacity for life, is always connected with continuous chemical and physical change * * * The very existence of living matter is supposed to imply change. There is now reason for believing that living matter may exist, in a completely passive state, without any chemical change whatever, and may therefore maintain its special properties for an indefinite time, as is the case with mineral and all lifeless matter. Chemical change in living matter means active life, the wear and tear of which necessarily leads to death. Latent life, when completely passive in a chemical sense, ought to be life without death.

But even though ordinary respiratory exchanges are not necessary for the maintenance of vitality, and granting that intramolecular respiration does not occur in the resting protoplasts, there is no experimental evidence pointing to the fact that all chemical action ceases, although some writers, as has already been shown, maintain the view that living matter may exist in a completely passive state. If "completely passive" meant devoid of respiratory activities none would dare dissent; but that seeds are entirely quiescent under any known conditions has not been proved. To conceive of all activity ceasing within the seed under certain conditions, and that with such cessation of activity an immortality of the seed is possible, i. e., if such conditions continue to exist, is, from our present knowledge of the chemistry and behavior of the living cell, impossible. In Giglioli's experiments respiration was undoubtedly prevented, and, according to his own conclusions, vitality should have been preserved, for he says "in the absence of any chemical change the special properties may be maintained indefinitely." But, in his own experiments, the special properties were not maintained, for all of the seeds with which he experimented deteriorated very much, and many died. Granting that those which suffered the greatest loss in vitality were injured by the presence of the particular gas or liquid used there remain no means of accounting for the deterioration in those giving the highest percentages of germination. His experiments were made for the most part with *Medicago sativa*, which, under ordinary conditions of storage, is especially long lived. Samek[b] has shown that seed of *Medicago sativa* 11 years old was capable of germinating 54 per cent. Giglioli succeeded in getting a germination of only 56.56 per cent after a little more than 16 years in hydrogen, and 84.20 per cent when they had been kept in carbon monoxid. Jodin[c] kept peas immersed in mercury for 4½ years and they germinated 80 per cent. After 10 years the vitality had fallen to 44 per cent. Nobbe obtained a germination of 33 per cent in peas 10 years old which had been stored under normal conditions. Likewise the experiments of Brown and Escombe do not justify the

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[a] Nature, **52**: 544–545, 1895.

[b] Tirol. landw. Blätter, **13**: 161–162, 1894.

[c] Ann. Agron., **23**: 433–471, 1897.

conclusions which they have drawn. It is now definitely known that all chemical actions do not cease at the temperature of liquid air. Thus it can not be granted that the protoplasm becomes inert as a result of the reduction in temperature. Maquenne[a] more nearly expressed the true conditions applicable to low temperatures when he wrote that with dessication, at low temperatures, seeds are transformed from a condition of diminished activity into a state of suspended life. But there are still other factors to be considered. The vegetative functions may cease, metabolic processes may be at a standstill, intramolecular respiration need not exist, yet vitality is not, nor ever has been, preserved; sooner or later life becomes extinct. What does this signify? The gradual process of devitalization means chemical change, and chemical change means activity within the cells. We must not forget the great complexity of the composition of the protoplasmic bodies which go to make up a seed. The chemistry of the living cell is still surrounded by many difficulties and is likewise filled with many surprises, and before the question of the vitality of seeds can be understood a more comprehensive knowledge of both the functions and composition of the cell contents is necessary.

It is well known that all organic compounds are made up of a very few elementary substances, but the numerous and obscure ways in which they are put together furnish questions of the greatest perplexity. Substances having the same elements may differ widely as to their properties. Moreover, isomeric substances—i. e., those having the same elements in the same proportions, giving an equivalent molecular weight—are usually very different in their chemical reactions and physiological functions. As yet this intramolecular atomic rearrangement is but vaguely understood, and the writer ventures to suggest that with a more comprehensive knowledge of the chemistry of the living cell some such chemical activity will be discovered. With these discoveries will come, perhaps, an understanding of the devitalization of seeds, and with it the theory of the immortality of seeds will vanish.

SUMMARY.

(1) Seeds, like other living organisms, respire when subjected to normal conditions of storage.

(2) Respiration means a transformation of energy, and consequently a premature death of the seed.

(3) Within certain limits respiration is directly proportional to the amount of water present in the seeds and to the temperature at which they are stored.

(4) By decreasing the water content of seeds respiration is reduced and vitality greatly prolonged.

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[a] Compt. Rend., **134**: 1243–1246, 1902.

(5) In most seeds the quantity of oxygen absorbed greatly exceeds the quantity of carbon dioxid evolved.

(6) Respiration is nearly as active in the dark as in the light.

(7) Respiration apparently is not necessary for the maintenance of seed life.

(8) A cessation of respiration does not mean a cessation of chemical activities.

ENZYMES IN SEEDS AND THE PART THEY PLAY IN THE PRESERVATION OF VITALITY.

During the past decade the so-called unorganized ferments have taken an important place among the subjects of biological research. Our knowledge of their wide distribution has increased many fold. The part they play in both anabolism and catabolism has furnished us many surprises, but with all of the work that has been done our knowledge of these most complex compounds is very limited.

The part that enzymes play in the processes of germination is of the utmost importance. It is now quite well understood that they are developed as germination progresses. They act on the most complex reserve food products, converting them into simpler substances that can be more readily utilized by the growing seedling.

However, even in this connection there is a great diversity of opinion, especially as to their distribution and enzymic action within the endosperm itself. Puriewitsch,[a] Grüss,[b] and Hansteen[c] are cited by Brown and Escombe[d] as holding the view that the amyliferous cells of the endosperm of the grasses can digest their reserve materials independently of any action of the embryo—i. e., the starch-bearing cells are living cells and secrete enzymes in the grasses as well as in the cotyledonous cells of *Lupinus*, *Phaseolus*, and *Ricinus*. In 1890, Brown and Morris[e] did not find such to be the case; but the results of Puriewitsch, Grüss, and Hansteen led to a duplication of the experiments by Brown and Escombe in 1898. At this time they demonstrated that the amyliferous cells play no part in the chemical changes which take place during the process of germination, but on the contrary that the enzymic action in the endosperm of the grasses is confined to the aleuron layer.

But the purpose of the present paper is not to consider the localization of the particular enzyme, and much less the action of enzymes during germination. At this time quite another question is to be

[a] Pringsheims Jahrb., **31**: 1, 1897.

[b] Landw. Jahrbücher, 1896, p. 385.

[c] Flora, **79**: 419, 1894.

[d] Proc. Roy. Soc., **63**: 3-25, 1898.

[e] Jour. Chem. Soc., London, **57**: 458-528, 1890.

considered, viz, In what way do enzymes function in the preservation of vitality?

Maquenne[a] points to the view that the vitality of seeds is dependent on the stability of the particular ferment present. He attributes the prolongation of vitality in seeds that are kept dry to the better preservation of the enzymes. This view has been largely strengthened as a result of the investigations made by Thompson,[b] Waugh,[c] Sharpe,[d] and others, in which they have shown that the artificial use of enzymes may greatly increase the percentage of germination in some old seeds. By the use of diastase the percentage of germination of 12-year-old tomato seed has been increased more than 600 per cent.

If the suggestions made by Maquenne were true in every sense, then dead seeds should be awakened into activity by artificially supplying the necessary enzymes; but this can not be, or never has been, accomplished. True, many experiments have been recorded in which a greater percentage of seed has been induced to germinate by the judicious use of commercial enzymes than by the ordinary methods of germination; but this treatment is applicable only where the vital energy is simply at a low ebb and does not in any way affect dead seeds. The experiments of the writer with naked radicles from the embryos of living and dead beans have shown the presence of enzymes in both. The carefully excised radicles were ground and macerated in water for one hour. The filtrate was then added to dilute solutions of starch paste. The solutions from the living embryos gave rise to an energetic hydrolytic action. In all cases hydrolysis was sufficiently advanced to give a clear reaction with Fehling's solution. The solutions extracted from the radicles from the dead beans also gave reactions sufficiently clear to indicate that there was still some ferment present.[e]

However, the hydrolysis was scarcely more than begun, giving only a brown color with iodin, but not reacting with Fehling's solution. Results of a similar character were obtained from portions of the seed

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[a] Ann. Agron. **26**: 321–332, 1900; Compt. Rend., **134**: 1243–1246, 1902.

[b] Gartenflora, **45**: 344, 1896.

[c] Ann. Report, Vt. Agr. Exp. Sta., 1896–97, and Science, N. S., **6**: 950–952, 1897.

[d] Thirteenth Annual Report, Mass. Hatch Exp. Sta., Jan., 1901, pp. 74–83.

[e] This was a sample of "Valentine" beans grown in 1897. The same year they tested 97.3 per cent. In March, 1898, the same sample tested 87 per cent. At this time they were sent to Orlando, Fla., where they remained until May 8, 1899, approximately fourteen months. The beans were then returned and numerous germination tests were made at irregular intervals, but in no case was there any indication of vitality. Several samples were also treated with "Taka" diastase (solutions varying in strength from 2 to 10 per cent), but none was stimulated into germination. The radicles were tested for enzymes in the spring of 1902, nearly three years after the beans first failed to germinate, at which time they were nearly 6 years old.

taken from the point of union of the axis and the cotyledons. These possessed stronger hydrolytic powers, the preparations from the living and dead beans each giving clear reactions with Fehling's solution. A third series of tests was made by stopping the germination of beans when the radicles were from 1 to 1.5 cm. long. These were then kept quite dry for nearly seven months, after which the dessicated radicles were broken off and macerated like the above. This solution was then allowed to act on starch paste, and the transformations were almost as rapid and complete as when a 1 per cent solution of commercial "Taka" diastase was used.

These results lead one to believe that the loss of vitality in seeds is not due to the disorganization of the enzymes present. There is something more fundamental and probably more complex to which we must look for this life-giving principle. True, as Maquenne has suggested, there is a close relationship between the loss of vitality in seeds and the decomposition of enzymes.

In order to determine what such a relationship might signify, the following series of experiments were made:

Beans, peas, cabbage, lettuce, onion, phlox, and pansy seed, with definite quantities of good commercial "Taka" diastase, were put up in bottles of 120 cc. capacity, as follows:

(1) In bottle closed with cork stopper.

(2) In bottle closed with cork stopper and paraffined.

(3) 0.5 cc. of water in the bottle with the seeds and the diastase, the bottle sealed with paraffin.

(4) 1 cc. of water in the bottle with the seeds and the diastase, the bottle sealed with paraffin.

(5) 2 cc. of water in the bottle with the seeds and the diastase, the bottle sealed with paraffin.

(6) 3 cc. of water in the bottle with the seeds and the diastase, the bottle sealed with paraffin.

(7) 4 cc. of water in the bottle with the seeds and the diastase, the bottle sealed with paraffin.

The water in each case was carefully added on small strips of filter paper and never were the seeds or the diastase wet, only becoming gradually moist as the water was absorbed.

These different preparations, each containing one of each of the samples of seeds and a definite quantity of the dry powdered diastase, were then maintained at the temperature of the laboratory for a period of 85 days. At the end of that time the vitality of the seeds was determined and simultaneously the hydrolytic power of the diastase was ascertained. The results of the germination tests are given in Table XXIX. The effect of the increased quantity of moisture on the diastase is given in the discussion following the table.

TABLE XXIX.—*Loss in vitality of seeds with varying degrees of moisture when kept at ordinary room temperature.*

[Duration of experiment, 85 days.]

Laboratory number.	Preparation of sample.	Amount of water added.	Percentage of germination.						
			Beans.	Peas.	Cabbage.	Onion.	Phlox.	Pansy.	Average of all samples.
		cc.							
	Control[a] ...	None ...	96.0	90.0	91.5	95.0	41.25	46.0	76.6
1547	Corked	None ...	98.0	96.0	91.0	92.5	52.0	32.0	76.9
1548	Paraffined..	None ...	96.0	92.0	91.5	93.0	39.5	31.0	73.8
1549	.....do......	0.5	96.0	92.0	89.0	88.8	28.5	25.5	69.9
1550	.....do......	1.0	96.0	88.0	89.0	64.0	12.5	18.0	61.2
1551	.....do......	2.0	96.0	86.0	78.0	13.0	.5	2.5	46.0
1552	.....do......	3.0	94.0	94.0	65.0	2.5	.5	.5	46.1
1553	.....do......	4.0	90.0	81.6	54.5	.0	.0	.0	37.6

[a] The samples prepared, excepting the control, were in bottles of 120 cc. capacity.

The above table shows that there was a gradual deterioration in vitality as the quantity of water was increased. All stages of injury were manifested, but it is not necessary to enter into a discussion of the table at this time, inasmuch as similar tabulations, showing the injurious effects of varying quantities of moisure on the seeds, have already been given on page 38. This table is inserted here in order that a comparison can be made with the decomposition of the commercial diastase used and the loss in vitality of the seeds.

For a determination of the diastasic activity various quantities of 1 per cent "Taka" diastase solutions were allowed to act on definite quantities of a 1 per cent solution of starch paste, the whole being maintained at a temperature of from 45° to 48° C. Ten cubic centimeters of the starch solution were taken for each determination, and the amount of the diastase solution varied from one-half to 1, 2, 3, and 5 cc. In the control sample, consisting of diastase from the original bottle as it was kept in the laboratory, 2 cc. of the 1 per cent solution were sufficient to cause a complete hydrolysis of the 10 cc. of 1 per cent starch solution. In Nos. 1547, 1548, and 1549 the samples from the control bottle, the paraffined bottle, and the paraffined bottle containing 0.5 cc. of water, respectively, 3 cc. of the diastase solution were necessary for a complete hydrolysis. In Nos. 1550, 1551, and 1552—that is, the samples from the bottles which contained 1, 2, and 3 cc. of water, respectively—the diastase was very much injured as a result of the increased quantity of water in the bottle and 5 cc. of the diastase solution were required to hydrolyze the 10 cc. of the 1 per cent starch paste. No. 1553—the sample from the bottle which contained the 4 cc. of water—showed that the diastase had been almost completely disorganized, inasmuch as the greatest quantity used (5 cc. of the 1 per cent diastase solution) was only sufficient to cause a slight hydrolytic action. When tested with iodine there was still a deep, purplish-blue color. In this last case the average percentage of germination had decreased to 37.6 per cent, as compared with 76.6 per cent for the control samples. Moreover, in the latter case, the onion, phlox, and pansy seeds were killed.

These results show that there is a remarkable uniformity between the loss in vitality of seeds and the loss in the enzymic action of the "Taka" diastase under similar conditions, but it does not furnish conclusive evidence that the loss in vitality of the seeds is in any way governed by the particular enzymes present. In fact, the evidence at hand better substantiates the opposite view. In the first place dead seeds may still contain active ferments. Secondly, the prolonged subjection of seeds to the action of ether and chloroform is generally accompanied by a premature death, and if the seeds are moist the loss in vitality is much more marked. On the other hand, it is generally accepted that either of these gases exerts no injurious effect on the hydrolytic action of the various ferments. Townsend[a] has shown that the action of diastase on starch paste is even more energetic in the presence than in the absence of ether, but in germination ether usually has a retarding influence. In some cases, however, growth is stimulated by the use of ether.

In the third place enzymes can not be the chief factors controlling the vitality of a seed, because the more sensitive growing point of the radicle suffers injury much in advance of the other portions of the seed. Not infrequently in making germination tests do we find that the growing tip of the embryo is dead, while other portions of the seed may still be living and capable of carrying on all normal metabolic processes. The bean is one of the best examples for demonstrating this fact. Here the radicle may be entirely dead, yet the cotyledons may still be able to make some growth; but in all seeds where the growing tip is dead the remaining portion of the radicle may be living, in which case adventitious roots may be formed and growth may continue for a considerable time, though very rarely will a healthy seedling be developed. It thus seems quite clear that the real vital elements are closely associated with the growing point, and when this portion of the embryo is once dead the vital energy in the other parts of the seed is not of such a nature as to enable growth to continue for any length of time. Even though the reserve food products are digested they can not be assimilated by the growing radicle, which should be the case were enzymes the chief elements to which the preservation of vitality is attributed.

Enzymes play an important part in the vitality of seeds, and are undoubtedly necessary for the normal development of a seedling, but the points above given show that the life of a seed is not entirely

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[a] Bot. Gaz., 1899, **27**: 458–466.

dependent on the stability of the particular ferment or ferments present. There is something more remote, possibly of a simpler but probably of a more complex composition, to which we must attribute the awakening of the metabolic processes. Reference is not made here to the zymogenic substances which develop into the particular ferment, for what has been said of the latter applies equally well to the former. If the zymogens were perfectly preserved the resulting ferments would be developed normally and germination would continue in the usual manner.

In conclusion, it may well be emphasized that no single element or compound can be isolated as the sole source of vitality in seeds. There must be a combination of factors, each of which plays an important rôle in the preservation of vitality. The destruction of any one of these factors may upset the principles governing the life of a seed, and consequently cause a premature death.

It is quite probable that the nucleus is one of the most important organs governing vitality, for unless it continues to function no other growth can take place. Other parts of the cell, however, may be of equal importance. At all events all hope of future gain must come from more critical studies of the cell contents to know their chemical composition and possible reactions. A correct solution of these perplexing questions is nothing less than a determination of the fundamental principles of life. What will be the ultimate results no one is prepared to say.

SUMMARY.

(1) A seed is a living organism, and must be dealt with as such if good results are expected when put under favorable conditions for germination.

(2) The first factors determining the vitality of a seed are maturity, weather conditions at the time of harvesting, and methods of harvesting and curing.

(3) Immature seeds sown soon after gathering usually germinate readily, but if stored they soon lose their vitality. On the other hand, well-matured seeds, harvested under favorable conditions, are comparatively long lived when properly handled.

(4) Seed harvested in damp, rainy weather is much weaker in vitality than seed harvested under more favorable conditions. Likewise, seed once injured will never regain its full vigor.

(5) The curing of the various seeds is of the utmost importance, and great care should be taken to prevent excessive heating, otherwise the vitality will be greatly lowered.

(6) The life period of any species of seed, granting that it has been thoroughly matured and properly harvested and cured, is largely dependent on environment.

(7) The average life of seeds, as of plants, varies greatly with different families, genera, or species, but there is no relation between the longevity of plants and the viable period of the seeds they bear. The seeds of some plants lose their vitality in a few weeks or months, while others remain viable for a number of years.

(8) With special precautions and treatment there is no question that the life of seeds may be greatly prolonged beyond that which we know at present, though never for centuries, as is frequently stated. Cases so reported can not be taken as evidence of the longevity of seeds.

(9) It is known that seeds retain their vitality much better in some sections of the country than in others. The part which climatic influences play in the vitality of seeds is of much more importance than is generally supposed.

(10) Experiments have shown that *moisture* is the chief factor in determining the longevity of seeds as they are commercially handled. Seeds stored in dry climates retain their vitality much better than when stored in places having a humid atmosphere.

(11) The deleterious action of moisture is greatly augmented if the temperature be increased. Not infrequently is vitality destroyed within a few weeks or months when the seeds are stored in warm, moist climates. If stored in a dry climate, the question of temperature within the normal range is of little moment.

(12) The storage room for seeds as they are ordinarily handled should always be *dry*. If seeds could be kept dry and at the same time cool, the conditions would be almost ideal for the preservation of vitality; but the difficulties to be overcome in order to secure a dry and cool storage room render this method impracticable.

(13) The most feasible method for keeping seeds dry and thus insuring strong vitality is to store them in well ventilated rooms kept dry by artificial heat. This method of treatment requires that the seeds be well cured and well dried before storing.

(14) If seeds are not well dried vitality is best preserved at temperatures just above freezing, provided that the temperature is maintained uniformly.

(15) In no case must the temperature of the storage house be increased unless the seed is amply ventilated so that the moisture liberated from the seed can be carried off readily by the currents of warm air. If this precaution is not taken the increased humidity of the air confined between the seeds will cause a marked injury. For this same reason seeds kept at low temperatures during the winter will deteriorate in the warm weather of spring, especially if they contain much moisture.

(16) Most seeds, if first carefully dried, can withstand long exposures to a temperature of 37° C. (98.6° F.) without injury, but long exposures to a temperature of from 39° to 40° C. (102.2° to 104° F.)

will cause premature death. If the seeds are kept in a moist atmosphere a temperature of even 30° C. (86° F.) will soon cause a marked injury.

(17) Seeds can endure any degree of drying without injury; that is, by drying in a vacuum over sulphuric acid. It is believed that such a reduction in the water content is necessary if vitality is to be preserved for a long period of years. However, with such treatment the seed coats become very firm, and there usually follows a retardation in germination as a result of the inability of the seeds to absorb water rapidly enough to bring about the necessary physical and chemical transformations for the earlier stages of germination.

(18) Seeds that are to be sent to countries having moist climates should be put up in air-tight packages. Experiments have shown that by the judicious use of bottles and paraffined packages seeds can be preserved practically as well in one climate as in another.

(19) It is of the utmost importance that the seeds be dry before being sealed in bottles or paraffined packages. A drying of ten days at a temperature of from 30° to 35° C. (86° to 95° F.) will usually be sufficient. However, a better method to follow is to dry until no more moisture is given off at a temperature equivalent to the maximum of the region in which the seeds are to be distributed. If this is not done, the subsequent increase in temperature will liberate an additional quantity of moisture, which being confined in the package will leave the seeds in a humid atmosphere and a rapid deterioration in vitality will follow.

(20) Experiments in storing seeds in open and sealed bottles and in packages with definite quantities of moisture and at various known temperatures have shown a very close relationship between the loss in vitality and the increase in water content, the deterioration likewise increasing with the temperature.

(21) Of a series of experiments the average loss in vitality of seeds kept in envelopes in a "dry room" was 21.19 per cent, "trade conditions" 36.63 per cent, "basement" 42.28 per cent, while the loss in the case of seeds stored in bottles was only 8.08, 3.92, and 4.51 per cent, respectively. (See Table XXV.)

(22) Seeds under ordinary conditions of storage respire quite freely, and respiration is much more rapid if much moisture is present. Within certain limits respiration is directly proportional to the amount of moisture present in the seed and inversely proportional to the duration of vitality.

(23) Respiration is not necessary to the life of seeds, as they can be kept in conditions unfavorable for respiratory activity and still retain their vitality even better than under normal conditions of storage. Even though respiration be entirely prevented seeds will continue to deteriorate, and sooner or later lose their vitality.

(24) The continued deterioration in the vitality of a seed after respiration has ceased indicates a chemical activity within the cells, giving rise to a transformation of energy which sooner or later leads to the death of the seed.

(25) Respiration is almost as active in the dark as in the light, provided that the temperature and humidity remain the same.

(26) Ferments and seeds lose all power of activity under similar conditions of moisture, and the former are undoubtedly of the utmost importance in metabolic activity, but the evidence at hand goes to show that the life of a seed is not dependent on the preservation of the particular ferment involved or on the zymogenic substances giving rise to the enzyme.

(27) The life of a seed is undoubtedly dependent on many factors, but the one important factor governing the longevity of good seed is *dryness*.

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INDEX.

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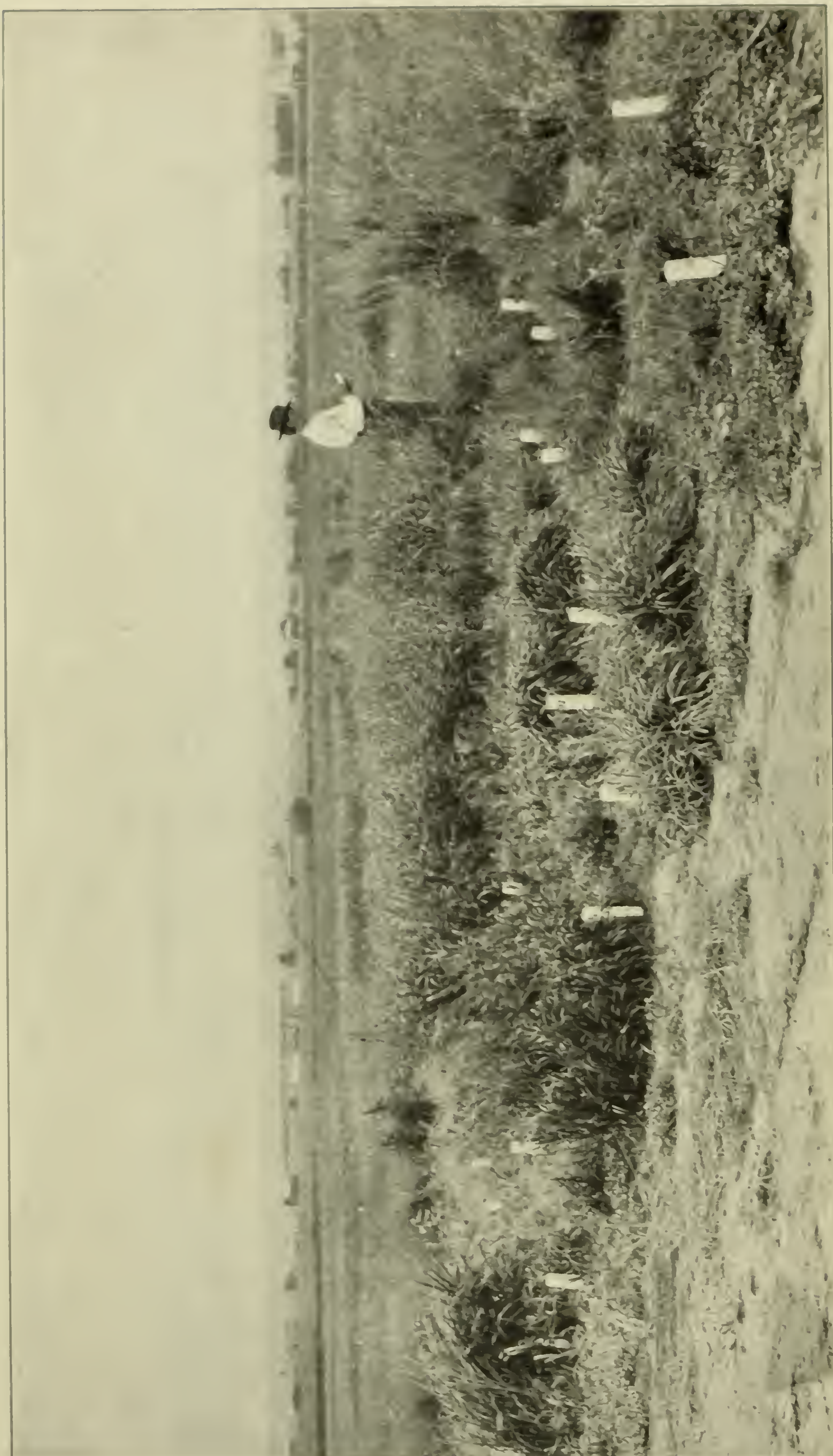

GRASS GARDEN, NEBRASKA EXPERIMENT STATION.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN No. 59.

B. T. GALLOWAY, *Chief of Bureau.*

PASTURE, MEADOW, AND FORAGE CROPS IN NEBRASKA.

BY

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Agriculturist, Nebraska Experiment Station,

AND

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U. S. Department of Agriculture.

GRASS AND FORAGE PLANT INVESTIGATIONS.

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1904.

BUREAU OF PLANT INDUSTRY.

Beverly T. Galloway, *Chief.*

J. E. Rockwell, *Editor.*

GRASS AND FORAGE PLANT INVESTIGATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., March 4, 1904.

Sir: I have the honor to transmit herewith a paper entitled "Pasture, Meadow, and Forage Crops in Nebraska," and respectfully recommend that it be published as Bulletin No. 59 of the series of this Bureau.

This paper was prepared by Mr. T. L. Lyon, Agriculturist of the Nebraska Experiment Station, and Mr. A. S. Hitchcock, Assistant Agrostologist, in Charge of Cooperative Experiments, Grass and Forage Plant Investigations, and has been submitted by the Agrostologist with a view to publication.

The illustrations, consisting of six half-tone plates and eight text figures, are necessary to a full understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

During the past few years a large number of tests of grasses and forage plants have been made by the Nebraska Agricultural Experiment Station in cooperation with the United States Department of Agriculture. The Department has furnished a part of the seeds for these tests, and has from time to time, at the request of the director of the station, made suggestions regarding the nature and plans of the work to be done. At the request of Prof. T. L. Lyon, Associate Director of the Station, Prof. A. S. Hitchcock, of this Office, visited the station during the past winter and prepared the following bulletin from notes made by the officers of the station. It is a matter of gratification that these notes were in such form as to render the task comparatively easy.

The present paper contains the results of the cooperative experiments and also some general information upon the forage conditions of Nebraska, in the preparation of which Professor Hitchcock has been in constant consultation with Professor Lyon.

The results of these experiments are of interest to many of the surrounding States having similar climatic conditions and in which many of the same forage plants are grown.

W. J. Spillman,
Agrostologist.

Office of the Agrostologist,
Washington, D. C., February 27, 1904.

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

B. P. I.—95. G. F. P. I.—103.

PASTURE, MEADOW, AND FORAGE CROPS IN NEBRASKA.

INTRODUCTION.

The value of the hay and forage crop of the United States may best be presented by reciting a few facts taken from the agricultural statis-

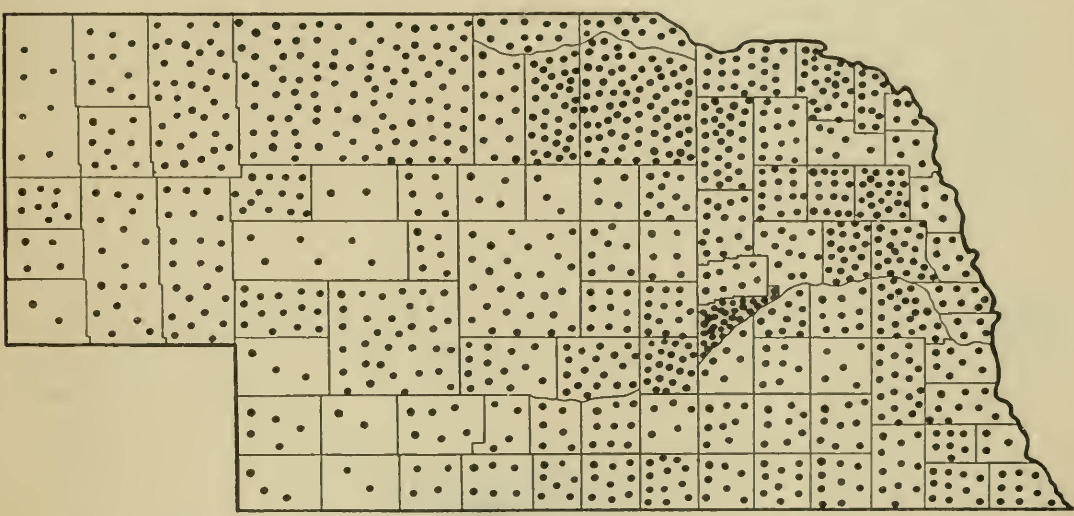

FIG. 1.—Localities in Nebraska where prairie hay is grown. Each dot represents 2,000 acres.

tics given in the Report of the Twelfth Census, where it is shown that in 1899, out of a total valuation for all crops of $2,910,138,663, the value of the hay and forage crop was $484,256,846, or 16.6 per cent.

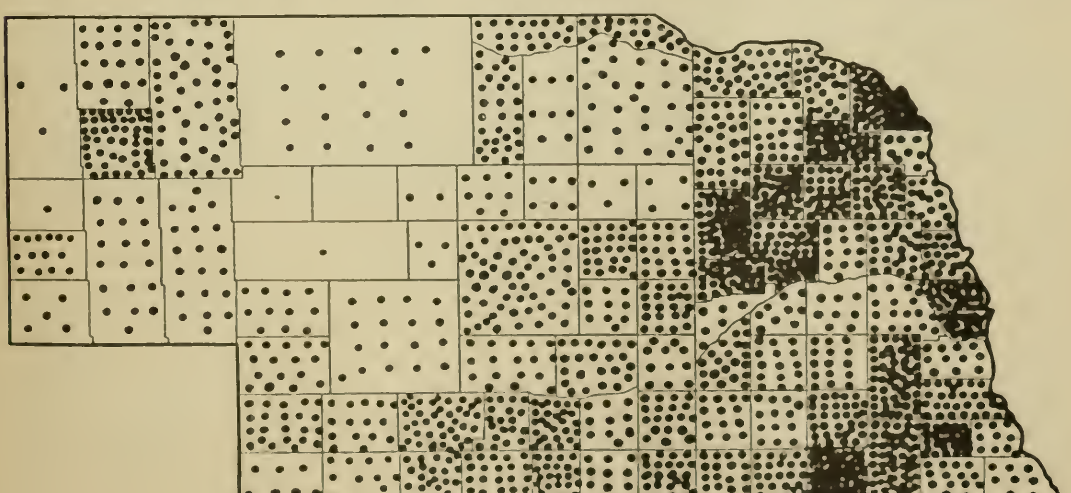

FIG. 2.—Localities in Nebraska where millet is grown. Each dot represents 100 acres.

The value of this crop is greater than that of any other, with the single exception of corn, which had a valuation that year of $828,258,326.

From the same source it is learned that out of a total valuation of $92,056,580 for all crops grown in Nebraska in 1899, the forage crop was worth $11,230,901, or 12.2 per cent.

TABLE 1.—*Statistics for Nebraska of hay and forage crops for 1899, taken from the Report of the Twelfth Census.*

Total acreage devoted to hay and forage crops	2,823,652
Total acreage devoted to all crops	15,153,956
Total acreage of improved land	18,432,595
Per cent of acreage of forage crops to that of all crops	18.6
Per cent of acreage of forage crops to that of improved land	15.3
Value of all crops	$92.056,580
Value of forage crops	$11,230,901
Per cent of value of forage crops to that of all crops	12.2
Average value per acre of all crops	$6.07
Average value per acre of forage crops	$3.98
Tons of forage crops (excluding cornstalks)	3,502,380
Average value per ton	$3.19

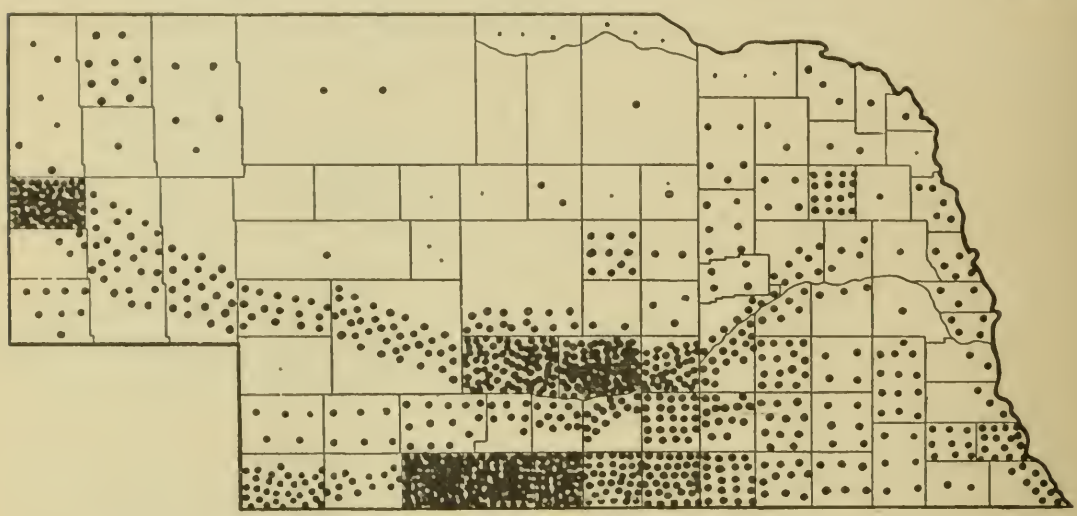

FIG. 3.—Localities in Nebraska where alfalfa is grown. Each dot represents 100 acres.

During the year mentioned Nebraska produced 2.3 per cent of the total valuation of the forage crop of the United States, ranking thirteenth in this respect. New York was first, with 11.4 per cent. The records show that during the last three decades the average yield per acre in Nebraska has decreased, while that of the entire United States has increased:

Year.	Nebraska.	United States.
	Tons.	*Tons.*
1899	1.2	1.4
1889	1.3	1.3
1879	1.5	1.1

In 1880 Nebraska was eighteenth among the States in the per cent of the total acreage that was devoted to forage crops, the percentage being 1.7. In 1890 and 1900 it stood ninth, with a percentage of 4.6.

In tonnage the figures are much the same, Nebraska ranking in 1860 as the thirty-second State in the Union, with only 0.1 per cent of the total; in 1870, twenty-third, with 0.6 per cent; 1880, fifteenth, with 2.2 per cent; 1890, ninth, with 4.7 per cent; 1900, ninth, with 4.4 per cent.

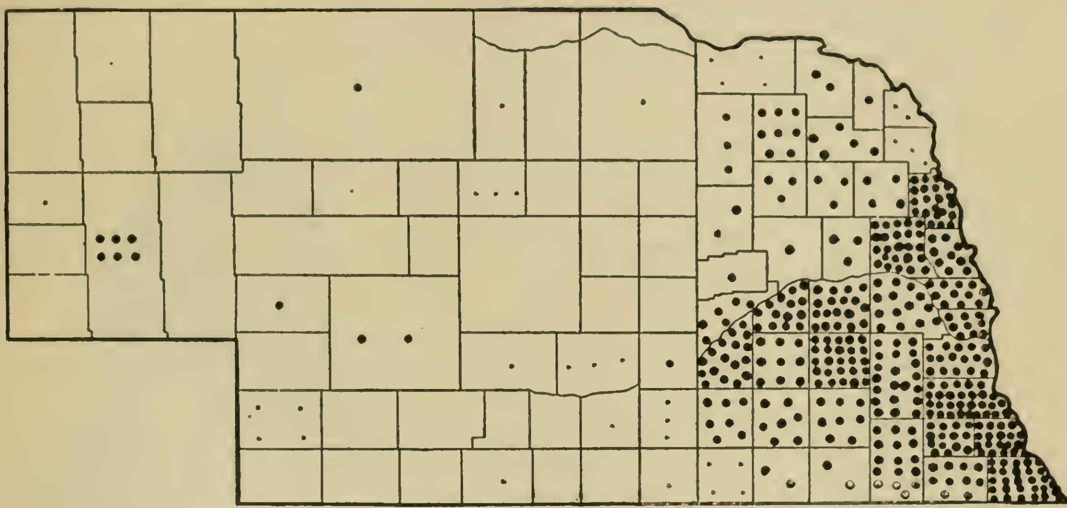

FIG. 4.—Localities in Nebraska where clover is grown. Each dot represents 100 acres.

Equally interesting are the figures showing the acreage, tonnage, and yield of the various forage crops in 1899, as classified in the census report, as follows:

Crop.	Rank of State.	Acreage.	Tonnage.	Average yield per acre.
				Tons.
Prairie hay	1	2,248,927	2,416,468	1.1
Millet	2	191,347	357,356	1.9
Alfalfa	6	115,142	275,334	2.4
Clover	15	42,447	72,747	1.7
Other tame grasses	27	92,895	143,109	1.5
Coarse forage	9	90,828	183,097	2.0

For comparison the following table is given of the acreage of the leading States for the above crops:

Crop.	State.	Acreage.
Millet	Kansas	349,906
Alfalfa	Colorado	455,237
Clover	Indiana	776,810
Other tame grasses	New York	4,758,523
Coarse forage	Kansas	1,041,447

In this classification the term "other tame grasses" includes in Nebraska chiefly timothy (also timothy and clover mixed) and bromegrass, and some bluegrass. Forage refers to sorghum, Kafir corn, and corn that was cut green for forage. It does not, however, include corn that was cut and allowed to ripen in the shock, or what is usually known as corn fodder.

It appears that Nebraska also produced 8,156 bushels of clover seed, valued at $37,332, and 41,816 bushels of other grass seed, valued at $32,450.

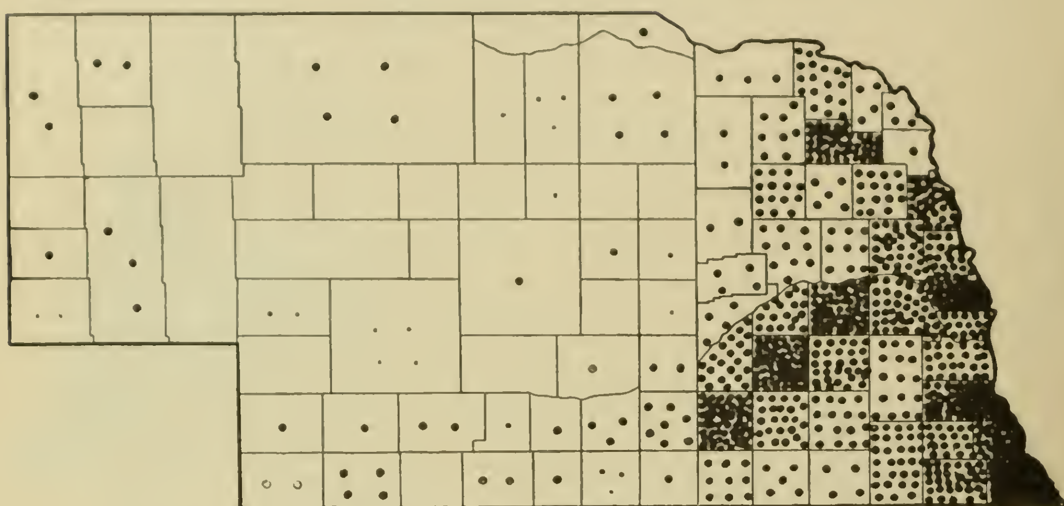

FIG. 5.—Localities in Nebraska where tame grasses are grown. Each dot represents 100 acres.

The accompanying maps (figs. 1–6) show graphically the distribution of the chief forage crops of Nebraska by counties. The distribution is based upon the tables given above. Each large dot represents 100 acres, except in the map illustrating the acreage of prairie hay, where each

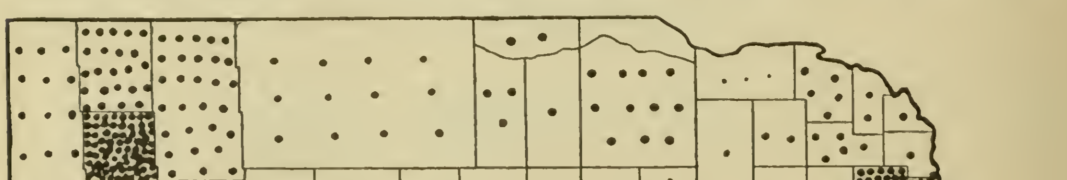

FIG. 6.—Localities in Nebraska where coarse forage is grown. Each dot represents 100 acres.

dot represents 2,000 acres. From 50 to 149 acres would be represented by one dot; 150 to 249 acres by two dots. Each small dot represents 10 acres and is used for acreages from 5 to 49. On the alfalfa map the dots in certain western counties are congregated in the vicinity of the Platte and Republican rivers, although the figures given in the tables do not indicate the distribution within the counties.

CLIMATIC AND SOIL CONDITIONS OF NEBRASKA.

RAINFALL.

For details concerning the rainfall the reader is referred to Bulletin No. 45 of the Nebraska Station, "The Rainfall of Nebraska," by G. D. Swezey and George A. Loveland. Since the amount and distribution of the rainfall is one of the most important factors in determining the agricultural possibilities of a country, it is well to summarize here the chief points as indicated in that bulletin.

The annual rainfall decreases from 34 inches in the extreme southeast to 13 inches in the extreme southwest. However, the average rainfall does not tell the whole story. Much depends upon the distribution of rain through the year, and especially during the growing

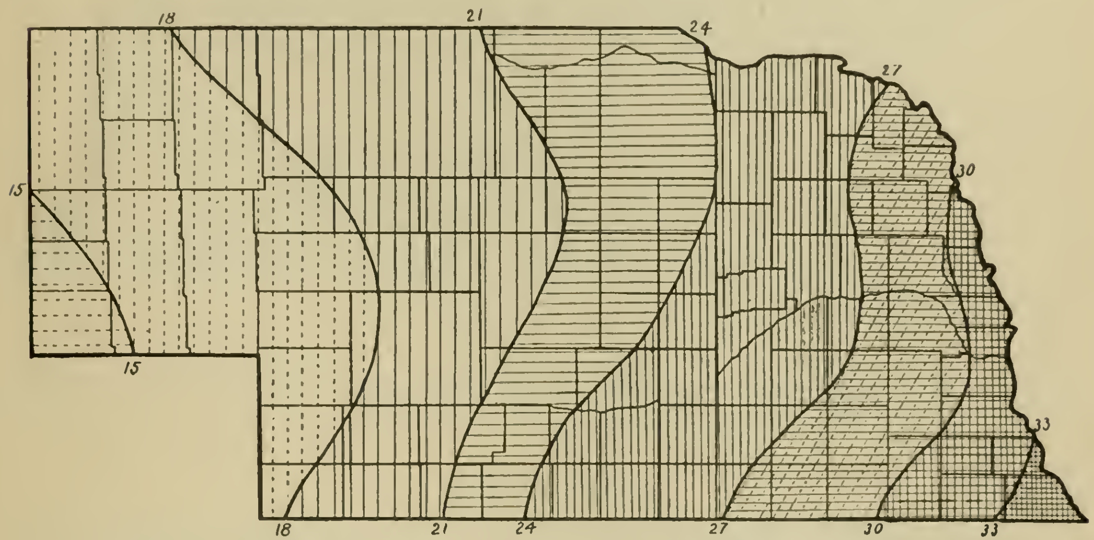

FIG. 7.—Normal annual rainfall for Nebraska, in inches.

season. The average rainfall for the entire State is 23.33 inches, of which 16.08 inches, or 69 per cent, falls in the five months from April to August, inclusive.

TABLE II.—*Average monthly precipitation for Nebraska.*

Month.	Precipitation.	Month.	Precipitation.	Month.	Precipitation.
	Inches.		*Inches.*		*Inches.*
January	0.68	May	3.62	September	1.84
February	.71	June	3.93	October	1.49
March	1.16	July	3.51	November	.68
April	2.40	August	2.62	December	.69

An examination of the table and of the accompanying charts (figs. 7 and 8) shows that it is only in the eastern tier of counties, lying approximately within the region receiving as much as 30 inches average rainfall, that the common eastern meadow and pasture grasses, such as timothy, red clover, redtop, and Kentucky bluegrass, will thrive with a fair degree of certainty. The next region, included between 27 and 30 inches, is one in which these grasses may do well in favorable localities, but are more or less uncertain, and are quite sure to fail in dry seasons. On account of the lower summer temperature, these grasses may extend farther west in the northern part of the State than in the southern portion. For this belt, orchard grass and meadow fescue are more likely to be successful than timothy and clover, while brome-grass

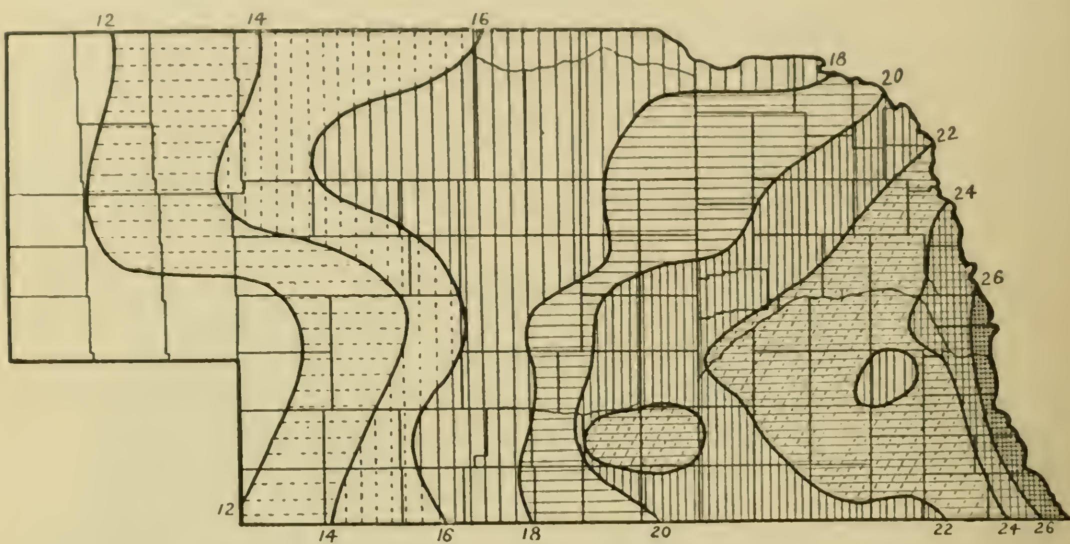

FIG. 8.—Normal rainfall in Nebraska during the growing season, April to September, in inches.

is the only satisfactory cultivated pasture grass west of this. Even brome-grass fails in the extreme west.

TEMPERATURE.

Prof. George A. Loveland, director of the Nebraska section of the Weather Bureau, has furnished the normal monthly temperature for several stations distributed over the State, which data are incorporated in the following charts. Besides these are given the normal annual temperature for the same stations, the average yearly minimum and the lowest recorded temperature for each station.

TABLE III.—*Normal monthly temperature, normal annual temperature, average minimum and absolute minimum for several stations in Nebraska.*

Town.	County.	Normal monthly temperature.												Annual temperature.	Average minimum temperature.	Absolute minimum temperature.
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.			
Lincoln	Lancaster	21.3	23.5	36.6	51.7	61.8	70.9	76.3	74.7	66.4	55.0	38.7	29.4	50.6	−15.4	29
Auburn	Nemaha	25.7	25.0	38.0	54.4	63.4	71.9	77.0	75.5	67 2	56.5	39.8	29.6	52.0	18.2	35
Crete	Saline	21.4	23.5	35.6	52.3	61.1	70.4	75.7	73.3	65.8	54.0	37.6	27.6	49.8	−15.8	−32
Hebron	Thayer	23.8	25.7	37.2	53.9	62.4	71.7	76.6	74.5	66.5	54.4	38.4	30.0	50.5	−16.7	34
Harvard	Clay	24.4	22.4	31.7	51.1	60.9	70.4	75.5	73.8	64.9	52.5	35.6	27.0	49.5	−18.2	−33
Beaver City	Furnas	28.9	26.6	38.8	51.6	62.8	71.0	76.2	75.3	66.9	54.6	39.6	31.1	52.1	−19.0	35
Imperial	Chase	27.2	26.3	36.2	49.8	60.0	70.2	75.8	74.6	65.1	51.7	37.0	28.6	50.3	−21.2	−35
North Platte	Lincoln	20.0	25.3	35.1	48.6	58.2	67.9	73.5	71.4	62.4	49.8	35.2	27.4	47.9	−19.5	−35
Ravenna	Buffalo	24.4	22.9	31.7	50.9	59.6	69.0	74.4	73.0	64.7	52.3	36.0	28.5	49.2	−19.4	−38
Genoa	Nance	19.1	22.0	33.2	49.8	60.3	69.9	75.2	73.2	64.0	50.7	34.4	24.4	48.0	−20.2	35
David City	Butler	21.4	20.8	31.8	50.0	58.9	69.1	73.7	70.9	63.0	50.6	33.9	26.1	47.5	......	−30
Fremont	Dodge	18.5	21.0	34.0	50.6	60.2	70.5	75.3	72.6	64.5	52.6	35.6	25.0	48.4	−20.9	−31
Omaha	Douglas	19.2	25.0	35.5	51.0	61.7	71.8	76.2	73.7	64.8	52.9	36.6	26.7	49.6	−15.2	−26
Stanton	Stanton	20.8	19.5	32.6	49.7	60.6	69.0	73.4	71.6	63.5	51.7	33.9	23.6	41.5	20.5	33
Oakdale	Antelope	18.9	19.2	31.1	49.6	59.0	68.8	73.8	71.6	62.5	49.8	32.7	25.3	46.9	−22.9	−40
Sioux City (Iowa)	......	16.3	19.0	31.6	50.6	58.4	70.3	74.3	71.6	65.2	51.0	31.3	27.8	47.6	......	....
Santee	Knox	18.3	18.4	32.3	49.0	62.0	71.6	76.4	74.3	64.6	52.1	34.1	21.9	47.9	−21.3	−33
O'Neill	Holt	20.7	19.8	31.1	48.3	58.9	67.8	73.3	71.2	63.4	50.9	33.5	24.9	47.0	−21.0	33
Valentine	Cherry	16.9	21.5	31.2	47.2	55.8	67.2	73.3	70.3	61.6	49.2	34.3	27.2	46.3	23.1	−37
Kimball	Kimball	26.9	23.9	33.1	46.3	55.8	65.8	71.6	70.6	61.0	48.6	36.2	28.5	47.5	−20.3	−30
Fort Robinson	Dawes	23.3	22.5	33.2	47.0	56.4	65.9	72.0	70.8	61.2	49.0	35.2	28.2	47.1	−23.8	−37

PHYSIOGRAPHY.

Nebraska lies in the central portion of the Great Plains region, and extends from the Missouri River to the foothills of the Rocky Mountains, 104° west longitude, and between the fortieth and forty-third parallels of latitude. The area is 76,794 square miles.

As to general topography, the State is little diversified, consisting for the most part of undulating prairies. The extreme eastern portion of the State along the Missouri River is forested, or was covered with forest before the timber was removed. These forests extended west along the rivers, the trees becoming fewer in number and species until they finally disappeared about halfway across the State. The prairies are covered with herbaceous vegetation, a large proportion of which consists of various species of nutritious grasses, which will be discussed briefly in another paragraph.

The altitude varies from a little less than 1,000 feet in the southeastern part to about 5,000 feet in the western portion of the State.

For a discussion of the botanical areas of the State and their relation to climatic and soil condition, the reader is referred to various articles by Dr. C. E. Bessey, in the reports of the Nebraska State Board of Agriculture, and more particularly to the Phytogeography of Nebraska by Pound and Clements.

SOIL.

A full discussion of the soils of Nebraska is given in the report of the geologist, E. H. Barbour, in the Annual Report of the State Board of Agriculture for 1894, page 61. It may be remarked that the basis of the agricultural soils of Nebraska is silt rather than clay, such as is found in the Eastern States. The State is divided into five soil regions, two of which—the Bad Lands and the Western Region—are in the extreme western portion of the State, and do not lie in what is now a crop district. The other three are the Drift, Loess, and Sand Hill regions. From the crop standpoint the first is the most important, as it lies in the region of greatest rainfall. The Drift is of glacial origin, and is agriculturally a rich soil. The Loess, or wind drift, is a deposit covering all the southern portion of the State, and is also a rich soil. The Sand Hills, which comprise the northern portion of the State north of the Platte and extend from Holt to Deuel counties, are less adapted to crops, but locally, where the conditions of moisture are favorable, results show that the agricultural possibilities are considerable.

In general, it may be said that the soils of Nebraska are highly favorable for the production of crops and the product is limited chiefly by rainfall and to a less extent by temperature. In many parts of the State there are small areas of soil, known as gumbo, which are poorly suited to crops, being too alkaline or too poorly drained. But such areas are relatively very insignificant.

CROPS.

East of the one hundredth meridian the rainfall is usually sufficient for the cultivation of crops without irrigation. This meridian is approximately that precipitation line for the annual rainfall of 20 inches. West of this, crops of some kinds are uncertain under the present methods of farming, although winter wheat and such drought-resistant plants as sorghum and Kafir corn are grown. The climate here is characterized by being very hot in summer and very cold in winter. The snowfall is usually slight. It is in this region that irrigation has reached its greatest development, although it is practiced occasionally in the eastern portion of the State to supplement the rainfall.

The following tables, taken from the Twelfth Census report, give the available statistics for irrigation in Nebraska:

TABLE IV.—*Number of acres irrigated, by counties, 1899.*

County.	Acres.	County.	Acres.	County.	Acres.
Buffalo	1,393	Holt	2,218	Scotts Bluff	29,214
Cheyenne	21,288	Keith	12,646	Sioux	1,433
Dawes	4,027	Kimball	4,225	All other counties	10,083
Dawson	20,097	Lincoln	22,508	Total	148,538
Deuel	11,794	Platte	1,488		
Dundy	4,552	Redwillow	1,542		

TABLE V.—*Acreage of crops produced on irrigated land, 1899.*

Crop.	Acres.	Crop.	Acres.	Crop.	Acres.
Corn	33,078	Alfalfa or lucern	22,172	Sweet potatoes	5
Wheat	14,143	Clover	47	Onions	68
Oats	5,090	Other tame and cultivated grasses	206	Miscellaneous vegetables	651
Barley	940	Grains cut green for hay	892	Dry peas	2
Rye	741	Forage crops	417	Grapes	7
Buckwheat	10	Dry beans	126	Orchard fruits	1,234
Prairie grasses	47,890	Potatoes	1,075	Small fruits	64
Millet and Hungarian grasses	868				

Most of the irrigation is along the Platte River, from Dawson County to the western border of the State, and is maintained by ditches from the rivers. A few acres are irrigated by windmills and wells (843 acres in 1899).

It follows that in the western portion of the State, aside from the comparatively insignificant irrigated areas, the principal industry is stock raising. The herds are allowed to graze all summer and a considerable portion of the winter upon the open grassy plains or range. The wandering of the herds is usually limited principally by access to water.

Stock raising is also an important industry in the eastern portion of the State, but the amount of open range is becoming much reduced. On the other hand, on account of the greater rainfall and other conditions favorable for growing forage crops, the same area will support more stock than in the western portion.

The principal field crops grown in Nebraska, arranged according to their value, are corn, wheat, oats, hay and forage, potatoes, and vegetables.

The following table gives the acreage and value of these crops for 1899:

TABLE VI.—*Acreage and value of crops for 1899.*

Crop.	Acreage.	Value.
Corn	7,335,187	$51,251,213
Wheat	2,538,919	11,877,347
Oats	1,924,827	11,333,393
Hay and forage	2,823,652	11,230,901
Potatoes	79,901	1,734,666
Vegetables	31,044	1,383,470

Of lesser importance are rye, barley, fruit, sugar beets, and broom corn.

CLASSIFICATION OF FORAGE PLANTS.

Forage plants may be classified, according to duration, into perennials and annuals; according to kind, into grasses, legumes, and miscellaneous; according to use, into pasture, meadow, soiling, and silage plants.

DURATION.

Perennials.—This group includes those plants which live more than one year. The forage plants under consideration are all herbs, of which most of the portion above ground dies during winter, but the roots live and throw up new shoots the following spring. For most purposes it is manifestly an advantage that a crop should yield returns year after year without the expense of reseeding. On the other hand, the actual yield of forage the first season is almost always less with a perennial than with an annual, and furthermore, a perennial may not lend itself to the most desirable rotation. The important perennial forage crops of Nebraska are alfalfa, clover, bromegrass, timothy, and bluegrass. Some of these, such as timothy and clover, are known as short-lived perennials; that is, as a crop they tend to disappear in two or three years to such an extent that they need reseeding. This is also true of such grasses as Italian rye-grass.

Annuals.—These are plants which reach their maturity during the season that they are planted and then die. Common examples of this group are the grains, corn, sorghum, millet, cowpea, soy bean, and rape. Where land is valuable and it is necessary to grow a maximum crop upon a given area, annuals are more profitable as forage crops than perennials; or when it is desired to produce a crop at a given season of the year, such as early or late pasture of rye, a succession of succulent forage for dairy cattle, or a catch crop to utilize the land, annuals are invariably used.

Some plants, which are normally annuals, are sown in the autumn, and after making a growth of foliage that season, lie more or less dormant during the winter and resume growth the following spring, reaching maturity in the early summer. This is true of rye, some varieties of wheat, and some of the grasses. The severity of the winter determines in many cases whether plants may be used in this way. Many crops that are spring sown in the Northern States are fall sown in the South. Furthermore, some plants can be made to live for an abnormally long period by frequent mowing, thus preventing the production of seed.

NATURAL GROUPS.

Legumes.—This important group of plants includes the clovers, alfalfa, the cowpea, soy bean, the vetches, the garden beans and peas, and all similar plants, and it derives its importance from the fact that both the seeds and the foliage are richer in nitrogen than other forage plants. Since the proteids, or nitrogen-containing materials, are the most expensive portion of feeding rations, the growing of legumes for forage has long been recognized as an important factor in the economy of agriculture. But furthermore, as is well known, the legumes have the power, not possessed by other forage plants, of utilizing the free nitrogen of the air by means of the nodules on their roots. (See Pl. II.) When legumes are turned under as green manure, or even if the tops are removed by mowing and the roots allowed to remain in the soil, the nitrogen content of the latter is increased. Since nitrogen is a very essential plant food, and is one of the first to be exhausted in soils upon which crops are grown, and since this element is the most expensive to add in the form of fertilizer, the importance of growing legumes in rotation with other crops for the purpose of renovating the soil is quite evident. These facts emphasize the necessity of adopting a system of agriculture for a given region which shall include the growing of suitable crops of legumes in the rotation, thus utilizing the crop as forage and at the same time keeping up the fertility of the soil. The leguminous forage crops adapted to Nebraska are alfalfa and red clover, which are perennials, the latter usually short lived, and cowpeas and soy beans, which are annuals. In addition to these, white clover and alsike clover are occasionally used.

Grasses.—The great bulk of the forage plants, not included in the above group of legumes, belongs to the natural group of plants known as grasses, which includes besides the common meadow and pasture grasses, both wild and cultivated, such plants as the grains or cereals, sorghum, millet, and the sugar cane of the South. The grasses do not have the power of adding nitrogen to the soil after the manner of the legumes. Most of our native grasses are perennials, as are also our cultivated pasture and meadow grasses, such as brome-grass, orchard grass, meadow fescue, and timothy, though the latter is short lived.

Miscellaneous.—Aside from the two large groups mentioned above there are a few forage plants which bear no close natural relation to these and are most conveniently considered under this heading. The only important plant of this category that is adapted to Nebraska conditions is rape. Australian saltbush belongs here and has received some attention, but as yet it has not shown itself to be of particular value in that State.

METHODS OF UTILIZING THE CROPS.

Pastures.—In general the term pasture may be applied to all cases where stock is allowed to feed directly upon the growing plants. Where the area is unfenced and consists of native vegetation it is called open range, or simply range. In some parts of the United States, especially the Southern States, the range consists of forest, but in Nebraska the range is the unfenced portion of the Great Plains region, the vegetation consisting of native grasses. The subject of the range will be considered in another part of this bulletin.

In the ordinary and popular sense pasture refers to fenced areas of native or cultivated perennial forage crops upon which stock feeds at will. All the perennial forage plants are used for this purpose, although alfalfa and clover must be used with caution in order to prevent bloating.

Another important class of pastures, especially where land is relatively valuable and a more intensive system of agriculture is employed, is that of temporary or annual pastures.

In winter-wheat regions it is a common practice to pasture the grain during favorable portions of the fall and winter. In this case the pasturing is incidental. On the other hand it is a not uncommon practice to sow wheat or, more frequently, rye in the fall for pasture purposes alone, a crop of grain, if secured at all, being secondary. Temporary pastures are used for two purposes. (1) To extend the pasture season over a greater portion of the year than can be done with ordinary permanent pasture. For this purpose wheat or rye give early and late pasture, and certain summer annuals can be used to supplement the permanent pastures during the dry summer season, which usually occurs in July or August. (2) By successive sowing of the proper plants succulent feed may be provided through the season so as to yield a maximum crop from each area. This is particularly applicable to dairy districts. It is often convenient and economical in growing a succession of succulent crops to cut the green feed and supply the stock either in the permanent pasture or in the stalls or yards, as will be referred to under soiling. The proper rotation of such annual pasture for Nebraska will be discussed in a separate paragraph.

The plants which can be used to advantage in Nebraska for temporary pasture are the grains as mentioned above, rape, cowpea, and soy bean. The various kinds of sorghum, especially the ordinary sugar sorghum or cane, are used in Texas and northward for this purpose. In the southern portion of this area sorghum can usually be used for pasture with impunity, but in Nebraska its use in this way is attended with some risk from poisoning. An account of this subject will be found in Bulletin No. 77, Nebraska Experiment Station.

Meadows.—The term meadow is applied to land where the crop is cut for hay, whether fenced or unfenced. When the hay is cut from native grass land, the land is called a wild meadow. As shown by the statistics in the first part of this bulletin, the wild meadow land of Nebraska amounts to over 2,000,000 acres and produces about 2,500,000 tons of hay. Nebraska leads all States in the acreage of its wild meadows. The grasses composing this wild hay will be discussed in another paragraph devoted to the native grasses.

The tame meadows consist in that State of alfalfa, timothy, clover, and brome-grass. Orchard grass and meadow fescue are used to a limited extent and their wider use is to be recommended.

Some annual plants are widely used for hay, such as millet, sorghum, Kafir corn, and corn. For this purpose the last three are sown thickly in order to produce a large number of small stalks.

These coarse plants are often grown in rows and cultivated, the nearly mature stalks being cut by hand or with a corn binder and shocked, when the dried material is called fodder rather than hay. In a general sense, however, it is hay and contributes no inconsiderable amount to the sum total of dry, rough feed. The same remarks are true of the corn fodder which results after the ears have been removed, although such fodder if it is gathered at the time most favorable for grain production from necessity is relatively poorer in nutrient material than that cut earlier. Ordinary corn fodder has about the same feeding value as oat straw. When corn is husked in the field the remaining stalks are usually utilized by turning stock upon them. Aside from the waste grain recovered such stalks have very little nutriment.

In the Southern States the cowpeas and soy beans are widely used for hay, but in Nebraska they have not been used for this purpose, for which they are not so well adapted as other hay plants.

Soiling crops.—The feeding of cut green forage to stock in the stall, yard, or pasture is known as soiling. The advantage of soiling is the saving of fodder when compared with pasturing upon the same field, as in the latter case there is some loss from trampling. This is especially true of the coarse fodders, such as corn and sorghum. Other advantages of minor importance are that by soiling the rations of animals may be more definitely controlled, that fodder may be taken from fields a part of which is to be used for other purposes, and that this method avoids the necessity in pasturing the fields of subdividing them by erecting permanent or temporary fences. The great disadvantage of soiling is the extra expense of the labor necessary in cutting, hauling, and feeding the green forage. For this reason it is not practicable to utilize forage in this way on any large scale except in intensive farming, more particularly dairy farming in Nebraska. On a small scale almost every farmer cuts in early summer green grain, especially oats or rye, to feed to hogs or cattle. Later in the summer corn is cut and fed in the same manner, supplementing the pastures, which usually develop a shortage in August. The sum total of forage used in this way in Nebraska is not inconsiderable, yet in most cases it is incidental and the crops are not sown primarily for soiling purposes; neither is the soiling usually a definite part of the system of agriculture.

In dairy farming it may be advantageous to adopt soiling as a definite system in order to obtain a maximum yield of succulent forage from a small area. For this purpose it is best to plan a series of crops which will form a succession through the growing season. The individual crops depend upon the locality and must be chosen to suit conditions. Near large cities, where land is valuable, it often pays to have such a succession which, combined with silage during the winter, will give green feed the entire year. Usually, however, at least in Nebraska, soiling is resorted to only to fill in the gaps of a succulent pasture series, even in dairy farming. For example, early and late green feed may be produced by a pasture of rye. A proper sowing of oats or rye may then furnish soiling in connection with grass pasture. If there is sufficient area of pasture this may furnish all the feed necessary during May and June, but such pasture usually shows a marked falling off about the 1st of July, as is indicated by the shrinkage in the milk flow. This shrinkage should by all means be avoided, and it is therefore desirable to furnish at this time soiling crops for the rest of the summer in connection with the pasture. Besides the small grains and corn mentioned, there are several other plants that can be used for soiling, particularly sorghum, Kafir corn, cowpeas, soy beans, and rape. The latter is not so well adapted to milch cows, as there is danger of tainting the milk. Alfalfa and clover can be used, but in Nebraska they have no special adaptation for this purpose. Rape is an excellent soiling crop for hogs, sheep, or growing cattle during the autumn. For further information on this subject the reader is referred to the article in the Yearbook of the United States Department of Agriculture for 1899, page 613, entitled "Succulent forage for the farm and dairy," by Thomas A. Williams.

Silage.—Forage preserved in a green state in such a manner as to prevent decomposition or drying is called silage. The pits, rooms, or tanks in which the forage is preserved are known as silos. The advantage of silage is that the benefits derived from feeding succulent forage may be continued through the winter. As in the case of soiling crops, silage is used chiefly in connection with dairy farming. By far the best crop for the silo, where that crop can be raised, is green corn. As it is not the purpose of this bulletin to deal particularly with this subject, the reader is referred for further information to Farmers' Bulletin No. 32 of the United States Department of Agriculture and to other publications dealing with silos and silage.

RESULTS OF EXPERIMENTS WITH GRASSES AND FORAGE PLANTS AT THE NEBRASKA EXPERIMENT STATION.

GRASSES AND FORAGE PLANTS WHICH HAVE GIVEN SUCCESSFUL RESULTS OR ARE WORTHY OF FURTHER TRIAL.

Brome-Grass.

An extended account of brome-grass (*Bromus inermis*) will be found in Bulletin 61 of the Nebraska Station and also in Circular 18 of the Division of Agrostology, United States Department of Agriculture. This valuable grass has been tested over a wide area in the United States, but it finds its best development in the region from Kansas northward in the Great Plains, and west into Montana and eastern Washington. It gives fair results east of this region, but in the Eastern States is unable to compete with timothy and bluegrass. In the Southern States it has not given satisfactory results.

Numerous trials of this grass have been made at the Nebraska Station under varying conditions, both in combination with other grasses and with alfalfa. In general the grass has given good results and has shown that it is better adapted to the conditions obtaining in Nebraska than any other of the cultivated forage grasses, with the exception of meadow fescue and possibly orchard grass, both of which have given good results.

A plot sown in the spring of 1897 (0.136 acre) yielded June 27, 1900, 580 pounds of hay, or at the rate of 2.32 tons per acre. On April 8, 1901, as the grass was turning green, the east half of the plot was disked. During the remainder of the season there seemed to be no difference between the disked and undisked portions. In 1903, the plot yielded 1.32 tons of hay per acre on June 16. Other plots yielded at about the same rate.

One plot sown in April, 1899, and giving a cutting of hay June 27, 1900, at the rate of 3.8 tons per acre (220 pounds on 16½ by 76 feet) was treated October 5 with 300 pounds of well-rotted horse manure, and the following spring with 10 pounds of sodium nitrate (Chile saltpeter). On account of the drought no crop of hay was obtained in 1901, but this plot was distinctly better in appearance than untreated contiguous plots. June 16, 1903, the plot yielded 170 pounds of hay, or 5,666 pounds per acre, while a check plot yielded at the rate of 2,166 pounds per acre.

One plot sown in spring of 1900 and manured in the autumn of 1901, gave June 23, 1902, 1.66 tons of hay per acre, and June 16, 1903, 1.7 tons, and in each case the aftermath was fine and would have produced an excellent pasture.

The plots were all greatly affected by the drought in the summer of 1901, but recovered in the autumn and showed that although they had been dried up they were unhurt.

A sowing at the rate of 14 pounds per acre on one plot showed that much more seed was produced than upon plots more thickly sown. This plot was thoroughly disked in the spring of 1903, with the result that the growth the following season was not improved.

In order to test spring and fall sowing, one plot was sown October 5, 1900, at the rate of 25 pounds per acre, upon disked land, and another April 8, 1901, at the same rate and upon ground prepared in the same way. Although there was a good stand of grass obtained from fall sowing, there was no noticeable difference the following season between the two plots.

In order to test the time of seeding several plots were sown broadcast on the following dates in 1902: March 24, April 8, April 21, May 7, May 19, August 7, August 19, September 15, October 1, and October 21. All showed a good stand on May 1 of the following year and no injury from winter killing, except the last sowing, which had barely sprouted and was then killed by the cold. With this exception all yielded good crops of hay on June 23. (See Pl. III, fig. 1.)

If the soil is in proper condition it is probable that brome-grass may be sown any time from April to the first of October.

Brome-grass was sown in 1898 with bluegrass and with red clover. In both cases there was a good stand of brome-grass at first, but where combined with bluegrass the latter gradually increased in proportion until in 1903 it was estimated that the plot contained two-thirds bluegrass.

The red clover was also able to hold its own with the brome-grass in those years favorable to the growth of clover, but the dry season of 1901 nearly exterminated the clover from the plot.

In the paragraph upon pastures it will be noted that when brome-grass was sown with other grasses it was usually able to crowd out its competitors.

RESULTS OF COOPERATIVE EXPERIMENTS.

The United States Department of Agriculture has distributed seed of brome-grass through the Nebraska Experiment Station to a number of farmers with the understanding that reports upon the results obtained would be made. These cooperative distributions were made between 1898 and 1902.

There were 170 replies received from those who have grown brome-grass, of which 36 reported failures. Of these failures 26 were in the southwestern portion of the State, from McPherson to Chase and Franklin counties. The reasons for failure were mostly because the seed did not germinate or gave a very scattering stand, but 8 failures were due to the depredations of grasshoppers.

The remaining 134 replies have been summarized as follows: The present condition of the field of grass was reported good by 100, while 13 stated that the condition was poor. Spring sowing was recommended by 86 and fall sowing by 22. That a stand of brome-grass is easier to obtain than of other grasses was stated by 48, while 42 thought that this was not the case. A few had tried sowing brome-grass with other crops but with varied results. With alfalfa, there were 5 successes and 2 failures; with clover 3 successes and 2 failures. Three reported a successful stand when sown upon prairie sod, while 5 failed in this. That this is a good hay grass was reported by 42, while 17 thought not. As a pasture grass, all except 2 reported favorably so far as this point was touched upon, while 42 stated that it was good for early and 49 for late pasture. Twenty-four stated that it was good for winter pasture. The drought resistance was reported good by 53 and poor by only one. The reports of 14 farmers showed that it was good for sandy soil and 50 stated that it made a good sod.

Alfalfa.

The well-known perennial legume alfalfa (*Medicago sativa*, Pl. II) is the most valuable forage plant grown in Nebraska. Every effort should be made to extend the culture of this plant to all parts of the State. Being a legume it is highly nutritious; being a perennial it produces a permanent meadow; being palatable it is relished by all kinds of stock. Although it is valuable as a pasture plant it is not entirely suited to this purpose. Close pasturing is likely to kill it out in spots. The great value of alfalfa lies in the production of hay. The reader is referred to Farmers' Bulletin No. 31, United States Department of Agriculture, for details in regard to this plant.

It may be briefly remarked here, however, that in growing alfalfa the ground should be well prepared, as free as possible from weeds, and the seed should be sown when the soil is in favorable condition for germination. The seed should be sown alone at the rate of about 20 pounds per acre, broadcast or, better, in drills. Where possible Nebraska-grown seed should be used, or at least seed grown under about the same conditions.

COOPERATIVE EXPERIMENTS WITH ALFALFA

Press Bulletin No. 16 of the Nebraska Experiment Station, entitled "Alfalfa Experiences," gives the following summary of results obtained by growers of alfalfa in that State:

During the winter of 1902 a list of between 600 and 700 successful alfalfa raisers in this State was collected, and to each was sent a report blank calling for a definite stateme t regarding a number of the processes he employed in obtaining his stand of alfalfa, and also regarding his subsequent care of the crop. More than 500 satisfactory replies were received, representing 80 counties in the State. A study of this large number of reports from successful alfalfa raisers gives some valuable information respecting alfalfa culture.

There were 288 stands reported upon upland, and 273 upon bottom land. Even in the western portion of the State the amount of alfalfa on the upland is shown to be considerable, and very satisfactory results are evidently obtained, although naturally the yields of hay are smaller than on the bottom lands of that region. In the eastern part of the State somewhat heavier yields appear to be obtained from bottom land, but loss from winter killing or other cause is greater. Twenty-three reports state that upland is more satisfactory than bottom land. These come principally from the eastern portion of the State or the irrigated land of the western portion.

An astonishing feature of the replies is the large amount of alfalfa that they show to be growing on land with a clay subsoil. Sandy clay, clay loam, clay and lime, etc., were not counted as clay. In spite of this limitation, 245 clay or gumbo subsoils are reported. A clay or even a gumbo subsoil does not appear to be a barrier to successful alfalfa culture.

The seed bed was prepared by plowing and further working in 373 cases, and by disking or cultivating in 75. Among the latter is one method that appears to be popular and satisfactory. This consists in thoroughly disking corn land after all trash has been removed from the field. In the western part of the State there are a number of good stands of alfalfa obtained by breaking prairie sod, disking it, and harrowing in the seed. Also by disking the unbroken sod and harrowing in the seed. The latter commends itself as an easy way of supplementing the native grasses in pastures. The tendency to dispense with plowing on unirrigated land increases with the distance westward from the Missouri.

A study of the dates of sowing alfalfa seed in the spring shows a range from early March to late June, although where advice was volunteered it was practically unanimous in favor of early sowing. There were only 8 reports of summer or fall sowing, of which 1 was sown in July, 4 in August, and 3 in September.

In 108 cases a nurse crop was used, while in 393 cases the alfalfa seed was sown without that of any other crop. The use of the nurse crop was largely confined to extreme eastern Nebraska and the irrigated land of the West. Many persons who used a nurse crop say that they would not do so again. It has been recommended to use a light seeding of small grain, sown earlier or with the alfalfa, to prevent damage by severe winds. When sown in this way the nurse crop is mown when 8 or 10 inches high, to prevent it smothering the alfalfa.

In 55 cases the seed was put in with a drill, and in 447 cases it was sown broadcast. This is at least an indication that if a drill is not available a satisfactory stand can be obtained by broadcasting and harrowing in, provided the other conditions are favorable.

There were 138 reports of less than 20 pounds of seed per acre being used, and 336 reports of 20 pounds or more being sown. The evidence seems to be in favor of the use of at least 20 pounds of seed per acre.

Of the persons replying to the inquiries, 221 have stands of alfalfa that yield more than 4 tons of cured hay per acre each season, while 157 do not get as much as 4 tons of hay per acre.

Of persons having practiced disking alfalfa in the spring or at other times, 138 report that beneficial results have been obtained, while 7 report that disking has been ineffective or injurious. By disking alfalfa is meant going over it in the spring with a disk harrow before growth starts, or during summer immediately after cutting for hay. It is customary to set the disks at a slight angle. This cuts the crown root and stirs the soil. Some of the correspondents prefer harrowing to disking. Where positive objection was made to disking, it was based on the claim that it caused the crowns to become diseased. The great bulk of the evidence was, however, in favor of disking.

Of the persons who have manured alfalfa, either by plowing in the manure immediately before seeding or by spreading it on the field after a stand had been obtained, 110 obtained beneficial results, and 13 found it to be ineffective or injurious. Objections are based on the claim that plowing in manure causes the soil to dry out, but objections to spreading manure on alfalfa are rather indefinite in their nature, except that on low land it makes the growth too rank, and the alfalfa falls down. Many of those who advocate its use specify that the manure should be rotted and fine. One man suggests harrowing after spreading, to fine it. The reports of beneficial results from plowing under manure come largely from the eastern portion of the State, but the use of fine manure applied as a top dressing has proven beneficial in all parts.

ALFALFA SEED FROM DIFFERENT SOURCES.

Turkestan alfalfa.—One plot of one-fifth acre was sown alone with 5 pounds of seed April 8, 1901. There was a good stand and no loss from winter killing in 1901–2 or 1902–3, thus showing its superiority in respect to hardiness during the winter. On the other hand, this plot was injured by the wet weather in the summers of 1902 and 1903 to a greater extent than common alfalfa. On June 12, 1903, a crop of hay was obtained, weighing 605 pounds (3,025 pounds per acre), and a second crop on July 23, weighing 500 pounds (2,500 pounds per acre), making 2.75 tons of hay per acre, besides fall pasturage. It was noted that this plot started one week earlier in the spring than the ordinary alfalfa, but did not continue growth so late in the autumn. At no time did it grow so tall as ordinary alfalfa, but the stand was much thicker, and there appeared to be less tendency for the crowns to become large and crowd out weaker plants, as is the case with ordinary alfalfa. As compared with the latter the leaves and especially the stems are smaller.

A second plot, one-tenth acre,[a] drilled in rows 6 inches apart May 24, 1898, gave a good stand, with no loss from winter killing the first year and yielded 215 pounds of hay (2,150 pounds per acre) on June 17, 1899. The third year the yields of hay from one-eighth acre were

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[a] The plots here, as in several other cases, are 66 feet by 76 feet and contiguous on the longer sides. If the marginal growth was greater than the central, 5 feet was mowed off each end, reducing the plots to 66 by 66 feet, or one-tenth of an acre, and thus eliminating the marginal factor.

as follows: June 14, 515 pounds; July 20, 590 pounds; August 20, 305 pounds, or a total for the season of 5.64 tons per acre.

In 1901 the yield on the one-eighth acre was: June 5, 645 pounds; July 19, 160 pounds; August 20, 125 pounds; a total of 3.22 tons per acre. In 1902 the yield on June 9 was 445 pounds; in 1903, June 11, 475 pounds; July 23, 365 pounds; a total of 3.34 tons per acre. The results of this test are especially satisfactory, as showing that Turkestan alfalfa is well adapted to Nebraska conditions, and that in a dry season such as 1901 it yields larger crops than the ordinary alfalfa.

Peruvian alfalfa.—Seed was obtained from C. Bonitiez, Peru, through the Division of Agrostology of the Department of Agriculture, and was sown on May 11, 1900. The stand was good and the growth vigorous, but the plot was badly injured each winter, till, in 1903, there was none remaining.

Samarkand alfalfa.—Sown May 11, 1900. The stand was good and subsequent growth vigorous, with no loss from winter killing; but the growth was not so tall as common alfalfa, or as Turkestan alfalfa. In 1902 and 1903 crops were obtained from this plot, but the plot is too small for an accurate estimate of the yield to be determined. Owing to the small growth, it was estimated that the yields were less than from the ordinary or the Turkestan alfalfa. To offset the effect of shorter growth the stand is much thicker than that of ordinary alfalfa. It appears to be a strong drought-resisting plant, and if it is to have any value it will be on the highlands of the West.

Seed from different States.—Alfalfa obtained from five different States—Arizona, California, Colorado, Kansas, and Utah—was tested. The plots were sown in 1898 by drilling the seed in rows 6 inches apart. They all grew about equally well until the winter of 1898–99, when the alfalfa from Arizona and California was almost entirely killed out. At the same time the Colorado alfalfa was injured, while the Utah and Kansas plants did not suffer so much as those just mentioned, though more than the Turkestan alfalfa or that from Nebraska-grown seed.

There was no further marked loss from winter killing until the winter of 1902–3, when the remainder of the Arizona and California plants entirely disappeared, the Colorado crop suffered further injury, and both the Utah and Kansas alfalfa were injured to some extent.

The conclusions to be drawn from this experiment are that it is not desirable to bring alfalfa seed from a southern to a more northern region, or from an irrigated to a nonirrigated soil.

OTHER EXPERIMENTS WITH ALFALFA.

A series of experiments was carried on for the purpose of testing the effect of planting alfalfa in rows and the effect of a few kinds of fertilizers. Plot 43, drilled 24 inches apart, and plot 44, drilled 18 inches apart, were cultivated by hand, and plot 45, drilled 6 inches apart, was cultivated by harrowing. The results show that there is little difference in the yield under the different treatments, and that there is no advantage in planting alfalfa in rows and cultivating it, at least under the conditions at the Nebraska Station. The individual plants tend to grow larger and the stems fall over, filling the space between the rows. As the larger crowns with age tend to rise above the soil, the mowing becomes more difficult and there is more loss of foliage than when the seed is sown thickly. It is quite possible that in the drier portion of the State the moisture could be conserved by cultivation and a crop produced when under ordinary methods there would be failure. On the other hand, the extra expense of such treatment is likely to more than offset any such advantage. In the Southern States alfalfa is frequently raised in rows and cultivated, as it can thus be more easily kept free from weeds; but such methods are used only on a small scale.

The treatment of plots with fertilizer showed no marked advantageous effect. Plots 46 to 49 were treated respectively with fertilizer at the following rate per acre: One ton gypsum, 1 ton lime cake, 2 tons lime cake, 3 tons hog manure.

In order to determine the effect of using heavy or light seed, common alfalfa seed was separated by a grain grader into approximately equal parts of heavy and light weight. This was sown by drilling in 1902. On June 23, 1903, a cutting was made from each plot. The light seed yielded at the rate of 2,500 pounds per acre, and the heavy seed at the rate of 3,000 pounds per acre. The notes made at the time show that both plots were weedy the first year, but the second year there was a much thinner stand in the plot from light seeds.

To test the effect of seeding at different times plots of common and Turkestan alfalfa were sown by drilling and by broadcasting from spring till fall, in 1902, on the following dates: March 10, March 24, April 8, April 21, May 7, May 19, August 7, August 19, September 15, October 1, October 21. On account of lack of seed the experiment with Turkestan alfalfa was discontinued after August 19. The plots of this variety showed a good stand in almost every case and no injury during the succeeding winter.

The sowings of common alfalfa during March, April, and on May 7 gave a fair to good stand, but were all seriously injured the following winter. Later sowings gave good results and not much injury from winter killing except that the sowing of October 21 was a failure, as the plants did not reach a sufficient size to withstand the winter. It was also observed that of the fall-sown plots those sown broadcast gave a much better stand than those that were drilled. (See Pl. III, fig. 2.)

These experiments, as well as the experience of alfalfa growers, show that alfalfa may be sown at any time of the year from spring to early fall, provided the soil is in the proper condition as to tilth and moisture. In the eastern part of Nebraska summer and fall sowings may be advantageous because of the weeds. The soil may be freed from weeds during summer and thus the alfalfa is given a chance to get a start.

To test the relative value of sowing seed alone or with a nurse crop, two one-fifth acre plots were planted with 5 pounds of seed on April 8, 1901. On plot No. 1 the seed was sown alone. A good stand followed, with vigorous growth, though some plants were killed during the winter of 1902–3. The result was entirely satisfactory. The plot was disked in the same manner as No. 2. On plot No. 2 the seed was sown with 2 peck of oats. On June 28, 1901, 58 pounds of oats were gathered, followed by a fair stand of alfalfa by October. In the spring of 1902 the stand was very poor, but after being disked and harrowed (March 22) there was some recovery and a good stand resulted in the spring of 1903, though there had been some loss during the preceding winter. The results show that a good stand is more certain to follow sowing alone, the growth of alfalfa being vigorous the first season, while if sown with a nurse crop the alfalfa does not reach its maximum till the second season and there is some risk of a poor stand. The poor results the first season are partly offset by the oat crop gained.

A third plot was treated in the same manner as No. 2, with the intention of mowing the oats for hay, but the dry spring ripened the oats prematurely. The results otherwise were similar to plot No. 2.

A series of experiments has now been in progress for three years to test the effect of combining alfalfa with various grasses. In the spring of 1901 plots one-fifth acre in size were sown with the following mixtures:

Alfalfa, 5 pounds; brome-grass, 3 pounds.

Alfalfa, 4 pounds; brome-grass, 4 pounds.

Alfalfa, 4 pounds; bluegrass, 3 pounds.

Alfalfa, 4 pounds; meadow fescue, 5 pounds.

Alfalfa, 1 pound; brome-grass, ½ pound; red clover, ½ pound; white clover, ¼ pound; bluegrass, ½ pound; meadow fescue, ½ pound; orchard grass, ½ pound; timothy, 1 pound; perennial rye-grass, 1 pound; tall oat-grass, ½ pound.

Alfalfa, 4 pounds; timothy, 5 pounds.

In all cases there was a good stand of alfalfa the first year, and scarcely any of the grasses could be found. All of the plots were disked and harrowed in the spring of 1902. During this season there was a good growth of alfalfa and only a little grass to be seen. This result is especially noteworthy for the plot containing only 1 pound of alfalfa, with several grasses. It was not till the third year that the grasses began to assert themselves. In all the plots the grass constituted a considerable portion of the plots except in the case of the mixture with timothy, which appears to be unable to compete with alfalfa. In the mixture of several grasses it was the orchard grass that took the lead, the plot being estimated to consist of about one-third of this grass.

Another plot of alfalfa and brome-grass sown in equal parts in 1899 has had a similar development, but at the present time the brome-grass has succeeded in nearly crowding out the alfalfa. In the plots where brome-grass was sown with alfalfa—both the common and Turkestan—it was noted that the grass appeared more vigorous in those places where the alfalfa was thickest, and that the grass in these plots appeared also to be more vigorous than in adjacent plots where there was no alfalfa. It would appear that the brome-grass derived some advantage from the fertilizing effect of the alfalfa. (See Pl. IV, fig. 2.)

It will be of interest to record here the results obtained by two correspondents in sowing alfalfa upon native grass in the sand-hill region.

William Fagan, foreman of the Robert Taylor ranch at Abbott, Hall County, states that he disked the sandy sod three times, lapping the disk half each time, and sowed 20 pounds of seed per acre. This was in the spring of 1902. A good stand was obtained, and in 1903 a crop of hay was cut consisting of about one-third prairie hay and two-thirds alfalfa. The alfalfa succeeded better on the knolls where the sod was more thoroughly broken.

Mr. H. W. Sullivan, Broken Bow, Custer County, states: "Beginning in the early spring and continuing up until August, I caused light sandy soil to be broken. I disked this well, harrowed it down smoothly, put seed in with a press drill, 15 pounds to the acre, and got a splendid stand on every foot of it." He remarks that the best stand seemed to follow the August sowing.

Meadow Fescue.

Meadow fescue (*Festuca pratensis*) is a native of Europe and has been cultivated in this country for many years. It can not compete with timothy where the latter is at its best, but being more drought resistant, its range is somewhat more extended in the West, as indicated in the paragraph upon orchard grass. It is more common in the Middle South, where it is grown as a winter grass, being sown in the autumn.

In Nebraska it is recommended that it be sown with orchard grass in the spring. It can also be sown alone or with clover, and in Nebraska is best adapted for pasture, though it can also be used for hay. For the latter purpose, however, brome-grass or alfalfa give better returns.

Many seedsmen sell meadow fescue under the name of English blue-grass, but the latter name is inappropriate, as the grass is not a bluegrass, and the term English bluegrass is sometimes applied to a different plant.

A closely allied grass is tall fescue (*Festuca elatior*). Botanically they are usually considered to be the same species, but agriculturally there is considerable difference, and, for Nebraska conditions, in favor of the meadow fescue.

For further notes upon this grass see the paragraph upon grass mixtures.

One plot, 76 by 132 feet in size, sown in the spring of 1900 and manured in the fall of 1901, gave on June 23, 1902, 750 pounds of hay, or 3,450 pounds per acre. The grass was injured somewhat by the drought of 1901, but recovered sufficiently to give good fall pasture. The fourth year, June 16, 1903, this plot gave a cutting of hay of 670 pounds, or at the rate of 2,836 pounds per acre.

Another plot (one-eighth acre), drilled in rows on May 25, 1897, gave on June 27, 1900, a cutting of 300 pounds of hay, or at the rate of 2,400 pounds per acre. The growth in the following years was good, but the notes show that the grass does not start to grow so early in the spring as brome-grass.

Eight growers of meadow fescue have reported upon their results. All report that their fields are now in good condition, but the reports are equally divided as to the advantages of spring and fall sowing, while five state that it is easier to obtain a stand of this than of other grass. Several have tried meadow fescue mixed with timothy, clover, or alfalfa, all of which trials were successful.

Orchard Grass.

Orchard grass (*Dactylis glomerata*) is a native of Europe, but has been cultivated in this country since the middle of the eighteenth century. It is a bunch grass, and when sown alone forms tufts which in time become large tussocks, considerably raised above the general surface of the soil. This is a hindrance to the mowing machine and also a waste of land. For this reason it is recommended that orchard grass be combined with some other grass, for which purpose meadow fescue and brome-grass are best adapted to Nebraska conditions.

Orchard grass is one of the most nutritious and palatable of the cultivated meadow grasses. It thrives in more shaded situations than other meadow grasses, for which reason it is often planted in orchards; hence the name. It withstands drought better than timothy, and consequently can be grown farther west in Nebraska than can timothy. The chief disadvantage of orchard grass is the greater expense of the seed.

Orchard grass and meadow fescue, sometimes combined with red clover, are to be recommended especially for pasture in that part of Nebraska west of the timothy belt as far as about the ninety-ninth meridian, beyond which the summer conditions become too severe. It is true that fields of these grasses usually dry up more or less during the middle of summer, but the same is true of all available pasture grasses, it being necessary to supplement them during this season with green feed, such as cane or corn. On the other hand, orchard grass and meadow fescue furnish green feed in early spring and late fall, seasons when the wild pastures are not available. The seed should be sown in the spring at the rate of about 20 pounds of orchard grass and 15 pounds of meadow fescue per acre. Unless the ground is free from weeds it will be necessary to mow once or twice during the first season to keep the weeds down until the grass is well established. When grown for hay the grass should be cut in blossom, as at a later period the value of the hay rapidly decreases.

Orchard grass has been grown on the Nebraska Station farm for several years and has given very satisfactory results. (See Pl. IV, fig. 1.) The reader is referred to the paragraph upon grass mixtures for further information as to this grass.

Timothy

Timothy (*Phleum pratense*) is a native of Europe, and is said to have been brought to Maryland in 1720 by Timothy Hanson, for whom it was named. The history of this standard meadow grass is somewhat obscure, however. The name herd's grass, by which it is known in New England, is said to have been derived from a Mr. Herd, who found it growing wild in New Hampshire and introduced it into cultivation. Timothy is cultivated in Europe, while in the United States it is the common meadow grass through all the Northern States as far west as eastern Nebraska and south to Virginia and Tennessee, and even farther in the mountains. It is also cultivated in the Rocky Mountains at high altitudes, in the irrigated districts of the Northwest, and the moist region of western Oregon and Washington.

Timothy is a less nutritious grass than most of the other cultivated grasses, but it has a great advantage from the fact that seed of good quality is easily produced for the market and hence is cheap, and because the grass may be easily grown and handled. In Nebraska timothy can be grown successfully only in the eastern counties, although it is being gradually pushed westward, and there are many fields that give fairly good results as far west as the ninety-ninth meridian, or even farther when there is an abundant water supply near the surface. However, these are isolated cases and represent localities where the conditions are especially favorable, and it can not be said that timothy is to be depended upon much west of the line indicating 30 inches of annual rainfall.

Timothy is chiefly used for meadows, but may be also used for pastures. When sown alone there is some danger of injury from close pasturing, as stock are likely to pull up the bulblets at the base of the stems and thus destroy the crown. It is usually sown, when intended for pasture, with red clover. When used for hay it is also frequently combined with clover, which is very satisfactory for home use, as the clover increases its feeding value. Upon the hay market, however, pure timothy brings a higher price than mixed; hence when grown for sale timothy is usually sown alone.

It may also be remarked that the soil conditions of Nebraska are not suited to the best development of timothy, even where the rainfall is sufficient, as the soil is of a sandy type rather than clay. Timothy may be sown in the autumn or spring. If sown alone it is best to sow in the fall, as a full crop can then be obtained the following year. If sown in the spring there is not generally a full crop till the second year and hence some time is lost. It is usual in Nebraska to combine it with clover and sow with a nurse crop, the object of the latter being to obtain more from the land the first year. As the timothy and clover may not reach their full development the first season, the grain crop is thrown in for economy. Where winter wheat is grown it is common to use this as the nurse crop, sowing the timothy and wheat in the fall and the clover the following spring. The wheat and timothy can not be sown mixed in a drill on account of the difference in the size of the seed, but they may be sown at the same time by using a wheat drill having a special attachment. The timothy may be sown in the spring, but in that case should be sown early, about the time the snow is disappearing and while the ground is wet. If there is no snow and the ground is dry the timothy is likely to fail. The clover is sown in the spring in either case and later than is suitable for timothy, usually the first part of April.

The amount of seed used is from 6 to 8 quarts of timothy and 8 to 10 pounds of clover. When combined with grain the timothy and clover produce a good growth after the grass is cut, and may be lightly pastured the same year. The following year one or more crops of hay may be cut or the field may be pastured, according to circumstances. When timothy is sown alone there is some danger in Nebraska of injury to the roots after the cuttings, as they may be unduly exposed to the hot sunshine during dry weather. There is less danger of this when clover is used in combination.

Clovers.

Red clover (*Trifolium pratense*), the standard forage legume of the Northeastern States, can be grown in the eastern counties over about the same area as timothy. As clover is usually combined with timothy for both pasture and meadow, its cultivation has been considered in connection with the latter plant. In the census returns cited in the introduction to this bulletin mixed timothy and clover are included under "other tame grasses." As Nebraska is credited with 42,000 acres of clover and 92,000 acres of other tame grasses, it is quite likely that a large proportion of the latter area is devoted to timothy and clover mixed. Red clover has been grown upon the Nebraska Station farm for many years with great success.

Mammoth clover is a variety of red clover of more vigorous growth and longer lived than the ordinary kind. The seed was sown at the Nebraska Station in 1900, and gave a good stand, a vigorous growth, with good fall pasture. The following year it was subjected to a severe test by drought, but withstood this better than any other clover upon the farm. It was about half winterkilled in the winter of 1902–1903.

Alsike clover (*Trifolium hybridum*) is a perennial clover, in size and appearance intermediate between red and white clover. It is adapted to more moist ground than red clover and is recommended as a constituent of wet pastures. In Nebraska it does not usually grow tall enough for hay, but is a fine clover for pasture. On the station farm alsike has given good results in low spots in pastures and has withstood drought well.

Kentucky Bluegrass.

Kentucky bluegrass (*Poa pratensis*) is a native of Europe and of the northern part of the United States, but it is now widely cultivated; it is also found as a wild grass throughout all the northern portion of the United States, except the arid regions. Bluegrass is essentially a pasture grass and can scarcely be excelled in regions where it reaches its greatest development. In Nebraska it thrives only in the eastern counties over about the same range as timothy, though it is gradually spreading westward. However, in many places lying west of the normal range it is a common constituent of pastures, and is then usually established in the more shaded situations. If there are shade trees or hedges, the bluegrass is quite certain to obtain a foothold and spread outward, holding its own very well with even the native grasses. It gives early and late pasture, but dries up in summer.

The seed should be sown very early in the spring, on the melting snow if possible, at the rate of about 25 pounds of good seed per acre. If the seed is chaffy more must be used. It is customary to sow with bluegrass a little white clover—2 or 3 pounds. The latter, however, is usually widespread in the bluegrass region and soon comes in itself.

Results at the Nebraska Station show that bluegrass furnishes considerable pasture, especially during spring and fall, as indicated in the paragraph on pastures.

Closely allied to Kentucky bluegrass is Canada or Canadian bluegrass (*Poa compressa*). This differs from the former in having a distinctly flattened stem, being of a bluish-green color, in having smaller flower clusters, and usually growing less tall. It is the common bluegrass of the New England and Northeastern States, and in some localities is called wire grass and also English bluegrass. It is adapted to somewhat more sterile soil than Kentucky bluegrass, but on the whole is scarcely to be recommended for Nebraska. The station trial of this grass was unsatisfactory.

Redtop.

Redtop (*Agrostis alba* and *A. vulgaris*) is a native of Europe and also of the northern parts of North America. In the Eastern States, especially from Pennsylvania southward, this grass is more commonly known as herd's grass. Redtop is widely cultivated and is now found growing wild through all the region indicated for timothy. Like bluegrass and white clover, it is now a common constituent of meadows and pastures even where it was not sown. It is particularly adapted to moist soils and is always recommended as a constituent of meadows or pastures on low ground. It is, however, inferior in quality to the other grasses mentioned, and also on ordinary dry ground it is inferior to them in quantity. It is to be recommended for moist meadows in the eastern part of the State and also for those localities in the sand-hills and other portions of western Nebraska where the soil is too moist for the growth of ordinary meadow grasses.

As the seed obtained in the market usually contains a large amount of chaff it is necessary to sow a correspondingly large quantity of seed. A half bushel of clean seed per acre is probably sufficient, but it may be necessary to increase this to 2 bushels if the seed is chaffy. When sown in mixtures, as is usually the case, a much less quantity may be used. A common mixture is 3 pounds of alsike clover, 4 pounds of timothy, and 4 pounds of redtop. Botanically there is a slight difference between *Agrostis alba* and *A. vulgaris*, but the seed upon the market may be of either variety. A variety known as creeping bent (*A. stolonifera*, of the seed catalogues) is often used as a lawn grass in the Eastern States. A related species, Rhode Island bent (*A. canina*), is also used as a lawn grass, but in Nebraska both these grasses are inferior to bluegrass for this purpose.

Redtop has been grown upon the Nebraska Station farm for several years and has been found to be entirely adapted to this region.

Side-oats Grama.

The first seeding of side-oats grama (*Bouteloua curtipendula*), also called prairie oats and tall grama, was made in 1897. It gave the same year a yield of hay amounting to nearly two tons per acre, and the following year the product was nearly four tons per acre. The grass was partially killed during the unprecedentedly cold winter of 1899. Being a native, it is not injured by ordinarily cold weather. Seed sown in 1900 produced a good stand the first year but no crop.

During the second season, 1901, which was very dry during the late summer, the grass continued in good condition in spite of the drought, and produced a crop of seed on August 21 and a second crop October 16, after which it kept green during fall. This plot continued to give good results during 1902 (see Pl. VI, fig. 1), but as it does not form a close sod it gives a chance for various weeds to become established between the bunches. In 1903 the plot had greatly deteriorated and the grass was finally driven out by weeds.

Taking everything into consideration this is a very promising grass for the drier regions of Nebraska. It is a native of the plains and furnishes excellent forage for pasture and also promises well for hay. An important point in its favor is the fact that the plants seed abundantly and the seed is easily gathered—of good quality, and easily sown. On account of the tendency to grow in bunches it may be best to sow this with some other grass, such as brome-grass, or even with alfalfa. Much of the success in growing this grass depends upon securing good seed. In the experiment noted above, the seed was obtained from a plot previously grown upon the farm. Other plots of the same grass sown with seed obtained from the Department of Agriculture were failures on account of low vitality. The Kansas Experiment Station reports good results in the culture of this grass (Bulletin 102).

Wheat-Grasses.

Western wheat-grass (*Agropyron occidentale*) is commonly found in the western portion of the Great Plains, extending into the mountains. It propagates by stout creeping rootstocks, but does not form a close sod. In the west, from Colorado to Montana, it is called bluestem, Colorado bluestem, or Colorado grass, and it forms the bulk of the native hay of this region. It grows on bench land or bottom land, and though the yield per acre is not large it furnishes more hay than any other common grass of this region. The foliage is stiff and harsh, but the quality of the hay is good and it is readily eaten by stock.

The trials on the plots at the Nebraska station were satisfactory. Where a good stand was obtained the plant showed that it could withstand drought and produce a good crop of hay. One plot of one-fifth of an acre, sown in 1901, and on account of the poor stand resown the following year, produced on June 23, 1903, 457 pounds of hay, or at the rate of 2,485 pounds to the acre.

Wheat-grass is in fact one of the most promising of our native hay grasses. The seed is produced in abundance and is easily gathered. Experiments at stations in the arid regions have usually given good results. The rootstocks soon fill the soil and the field may require rejuvenating. This can be accomplished by disking or harrowing to cut up the rootstocks, as is often done upon the native meadows.

Although *Agropyron repens*, known as quack-grass, quitch-grass, and couch-grass, is a pestiferous weed in the Eastern States, yet for Nebraska it shows many qualities which recommend it as a hay grass. The grass is nutritious, palatable, drought resistant, and thickens up readily to form a good stand. It is true that it may tend to spread where it becomes established, but in the semiarid regions such a quality in an otherwise desirable grass would be readily overlooked. Four years' testing of this grass upon the station plots shows that it recovered easily from the drought of 1901 and formed a good growth of hay in 1902 and 1903.

Slender wheat-grass (*Agropyron tenerum*) is a native of the Northwestern States from western Nebraska to Canada and westward. This has been recognized in the region to the north of Nebraska as a valuable wild grass and has already been brought into cultivation, so that the seed can be obtained of several seedsmen in the Northwest. It resembles *A. occidentale* in many respects, but differs in the important fact that it is a bunch grass, and does not spread by creeping rootstocks. Like the other wheat-grasses, the seed habits are good, and it gives promise of meeting the requirements of a hay grass for the Northwest.

One plot at the Nebraska Station, sown in 1897, was apparently much injured by the drought of 1901, but the following spring it quickly recovered and produced a thick stand of excellent hay. Another plot, one-fifth acre in size, sown in 1901, had a similar history, but it was resown in the spring of 1902, produced a good stand, and gave a cutting of hay on July 23 of 457 pounds, or at the rate of 2285 pounds to the acre.

Grasses and Legumes of Less Importance.

Big bluestem (*Andropogon furcatus*).—This is one of the tall grasses common over the prairie region and forms, probably, the most valuable constituent of native hay produced in eastern Kansas, eastern Nebraska, and Iowa. It is usually called bluestem, or bluejoint, and is characterized by having the seed in crowfoot clusters at the top of the stem, by which it may be distinguished from the bluejoint of Colorado, which is a wheat-grass, and from the bluejoint of Minnesota, which is a grass of low grounds rather than prairies. The station plot gave rather unsatisfactory results on account of the poor stand obtained, but the bunches that were produced grew well. Although a valuable grass, the seed habits are such that it is not likely to adapt itself to cultivation. The seed is produced in small quantity, is of uncertain vitality, and the seed stalks vary so in height that it is not readily harvested.

The allied *A. scoparius*, which is another important native hay grass, called little bluestem, or, on the plains, "bunch-grass," has not been tested at the Nebraska Station, but the above remarks concerning the seed habits apply nearly as well to this species.

Indian grass (*Andropogon nutans*).—A tall grass growing in the Eastern States and westward nearly to the mountains. It forms an important constituent of all the wild hay of the prairie regions except toward the north. It is of especial value on account of its numerous root leaves. The plot of this grass tested gave finally a luxuriant growth of foliage, although it was injured somewhat by the drought of 1901. The poor seed habits of this grass stand in the way of its cultivation. The seed is usually not very abundant and is often of low vitality.

Tall oat-grass (*Arrhenatherum elatius*).—One of the European meadow grasses which has been grown on a small scale in this country for many years. As it is a bunch grass and does not form a close sod it should not be used alone, but doubtless it will be a valuable addition to a mixture such as orchard grass and meadow fescue. It is fairly drought resistant, and has the quality of producing a comparatively rank growth the first season, for which reason it has found favor as a winter pasture grass in the South. In general, however, it seems to be better adapted to meadows than to pastures. The station plots gave a good growth of forage which produced excellent hay. One plot, one-fifth acre in size, sown in 1901 and resown in 1902, produced on June 23, 410 pounds of hay, or at the rate of 2,050 pounds to the acre. After the cutting a fine aftermath was formed. In 1903 the same plot yielded (June 16) only 310 pounds, or at the rate of 1,550 pounds to the acre, bearing out the experience elsewhere that a meadow of tall oat-grass reaches its maximum development early and then deteriorates.

Blue grama (*Bouteloua oligostachya*).—Blue grama is one of the important constituents of upland grazing regions of the Great Plains and is often called buffalo grass, but it should be distinguished from the true buffalo grass with which it is usually associated. Blue grama does not produce so large a quantity of seed and the seed is not so easily gathered or handled as side-oats grama, but ranchmen state that it is superior to this grass in nutritive qualities and palatability, and furthermore that it forms a thick sod, while the other does not. The growth is short, usually about a foot high, and hence this grass is not adapted for hay except under favorable conditions, though for pasture it is exceedingly valuable. Seed was sown on one plot in 1898 and on a second plot in 1900. The grass was slow to start from seed and the growth in the spring was slow even when the plot was established, but the stand thickened up well, and during the dry season of 1901 it was the only grass besides side-oats grama that gave sufficient growth for pasture during the period of extreme drought.

Western brome (*Bromus carinatus hookerianus*).—Three trials of this gave negative results on account of the failure of the seed to germinate, but one plot sown in the spring of 1902 with seed from the grass garden of the Department of Agriculture at Washington gave good results and showed that the grass is at least promising for the semiarid regions. Trials at stations in the Northwest have also shown that this species gives much promise. This grass is closely allied to *B. marginatus*.

Western brome (*Bromus marginatus*).—Four trials of this grass showed that it is well adapted to the conditions in Nebraska, giving a good growth and resisting the dry weather of 1901, and that it is not injured in the winter. The foliage is rather coarse and not as leafy as would be desirable, but the grass is well worth an extended trial.

Buffalo grass (*Bulbilis dactyloides*).—Buffalo grass is the common "short grass" of the Great Plains, and forms a close, thick sod by means of its numerous creeping stolons. It is entirely resistant to drought, it is very nutritious, and it cures upon the ground, thus furnishing winter feed to the range cattle. The grass forms the seed close to the ground in little nut-like clusters that are likely to escape the casual observer. The staminate or male flowers are produced in little spikes or flags, which are raised a few inches above the ground and are much more easily distinguished than are the pistillate or female flowers that produce the seed. The seed, however, is quite fertile, but is so difficult to gather that it will never be practicable to grow buffalo grass from the seed. If it is desired to produce a field of buffalo grass it should be started from the cuttings. For this purpose the sod should be cut into small pieces and planted upon prepared soil. The pieces can be dropped upon the surface of the soil and forced into the ground by stepping upon them. The distance apart depends upon the desirability of obtaining a thick stand at once. If the pieces of sod are placed 2 feet apart each way, they will thicken up between fairly well in one season. In experiments at the Nebraska Station the seed failed to germinate.

Wild rye (*Elymus canadensis*).—A common grass in many parts of the United States and extending over a large part of Nebraska, where it is found chiefly in draws and low places. It produces a large amount of hay of good quality, though rather coarse. It resists drought quite well and seems well worth an extended trial as a meadow grass. One plot on the station grounds, sown in 1901 (see Pl. VI, fig. 2), was cut on July 26, 1902, and yielded at the rate of 5,875 pounds to the acre (1,175 pounds on one-fifth acre). The same plot yielded on July 23, 1903, at the rate of 3,700 pounds per acre. The shattered seed from the plot germinated in the autumn of 1902 and produced a good stand the following season. The cutting was made after the grass had headed out, but for the best hay the cutting should be made much before the heads appear. The form here cultivated is sometimes referred to as *E. robustus*.

Elymus virginicus.—The same remarks apply to this species as to *E. canadensis*, but this grass shows the effect of drought more quickly than that species.

Elymus virginicus submuticus.—The results with this variety are more satisfactory than with the species.

Eragrostis tenuis.—This grass has given good results in the plots, and promises well as a hay grass, although the foliage is rather wiry. The grass is a native of sandy regions of the plains, and it may prove valuable in the Sand Hills.

Wild timothy (*Muhlenbergia racemosa*).—A native grass found in moist places through the Northern States west to the Rocky Mountains. In Nebraska it is a common constituent of slough-grass hay. The results upon the station plots show that this grass can be cultivated and a fair quality of hay produced.

Japanese barnyard millet (*Panicum crus-galli*).—An annual grass of much nutritive value which gives a luxuriant growth of fodder suitable for coarse hay. The station plot of this grass, one-fifth acre, sown March 22, yielded on July 26, 1902, 1,100 pounds of hay, or at the rate of 5,500 pounds to the acre. The yield should have been much higher, but the stand was not of the best. There is no doubt that this is a good annual hay grass for portions of Nebraska which are not too dry, but as it has no especial advantage over millet and is inferior to sorghum it probably will not be used extensively. Some seedsmen have sold this under the name of Billion Dollar Grass.

Switch-grass (*Panicum virgatum*).—A bunch grass which is one of the important constituents of prairie hay in Nebraska and is well worth cultivating. The plot at the station was unsatisfactory on account of the poor stand, but the bunches present produced a good quality of hay. The grass is quite resistant to drought and produces a quantity of seed which is usually of good quality.

Reed canary grass (*Phalaris arundinacea*).—A native of marshes and sloughs through the northern tier of States. In the northern portion of the Great Plains it forms a large part of the native hay, which is generally recognized as of excellent quality. Although a native of wet soil it gives good results on comparatively dry soil. It is to be recommended for cultivation in the States from Minnesota to Washington, and south probably as far as northern Kansas, but in the southern portion of the range is adapted only to low meadows. The great disadvantage of this grass at present is the difficulty of obtaining good seed. Ordinarily the seed shatters easily at maturity. The results of the trial at the station were unsatisfactory from the fact that there was a very thin stand, which was probably due to poor seed. The common ribbon grass of gardens is a variety of this species.

Stipa robusta.—A native of the Rocky Mountain regions and the western portion of the Great Plains, where it is a common constituent of the native hay. The station plot sown in 1897 withstood the drought of 1901 and gave good crops of hay in 1902 and 1903. This grass is worthy of an extended trial.

PASTURES AND MEADOWS.

NATIVE GRASSES.

Since the native grasses and forage plants play such an important rôle in the agricultural economy of Nebraska, it will not be out of place to discuss them briefly. They have been very thoroughly studied by Dr. C. E. Bessey and other botanists of the State and for detailed information the reader is referred to articles by Dr. Bessey in the reports of the Nebraska State Board of Agriculture from 1886 to 1896, to the Phytogeography of Nebraska, by Pound and Clements, the Flora of the Sand Hills, by Rydberg, and to various articles on the grasses of Nebraska by Webber, Smith, and others.

The agricultural grasses are divided into two types, according to root formation—bunch grasses and sod formers. The bunch grasses form a crown which increases from year to year and becomes in time a raised tussock. Where bunch grasses abound there is no continuous sod but a succession of tussocks with bare soil between which supports a variety of other plants scattered here and there. Some of the common bunch grasses are bluestem, switch-grass, and Indian grass. Sod formers have rootstocks or stolons by which they spread, forming a continuous sod. Buffalo grass and Kentucky bluegrass are examples of this type.

The grasses may also be divided into those which grow tall enough to make hay, and are sometimes called "tall grasses," and the strictly grazing grasses of the western plains, called "short grasses."

Hay is made from the tall grasses which are found on all unbroken prairie of the eastern portion of the State. In the wet places or sloughs, there are various swamp grasses (chiefly slough-grass, *Spartina cynosuroides*), which, when cut young, furnish a fair, though coarse, hay. The most important hay grasses are: Little bluestem (*Andropogon scoparius* Michx.), Big bluestem (*Andropogon furcatus* Muhl.), Indian grass (*Andropogon nutans* L.), Switch-grass (*Panicum virgatum* L.), and Side-oats grama (*Bouteloua curtipendula* Michx.). These five grasses form the great bulk of the prairie hay throughout the eastern half of the State. In the western portion these grasses are confined to the river bottoms, draws, and other moist spots, and often are found in sufficient abundance for mowing. These same grasses are also used for native pasture. But in the grazing portions of the West, except the Sand Hills, the important grasses are: Buffalo grass (*Bulbilis dactyloides* Raf.) and blue grama (*Bouteloua oligostachya* Torr.).

An important grass in the West, especially for hay, is the wheat-grass (*Agropyron occidentale*). This spreads by extensively creeping underground stems. The foliage is stiff and rather harsh, but nevertheless it forms a very nutritious hay. This grass is more resistant to drought than any of the hay grasses of the West.

There are many other grasses which are of more or less agricultural importance, but, compared with those mentioned, they are insignificant.

CARE OF NATIVE PASTURES AND MEADOWS.

Unless proper precautions are taken to prevent it, both meadows and pastures tend to deteriorate. In pastures the stock are continually eating off the most palatable plants and avoiding the others, which are in this respect weeds. To prevent such exhaustion it is necessary to limit the number of stock to the forage-producing power of the pasture. The same is true of the open range. Great harm has resulted in many instances from overstocking. Particular care must be exercised in this respect at what might be called critical periods, or when unfavorable conditions, such as drought, curtail the production of grass. In pastures this exhaustion can be avoided by supplementing the grazing by soiling crops. An excellent way to encourage the recuperative power of the native grasses is to give the pasture a rest by providing two pastures, which may be used alternately for periods of from two to four weeks.

With meadows deterioration is less marked, as the weeds are cut at the same time as the grass. However, it is advisable to allow the grasses to go to seed occasionally. It is a bad practice to pasture the aftermath during the autumn, as this encourages the growth of weeds.

The burning off of pastures or meadows is not to be recommended, as experience has demonstrated that though a green growth can be induced earlier the final results are harmful. The crowns of the grasses are injured and the fertilizing effect of the dried leaves is lost.

On the other hand, the practice of mowing the weeds in pastures in summer is good, as they are thus prevented from going to seed.

If the number of stock limited to its capacity is allowed to use the pasture, the manure thus distributed tends to keep up fertility; but meadows are constantly giving up nutriment drawn from the soil, the loss of which must in time visibly affect the capacity. Therefore, wherever the value of the hay is a sufficient recompense, it is well to supply barnyard manure to make up this loss.

TAME PASTURES AT THE NEBRASKA EXPERIMENT STATION.

A field of 30 acres was sown in April, 1899, with a mixture of 2 pounds each of orchard grass, timothy, bluegrass, tall oat-grass perennial rye-grass, and white clover, 4 pounds of red clover, and 1 pound of alsike. Three pounds of alfalfa were added to 5 acres of this mixture. In 1900, 30 tons of hay were cut and excellent pasture was obtained through the fall. In 1901, the pasture was in excellent condition, supporting 25 to 35 head of cattle and giving 14 tons of fine hay. This pasture has been top-dressed with barnyard manure about every other winter, and during the summer the weeds have been mown two or three times. In the spring of 1900 the field was disked and sown with brome-grass and meadow fescue. These grasses have gradually gained the ascendency until now the alfalfa has disappeared and there is little to be seen besides the grasses mentioned.

This tendency for certain grasses to predominate in a mixture is shown by the history of a 30-acre field of native pasture. About 1887 a portion of this pasture on the south side was sown with bluegrass and white clover. The bluegrass has gradually spread over the whole field, and at present the pasture appears to be mostly bluegrass, which is especially in evidence during early spring and late fall, while during the summer, particularly if the season is dry, the native grasses are conspicuous. This is the usual tendency where bluegrass is able to thrive. It holds its own with other cultivated grasses, and may even crowd out its competitors; but when combined with native grasses, these are able to hold their own in the prairie region of the State. The bluegrass starts to grow much earlier than the native grasses and gives in early spring an excellent quality of pasture. In the dry part of the summer the bluegrass dries up and becomes dormant while the native grasses continue to vegetate. In the autumn as the weather becomes cooler the bluegrass again starts up and gives late pasture. The experimental pasture had been top-dressed with barnyard manure about every third winter, and during the summer the weeds were mowed two or three times. In 1898, 4 acres of the above fields were plowed and sown to brome-grass. In the spring of 1901, 3 acres of alfalfa were added from an adjoining field. This portion was disked the following spring and sown with brome-grass and meadow fescue. These grasses have driven out the alfalfa, and now none of the latter can be found in the field. During the season of 1903 this field carried 40 head of cattle all summer, and also yielded a crop of hay estimated at one-fourth ton per acre.

Another field sown with timothy, orchard grass, bluegrass, meadow fescue, and brome-grass is now nearly all brome-grass.

THE SEED BED FOR GRASSES AND CLOVERS.

The ideal seed bed for grasses and clovers is a firm but friable lower soil, with loose, well-tilled top soil. To produce this condition requires careful tillage for several years preceding the sowing. The soil should contain sufficient moisture to insure the young plants a good start in case there should be a deficient rainfall after sowing. Seed sown on a dry soil may receive sufficient rainfall to germinate, but not enough to supply the young plants with the necessary moisture. Careful preparation of the seed bed is more essential in seeding grasses than in seeding almost any other crop, and failure to obtain a stand entails a greater loss. Land that has been planted to a cultivated crop, for which the soil has been well tilled and which has received clean and level cultivation, may in most cases be well fitted for seeding grasses by disking and harrowing without plowing, provided the trash be removed. When disking the disk should always be lapped one-half on each round, thus covering the field twice, and generally it is well to go over the field a second time at right angles to the first disking. A smoothing harrow should follow the disk. Well-cultivated land has these advantages: The weeds have been exterminated, the moisture has been conserved, and the top soil is in good tilth. Fall plowing is desirable on land that settles well through the winter and that does not blow badly, but there is much soil on which fall plowing can not be done advantageously when spring seeding is intended. In any case as long a period as possible should elapse between plowing and seeding, but during that time the top soil should be kept loose and clean with the disk or drag. During this period the soil settles, the large spaces are filled, and the moisture is diffused through the plowed soil. Disking the soil before plowing is advisable, as it cuts up the trash if there is any, and pulverizes the soil turned under so that it settles more quickly. The use of the subsurface packer or the disk set straight and run in the direction of the furrow also helps greatly to firm the soil. The use of either of these implements should follow the plow by the least possible number of hours. Stubble land for fall seeding may in some cases best be plowed and in others disked, depending on a great variety of circumstances, but in any case the sooner the soil is prepared after cutting the grain the better, and it is imperative that the surface be kept stirred and clean up to the time of seeding.

ANNUAL FORAGE CROPS.

SORGHUM.

Sorghum (*Andropogon sorghum*) is one of the most important annual forage grasses of the United States. It is grown throughout the South and well to the west on the Great Plains. It resists drought better than any other succulent forage crop and gives large yields of excellent hay. Sorghum may be used for soiling and for pasture, but its most important use is for cured fodder or hay. For this purpose it may be sown thickly and mowed with a mowing machine. The hay is succulent and requires some time for curing, but in the drier portions of Nebraska it can be thrown into bunches or cocks and allowed to remain until cured.

Kafir corn, a variety of nonsaccharine sorghum, is also quite drought resistant and is frequently grown for forage, but under the same conditions the sorghum gives a greater yield of fodder. Sorghum can also be planted in rows and cultivated. The forage can then be gathered by cutting and shocking, preferably with a corn harvester. The ordinary sugar sorghums, such as Early Amber, Colman, and Orange, are used for this region. Sorghum is frequently referred to as "cane."

Other races of sorghum are milo maize, Jerusalem corn, and dhoura, but in Nebraska none of these is equal to sorghum for fodder.

Sorghum was tested in the series of pasture tests already mentioned (Bulletin 69 of the Nebraska Experiment Station), as were also white Kafir corn and milo maize. One-fifth acre of sorghum gave twenty-five days' pasturage and was, along with rye, one of the crops giving the greatest quantity of forage. Some experiments were also tried with sorghum for soiling, which indicated that the quantity of forage thus obtained was two to three and one-half times as much as when the crop was pastured.

The possible injurious effects of pasturing sorghum have already been alluded to in another paragraph. (See also Bulletin 77 of the Nebraska Experiment Station.)

An acre of Early Amber sorghum, drilled with a corn planter in double rows, 6 inches between rows, 3 feet apart, June 12, was cut on September 19 with a corn binder and shocked in the field. The weight of this, taken December 1, was 8,715 pounds.

A similar plot was treated in the same manner, except that the seed was planted with a grain drill in rows 8 inches apart. The forage was cut the same as the other plot but with a mowing machine, and was put in cocks, where it remained till December 1. The weight was then found to be 12,350 pounds, or over 6 tons per acre.

In the drier portions of the State where it is necessary to conserve the moisture, it is advisable to plant the seed in rows in order to admit of cultivation. The crop is thus made more certain.

Millet.

Common millet (*Setaria italica*) is much grown in eastern Nebraska as a summer hay crop and frequently as a catch crop after grain. It can be cut in about two months from the time it is planted, and is an excellent hay plant. It should be cut between the time of heading out and that of late bloom, for if cut too early the hay is too laxative in its effect and if cut too late the seed has injurious effects, especially upon horses. The hay is succulent and requires more time to cure than does timothy. About one-half bushel of seed per acre is used. Different varieties are called Hungarian grass, German millet, Siberian millet, etc.

In the pasturing tests (see Bulletin 69 of the Nebraska Experiment Station) millet gave eighteen and a half days' pasturage for one cow and was available at the same time as sorghum, Kafir corn, and cowpeas. "It did not have as favorable an effect upon the milk flow or butter fat production as did any of these crops or as did the mixed grasses."

Broom-corn millet (*Panicum miliaceum*) is a different species, sometimes called hog millet. This gives good results in the Dakotas and other Northern States and also promises well for Nebraska. In 1903, a one-half acre plot of Red Orenburg (S. P. I. 9423) sown June 12 and cut August 15 yielded at the rate of 3,250 pounds of hay to the acre.

Cowpea.

Cowpea (*Vigna catjang*) is an annual legume which has been grown in oriental countries for an indefinite period. It is now one of the standard forage plants of the South, being extensively cultivated as an annual summer crop for hay, pasture, and green manure. During recent years its range has been steadily pushed northward, until now it is grown with more or less success as far north as Wisconsin and New York. There are a large number of varieties, differing greatly in their method of growth, time necessary to reach maturity, hardiness, and many other characters that affect the adaptability to conditions.

Although one of the standard hay plants of the South, it is not adapted for hay in Nebraska. It is difficult to cure and can not compete with alfalfa and clover. It is an excellent soiling plant, but under present conditions of agriculture it is not likely to be needed for this purpose in Nebraska in the near future, except possibly on a small scale in dairy districts. It is not well adapted for silage on account of its succulence, but has been used in this way when mixed with other plants. (See Circular 24 of the Division of Agrostology, U. S. Department of Agriculture.)

The chief field of usefulness of the cowpea in Nebraska is for pasture during the autumn. The seed must be sown when the ground is well warmed, which in Nebraska may not be until June. Although late varieties, which produce no pods in this State, can be utilized for forage, yet the plant gives best returns when the pods are forming. Hence, those varieties should be grown which mature at least a part of the seed before frost. This is especially advisable, because of the high price of seed. Where adaptability to climate is so important as in the case of the cowpea, growers should endeavor to use home-grown seed, which always aids in such adaptation. For pasture the cowpea is well adapted to cattle, sheep, and, especially when the pods are ripening, to hogs. Poultry readily eat the seeds.

The pasture tests of 1900 (see Bulletin No. 69 of the Nebraska Experimental Station) showed that one-fifth acre furnished twenty days' pasture—July 24 to August 13. There was a highly favorable effect upon the milk flow and the butter fat produced, in which respect "the forage far surpassed all of the other crops except alfalfa, and was even slightly superior to that very valuable forage plant." In this test the variety used was the Whip-poor-will.

Two plots of the above variety were sown in 1897 to test the yield of fodder. They were harvested on September 23 and gave at the rate of 4.37 tons and 4.62 tons to the acre. A plot grown in 1896 gave a yield of green fodder amounting to 22,850 pounds per acre, or something over two tons of hay.

Small Grains.

For late fall and early spring pasture nothing excels the winter grains in palatability, nutritive qualities, and in quantity of forage. It is customary to utilize winter wheat incidentally for pasture at such seasons of the year in localities where this crop is grown for grain. Rye is frequently used for pasture, and this plant is to be highly recommended wherever it can be grown as a winter crop. The grains can also be used to advantage as a spring crop, but in this case the pasturage comes later in the season when the want is less keenly felt. Rye sown in the autumn produces pasture at a season when permanent pastures are dormant or giving only meager returns.

In the pasturing tests, a one-fifth-acre plot gave about twenty-seven days' pasturage. "It furnished the earliest pasturage of any of the annual forage crops and could have been pastured in the fall."

The small grains make an excellent quality of hay and in Nebraska are not infrequently used for this purpose. In California the great bulk of the hay upon the city markets is grain hay made from wheat and oats.

Oats and rye are also used in Nebraska as soiling crops during spring and early summer. Although the amount used by each farmer in this way may be small, yet the aggregate must be considerable.

Corn.

This is by far the most valuable plant grown in Nebraska, as it is also of the United States. It is grown chiefly for the grain, but in this bulletin we are concerned with its forage value. Where corn is grown for the grain there are two common methods of utilizing the stalks. The corn may be allowed to mature in the field and the ears husked from the standing stalks during the autumn, or as soon as convenient. After the ears have been harvested, the remaining stalks are utilized by turning cattle, sheep, or horses upon them to secure what they can from the waste grain and the dry fodder. The nutritive value of such fodder is slight, especially during the winter. The second method of harvesting corn is to cut the stalks a short time before the grain is mature and while the foliage is still green. The stalks are placed in shocks to cure, after which the ears are husked out and the remaining stalks may be reshocked, or placed in stacks or barns, and constitute what is usually known as corn fodder or, more properly, corn stover. Properly cured corn stover is quite nutritious and compares favorably with hay. When the fodder is shredded a greater proportion is utilized. There is considerable deterioration in the nutritive value of stover during storage in the field or even in barns.

The value of corn grown for hay should not be underestimated. When planted thickly so that the ears are reduced to one-half or one-fourth the normal size and the stalks cut earlier than when grown for grain, the fodder is large in quantity and very excellent in quality. Besides its value for hay, corn is one of the best plants for silage or ensilage and for a soiling crop.

The pasturing tests at the Nebraska Station show that one-fifth acre plot gave eighteen and one-half days' pasturage for one cow, but though "It may be of value to furnish feed between the periods of rye and sorghum pasturage, it is not equal to either of these."

Soy Bean.

Soy bean (*Glycine hispida*)[a] is a leguminous plant grown for forage and for grain. For forage it is much used in the Middle South, but has not thus far given much promise for this purpose in Nebraska. For seed or grain it has given fairly good results in Kansas. (See Bulletin No. 100 of the Kansas Experiment Station.) In that State the Early Yellow variety has given the best returns. There is some difficulty in harvesting the crop, as a special harvester is required if the beans are raised on a large scale.

Soy beans (American coffee berry) were tested in 1898 to determine their value as summer feed, but the results were not sufficiently satisfactory to warrant the continuance of the experiment. (See Bulletin 69 of the Nebraska Experiment Station.) In 1896 a plot of soy beans yielded at the rate of 15,000 pounds of green fodder per acre.

Several varieties have been grown at the Nebraska Station to test their seed production, but the results were not satisfactory, as none gave a sufficiently high yield to be profitable for this purpose.

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[a] For a full account, see Farmers' Bulletin No. 58, United States Department of Agriculture.

RAPE.

Rape (*Brassica napus*) is a succulent plant, resembling the turnip, which is used for pasture in the cooler parts of the United States. It has been grown upon the station farm and is to be recommended for fall pasture for hogs and sheep. It is also useful for calves and growing cattle, but there is much loss from the trampling of the larger stock. The milk is likely to be tainted when rape is fed to cows, although this may be avoided by feeding (soiling) just after milking. The chief value of rape in Nebraska, however, is as fall pasture for hogs and sheep. It gives succulent feed until frost or even somewhat later. A succession of pasture may be produced by planting the seed at different dates. It is ready to use about ten weeks after planting. For further information as to rape see Farmers' Bulletin No. 164, United States Department of Agriculture.

CANADA FIELD PEA.

Canada field pea (*Pisum arvense*), a legume, resembling the garden pea, has proved very successful in Canada and the cooler parts of the United States. It is adapted to a cool, moist climate, though it can be grown with some success in the Middle South as a winter crop. It is usually sown with grain, especially oats, the grain serving to hold up the peas, the combination being very satisfactory for forage. The peas and oats are usually made into hay, although they may be used for pasture or soiling.

Experiments were tried at the station in the pasture tests. (See Bulletin 69 of the Nebraska Experiment Station.) One-fifth acre plot of oats and peas gave twenty-one and one-half days' pasturage, which was available in June, somewhat later than rye. Although peas can be used in this way in moist years, the conclusion was reached that Nebraska is too far south for the best results with this crop.

VETCH.

Hairy vetch (*Vicia villosa*) is an annual legume more drought resistant than the common vetch and better adapted to sandy soils, for which reason it is sometimes called sand vetch. It has proved very successful in eastern Washington and is much used as a winter crop in the Middle South. It gives the best results when combined with grain. Although it can be grown in eastern Nebraska, experiments show that the forage produced is inferior in quantity, and that it can not compete with other legumes.

Spring vetch (*Vicia sativa*) is not suited to Nebraska, as it requires a cool, moist climate. Winter vetch (*Lathyrus hirsutus*) is not to be recommended for that region.

PLANTS WHICH CAN NOT BE RECOMMENDED.

The following grasses and forage plants have been tested, but the results are not such that they can be recommended for Nebraska. Some of the trials were failures because the seed did not germinate. In such cases judgment upon the value of these plants must be reserved. The experiments were based upon trials extending, in many cases, over as many as six years:

Agropyron caninum.—The tests with this wheat-grass were unsatisfactory on account of a mixture of seed, but it showed no evidence of value.

Agropyron divergens.—There was no stand produced with this grass, but experiments at other stations in the Northwest, notably at Pullman, Wash., have shown that it can be grown successfully from the seed and is well adapted to the semiarid conditions of that region. Although with seed of good vitality it may prove successful here, it probably has no advantage over *Agropyron occidentale. Agropyron divergens inermis* was also tried, but it produced a poor stand and was not promising.

Agropyron violaceum.—Several trials were made, but the results were unsatisfactory.

Johnson grass (*Andropogon halepensis*).—A common and valuable hay grass for the Southern States, but it has shown itself to be a difficult plant to eradicate, and hence has become in many sections a great pest. In Nebraska it will not usually survive the winter. This grass was sown at the station in the spring of 1897 and survived the winter of 1897–98, but it was killed out during the next winter. Other attempts to raise it resulted in continual loss during the winter.

Sweet vernal grass (*Anthoxanthum odoratum*).—This grass has little forage value anywhere, but it is sometimes used in the Eastern States to impart a pleasing odor to the hay, for which purpose a small quantity suffices.

Australian saltbush (*Atriplex semibaccata*).—This forage plant has proved quite successful in California and in some other parts of the Southwest, especially in alkali soil. However, in States as far north as Nebraska it is unable to survive the winters, and hence must be grown as an annual, but the uncertainty of germination and the rather meager growth the first season render it unsatisfactory as an annual forage plant. The trial at the station extended over four years, but in no case were the results at all promising. The plants were killed out every winter except in 1900–1901. Even the second year's growth was too small to be of much value.

Swamp-chess (*Bromus ciliatus*).—The plots gave a fairly good stand, but the plants do not thicken up in the plot, and the individuals are coarse and not leafy enough for hay. Although this grass might be grown for hay, it shows nothing to recommend it to favor compared with other grasses better adapted to the purpose.

Rescue grass (*Bromus unioloides*).—A fairly good grass, but it will not endure the winters in Nebraska.

Bluejoint (*Calamagrostis canadensis*). This is a common prairie grass of the Northern States, extending west into eastern Nebraska. In Minnesota and Iowa it is a valuable wild hay grass and there called bluejoint (not to be confused with the bluestem of Nebraska, *Andropogon furcatus*, nor the bluestem of the foot hills, *Agropyron occidentale*). It thrives particularly on moist prairie and swales. Attempts to grow this grass from seed have usually been unsuccessful, as the seed seems to lack vitality. At the Nebraska Station the seed produced a very poor stand.

Bermuda grass (*Cynodon dactylon*).—The best grass for summer pasture in the South, but not hardy in Nebraska.

Crested dog's-tail grass (*Cynosurus cristatus*).—No improvement over Nebraska grasses and not to be recommended.

Florida beggar-weed (*Desmodium molle*).—An annual leguminous plant of Florida and the West Indies, where it is frequently used for forage. It can be grown throughout the Southern States and even as far north as Nebraska. For the latter State, however, it is not likely to be grown extensively, as it does not meet the requirements so well as other plants. On the station plots this made quite a heavy growth of woody, unpalatable forage.

Elymus glabriflorus and *Elymus glaucifolius*.—A poor stand was obtained of both these grasses, but they should be tested further.

Eriocoma cuspidata.—A common range grass in the Rocky Mountain region, but it does not give promise under cultivation.

Eriochloa punctata.—A promising grass for the South, but scarcely able to endure the winters of Nebraska.

Teosinte (*Euchlæna mexicana*).—A tropical annual forage plant which is often grown in the rich bottom lands of the Southern States and is frequently advertised by seedsmen for the North. It produces under favorable conditions a large quantity of forage, but in Nebraska it is far inferior to sorghum for this purpose. It is a coarse grass, resembling corn.

Eurotia lanata.—This is not a grass, but a forage plant, well known under the name of "winter fat." In the Western States, where it furnishes excellent feed upon the range, attempts to cultivate it have not been attended with much success. Seed planted at the Nebraska Station failed to germinate.

Horse bean (*Faba vulgaris*).—The common field bean of Europe, where it is a staple forage plant; but in this country it has not given satisfactory results.

Tall fescue (*Festuca elatior*).—Results unsatisfactory and plot finally discarded.

Reed fescue (*Festuca elatior arundinacea*).—A tall form of *Festuca elatior*, which gives good results in the Eastern States, but is much inferior in Nebraska to *Festuca pratensis*, the meadow fescue.

Sheep's fescue (*Festuca ovina*.)—A bunch grass of low growth, cultivated in Europe and recommended frequently for the northern portion of the United States. It is not suited for hay, but is of some value for pasture in mountain regions and in the cooler parts of the country, especially in mixtures for sterile soil. But it appears to be entirely unsuited to conditions in Nebraska. Several varieties or related species of this grass (*Festuca sulcata*, *Festuca duriuscula*, *Festuca rubra*) have been tried at the Nebraska Station, but none is to be recommended.

Curly mesquit (*Hilaria cenchroides*).—The common upland grass upon the plains of Texas, where it replaces buffalo grass, which it much resembles in appearance. The plots gave only a thin stand. This species is not hardy as far north as Nebraska.

Velvet grass (*Holcus lanatus*).—A native of Europe and cultivated occasionally in this country, especially in the Puget Sound region, where it is also now growing without cultivation. It has little to recommend it anywhere, and is certainly not worthy of cultivation in Nebraska.

Hordeum bulbosum.—This grass gave a fair stand, but seems not well adapted to the climate, being injured by cold winters.

Wild barley (*Hordeum nodosum*).—Growth not sufficiently rank for a forage grass.

Koeleria cristata.—A common native grass upon the prairies throughout Nebraska. It is a small, slender perennial, flowering in June and not sufficiently rank in its growth to warrant cultivation. The plot of this grass gave a fair early growth, but disappeared the latter part of the summer.

Winter vetch (*Lathyrus hirsutus*).—This vetch has not been tried at the Nebraska Station, as it is unsuited to the climate.

Bitter vetch (*Lathyrus sativus*).—A good stand was obtained, but the climate is entirely too hot and dry in Nebraska for this legume.

Flat pea (*Lathyrus sylvestris wagneri*).—A strong growing perennial which has given excellent results at several experiment stations in the arid regions. The plant seems to be very resistant to drought, but those who have tried it report that it is not palatable to stock and that they have been unable to utilize it as a forage plant.

Leptochloa dubia.—A grass of the Southwestern States which is not adapted to the Nebraska climate.

Japan clover (*Lespedeza striata*).—An annual legume, but not resembling clover very closely. It is frequently grown in the Southern States but is not hardy in Nebraska.

Perennial rye-grass, *English rye-grass* (*Lolium perenne*).—A well-known cultivated grass in England and other European countries. In the United States it has been cultivated for many years. On the station plot there was a good stand produced, but the grass was soon run out by other plants.

The Italian rye-grass (*Lolium italicum*) was not tried at the station, but its characters are similar to those of perennial rye-grass. Both are short-lived perennials and are not well suited to permanent pasture. Where the climate is adapted to their growth, they have the advantage of giving an abundant early growth, for which reason they are to be recommended for mixtures, as they give a luxuriant growth the first season and then give way to the other grasses. The climate of Nebraska is too dry for successful results with these grasses.

Lupines (*Lupinus spp.*).—None of the lupines has given satisfactory results in America.

Bur clover (*Medicago denticulata*).—An annual clover, frequently grown for winter forage in the Southern States, but not suited to Nebraska conditions. The station plot produced a thin stand and unsatisfactory growth.

Melica altissima.—A fair stand was obtained, but it soon disappeared.

White sweet clover or *Bokhara clover* (*Melilotus albus*).—An excellent legume for renovating clay lands, and fairly drought resistant. The great objection to its use as a forage plant in the West has been the fact that stock will not eat the plant. However, it is not infrequently reported that it has been fed to stock with success. The foliage contains a bitter substance which is disagreeble to animals, and it seems necessary that the taste for the plant be acquired. It is reported by some that if stock are turned into a field early in the spring such a taste is easily acquired. The plant has not been sufficiently tested in Nebraska. Besides its possible forage value it is an excellent bee plant.

Velvet bean (*Mucuna utilis*).—An annual legume which forms long trailing vines, and is much used in Florida for a green fertilizer and as a forage plant. It has been recommended for growing much farther north; but though it produces a good growth of vine it is less valuable than the cowpea for the same purpose. This has not been tested at the Nebraska Station.

Sainfoin (*Onobrychis sativa*).—A legume cultivated in Europe and advertised by most seedsmen in this country. The results of the trials in Nebraska are too unsatisfactory to recommend it for use in that State. In fact, there has been little success with this plant anywhere in this country.

Panicum bulbosum.—A native hay grass of Texas, and quite promising for cultivation in the Southwest, but Nebraska is evidently too far north for its successful growth.

Pearl millet or *pencilaria* (*Pennisetum spicatum*).—A coarse annual forage plant, resembling sorghum. Some extravagant claims have been made for this plant, but though it has much to recommend it in the Southern States, in Nebraska it is inferior to sorghum. At the station, in 1903, it made a large growth of forage, but it was not of great food value. For a full account of pearl millet the reader is referred to Farmers' Bulletin No. 168, U. S. Department of Agriculture.

Poa lævigata.—Three years' trials show that this grass would be excellent for pasture, but does not grow tall enough for hay. It showed great drought resistance during the dry period in 1901.

Sacaline (*Polygonum sachalinense*).—This plant, which resembles a large smartweed, has been occasionally advertised by seedsmen, but it has no value as a forage plant in Nebraska.

Burnet (*Poterium sanguisorba*).—A plant belonging to the rose family and used in Europe for pasture, for which purpose it has been recommended in this country. The trials at the Nebraska Station show that the plant gave a fair stand and is able to resist the winter, and also seems fairly drought resistant. Nevertheless, its good qualities are not sufficiently marked to warrant its being recommended for Nebraska. The trials at other stations have resulted much the same. For ordinary pasture purposes the growth is not sufficiently rank nor is the foliage as palatable to cattle as are the grasses. It may have a place as a constituent in sheep pasture upon sterile sandy or rocky soil in the Northeastern States, but in Nebraska it is not likely to be of much value.

Slough-grass (*Spartina cynosuroides*).—A native grass, common in sloughs and marshes, that furnishes considerable coarse hay when mowed early. The grass is commonly used for thatching sheds and for topping haystacks. In the trials at the Nebraska Station the seed failed to germinate.

Giant spurry (*Spergula maxima*).—This annual plant has some value for forage upon sandy land, but it is scarcely drought resistant enough for Nebraska.

Sporobolus cryptandrus.—A grass especially adapted to sandy soils, and one of the common native grasses of the Sand Hill region. It furnishes valuable grazing when young, but becomes dry and coarse by middle summer. At the Nebraska Station the seed did not germinate.

Saccaton (*Sporobolus wrightii*).—An important native forage grass of the Southwest, but not hardy as far north as Nebraska. There was no germination on the station plot.

Crimson clover (*Trifolium incarnatum*).—An excellent annual clover for the middle South, but not hardy in Nebraska.

The following plants were sown, but gave negative results, because the seed failed to germinate or gave only a thin or scattering stand:

Agropyron dasystachyum.
Agropyron dasystachyum subvillosum.
Agropyron riparium.
Agropyron vasegi.
Agrostis exarata.
Alopecurus occidentalis.
Atriplex holocarpa.
Atriplex nuttalli.
Atriplex pabularis.
Beckmannia erucaeformis.
Bouteloua polystachya.
Bromus kalmi.
Bromus vulgaris.
Bromus richardsoni.
Bromus richardsoni pallidus.
Calamagrostis hyperborea americana.
Dactyloctenium australense.
Deschampsia cæspitosa.
Eleusine coracana.
Elymus ambiguus.
Elymus condensatus.
Elymus glaucus.
Elymus macouni.
Elymus simplex.
Muhlenbergia gracilis.
Panicularia americana.
Panicularia nervata.
Panicum obtusum.
Phleum alpinum.
Poa fendleriana.
Poa lævicul mis.
Poa lucida.
Poa macrantha.
Poa nevadensis.
Poa pratensis var. (Washington bluegrass.)
Poa wheeleri.
Polypogon monspeliense.
Puccinellia airoides.
Triodia mutica.
Trifolium involucratum.

INDEX OF GRASSES AND FORAGE PLANTS.

PLATES.

DESCRIPTION OF PLATES.

Plate I. *Frontispiece.* Grass garden at the Nebraska Experiment Station. The forage plants are first tested on these plots, which are 3 feet square. Those which give favorable results are given a further trial on larger plots, some of which are seen in the background.

Plate II. An alfalfa plant from seed sown August 19, 1902, and dug up April 13, 1903, showing the tubercles upon its roots by means of which nitrogen is gathered from the air.

Plate III. Fig. 1.—Three plants of brome-grass (*Bromus inermis*) from seed sown August 19, September 19, and October 1, 1902, respectively. They were taken up and photographed April 13, 1903. The plant at the right from the last sowing had barely enough vitality to survive the winter. Fig. 2.—Three alfalfa plants from seed sown at the same date as the brome-grass, and also taken up and photographed April 13, 1903. A later sowing, October 21, was almost entirely winter killed, as the young plants had not sufficient vitality to withstand the cold.

Plate IV. Fig. 1.—Plots of *Bromus inermis* showing the effect of fertilizers. The plot at the left is a mixture of brome-grass and alfalfa; the plot at the right is brome-grass fertilized with sodium nitrate; the plot in the center is brome-grass alone and unfertilized. The effect of an admixture of alfalfa is about the same as an application of sodium nitrate. This seems to indicate that the brome-grass is able to share with the alfalfa the nitrogen which the latter obtains from the air. The plots were sown April 21, 1899, and photographed June 12, 1903. Fig. 2.—A pasture containing orchard grass, showing the growth of this grass upon low land. The pasture was seeded in 1898 with several grasses, among which was orchard grass, but in this part of the field the latter was especially rank. The photograph was taken in June, 1901.

Plate V. Fig 1.—A field of brome-grass sown in the spring of 1898 and broken in the fall of 1901. The picture was taken in January, 1902. Brome-grass forms a thick, firm sod, resembling that of native prairie. Fig. 2.—A field of brome-grass. The seed was sown in the spring of 1902, and the picture was taken June 15, 1903.

Plate VI. Fig. 1.—A field of side-oats grama (*Bouteloua curtipendula*) just before ripening. The seed was sown in the spring of 1900, and the photograph taken July 17, 1902. Fig. 2.—A field of wild rye (*Elymus canadensis*). The seed was sown in the spring of 1901, and the photograph taken July 17, 1902.

O

ALFALFA, SHOWING NITROGEN-GATHERING TUBERCLES.

FIG. 1.—BROME-GRASS PLANTED IN THE AUTUMN.

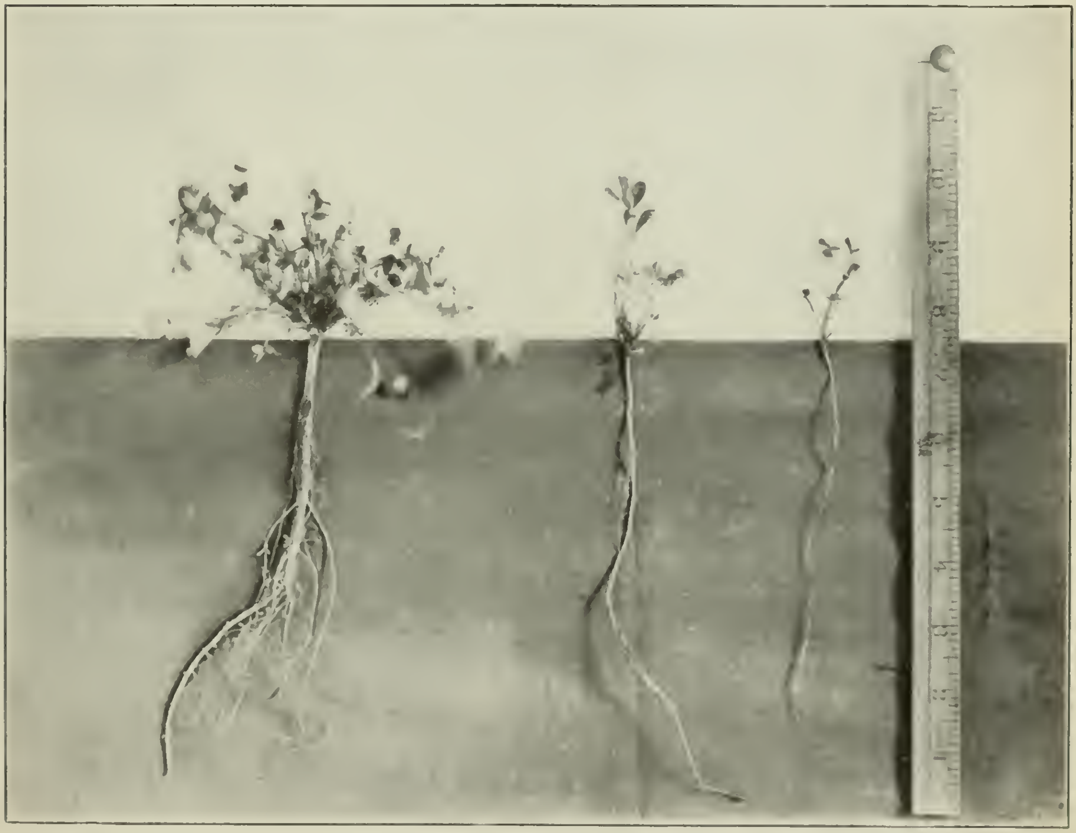

FIG 2.—ALFALFA PLANTED IN THE AUTUMN.

FIG. 1.—BROME-GRASS, FERTILIZED AND UNFERTILIZED.

FIG. 2.—FIELD OF ORCHARD GRASS.

FIG. 1.—BROME-GRASS. NEWLY TURNED SOD.

FIG. 2.—BROME-GRASS. A HAY FIELD.

FIG. 1.—SIDE-OATS GRAMA, GROWN FROM SEED.

FIG. 2.—ELYMUS CANADENSIS, GROWN FROM SEED.

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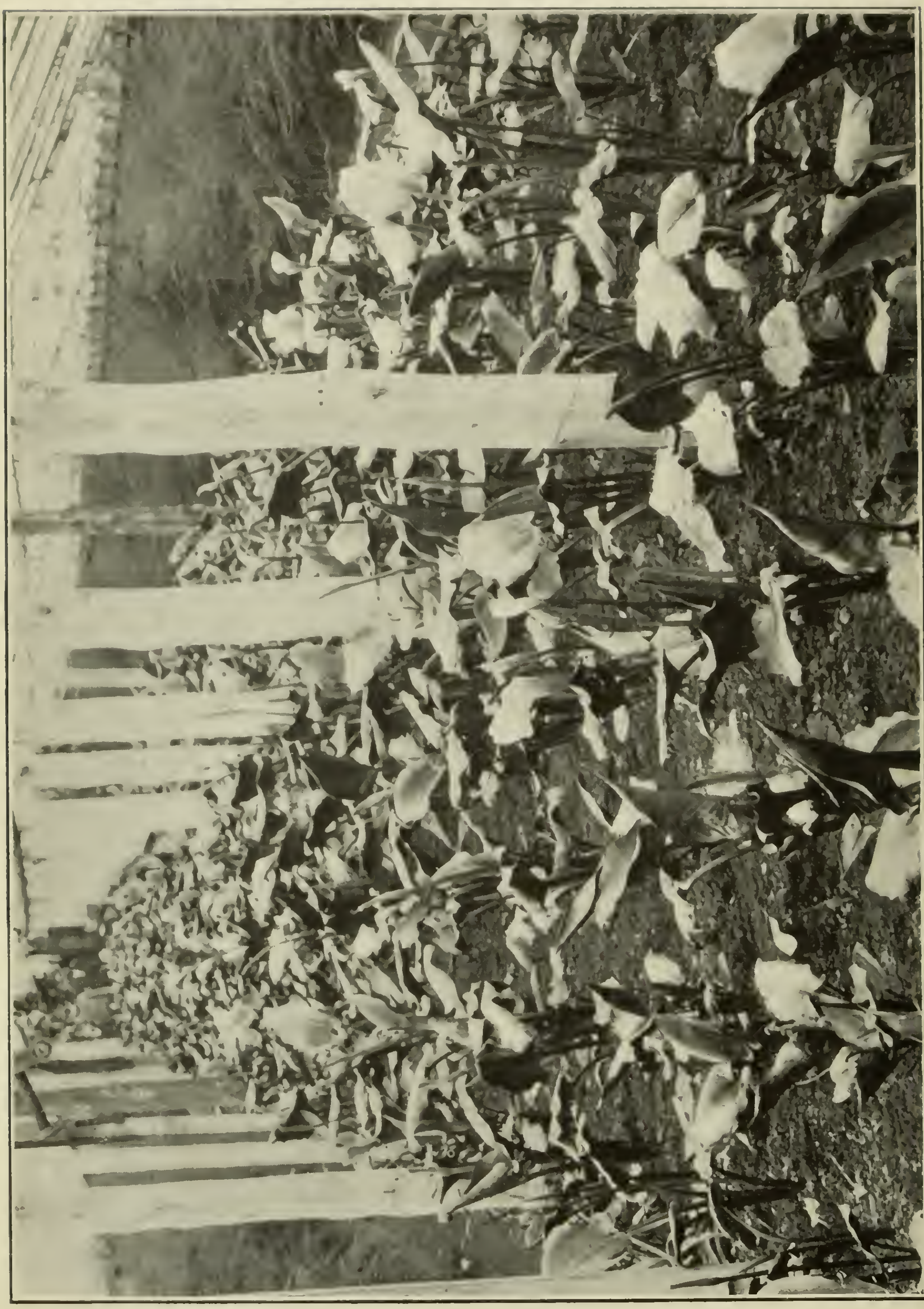

THIRD CROP OF HEALTHY CALLAS GROWN IN THE SAME SOIL ACCORDING TO METHODS ADVOCATED IN THIS BULLETIN.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 60.

B. T. GALLOWAY, *Chief of Bureau.*

A SOFT ROT OF THE CALLA LILY.

BY

C. O. TOWNSEND, PATHOLOGIST.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.

ISSUED JUNE 30, 1904.

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BUREAU OF PLANT INDUSTRY.

B. T. Galloway, *Chief.*

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3

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., March 31, 1904.

SIR: I have the honor to transmit herewith the manuscript of a technical paper submitted by the Pathologist and Physiologist on "A Soft Rot of the Calla Lily," by Dr. C. O. Townsend, Pathologist, Vegetable Pathological and Physiological Investigations, and recommend its publication as Bulletin No. 60 of the series of this Bureau. The accompanying nine plates and seven figures are necessary to a clear understanding of the subject-matter of the text.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

PREFACE.

Growers of the calla lily have suffered serious losses for several years from a soft rot which frequently destroys the plants just before or during the flowering period. A bacillus has been separated from the decayed portion of the calla in pure cultures and by repeated inoculations has been shown to be the cause of this destructive disease.

In addition to the principal morphological and physiological characters of the organism which are described in this bulletin, several preventive measures are suggested which have been found to be satisfactory in holding the disease under control. As the bacillus producing this disease is also capable of attacking many of our food plants, growers of vegetables should guard against any possible contamination of the soil with it.

A. F. Woods,
Pathologist and Physiologist.

Office of Vegetable Pathological
and Physiological Investigations,
Washington, D. C., March 30, 1904.

1

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

A SOFT ROT OF THE CALLA LILY.

INTRODUCTION.

Under favorable conditions the calla lily has heretofore been one of the most satisfactory plants produced either in the open or under glass. In most parts of the United States the calla will grow out of doors and will live and thrive from year to year even in the northern latitudes, especially if the corms[a] are protected during the winter season. As a marketable product, however, it is more profitable if grown under glass, where under proper conditions the plants may be forced and the flowers consequently produced in great abundance at the time when they will be in greatest demand. It is under these conditions of forced growth that the plants seem to be most susceptible to disease.

The profits which arise from calla growing are derived either from the sale of the corms or of the flowers, or from both. A bed of a thousand corms, for example, will under normal conditions produce 5,000 flowers, which ordinarily will sell for about $1,000. The corms are grown either in solid beds or in pots. As a rule the best results both as regards the size and the number of flowers produced are obtained from the solid bed. The flowers are always delicate and can not be satisfactorily shipped long distances, while the corms, on the other hand, may be transported for thousands of miles without injury.

There are several diseases to which the calla is susceptible, but the most serious one with which the growers have had to contend is the soft rot that forms the subject of this bulletin. This disease has recently made its appearance in the various parts of the United States where callas are cultivated and has caused enormous losses to the growers, rendering the production of this hitherto profitable plant very uncertain.

The soft rot of the calla was brought to the attention of the writer in the autumn of 1899, and it has been under his observation and study since that time. While there are some points that need further

[a] The true botanical name *corm* is used in this bulletin instead of the common but incorrect term *bulb*.

investigation, it has been deemed best to place the following results before the public, with the hope that the suggestions herein contained may be of value to the industry.

CAUSE OF THE CALLA ROT.

Upon examining microscopically the decayed portions of the calla corms myriads of bacteria were found to be present. In order to obtain cultures of the organism in the best possible condition a partly decayed corm was thoroughly washed with tap water, then with corrosive sublimate (1 part in 1,000), and afterwards with distilled water. A small opening was then made with a sterile knife through the sound part of the corm into the inner marginal part of the decayed spot. A little of the soft tissue just at the border between the decayed and healthy portions of the corm was obtained on a sterile needle and placed in sterile beef broth. Agar plates were then made from this culture, and but one kind of colony was obtained, indicating that the organism was present in the recently decayed portion of the corm in a pure culture. A few days after the colonies had formed, subcultures were made in beef broth and minute portions of these were introduced into various parts of healthy callas. The inoculations were made by placing a drop of the beef-broth culture on the part of the plant to be inoculated, and with a sterile needle punctures were made through these drops into the tissues of the plants. For control, punctures were made in similar parts of healthy plants without adding the broth culture. In a few days the inoculated spots had turned brown and decay had begun, while the controls in all cases remained healthy. Plate cultures were again made from the inoculated spots after decay had begun, and apparently the same organism in pure culture was obtained. This process was repeated many times—i. e., until there was no doubt that this organism was the cause of the soft rot of the calla.

Upon looking up the literature regarding calla diseases it was found that Halsted had discovered a soft rot of the calla corm in 1893.[a] Although Halsted's description is very brief, he undoubtedly refers to the same disease as that which forms the subject of this bulletin. He ascribes the cause of the affection to a bacterium which is found in great abundance in the diseased portions of the corm. A disease of similar nature is also mentioned by Selby.[b] This is referred to as a root rot of the calla, and as no description is given either of the disease or of the organism producing it, it is impossible to determine whether this is the disease now under consideration. The soft rot of the calla and the organism producing it have been observed by Dr. Erwin F. Smith, the pathologist in charge of the laboratory of plant pathology of the United States Department of Agriculture, and by Mr.

[a] Diseases of Calla. New Jersey Experiment Station Report for 1893, p. 399.

[b] Selby. Calla. In Condensed Handbook of Diseases of Plants in Ohio, 1900, p. 21.

Newton B. Pierce, the pathologist in charge of the Pacific coast laboratory of the Department, and probably by others, but so far as can be determined it has not hitherto received careful investigation.

GENERAL APPEARANCE OF THE DISEASE.

Several greenhouses where the disease was reported to be present were visited by the writer, who found the callas rotting off usually at or just below the surface of the ground, the disease sometimes extending down into the corm, sometimes upward into the leaves, and frequently in both directions. Occasionally the disease seemed to start in the edge of the leafstalk (fig. 1), in the flower stalk, or in some underground part of the corm, though as a rule it started at the top of the corm just above but near the surface of the ground. It was also noticed that the disease was worse and spread more rapidly in those houses where the callas were grown in solid beds.

Fig. 1.—A slightly diseased calla plant.

When a diseased corm was cut open it was found that there was a distinct line between the healthy and the diseased portion of the corm (fig. 2). The healthy portion of the corm is firm and nearly white, while the diseased part has a decidedly brown color and is soft and watery. When the disease extends upward into the leaves it is the edge of the petiole that first becomes involved, the affected part becoming slimy without immediately losing its green color. As the disease progresses it extends inward toward the center of the petiole and interferes with the transference of material between the corm and the leaf, the edges of the leaf becoming pale, then brown. Pale spots becoming brown then appear in other parts of the leaf blade, and finally the whole leaf becomes brown and dead. Frequently the disease develops so rapidly that the leaf rots off at the base and falls over before it has time to lose its green color. When the disease has progressed far enough to attack the flower stalk, the flower turns brown and the stalk, without having lost its color and frequently without having decayed upward more than a fraction of an inch, eventually falls over. When the disease works downward through the corm it sooner or later reaches the roots, which become soft and slimy within, while the epidermis remains intact, thus presenting the appearance of thin-walled tubes filled with a soft substance. The roots remain attached to the corm and eventually the slimy contents dry up and only the dead skin of the roots remains. When the disease begins its attack below the surface of the ground the lower portion of the corm frequently rots away, causing the plant to fall over without having previously given any indication of disease. An examination of the decayed corm shows that only a small part of the upper portion of the corm, with a few side roots, remains. The

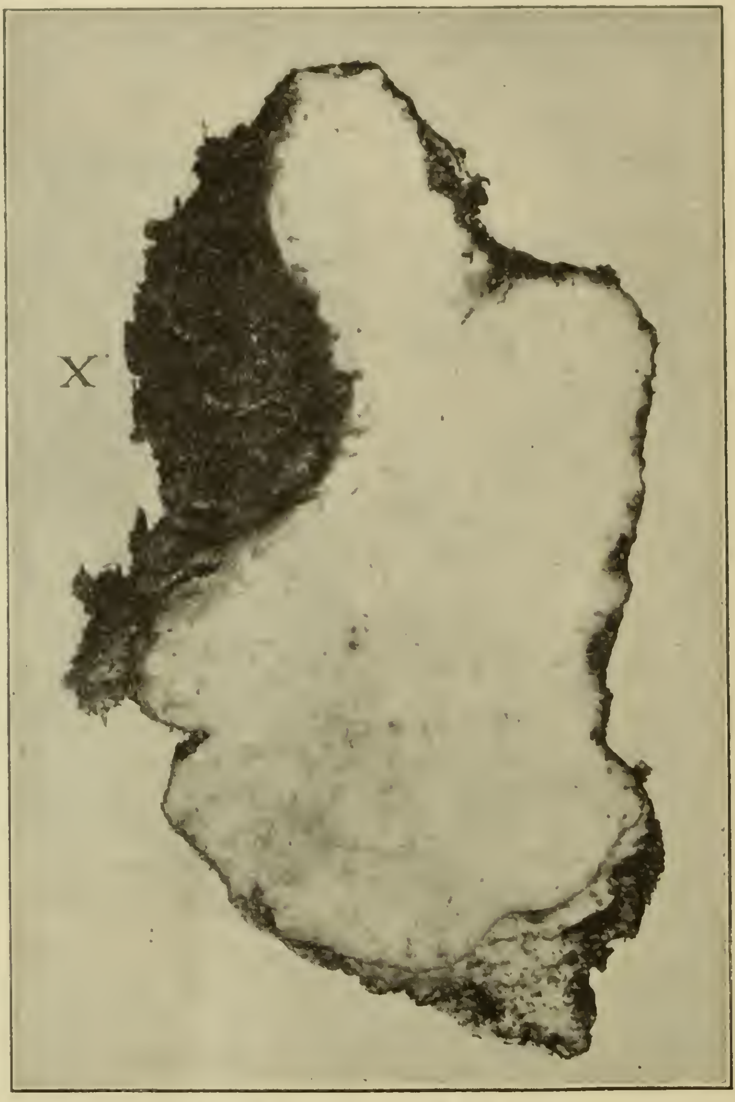

FIG. 2.—A partly decayed calla corm.

latter become less and less numerous as the disease advances, until at last they are unable to support the weight of the leaves and flower stalks.

If the conditions for the development of the disease are unfavorable after the corms are affected, the softened spots will dry down, sinking below the surrounding portion of the corm and becoming darker colored. In these spots the disease will often remain dormant until the conditions for the development of the organism again become favorable. In this way the disease is carried over from season to season, and it may be transported long distances.

EFFECT OF THE ORGANISM ON THE CALLA.

As already stated, the part of the plant usually attacked first is the upper portion of the corm at or just below the surface of the ground. A microscopic examination of the affected part, whether root, corm, leafstalk, or flower stalk, shows that the organisms occupy the intercellular spaces and by some means dissolve the intercellular layer, causing the cells to separate easily, so that when the diseased tissue is placed in a liquid each cell floats out by itself. The cell wall, however, remains intact, but the cell contents are contracted. The rapidity with which the disease advances depends to a large extent upon the external conditions surrounding the plants. Under favorable conditions a warm

FIG. 3.—Calla leaf twenty-two hours after inoculating with the calla organism. The point of inoculation is shown by X.

FIG. 4.—Calla flower stalk twenty-two hours after inoculating with the calla organism. The point of inoculation is shown by X.

atmosphere and an abundance of moisture—the disease may completely rot the corm in from three to four days, while under less favorable conditions it may be several weeks in destroying the corm, or, indeed, the progress of the disease may be entirely arrested for a period of several months. While the organism usually attacks the corm first, it may also attack either the leafstalk or the flower stalk and cause it to become discolored and decayed. (See figs. 3 and 4.)

MORPHOLOGICAL CHARACTERS OF THE ORGANISM.

The organism which causes the rotting of the calla corm is a very short rod, with rounded ends, as shown in figure 5, and also in Plate II, figure 1. The width of the rods is very nearly uniform.

In a 24-hour-old beef-broth culture they measure about 0.5μ in width. In the same culture the length varies from 2μ to 3μ. The very short ones, as shown by the measurements, are round, or nearly so; these eventually elongate, becoming rods. After the organisms have elongated, cross walls are formed and as a rule they soon break in two, forming separate organisms; but occasionally they remain intact until a long chain is formed, which may finally break up into individual cells (Pl. II, fig. 1). This organism moves with a gliding motion, and upon staining for flagella it is found to possess from two to eight wavy flagella scattered over the surface of the body (Pl. II, fig. 1). The flagella vary in length from 4μ to 18μ, i. e., two to six times the average length of the body. No spores belonging to this organism have been found in any of the artificial cultures or in the diseased plants.

FIG. 5.—*Bacillus aroideæ* with flagella × about 600.

PHYSIOLOGICAL CHARACTERS OF THE ORGANISM.

Certain physiological characters of the organism have been determined by growing it on different media and under various conditions of light, heat, etc., as described in the following pages.

NUTRIENT MEDIA.

In studying the physiology of this organism the following media have been used, viz, beef broth, agar, gelatin, Uschinsky's solution, Dunham's peptone solution, peptone water with rosolic acid, peptone water with methylene blue, simple peptone water,[a] milk, litmus milk, indigo-carmine peptone, and egg albumen. All these culture media were carefully prepared. The beef-broth stock was made from lean beef, the chemicals were "c. p.," and only distilled water was used. In addition to these media the following vegetables and fruits were used, viz, potatoes, onions, turnips, celery, cucumbers, peppers (green fruits), pieplant, beets, radishes, cauliflower, cabbage, eggplant, tomatoes, salsify, carrots, parsnips, apples, pineapples, and bananas.

In nearly all cases both the fruits and vegetables were used raw, but in some instances the vegetables were cooked. Usually the raw fruits and vegetables were sterilized by removing the outer layer with a sterile knife and washing thoroughly with corrosive sublimate (1 part in 1,000) and then with sterile water. They were then cut in thick slices and placed in deep petri dishes and inoculated with one or more loops of a 24-hour beef-broth culture of the organism. When the vegetables were cooked they were cut into cylinders and placed in test tubes with distilled water, then thoroughly sterilized, and when cool inoculated with fresh cultures of the organism.

[a] Witte's *Peptonum siccum* was the only peptone used.

Beef-broth.—Ten cubic centimeters of standard beef broth inoculated with a 1-mm. loop of a fresh culture fluid of the organism was distinctly clouded in from four to eighteen hours at a temperature of 35° to 18° C. If the temperature was raised or lowered through several degrees above or below the limits indicated or if the inoculation was made from a less active culture, the clouding took place less rapidly. Indeed, the clouding was delayed indefinitely by lowering the temperature to 5° C. or by raising the temperature to 41° C. If the beef broth was kept at room temperature (18° to 24° C.) the organism remained alive for several weeks and a nearly white deposit several millimeters in depth formed in the bottom of the tube.

Agar plate cultures.—On the ordinary nutrient agar poured plates made from a 24-hour-old beef-broth culture colonies were distinctly visible in twenty-four hours at room temperatures of 18° to 20° C., and plates made in the same way and kept at 30° to 35° C. showed colonies distinctly in from fifteen to eighteen hours. The form and size of the colonies on the agar plates depended upon certain conditions—e. g., if the colonies were numerous they were small and round, while if there were but few colonies in each plate they were sometimes round and sometimes radiating. They were usually radiating if the plates were made from fresh cultures and kept at a temperature of from 22° to 35° C. On the other hand, if the plates were made from an old culture or if they were kept at an abnormally high or an abnormally low temperature the colonies were round, even if there were but few in each plate. Agar plate cultures made from Uschinsky's solution or broth cultures that had been kept dormant for several months produced round colonies, but after a few transfers from the dormant state to fresh media the agar plate cultures became characteristically radiating (Pl. II, figs. 2, 3, 4, and 5, and Pl. III, fig. 1).

The foregoing applies to the surface colonies, but in addition to these there were some embedded colonies in practically all poured plates. The embedded colonies were all spindle shaped unless viewed end on, when they appeared to be round, with sharp, distinct outlines. They had a faint yellow tinge, and were much smaller than the surface colonies. If the embedded colonies broke through the surface, they spread out and behaved in the same manner as if they had been originally surface colonies. (See the small colonies on Pl. II, figs. 2 and 5.) Some of the colonies lying at the extreme bottom of the agar—i. e., between the agar and the bottom of the petri dish—spread out, forming a thin layer which eventually gave to the plate a milky appearance when held up to the light. (See Pl. II, fig. 2, and Pl. III, fig. 2.) The surface colonies, whether round or radiating, had a shiny white surface and were only slightly opalescent. If radiating, they usually had a central body, from which the branches radiated (Pl. III, fig. 1). The central body was more dense than the arms or branches and the whole colony was slightly elevated above the surface of the agar. The outlines were sharp and when magnified 125 times the 48-hour-old colonies had a granular appearance.

Agar streak cultures.—In addition to beef broth, peptone, etc., some of the agar tubes contained 5 per cent of grape sugar and others contained 5 per cent of glycerin. These were slanted and inoculated by dipping a sterilized needle in a 24-hour-old beef-broth culture and drawing it lightly over the surface of the slant agar. Streaks became distinctly visible in twenty-four hours at 20° to 25° C. in all the tubes inoculated. The outlines of the streaks were entire at first, but became more or less irregular in from two to four days at 18° to 25° C. Growth was elevated above the surface of the agar and had a shiny appearance, as if wet. It was of a white or grayish-white color and did not discolor the agar nor tend to grow into it. The condensation water became distinctly milky and more or less deposit was formed in it. On the other agars the organism remained alive for several months at room temperatures (20° to 25° C.) if the culture was not allowed to become dry.

Agar stab cultures.—At room temperatures (20° to 25° C.) growth was apparent in from eighteen to twenty-four hours near the top of the stab, and within twenty-eight hours it was distinctly visible throughout the entire length of the stab. The stab increased in size from day to day and in a week was from 1 to 2 mm. in diameter, slightly tapering toward the bottom. The "nail head" gradually increased in size and in from three to five days covered the surface of the agar in the tube. This growth was slightly elevated, grayish-white, with a wet, shining surface and an entire margin. It was thicker in the center, forming a convex layer on the agar. Growth continued for several weeks, with no change in the color of the agar and no change in the stab or line of growth except that it gradually increased in size, retaining its tapering form and its slightly serrate outline with no elongated projections into the agar.

Beef agar, with iron sulphate.—Several slant tubes containing 10 c. c. of nutrient agar plus 1 drop of a saturated solution of ferrous sulphate, and several slant tubes containing 10 c. c. of nutrient agar plus 2 drops of the iron sulphate solution, were inoculated with a fresh culture of the calla organism, while several tubes of each were left for control. In forty-eight hours the organism had spread over the surface of the agar in all inoculated tubes and the inoculated surfaces showed a copious growth for several weeks, but no change was produced in the color of the medium.

Gelatin stab cultures.—These cultures were made with gelatin of different kinds. The first was −10 on Fuller's scale, the second was neutralized with sodium hydroxid, while the third was the same as the second except that another kind of gelatin was used. Growth was apparent within twenty-four hours (at 18° to 22° C.) in all the tubes inoculated. At the end of twenty-four hours the stabs were distinctly visible throughout their entire length in all the inoculated tubes (Pl. IV, fig. 1, A). In forty-eight hours from the time of inoculation the gelatin in all the tubes began to liquefy (Pl. IV, fig. 1, B). Liquefaction advanced most rapidly in No. 3 and least rapidly in No. 1. In three days No. 3 had entirely liquefied, and in five days No. 1 and No. 2 had also liquefied (Pl. IV, fig. 1, C). After the gelatin had liquefied a cloudy mass floated about in the clear liquid. This finally settled, forming a copious white deposit. The deposit was most abundant in No. 3, but in No. 1 it formed a layer from 2 to 5 mm. deep.

Egg albumen. Several tubes of solidified egg albumen were inoculated with a fresh culture of the organism, but only a feeble growth appeared and no change had been produced in the color of the albumen at the end of eight weeks.

Milk.—This medium was sterilized by heating for ten minutes at 100° C. in a steam sterilizer on three successive days, the milk having been previously placed in test tubes (10 c. c. in each tube), and the tubes closed with cotton plugs. The milk was inoculated by placing a 1-mm. loop of a 24-hour-old beef-broth culture in each of several of the tubes. The curdling of the milk began to take place in from two to three days in all parts of the inoculated tubes. Two days later the entire 10 c. c. of milk was solidified and a layer of whey about 1 mm. deep rested upon the top of the curd. These experiments were repeated from time to time, with the same results. Whey continued to be separated for several days until from one-third to one-half the space formerly occupied by the milk was occupied by the liquid; but no abnormal coloring was produced in any of the tubes. None of the control tubes curdled in any case.

Litmus milk.—This medium was prepared in the same manner as the milk, except that a few drops of strong litmus solution were added to each tube of milk before sterilizing. Several of the tubes were inoculated with a 1-mm. loop of a 24-hour-old beef-broth culture. Within forty-eight hours the blue began to give way to a reddish color near the surface, which within three days had extended throughout the inoculated tube. At the end of five days from the time of inoculation the red color had decidedly faded throughout, so that the tubes that were litmus blue when inoculated were now only faintly pink, and the milk had curdled throughout. The curdling of the milk and the separation of the whey took place in the same manner as if the litmus had not been present. In nine days even the pink color had disappeared, with the exception of a faint rim near the surface. These discolored litmus tubes were then allowed to stand until the organism had died. The red litmus color, eventually becoming blue, gradually returned, although the milk remained curdled and the whey separated—about one-half whey and one-half curd.

Litmus milk in nitrogen.—It was noticed that the litmus milk tubes, whether they had been inoculated or not, contained a deposit of blue litmus. The calla organism that bleached the litmus in the milk failed to attack this deposit, so that it remained blue. It was suggested that the milk possibly contained an anaerobic bacterium that was not destroyed by sterilizing and that it favored the formation of the blue deposit. The two control tubes of litmus milk were placed in a bottle holding about a quart. The bottom of the bottle was covered with pyrogallic acid (powder) to a depth of about one-half inch. To this 50 c. c. of a 10 per cent solution of caustic potash were added, and the bottle was quickly sealed with Darwin's wax. The mixture was shaken for some time to enable it to take up the oxygen without forming much carbon monoxid. If the deposit were due to an anaerobic bacterium, it should increase farther up in the tubes. At the expiration of twelve months the jar was opened. A lighted match thrust just below the level of the opening in the jar was immediately extinguished, showing that the jar still contained nitrogen and had not allowed oxygen to enter during this time. An examination of the tubes showed that the blue deposit had not changed. This indicated that the deposit was undoubtedly a mechanical one and was not due to the presence of an organism. The inoculated tubes that were left in the ordinary air gradually regained their blue color after the organism died. The return of the color (first red, then blue) was apparent whether the organisms were left to die of their own accord or whether they were destroyed by heating; e. g., if an inoculated litmus tube had entirely faded and was then heated for ten minutes at 100° C., the color returned within twenty-four hours.

Uschinsky's solution.—Several tubes of Uschinsky's solution were inoculated with a 1-mm. loop of a 24-hour-old beef-broth culture. Seventeen hours later at 25° C. all inoculated tubes were slightly clouded. Thirty-six hours after inoculation the tubes were decidedly clouded throughout, with a slight whitish deposit in some of them. The cloudiness was not uniform in all parts of the same tube, but was somewhat stratified. Both the cloudiness and the deposit increased from day to day, until at the end of one week the solution was uniformly clouded, milk-white, with a copious white deposit in the bottom of the tube. Even at the end of three months at normal room temperatures the organism was still alive, as indicated by the fact that the tubes were still clouded and a 1-mm. loop placed in beef-broth caused a distinct clouding in twenty-four hours. At this time the precipitate was 3 mm. deep. Plating and inoculating into callas showed it to be the calla organism. This experiment was repeated several times with identical results both in regard to the clouding of the Uschinsky solution and the longevity of the organism in this medium.

Dunham's solution.—Several tubes of Dunham's solution were inoculated with a 1-mm. loop of a 24-hour-old culture of the calla rot organism in beef broth. In twenty-four hours at 20° C. a faint cloudiness was perceptible. This increased slightly from day to day for about six days. The temperature during this time ranged from 18° to 25° C. The cloudiness then seemed to remain practically constant for about one week. A deposit was gradually formed, and in one month from the time of inoculation the solution became almost clear, showing that the organism had ceased to live. The deposit formed was about 1 mm. in depth and had a faint brownish tinge.

Dunham's solution, with acid fuchsin.—This solution was inoculated the same as above. At the end of one week the solution in the inoculated tubes was lighter colored than in the control tubes. At the end of one month after inoculation the bleaching seemed to have ceased. The organisms were nearly all dead, as indicated by the fact that the liquid was practically clear. While the solution in the inoculated tubes was somewhat pinkish in color, it was decidedly lighter than the solution in the control tubes. The deposit was the same in color and in quantity as in the Dunham solution given above.

Dunham's solution, with indigo-carmine.—Sterile tubes of this solution were inoculated in the same manner as the Dunham's solution. In two days the inoculated tubes were slightly blue when seen by reflected light. This color deepened from day to day for about one week, after which time it remained practically constant. The inoculated tubes were only slightly clouded at the end of two weeks, and a small quantity of deposit with a faint brownish tinge had formed in the bottom of the inoculated tubes.

Peptone solution, with rosolic acid.—A nutrient solution containing rosolic acid was inoculated with a 1-mm. loop from a 24-hour-old beef-broth culture, and at the end of one week the solution had a milky appearance, due to the presence of a large number of organisms. Ten days later there was no change, except the formation of a small amount of white deposit. At the end of thirty days after inoculation the tubes were still slightly clouded, but no change in color was apparent. The deposit had increased and had assumed a faint brownish tinge.

Dunham's solution, with methylene blue.—Two preparations containing peptone and methylene blue were used. The first consisted of a 1 per cent solution of Witte's peptone, to which was added 0.5 per cent c. p. sodium chlorid and 3 c. c. of a 1 per cent aqueous solution of methylene blue. Sterile tubes of the solution were inoculated with pure 24-hour-old beef-broth cultures of the calla-rot germ. These inoculated tubes were compared with the controls for two months subsequent to inoculation, but no change in color could be detected.

The second preparation was the same as the first, except that it contained 1 per cent of grape sugar. Three days after inoculation there was no apparent change in color, but at the end of five days the inoculated tubes had a greenish tinge. This became more distinct from day to day for several weeks, and at the end of two months the inoculated tubes were entirely green, while the control tubes remained blue. The blue color of the inoculated tubes was not restored upon shaking.

Steamed potato cylinders.—Potato cylinders were sterlized by steaming on three consecutive days in the sterilizer. Some of these were inoculated with a 1-mm. loop of a 24-hour-old culture of the calla-rot organism in beef broth. Twenty-four hours after inoculation the organism had spread over about two-thirds of the slant surface of the inoculated cylinders. The rate of growth was slow as compared with that on other media. The surface of the growth had a shiny appearance and a faint tinge of yellow which corresponded very closely to Ridgway's Cream Color, No. 20, Plate VI, or Saccardo's Cremeus, No. 27, Table II. The inoculated cylinders began to turn gray toward the inoculated ends. Even in twenty-four hours the discoloration extended from one-third to two-thirds of the length of the cylinders. The color deepened from day to day until at the end of two weeks the upper ends of the cylinders were distinctly brown, the color fading into a gray toward the lower ends of the cylinders. All the many inoculated cylinders retained their shape, and the control cylinders remained firm and white throughout the experiment.

In testing the potato cylinders for starch the reaction was immediate in both the inoculated and the control cylinders and the color was nearly the same, but less purple and more blue in the control than in the inoculated tubes. These tests were made at the end of the second week and later. The odor of the inoculated cylinders at the end of two weeks was sour and disagreeable, resembling spoiled paste.

Raw potato.—A fairly smooth potato was selected and thoroughly washed with tap water to remove the surface dirt. It was then washed with distilled water and the surface was sterilized with a solution of corrosive sublimate (1 part in 1,000), after which it was rinsed with sterile water. It was then cut with a sterilized knife into slices about 2 cm. in thickness. Each slice was divided into four parts and placed in a deep sterilized petri dish. Several petri dishes were prepared in this manner. Two of the pieces in each were inoculated with a 24-hour-old beef-broth culture of the calla organism by placing several drops of the beef-broth culture on the surface of the pieces and then stabbing through these drops into the potato with a sterile needle. Two pieces were left for control. In twenty-four hours the inoculated and control pieces showed a slight discoloration owing to the action of the air, but only the inoculated pieces decayed.

At the end of five days the decayed portions closely resembled Ridgway's Broccoli Brown, No. 15, Plate III. It was not quite as dark as Saccardo's Umbrinus, No. 9, Table I. The inoculated pieces had the odor of decaying vegetables and were alkaline to litmus.

Raw eggplant.—A ripe fruit of the eggplant was obtained from the market, the surface was washed and sterilized as described above, and it was then cut with a sterile knife into slices of thickness suitable for placing in petri dishes. In some instances the slices were pared with a sterile knife so as to remove the outside skin, and in other cases the skin was left on. All slices were cut into four pieces, two of which were inoculated with a 24-hour-old culture of the germ in beef broth and two were left for control. Within eighteen hours at from 20° to 24° C. the inoculated pieces were discolored, and in forty-eight hours the discoloration had extended entirely through them. In three days some of the inoculated pieces were somewhat split and shrunken, as shown in Plate IV, figure 2. In color the interior—i. e., the part that was the center of the fruit—was Broccoli Brown, No. 15, Plate III, of Ridgway's tables, a little lighter than Saccardo's Umbrinus No. 9, Table I. The portion toward the margin was nearly Clove Brown, No. 2, Plate III, Ridgway's tables, or a little darker than Saccardo's Castaneus, No. 10, Table I. There was no sharp line between these two shades of brown, but one graded into the other. The inoculated pieces at the end of three days had a decidedly soapy odor and the reaction was alkaline to litmus. The checks remained perfectly sound.

Raw cauliflower.—A large head of cauliflower that had been three weeks in cold storage was obtained from the market. A portion of the main stalk was thoroughly washed with corrosive sublimate, and then with sterile water. With a sterile knife the outside was pared off and the remaining part was then cut into slices that could be conveniently placed in petri dishes. These were then inoculated with the calla-rot germ from a pure culture in beef broth, leaving a number of pieces for control. The culture used in this case was three days old. In twenty hours at 20° to 24° C. the inoculated pieces began to show a faint discoloration, turning slightly brown. This continued until at the end of about two and a half days the whole of each piece inoculated had become discolored. At this time the inoculated pieces were decidedly alkaline in reaction, gave a very strong odor of decaying vegetable matter, and on comparing with Ridgway's plates the color was found to correspond very closely to the Ecru Drab, No. 21, Plate III, or to Saccardo's Avellaneus, No. 7, Table I. The control pieces were still healthy. In several cases the inoculations did not take. Several branches from the head were sterilized and the lower part was inoculated with the same germ. In all these cases the inoculation was successful, with the same characteristic odor, color, and reaction.

Raw radish. Several red, so-called "white tip," round radishes were obtained from the market. These were washed and the surfaces sterilized in the same manner as the raw potatoes. They were then pared with a sterile knife, cut in half, and placed in petri dishes, four halves in each dish. Immediately after preparing these specimens, two in each dish were inoculated with the calla-rot organism, using a 24-hour-old beef-broth culture, and in eighteen hours at 20° to 25° C. all the inoculated pieces showed slight discoloration. In forty-eight hours the disease had advanced so that the whole of each inoculated piece was discolored. None of the uninoculated pieces showed any signs of disease. Some of the inoculated pieces were inoculated by contact and others by stab. The disease progressed as rapidly in the contact as in the stab cultures. The inoculated pieces only were affected; color, Cinnamon, No. 20, Plate III, Ridgway, a little lighter than Saccardo's Umbrinus, No. 9, Table I. In reaction the discolored pieces were strongly alkaline to litmus, and had the very disagreeable odor of decaying vegetables. All the inoculated pieces were involved (see Pl. V, fig. 1), gradually disintegrated, and settled down upon the bottom of the petri-dishes, as shown in Plate V, figure 2.

Raw cucumbers, sliced.—A green cucumber about 5 inches in length was thoroughly washed with distilled water and the surface sterilized with corrosive sublimate (1 part in 1,000). The outer rind was peeled off with a sterile knife, and the material was then cut into slices from 1½ to 2 cm. in thickness. Each slice was divided into two parts and placed in sterile petri dishes, four pieces in each dish. Two of these pieces in each dish were inoculated with the calla disease germ, using a 24-hour-old beef-broth culture. All the inoculated pieces began to show slight discoloration in eighteen hours at 20° to 25° C., and in forty-eight hours the disease had progressed rapidly, having discolored in some cases the whole of each inoculated piece. The color of the inoculated pieces at this time was light brown or yellowish, closely resembling Ridgway's Buff, No. 13, Plate V, or Saccardo's Ochroleucus, No. 28, Table II. The inoculated pieces had a peppery, pungent odor, and were strongly alkaline to litmus.

Raw cucumbers, whole.—The effect of the calla germ on whole cucumbers fresh from the vines was tried by taking nearly ripe cucumbers, sterilizing a spot near the stem by washing with corrosive sublimate (1 part in 1,000), and then washing with sterile water. Several punctures were made in the sterilized spot with a sterile needle to the depth of from one-half to 1 inch, and two 1-mm. loops of a 24-hour-old beef-broth culture of the calla organism were applied to the sterile surface over the punctures. For control several cucumbers were treated in exactly the same manner, except that the organism was not applied. At the end of twenty-four hours at 20° to 25° C. a watery spot about one-half an inch in diameter appeared around the punctures in the cucumbers that were inoculated. In three days from the time of inoculation the cucumbers were soft about one-half their length, and in five days they were soft throughout. The skin, however, remained intact, so that the inoculated cucumbers represented closed sacks containing a watery, pulpy mass (Pl. VI). If an opening were made in the sack the contents would flow out, leaving a semitransparent bag which could be filled with water and handled. All controls remained entirely unaffected. A drop of the watery substance from one of the inoculated cucumbers placed under a low power of the microscope showed that the cells had become separated so that each individual cell floated out by itself. The cells themselves were not collapsed, however, showing that the action of the organism had been upon the lamella connecting the cells, causing them to dissolve. This action was apparent not only upon the cucumber but upon all the raw vegetables which were rotted under the influence of this organism. The color of the cucumbers, both upon the surface and in the interior, remained unchanged. The odor of the soft contents of the inoculated cucumbers was strikingly like that arising from cucumbers that sometimes soften when pickled in brine. The reaction was distinctly acid to litmus.

To determine whether the organism that had caused the softening of the inoculated cucumbers was the calla-rot germ, a spot was sterilized on the surface of one of the soft cucumbers before the skin was broken. With a sterile needle a puncture was then made in the sterilized spot in the skin and a loop of the soft interior was removed with a sterile needle and placed in 10 c. c. of beef broth. In the usual way eight poured plates of beef agar were at once prepared from the dilutions of this beef-broth culture. In from twenty-four to forty-eight hours at 20° to 25° C. colonies appeared in all the plates. These colonies were all radiating and were alike in all respects, indicating that the cucumber contained a pure culture of an organism similar at least to the calla-rot germ. Twelve callas were inoculated with 24-hour-old beef-broth cultures made from these colonies, and in twenty-four hours the characteristic calla rot appeared in all cases, as indicated in the watery discoloration around the inoculated spots and by the subsequent decaying of the parts inoculated. In twenty-four hours more the inoculated leaves had entirely rotted off. The only part of the interior of the inoculated cucumbers not softened was the portion immediately beneath the spot sterilized for inoculation (Pl. VI, A). Here the interior remained firm, sometimes to a depth of one-half inch or more, showing that the corrosive sublimate had penetrated to a considerable depth and that the organism was unable to attack this part of the cucumber even after several days.

This series of experiments was repeated many times with practically the same results. Sometimes the action was a little slower and sometimes a little more rapid. It was found that the action was more rapid if the cucumbers were nearly ripe before inoculation and when the temperature of the air in which they were kept after inoculation was about 30° C. Some of the experiments were carried on in the dark and some in diffused light, but there was no apparent difference in the time required for the inoculation to take, nor in the rate of progress made in softening the cucumbers in the two cases. The rate of disintegration was the same on both the upper and the lower sides of the cucumbers.

Raw green peppers.—These peppers were obtained from the market, thoroughly washed with distilled water, and afterwards with corrosive sublimate, and again rinsed with distilled water. With a sterile knife they were cut into slices and placed in sterile petri dishes, two pieces in each dish. One piece in each dish was inoculated immediately with the calla-disease organism. In twenty-four hours at 20° to 25° C. it was seen that the inoculated pieces were slightly attacked by the germ, and in forty-eight hours the disease had progressed, although not as rapidly as in the cases of the cucumber, potato, carrot, and some other vegetables. The organism attacked both the central and the outer parts of the pepper, but the change in color was not sufficient to show in a photograph even after five days. The inoculated parts were all darker than the controls (Ridgway's Parrot Green, No. 7, Plate X, or Saccardo's Atro-virens, No. 34, Table II), while the original was nearly grass green toward the outside. The interior of the pepper, originally nearly white, was changed to Cream Buff, Ridgway's No. 11, Plate V, or Saccardo's Cremeus, No. 27, Table II. The inóculated parts were also soft, had the odor of decaying peppers, and were strongly alkaline to litmus.

Raw mature onion bulbs.—The outside layers were removed and the onion was then cut into pieces of convenient thickness and placed in petri dishes, three pieces in each dish. Two of these pieces were inoculated with a 24-hour-old culture of the calla germ and one was left for control. Several dishes were prepared in this manner. The organism grew on the onion, but not rapidly, and at the end of five days at a temperature of from 20° to 25° C. the decay was apparent, although the layers of the onion were not broken down. The color was Cream Buff, No. 11, Plate V, Ridgway, or Saccardo's Cremeus, No. 27, Table II. The odor was that of decaying onions. In reaction the inoculated pieces were moderately alkaline to litmus.

Raw young onions.—Several onions were grown from seeds, and when the young plants were about two weeks old they had produced three leaves each and the longest of the leaves measured from 6 to 8 inches. These plants were inoculated with the calla organism by placing a drop of a 24-hour-old beef-broth culture on a leaf with a sterile needle and puncturing the leaf several times through the drop of bacteria-laden broth. No sign of disease appeared in any case, although the plants were kept under observation for several weeks. This experiment was repeated several times with negative results, indicating that this organism is not a producer of disease in young green onions.

Raw pieplant.—Stalks of raw pieplant were washed with corrosive sublimate and then in distilled water. With a sterile knife the outside was removed and the stalks were then cut into slices about 2 cm. thick and four placed in each petri dish. Two of each four were inoculated with a 24-hour-old beef-broth culture of the calla germ. In two cases only was there any growth, and this was very feeble, resulting at the end of five days in a slight brown discoloration. The experiment was repeated several times, but in all cases the growth was very feeble and hardly perceptible.

Raw cabbage.—Cabbage heads were obtained from the market, the outer leaves were pulled off, and inoculations were made into the stumps and leaves of several plants, using a 24-hour-old beef-broth culture of the calla germ, several heads being left for control. In twenty-four hours the inoculated spots were slightly discolored. The color deepened for nine days (temperature, 18° to 27° C.), at the end of which time the rot had spread over the whole surface of the stumps and entirely through them. The color was Drab, No. 18, Plate III, Ridgway, or somewhat darker than Saccardo's Avellaneus, No. 7, Table I. At the same time the decay progressed in the leaves, producing the same color and advancing from leaf to leaf until at the end of nine days the whole of each inoculated head was affected. None of the control plants was affected during this time. The decayed specimens had the odor of rotten cabbage and in reaction were strongly alkaline to litmus.

In addition to these experiments with cabbage, pieces of stumps and leaves were washed with corrosive sublimate, then with sterile water, and placed in petri dishes, four pieces in each dish, two of which were immediately inoculated with a 24-hour-old beef-broth culture of the organism and two left for control. In twenty-four hours at 20° to 25° C. the inoculated pieces began to show discoloration and in five days the inoculated pieces were decayed throughout. The control pieces remained sound, except in a few instances in which the exuding juice from the decayed pieces came into contact with the controls, in which cases the latter decayed. The color, odor, and reaction were the same as in the experiments with the whole heads, as previously described.

Raw parsnips.—Raw parsnips were obtained from the market and treated in the same way as the raw potatoes. With a sterile knife pieces of convenient thickness were cut and placed in sterile petri dishes, four pieces in each dish. Two pieces in each dish were inoculated with the calla-rot germ, using a 24-hour-old beef-broth culture. At the end of twenty-four hours after inoculation the inoculated pieces began to show discoloration at the points of infection, and at the end of three days (temperature, 18° to 25° C.) the discoloration was very marked (Pl. VII, fig. 1). The inoculated pieces had a pungent, sweetish odor and were plainly alkaline to litmus. The color corresponded to Ridgway's Mummy Brown, No. 10, Plate III, or nearly to Saccardo's Fuligineus, No. 11, Table I.

Raw carrots.—Several roots of carrots were obtained from the market and prepared in the manner indicated above. Slices of suitable thickness to be placed in petri dishes were then cut off with a sterile knife. Four pieces were placed in each petri dish, and as in the other experiments two out of each set were inoculated with the calla-rot organism and two left for control. In twenty-four hours at 20° to 22° C. the inoculated pieces began to discolor at the points of inoculation, and in three days the discoloration was very striking over the entire surface of the inoculated pieces (Pl. VII, fig. 2). In the central part of the root the discoloration had extended entirely through, a distance of 2 cm., while toward the outer surface the progress was not so rapid, the discoloration having extended only about 1 cm. The color of the inoculated pieces three days after inoculation was Vandyke Brown, No. 5, Ridgway's Plate III, or nearly Saccardo's Fuligineus, No. 11, Table I. The decayed part was distinctly alkaline to litmus. At the end of eight days the inoculated pieces were entirely discolored and soft, while the uninoculated pieces still retained their normal color and were sound. At this time the inoculated pieces had changed in color from Vandyke Brown or Fuligineus to Olive, No. 9, Ridgway's Plate III, or to Saccardo's Olivaceus, No. 39, Table II.

Raw turnips.—A firm, white turnip was obtained from the market, prepared for the petri dishes, and inoculated in the same manner as the other vegetables. In twenty-four hours discoloration was distinctly noticeable at the points of inoculation, and in three days the discoloration was very striking and had progressed downward from 2 to 3 mm., while the uninoculated pieces were still white and sound (see Pl. VIII, fig. 1). The color of the inoculated pieces at this time closely resembled Ridgway's Olive, No. 9, Plate III, or Saccardo's Olivaceus, No. 39, Table II. The discolored parts were strongly alkaline to litmus and had a striking odor of decayed turnips.

Raw salsify.—Several roots of salsify were obtained from the market and the same method was used in preparing and inoculating them that was employed with the other vegetables. In twenty-four hours the inoculated pieces were discolored and in three days all had discolored but only the inoculated pieces had decayed, and as these kept their shape it was impossible to bring out the difference in color by means of a photograph. The growth of the organism, however, was apparently just as rapid in the salsify as in the parsnips, carrots, etc. The inoculated pieces were alkaline to litmus and had an odor of decaying salsify.

Raw tomatoes, ripe.—Several ripe tomatoes were inoculated with a 24-hour-old beef-broth culture of the calla germ. Before inoculating, a spot about one inch in diameter on the surface of the fruit was washed with a dilute solution of corrosive sublimate and then with sterile water. A loop of the culture was then placed on the sterilized spot and a sterile needle was used to puncture the skin through the drop of beef-broth culture. Some of the tomatoes so inoculated were left in diffused light, some were placed in a dark room, and all were maintained at a temperature of about 18° C. Twenty-four hours after inoculation each infected spot was surrounded by a watery area about 1¼ inches in diameter. The contents of the inoculated tomatoes softened rapidly, so that at the end of four days after inoculation openings were made in the skins of some of the infected fruits and the contents were poured out, leaving the skins intact. The cell contents of the inoculated tomatoes were apparently acted upon by some substance that dissolved the intercellular layers and allowed the individual cells to become entirely separated, as in the case of the cucumbers already cited. The cell contents did not seem to be affected, nor did the substance act upon the skin of the tomato.

Raw tomatoes, green.—Some tomato plants growing in the Department greenhouse bore a number of unripe tomatoes varying from 1 to 2 inches in diameter. Six of these were inoculated on the plants in the same manner as the ripe tomatoes described above. Twenty-four hours after inoculation (temperature, about 30° C.) all the infected tomatoes had small watery spots at the point of inoculation. Twenty-four hours later the watery spots appeared sunken and whitish. In another twenty-four hours the spots began to turn brown, the skin cracked, and the juice began to ooze out. In twelve days after inoculation the contents had oozed from all the inoculated tomatoes, leaving the skins still clinging to the vines. Plate VIII, figure 2, shows a photograph of one of the skins (No. 2) and of an uninoculated tomato (No. 1) on a piece of one of the vines. The skins did not cling firmly to the vines, but could be easily removed. The stems to which the skins were attached had a discolored and dead appearance, but were not at all soft. Green tomatoes brought into contact, either artificially or naturally, with a decayed tomato did not take the disease. While the general effect of the organism is the same upon the green as upon the ripe tomato, the progress is much more rapid in the case of the ripe fruits.

Raw apples (York Imperial).—The outside of the apple was washed with corrosive sublimate (1 part in 1,000) and then with sterile water.

Several pieces were then cut out with a sterile knife and placed in sterile petri dishes, four pieces in each dish. Two pieces in each dish were inoculated with a 24-hour-old culture of the calla-rot germ in beef broth and two pieces were left for control. After four days a slight growth was noticeable, but the rate of growth was very slow.

Raw pineapples.—The outside was removed and several pieces were cut from the interior with a sterile knife. As in the previous case, four pieces were placed in each of several petri dishes. Two pieces in each dish were inoculated as above and two left for control. These preparations were kept for about ten days, but no growth appeared on any of the pieces.

Raw yellow bananas.—The outside of the bananas was carefully peeled off, and with a sterile knife cross sections from 1½ to 2 cm. thick were cut off and placed in sterile petri dishes, four in each dish. As in the preceding cases, two pieces in each were inoculated with a 24-hour-old culture of the calla-rot germ in beef broth and two were left for control. After ten days no growth was noticeable on any of the pieces.

GAS.

To determine whether or not the calla-rot organism is a gas producer, six solutions were used, viz, peptone water +1 per cent mannite, peptone water +1 per cent maltose, peptone water +1 per cent dextrose, peptone water +1 per cent cane sugar, peptone water +1 per cent milk sugar, and peptone water +1 per cent glycerin. A half dozen fermentation tubes were filled with each of these solutions, and after sterilizing for fifteen minutes on three consecutive days several tubes of each set were inoculated with a 1-mm. loop of a 24-hour-old beef-broth culture of the calla-rot organism. A part of each set was left for control. In eighteen hours after inoculation of the infected tubes (temperature, 20° C.) they were clouded in the bulb, and the clouding extended from one-half to 1 inch into the closed ends of the tubes. In forty hours the clouding extended to the top of the closed end of each inoculated tube, but no gas had formed in any case. (Fig. 6.) The control tubes were all clear and free from gas. These tubes were kept under observation for two weeks, but no gas formed in any of the tubes, and the control tubes were still clear and free from sediment. The inoculated peptone-mannite tubes began to clear at the top of the closed ends in from twenty to thirty weeks after inoculation. The deposit formed from a settling of the sediment was cream buff in color, as seen by reflected light, and corresponded very nearly to Ridgway's No. 11, Plate V. The reaction of the contents of the tube was slightly acid to litmus at the close of the experiment. The inoculated peptone-maltose tubes began to clear in from ten to twelve weeks, and by the end of twenty weeks were entirely clear. The deposit formed was only about one-half the bulk of the deposit in the peptone-mannite tubes. It was of a drab color, corresponding very closely to Ridgway's Ecru Drab, or a little darker than Saccardo's Avellaneus, No. 7, Table I, when viewed by reflected light. The reaction of the contents of the tubes was slightly alkaline to litmus at the close of the experiment. The peptone-dextrose tubes began to clear in from ten to twelve weeks after inoculation, and in twenty weeks were entirely clear. A large part of the sediment clung to the back of the upright part of the tube instead of settling completely, as in the other inoculated tubes. The color of the deposit was also drab, corresponding very closely to Ridgway's Ecru Drab, No. 21, Plate III, or a little darker than Saccardo's Avellaneus, No. 7, Table I, when seen by reflected light. The reaction of the contents of the tube at the close of the experiment was slightly acid to litmus. The cane sugar, milk sugar, and glycerin tubes cleared in from one to six weeks. The glycerin tube cleared first, then the milk-sugar tube, and lastly the cane-sugar tubes. The deposit was heaviest—about 4 mm. deep—in the cane-sugar tubes, about 2 mm. deep in the milk-sugar tubes, and only 1 mm. deep in the glycerin tube. The color of the deposit was the same as in the other cases, viz, Ridgway's Ecru Drab, No. 21, Plate III, or a little darker than Saccardo's Avellaneus, No. 7, Table I. Each inoculated tube gave an acid reaction with litmus at the close of the experiment. No gas formed in any of the tubes. It is therefore apparent that the calla-rot organism is not capable of splitting up mannite, maltose, dextrose, cane sugar, milk sugar, or glycerin so that a gas will form.

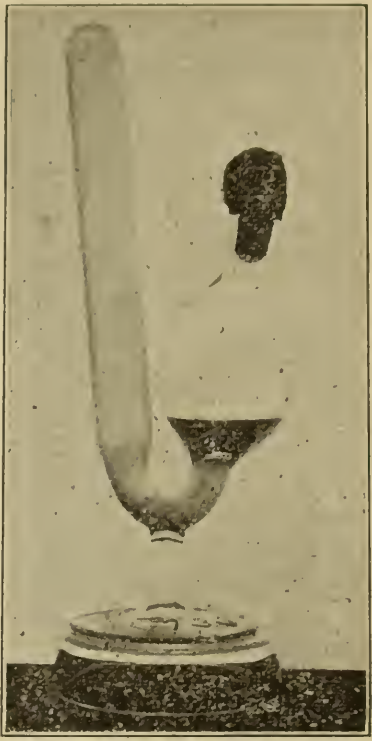

FIG. 6.—Fermentation tube ten days after inoculating with the calla organism.

ACTION ON LEAD ACETATE.

Slant tubes of lactose agar, colored with litmus, were inoculated with the calla-rot organism, and at the same time slips of filter paper saturated with lead acetate were introduced into the tubes. These paper strips were held at one end by a cotton plug, so that they did not come into contact with the medium. In twenty-four hours the color began to fade from the litmus-lactose agar, and in three days the agar was practically colorless, except a small area near the top, which was still slightly tinged. At the same time the lead acetate paper began to blacken around the edges. Twenty-four hours later the margins of the paper strips were still darker and the discoloration extended a little farther from the edge. At the end of eight days from the beginning of the experiment the color had entirely disappeared from the inoculated tubes, while it remained unchanged in the controls. The lead-acetate papers were blackened about three-fourths of an inch from the lower end upward, the color fading out and leaving no sharp line of demarcation. The liquid that settled in the angle of the inoculated tubes at the end of eight days had become nearly cream color, corresponding closely to Ridgway's No. 20, Plate VI, or Saccardo's Cremeus, No. 27, Table II, while in the control tubes the liquid was still litmus color. At the expiration of twenty-seven days from the beginning of the experiment the color began to return in the agar, and seven days later the original color had returned throughout the agar and also in the liquid that had previously been cream color. As soon as the color began to return to the agar the discoloration of the lead-acetate slips ceased to develop. The black color in the lead-acetate papers was undoubtedly due to the formation of hydrogen sulphid, which develops on certain media during the activity of the calla-rot organism. As soon as the organism became inactive the hydrogen sulphid ceased to form, and what had formed passed off from the agar, allowing the litmus color to return. Beef broth inoculated with the calla-rot organism discolored the margins of lead-acetate paper in twenty-four hours, the discoloration extending about one-fourth of an inch from the margin. This gas forms much more rapidly in beef broth than in litmus-lactose agar, while the organism growing on potato cylinders produced no blackening of lead-acetate strips, even at the end of three weeks after inoculation.

INDOL.

Several tubes of peptonized Uschinsky's solution were inoculated with fresh cultures of the calla-rot organism. The inoculated tubes clouded within twenty-four hours, and tests were made from day to day for indol, using concentrated sulphuric acid and sodium nitrite, but even at the end of twenty-four days no trace of indol could be detected, although the tubes were heated to 80° C. after the application of the acid and the nitrite.

NITRATES REDUCED TO NITRITES.

Four tubes of nitrate bouillon were inoculated with the calla germ. These became distinctly clouded in the usual time, and at the end of two days were tested for nitrites as follows: To 10 c. c. of the clouded bouillion 1 c. c. of starch solution and 1 c. c. of potassium iodid solution were added. One drop of sulphuric acid was then sufficient to give an intensely blue color, indicating that the nitrates had been changed to nitrites. The control tubes treated in the same manner gave no reaction.

MAXIMUM TEMPERATURE.

In determining the maximum temperature at which the calla-rot organism will grow several media were used, viz, agar, gelatin, beef broth, and Uschinsky's solution. These media were inoculated with a 24-hour-old culture of the calla-rot organism in beef broth, and several tubes of each medium were placed in an incubator which registered 40° C. At the expiration of forty-eight hours the temperature still remained at 40° C., and there was no visible growth in any of the media. Growth was apparent in all the control tubes at the end of twenty-four hours after inoculation. On the third day after the tubes were placed in the oven the temperature fell to 38° C., and at the expiration of twenty-four hours thereafter there was a visible clouding of the beef broth and of the Uschinsky solution, but no growth appeared on the other media. When the incubator had again become steady at 40° C., fresh cultures were introduced, including, in addition to the above mentioned media, milk, litmus milk, and poured-agar plates. At the end of forty-eight hours there was a slight clouding of the beef broth and of the Uschinsky solution, but no growth was yet apparent in the other media. Twenty-four hours later the clouding in the beef broth and in Uschinsky's solution had increased and minute colonies began to appear in the poured plates, slight growth being apparent also on slant agar and stab gelatin cultures. At the end of another twenty-four hours the milk was slightly curdled and the litmus milk was beginning to redden. The temperature remained constantly at 40° C., and growth advanced slowly in all cases for several days. The colonies in the poured plates increased in size until they were from 2 to 3 mm. in diameter. It should be noted that all the colonies produced on the agar plates at this high temperature were round, none of them showing any tendency to radiate as they did under temperatures from 20° to 30° C. While 40° C. retards the growth of the organism it does not prevent it. The incubator was next regulated at 41° C. and fresh cultures of the organism on the various media were placed in it. After forty-eight hours there was a slight growth in the Uschinsky solution and on the slant agar, but it was very slight as compared with the controls. No growth appeared in the other media. At the end of another forty-eight hours, growth in the agar and in the Uschinsky solution was not perceptibly advanced and no growth appeared in any of the other media. Upon removing all these cultures to conditions of normal temperature at the end of the fourth day, growth advanced rapidly in those cases where it had started and appeared in all the other media used within twenty-four hours after removal. When fresh cultures were kept constantly at 42° C. no growth appeared, but exposure to this temperature for twenty-four hours did not destroy the life of the organism, as evidenced by the fact that when the cultures were removed from the incubator at 42° and kept at 20° C. growth began within a few hours. If fresh cultures were placed in the incubator at 43° C. life was not destroyed within fifteen hours, but cultures removed at the end of twenty-four hours and placed under normal conditions failed to grow. If the temperature was kept constantly above 41° C. no growth appeared in any of the media used. Hence after many repeated tests it was decided that 41° C. is the maximum temperature at which this organism will grow.

MINIMUM TEMPERATURE.

To determine the lowest temperature at which the calla-rot organism will grow, fresh cultures were placed in the ice box at different elevations, with as little variation as possible in the quantity of ice, so that the temperature remained fairly constant for each set of cultures, but varied for the different sets from about 3° to 9° C. Set 1 consisted of cultures of beef broth, Uschinsky's solution, gelatin stab cultures, and slant agar, and was kept at a temperature between 3° and 5° C. for twenty-four days. The control cultures at room temperatures of 20° C. produced growth as usual within twenty-four hours, while the cultures at the low temperature showed no signs of growth until they were removed from the ice box at the expiration of twenty-four days, when all produced growth within twenty-four hours. Set 2 was kept at approximately 6° C. for nine days, at the end of which time growth appeared, slightly clouding the beef broth. The temperature sometimes fell to 5° C., but did not at any time during the nine days exceed 6½° C. Set 3 was kept at approximately 9° C. Slight growth began in from two to four days. Beef broth was the first to show the growth in the low temperatures, while in the high temperatures it was usually the Uschinsky solution that clouded first. Six and one-half degrees centigrade seems to be the lowest temperature at which growth will take place. At 9° C. growth takes place slowly and the colonies in agar-plate cultures at this temperature are small and round, as was found to be the case in the high temperatures.

OPTIMUM TEMPERATURE.

The calla-rot organism grows readily between 15° and 37° C. Fresh cultures of beef broth, Uschinsky's solution, and agar inoculated with a 1 mm. loop of a 24-hour-old beef-broth culture, placed in an incubator at 37.5° C., showed signs of growth within six hours. Similar cultures at 35° C. showed a distinct growth in four hours. As it is sometimes difficult to compare culture solutions accurately with reference to the intensity of clouding, agar-plate cultures were also used. The fresh cultures were placed at different temperatures—some at 20°, some at 30°, some at 33°, some at 35°, and some at 37.5° C. In fifteen hours the plates at 35° C. showed the colonies most distinctly.

The colonies measured from 1 to 3 mm. in diameter. Colonies were also visible in the plates at 20° and 30° and at 37.5° C., but they were smaller—scarcely larger than pin points. Similar tests were made of other temperatures above and below 35° C. with like results. Since all growth above and below 35° C. is slower than at this temperature, it appears that 35° C. is the optimum temperature for the growth of the calla-rot organism. In thirty-four hours the colonies at 35° C. had the characteristic radiating form, while those at and above 37.5° C. were round.

THERMAL DEATH POINT.

The thermal death point is the lowest temperature at which the life of the organism will be destroyed when a fresh culture is exposed to that temperature for ten minutes. To determine that point with the calla-rot organism fresh beef-broth cultures were made from a 24-hour-old culture of beef broth, each culture consisting of 10 c. c. of broth inoculated with a 1-mm. loop of the 24-hour-old culture. The tubes containing these fresh cultures were placed in water at constant temperature for ten minutes. In the first experiment three sets of tubes were used. One set was exposed to a temperature of 49°, another set was exposed to 49.20°, and the third set was exposed to 49.40° C. After exposing the tubes to these temperatures they were placed at room temperature of about 20° C., and at the expiration of eighteen hours all control tubes were clouded and all exposed tubes were clear. Six hours later set 1 (49° C.) was clouded slightly; sets 2 and 3 were still clear. Twenty-four hours later—i. e., forty-eight hours from the time the tubes were exposed to the heat—all inoculated tubes were clouded. In the second experiment three sets of tubes were again used. After inoculating in the same manner as above, one set was exposed for 10 minutes to a temperature of 49.50°, another to 50°, and a third to 50.20° C. Several inoculated tubes were left untreated for control. At the expiration of twenty-four hours all control tubes were clouded, and all exposed tubes were clear. Twenty-four hours later four tubes in set 1 (49.50° C.) were clouded and two were clear. All tubes in sets 2 and 3 (12 in all) were still clear. At the expiration of two weeks all tubes in sets 2 and 3 were still clear, and the two tubes in set 1 were also clear. Agar plates were made from the clouded tubes that were heated to 49.50° C., and in all cases pure cultures of the calla organism were obtained, as indicated by the shape of the colony and by the fact that inoculations into calla plants produced the characteristic symptoms of the disease. Several sets of cultures were subsequently exposed to a temperature of 50° C. for ten minutes, but always with the result that they all remained clear indefinitely, while a part, at least, of the cultures exposed below 50° C. clouded in a longer or shorter time, showing that 50° C. is the thermal death point for this organism.

DIFFUSED LIGHT.

Diffused light had no effect upon the development of the organism in any of the media used, i. e., beef broth and other liquid media, clouded or otherwise, showed the presence of the organism as readily under one condition as the other, and in the agar plates the colonies formed as quickly and grew as rapidly in diffused light as in the dark.

DIRECT SUNLIGHT.

To determine the effect of direct sunlight upon the organism several tubes, each containing 10 c. c. of agar, were inoculated and poured into thin petri dishes. One-half of each dish was covered with black paper and the dishes were then exposed to the direct sunlight. Some of the dishes were removed from the direct sunlight at the end of five, ten, fifteen, twenty, and sixty minutes. In those dishes that were exposed five minutes only, colonies appeared in all points of the plate in twenty hours. The colonies appeared just as readily and grew just as rapidly in the exposed as in the unexposed part of the plate, but were a little less numerous, showing that a few of the organisms had been killed by the direct light in five minutes. In the plates that were exposed ten minutes colonies appeared in the covered part of the plate within twenty-four hours, but none appeared in the exposed part of the plate until nearly forty-eight hours after being placed in diffused light. The colonies which finally formed in the exposed part were much less numerous than those in the shaded part. In the covered part of the plate that was exposed fifteen minutes colonies appeared within twenty hours, but no colonies appeared in the exposed side, even at the end of a week, except a few around the edge of the plate, which were apparently protected slightly either by the shadow of the margin of the petri dish or by the organism being several deep around the margin of the plate, so that the upper layers protected those below from being destroyed by the direct rays of the sun. The same was true of the plates exposed twenty minutes. It appears, therefore, that from five to fifteen minutes of direct sunlight are sufficient to destroy the life of the organism, but that a very slight protection only is necessary to prevent them from being destroyed. Even in the plates exposed for sixty minutes the organisms around the margin of the plate were likewise protected. In all cases colonies appeared close to the dividing line between the exposed and the shaded part of the plate, and growth extended in every instance from these marginal colonies into the exposed part of the plate, showing the characteristic radiation of the colonies when not crowded.

EFFECT OF NITROGEN.

Several tubes of beef broth were inoculated with the calla-rot germ and the tubes were placed immediately in a jar from which the oxygen was removed by the aid of pyrogallic acid and sodium hydrate, thus leaving practically an atmosphere of nitrogen. The jar was placed in diffused light at a temperature of from 18° to 25° C. At the expiration of thirty-five days it was opened and the beef broth was as clear as if it had not been inoculated, showing that no growth had taken place in the absence of oxygen. Twenty-four hours after the jar was opened the tubes were clouded as deeply as if the inoculation had been made the day the jar was opened instead of thirty-five days prior to that time. Hence, while nitrogen will not enable the organism to grow, its life is not destroyed by the action of this gas, and when inoculations were made from these cultures into callas the disease promptly appeared, and in forty-eight hours the inoculated leaves and flower stalks had rotted off. Agar-poured plates made from the clouded tubes and from the diseased portion of the inoculated calla showed the same characteristic pure cultures composed of radiating colonies. To determine how much longer the organism would live in the absence of oxygen, cotton-plugged tubes of beef broth, Uschinsky's solution, and a mixture of Dunham's and Uschinsky's solutions (half and half) were inoculated with the calla organism and were kept in an atmosphere of nitrogen two hundred and seventy-five days, in the manner described above. At the expiration of this time the tubes, all of which were clear, were exposed to the air at room temperature, i. e., 18° to 25° C., the same temperature at which they had been kept in the atmosphere free from oxygen. The atmosphere in the jar would not support combustion at the moment it was opened, indicating that the oxygen had not diffused into it. In twenty-four hours after exposing the tubes to the air the Uschinsky solution and the mixture of the Uschinsky and Dunham solutions were all clouded, but the beef-broth solutions were not clouded. The clouding increased for several days in those tubes in which it had begun, but no growth appeared in the beef broth even after several weeks of exposure to the air. Poured plates and inoculations into healthy callas from the clouded tubes showed that this was the calla organism.

EFFECT OF CARBON DIOXID.

Freshly inoculated tubes of slant agar, Uschinsky's solution, nitrate bouillon, and common bouillon were placed in an air-tight jar into which carbon dioxid was passed. Before the gas entered the jar containing the tubes it was passed through solutions of potassium permanganate, sodium hydrate, and distilled water. After being filled and exhausted six times, to insure an atmosphere of pure carbon dioxid, the jar was filled with the gas, sealed, and allowed to stand for fourteen days. At the expiration of this time it was opened and the tubes were examined. The slant agar showed a thin, pure white growth the whole length of the streak and a small amount of whitish precipitate in the fluid in the angle formed by the agar and the side of the tube. The amount of growth was only moderate. The Uschinsky's solution showed no growth at this time. In twenty-four hours the tubes of Uschinsky's solution were still clear, but at the end of forty-eight hours after exposure to the air the solution was distinctly clouded, showing that free oxygen is necessary for the growth of the calla organism in Uschinsky's solution.

In the nitrate bouillon there was only a moderate amount of growth at the time the jar was opened, but the solution was distinctly clouded. There was a white precipitate 7 mm. in breadth, but no pellicle or rim had formed. The nitrates were reduced to nitrites, as shown by the usual test. The common bouillon was distinctly and uniformly clouded. Apparently the growth had been twice as rapid as in the nitrate bouillon, as indicated by the degree of cloudiness of the tubes and by the large amount of white precipitate, which was fully twice as abundant as in the nitrate bouillon tubes. No rim or pellicle formed in any of the tubes.

EFFECT OF HYDROGEN.

Tubes of slant agar, Uschinsky's solution, ordinary bouillon, and nitrate bouillon were inoculated with the calla organism and placed in a hydrogen atmosphere. The hydrogen was generated by the action of dilute sulphuric acid upon zinc. The gas thus produced was passed through solutions of silver nitrate, potassium permanganate, sodium hydrate, and distilled water into a chamber containing the inoculated tubes. The chamber was filled and exhausted six times, thus insuring practically a pure atmosphere of hydrogen. The chamber was then sealed and left undisturbed for twenty days, at the end of which time the following results were noted:

The organism had made a feeble growth on the slant agar, as indicated by a very faint streak along the surface of the medium, and a small amount of whitish precipitate to the depth of 2 mm. had been deposited in the angle between the agar and the side of the tube. Uschinsky's solution was feebly clouded throughout. A small amount of deposit to the breadth of 7 to 8 mm. had formed in the bottom of the tube. The ordinary bouillon was feebly clouded throughout and a white precipitate 8 mm. in breadth had been deposited. The nitrate bouillon was feebly clouded, with a small amount of white deposit 12 mm. broad in the bottom of the tube. No rim or pellicle had formed in any of the fluids.

COMPARISON OF CALLA-ROT GERM WITH SIMILAR ORGANISMS.

Bacillus carotovorus Jones.[a]—Upon comparing the calla organism with the carrot-rot germ, as described by Jones, it is found to differ in

[a] Jones, L. R. A Soft Rot of Carrot and Other Vegetables Caused by Bacillus Carotovorus, Jones. Thirteenth Annual Report of the Vermont Experiment Station, 1900, p. 299.

several particulars—i. e., the calla rot does not, while the latter does produce gas. The former is not affected by diffused light, while the latter is affected, etc. The shape of colonies differs. There are, of course, numerous points in which the two organisms agree, but they differ in enough essential points to show that they are not the same.

Bacillus oleraceæ Harrison.[a]—Cultures of this organism were obtained, and repeated inoculations were made with fresh cultures into various parts of calla plants. At the same time parallel inoculations were made with similar cultures of the calla-rot germ. In twenty-four hours after inoculation nearly all the plants inoculated with the calla germ showed the characteristic symptoms of disease, and the decay continued to progress until the plants were practically destroyed. On the other hand Harrison's organism did not affect the plants in any way, showing that the two organisms are not identical.

FIG. 7.—Hothouse hyacinth inoculated in a flower with the calla organism.

Heinz's hyacinth germ (*Bacillus hyacinthi septicus*).[b]—In order to learn the effect of the calla organism on hyacinths, more than 100 hyacinths were inoculated with fresh cultures of the calla germ. The leaves, flower stalk, and flowers were inoculated. Most of the inoculations were made in plants growing in the open when the weather was bright and warm. A few hyacinths were potted and placed in a greenhouse. The flowers were inoculated by dropping a single drop of a 24-hour-old beef-broth culture into the flower. The leaves and flower stalks were inoculated by scraping a quantity of the fresh growth of the organism from a slant-agar surface, applying it to the diseased spot, and then puncturing the plant with a sterile needle through the mass of organisms. None of the plants in the open showed any symptoms of the disease whatever, although they were watched daily for more than two weeks. The inoculated plants in the greenhouse did not show any symptoms of disease until the expiration of five days, when a few of the leaves and flower stalks began to soften. The affected parts gradually decayed throughout (fig. 7). Pure cultures of the calla organism were obtained from these diseased parts of the hyacinths. The difficulty with which this organism

[a] Harrison, F. C. Preliminary Note on a New Organism Producing Rot in Cauliflower and Allied Plants. Science, n. s., Vol. XVI, July 25, 1902, p. 152.

[b] Heinz, A. Zur Kenntniss der Rotzkrankheiten der Pflanzen. Centralblatt f. Bakt. u. Parasitenkunde, Bd. V, 1889, p. 535.

affects the hyacinths indicates that it is not the same as Heinz's hyacinth germ, which attacked the plants readily and destroyed them rapidly when inoculated by either of the methods used in these tests. Heinz's organism (*Bacillus hyacinthi septicus*) does not liquefy gelatin, while the opposite is true of the calla organism. The colonies in plate cultures are round and when grown on sterile potato they are a dirty yellow color. The colonies of the calla organism are usually radiating and on potato they produce a brownish color.

Potter's Pseudomonas destructans.[a]—Potter's organism, when grown in a solution containing sugar, liberates carbonic acid gas. The calla organism is not a gas producer. Colonies in plate cultures are round, and when grown on vegetables the end reaction is acid. The calla organism usually produces radiating colonies, and on vegetables the end reaction is generally alkaline. *Pseudomonas destructans* has but one flagellum while the calla organism has several flagella.

Likewise in comparison with other forms the calla germ does not agree in all particulars with any other known organism, and the writer therefore proposes for the calla-rot germ the name *Bacillus aroideæ.*

ORIGIN AND SPREAD OF THE DISEASE.

The calla rot has been reported from the Western, Central, and Eastern States, i. e., from the Atlantic to the Pacific. It therefore appears to have spread over the entire calla-growing section of the United States, but it is much more destructive in some portions of the country than in others. It causes a loss of thousands of dollars annually and has become so destructive in some sections that the growers have either abandoned the calla altogether or have greatly reduced the space and time that they have heretofore devoted to this plant. It is therefore of the highest importance that the grower should know the source of this disease and the ways in which it may spread from place to place and from plant to plant.

Calla corms that are attacked late in the season go into their resting stage in a partly decayed condition. If the attack has been slight the infected spot will dry down and may be overlooked when corms are selected the following season for growing calla plants. When callas begin to grow from such corms the organisms which have remained dormant during the resting period of the corm are revived and decay is started afresh. Since this organism may remain dormant for months without its life becoming extinct, it may be spread from one locality to another, and even from country to country, whenever diseased corms are transported. It is undoubtedly in this manner that the disease has become so widespread in this country.

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[a] Potter, M. C. Ueber eine Bakterienkrankheit der Ruben. Centralblatt f. Bakt. u. Parasitenkunde, Bd. VII, II. Abt., 1901 pp. 282, 353.

The spread of the disease from plant to plant in the same house seems to be accomplished mainly through the soil. One reaches this conclusion from the fact that healthy calla plants growing in pots and standing near diseased callas are less likely to become infected than when similar healthy plants are growing in a solid bed with diseased corms. Furthermore, it is almost always the case that the disease, if undisturbed, first attacks the corm beneath or just at the surface of the ground.

Usually the first season that the disease appears only a few of the plants are actually destroyed, but the millions of organisms which are produced during the process of decay remain in the soil, and some of them reach corms that were perfectly healthy when planted. These infections, as already indicated, often produce the hold-over cases, which develop the following season. The organism may be carried from plant to plant by stirring the soil after some of the corms have become well rotted, or simply by walking about on the bed in cutting the flowers.

The nature of the soil apparently has much to do with the spread of the disease in the bed. A soil that is rich in vegetable matter is a better medium for the organism to grow and spread in than a soil that is poor in such material. Furthermore, a soil filled with humus retains the moisture better than one that is lacking in vegetable matter, a condition that greatly aids the multiplication of the organism. It often happens that the roots reach from corm to corm through the soil of the solid bed. Usually the corms are placed about 12 inches apart each way, and it is not uncommon for the plants to produce roots from 6 to 12 inches in length. Plate IX shows a small plant with a root more than 6 inches long. The writer has frequently been able to follow the progress of the disease through these roots from plant to plant. The contents of a calla root affected with this disease become soft, while the epidermis remains intact. The diseased roots are also somewhat darker than the healthy ones, so that they can be distinguished readily by sight as well as by touch. These appear to be the principal methods by which this disease is spread from plant to plant in the solid bed.

The only insect that has been observed by the writer in connection with the diseased plants is the so-called bulb-mite, but in no case has this insect been found on any part of a healthy plant and only on the decayed part of the diseased plants. To determine whether or not those insects were at all responsible for the spread of the disease a large number of mites were placed in petri dishes containing pure cultures of the calla organism. After the mites had come into contact with the colonies of bacteria they were transferred to healthy callas. Some were placed on the corms, others on the leaves, and still others on the flower stalks, but in no case did any of these plants develop the rot.

REMEDIES.

Various methods have been used with the hope of finding some remedy by which the progress of the disease could be stopped after the plants became infected. With this end in view the following treatments were used: The partly decayed corms were treated with the following substances, viz, air-slaked lime (two parts of the same with one part sulphur), formalin (varying from 1 to 10 per cent), corrosive sublimate, Bordeaux mixture, and copper sulphate solution. These were used on plants in different stages of decay. In some cases the soft part of the bulb was scraped away with a clean knife before the substance was applied, and in other instances the material was placed on the decayed part without in any way disturbing it. Sometimes the softened part was scraped away and nothing was applied, simply leaving the exposed surface to dry down. None of the treatments, however, was entirely successful. The lime and the lime and sulphur retarded the progress of the disease, but in a few cases only did the disease seem to be entirely eradicated. The solutions used appeared to make no impression upon the disease unless they were of sufficient strength to kill the plant. A few of the plants that were scraped and left without further treatment did not suffer further decay, but the percentage of cases of this kind was very low.

The successful treatment of the diseased plants in the bed was considered impracticable, and preventive measures were then resorted to. The soil was all removed from the solid bed in which practically all the callas had decayed, and this was replaced with fresh soil. At the proper time a new set of corms was obtained, but they were not planted directly in the bed. They were first carefully examined and all that showed suspicious dark-colored spots were discarded. The remainder were started in pots and then transplanted. This made it possible to discard all plants which showed any indication of the rot after growth began. As a result no disease appeared in the bed of 1,000 callas during the entire season. The same soil was used the second and third years and the same precautions were taken in regard to putting into the bed only healthy bulbs, so far as possible, with the result that while a few diseased plants appeared successful crops of callas were grown. Plate I shows the third consecutive lot of callas in the same bed since the crop was entirely destroyed by the soft rot. Very little of the disease has appeared owing to the precautions that were taken in changing the soil and in selecting healthy corms.

It is safe, therefore, to state that the soft rot of the calla may be prevented or held in check sufficiently for all practical purposes by changing the soil every third or fourth year, depending upon the number of cases of rot that appear, and by exercising due caution in selecting only healthy plants for the bed. Diseased corms may often be detected, even in the dormant state, by examining for discolored spots, but it is safer to start the plants in pots, even after the corms having discolored areas have been rejected, to insure getting as few diseased plants as possible in the bed, since experience shows that some corms are so slightly affected that the disease is not easily detected in the dormant state. Some growers prefer to keep their plants in pots throughout the season as a preventive measure against the rot, but as a rule callas grown in this manner do not produce as large flowers as when grown in a solid bed. Hence, if the trade demands a large flower, the solid bed is preferable.

In conclusion, the writer wishes to express his acknowledgment to Dr. Erwin F. Smith, pathologist in charge of the laboratory of plant pathology, for his many helpful suggestions and his assistance in carrying on this work, and also to Mr. Alexander B. Garden, of Anacostia, D. C., for his kindness in allowing free access to his calla house during the past four years.

SUMMARY.

(1) The soft rot of the calla is a bacterial disease.

(2) The organism that produces the calla rot is a short rod bearing peritrichiate flagella.

(3) The organism occupies the intercellular space in its host and dissolves the layers that connect the cells, causing the affected tissue to break down into a soft, slimy mass.

(4) The organism is able to attack a large number of raw vegetables, and is capable of producing soft rot in many of our useful plants. Care should therefore be taken not to throw any decayed or partly decayed callas or the soil from a bed in which callas have decayed in any place where the vegetables mentioned in this bulletin are to be grown.

(5) It does not attack tree fruits readily, and hence is not likely to produce fruit rots.

(6) It grows readily on beef agar, forming at room temperature (18° to 25° C.) radiating colonies, while on the same medium at extreme temperatures (8° or 37°) the colonies are usually round.

(7) It liquefies gelatin.

(8) It coagulates milk, and first reddens, then bleaches blue litmus milk.

(9) A 1-mm. loop of a fresh fluid culture of the organism placed in 10 c. c. of beef broth will distinctly cloud it in four hours at 35° C.

(10) The organism does not produce gas when grown in a peptone solution containing 1 per cent of cane sugar, milk sugar, glycerin, maltose, dextrose, or mannite.

(11) It bleaches litmus lactose agar.

(12) It will not grow at a temperature below 6° C., nor at a temperature above 41° C., and grows best at 35° C.

(13) The life of the organism is destroyed if it is kept for ten minutes in tubes of beef broth at or above 50° C.

(14) Its growth is not affected by diffused light, but direct sunlight will kill the organism in from five to fifteen minutes.

(15) It will not grow in an atmosphere from which the oxygen has been removed, but will remain alive for many months in this condition at a room temperature of 18° to 25° C.

(16) It does not grow well in an atmosphere of pure hydrogen.

(17) Its growth is very slight in an atmosphere of carbon dioxid.

(18) When grown on vegetables the end reaction is usually alkaline to litmus.

(19) The organism may remain dormant for many months in partly decayed corms, a condition which enables the disease to be transported long distances and to be held over from year to year.

(20) The soft rot of the calla may be prevented by a careful selection of sound corms and by changing the soil in the calla beds at intervals of three or four years.

(21) Brief description of the organism:

B. aroideæ n. sp. A short rod with rounded ends, generally single or in doublets or 4's, but under certain conditions growing in chains. Usual length when taken from a beef-broth culture 24 hours old 2μ–3μ, breadth about 0.5μ and fairly constant. Organism motile, flagella 2 to 8, peritrichiate. Growth white or nearly so on the various solid media. Aerobic and facultative anærobic. Not a gas producer. Liquefies gelatin; reddens litmus milk, separates the casein from the whey and solidifies the former. Grows slowly on potato cylinders, where it is white with a tinge of yellow, the potato being distinctly grayed. Growth good and vitality long in Uschinsky's solution. No indol produced. Nitrates reduced to nitrites. Methylene blue in Dunham's solution is changed to green on addition of grape sugar. Does not grow in nitrogen but remains alive many months. Grows feebly in hydrogen and carbon dioxid. Minimum temperature for growth about 6° C.; optimum, 35° C.; maximum, 41° C., thermal death point, 50° C. Surface colonies on agar, round at temperatures near the maximum and minimum, but fimbriate at optimum temperature.

B. aroideæ was isolated from rotting calla corms and is the cause of a soft rot of the corm, petiole, and flower stalk of the calla lily. It also causes a soft, dark colored rot when inoculated into many raw vegetables, such as carrot, potato, turnip, radish, cabbage, and cauliflower. It also causes a soft rot of certain green fruits, such as the tomato, eggplant, and cucumber.

PLATES.

DESCRIPTION OF PLATES.

PLATE I. *Frontispiece.* Calla bed in which all the callas, 1,000 in number, were destroyed by the soft rot four years ago. Since that time three successful crops of the plant have been grown in this bed under the writer's direction, this being the third crop.

PLATE II. Fig. 1.—The organism that produces the soft rot of the calla, showing the form of the individual, the development in chains, and the presence of flagella (× 1,000). Fig. 2.—Development of colonies of the soft-rot organism on agar plates at 18° to 25° C. The organism with which these plates were inoculated had been kept dormant for two hundred and seventy-five days by withholding oxygen. Nearly all the colonies are round. Only a few show a slight tendency to radiate. Photographed three days after the plates were poured. (Natural size.) Figs. 3, 4, and 5.—These figures were made from agar plates which were inoculated with the same organism as figure 2, but after it had been for a longer time exposed to the air and had been transferred several times to fresh sterile beef broth. These plates were three days old and had been kept at a temperature of from 18° to 25° C.

PLATE III. Fig. 1.—Agar plate colony of the calla organism three days old at room temperature of about 20° C. The organism had been grown in beef broth previous to making the agar plate. (Natural size.) Fig. 2.—Agar plate colonies of the calla organism three days old. Grown at a temperature of 37° C. for three days, then kept for two days at about 20° C. (Natural size.) Fig. 3.—Tubes from which agar plates were poured photographed three days after pouring the plates; temperature, about 20° C. The agar was inoculated with a beef-broth culture of the calla organism. (Natural size.)

PLATE IV. Fig. 1, A.—Stab culture of the calla organism in neutral gelatin twenty-four hours after inoculation at 18° to 20° C. Fig. 1, B.—Stab culture of the calla organism in neutral gelatin three days old at 18° to 20° C. Fig. 1, C.—Stab culture of the calla organism in + 15 (acid) gelatin twenty-four hours after inoculation at 18° to 20° C. Fig. 2.—Raw eggplant in petri dish. Pieces 1 and 4 were inoculated with the calla organism, while pieces 2 and 3 were left for control. The photograph was made three days after inoculation.

PLATE V. Fig. 1.—Raw radish in petri dish. Nos. 2 and 3 were inoculated with the calla organism, while Nos. 1 and 4 were left for control. Photographed three days after inoculation. Fig. 2.—Side view of same plate nine days after inoculation. No. 2 was inoculated and No. 1 was left for control.

PLATE VI. A.—A cucumber inoculated with the calla organism. Photographed two days after inoculation, when the contents were soft throughout, except the spot near the stem end where the cucumber was inoculated. B.—A cucumber used for control; i. e., it was treated in the same manner as A, except that the calla organism was not applied to the punctures.

PLATE VII. Fig. 1.—Raw parsnip root in petri dish. The discolored pieces at right and left were inoculated, while the upper and lower pieces were left for control. Photographed three days after inoculation. (Natural size.) Fig. 2.—Raw carrot root three days after inoculation with the calla organism. Pieces 2 and 3 were inoculated, while pieces 1 and 4 were left for control. (Natural size.)

Plate VIII. Fig. 1.—Raw turnip root in petri dish. The discolored pieces were inoculated with the calla organism, while the other pieces were left for control. As shown in this figure it is the center of the root that is most readily attacked by the organism. Fig. 2.—Green tomato fruit infected on the plant. The shriveled fruit shown at the base of the stem was inoculated with the calla organism. Photographed ten days after inoculation. The fruit at the left of the one inoculated remained sound in spite of the fact that it was in contact with the diseased fruit.

Plate IX. Small calla plant, showing roots about 8 inches in length. The corm shows scars where it had evidently been attacked by the soft rot and had either recovered or the organism was dormant at the time the photograph was taken.

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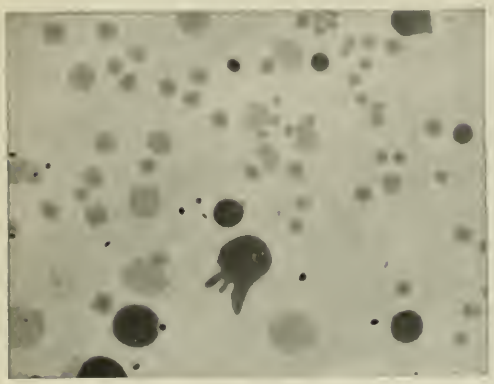

FIG. 2.—AGAR PLATE COLONIES.

FIG. 3.—AGAR PLATE COLONIES.

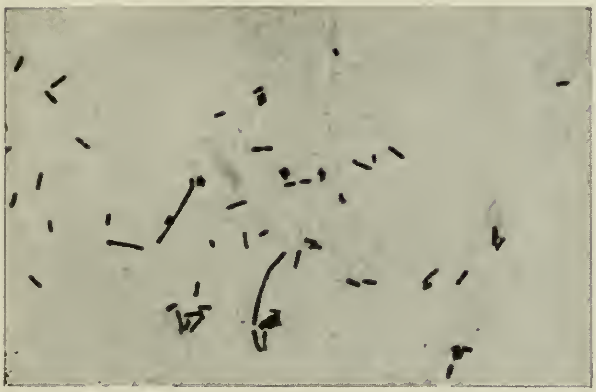

FIG. 1.—THE CALLA ROT ORGANISM × 1,000.

FIG. 4.—AGAR PLATE COLONIES.

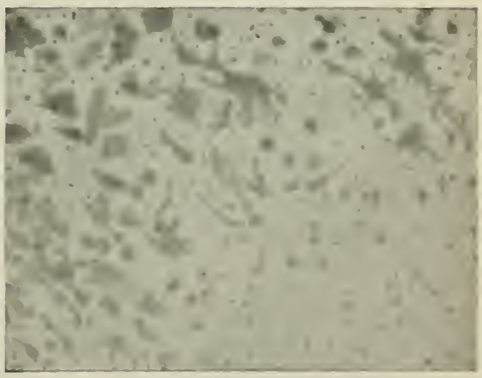

FIG. 5.—AGAR PLATE COLONIES.

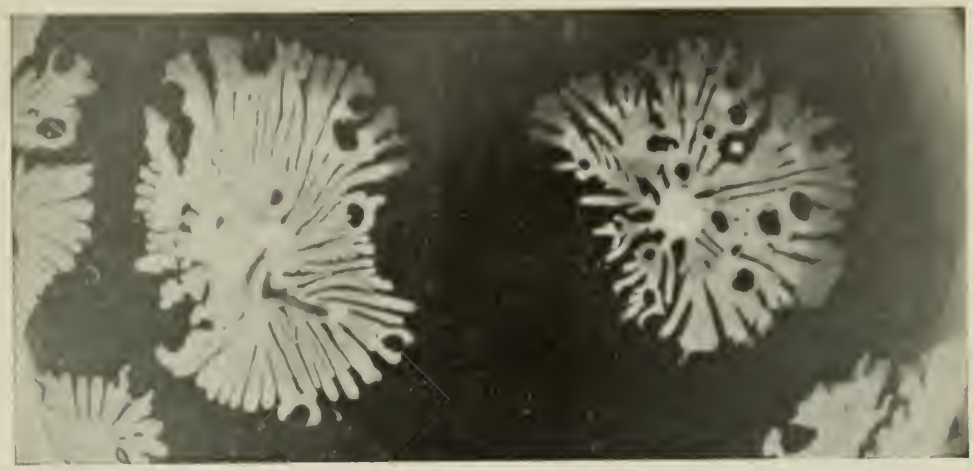

FIG. 1.—AGAR PLATE COLONIES OF THE CALLA ORGANISM GROWN AT 25° C.

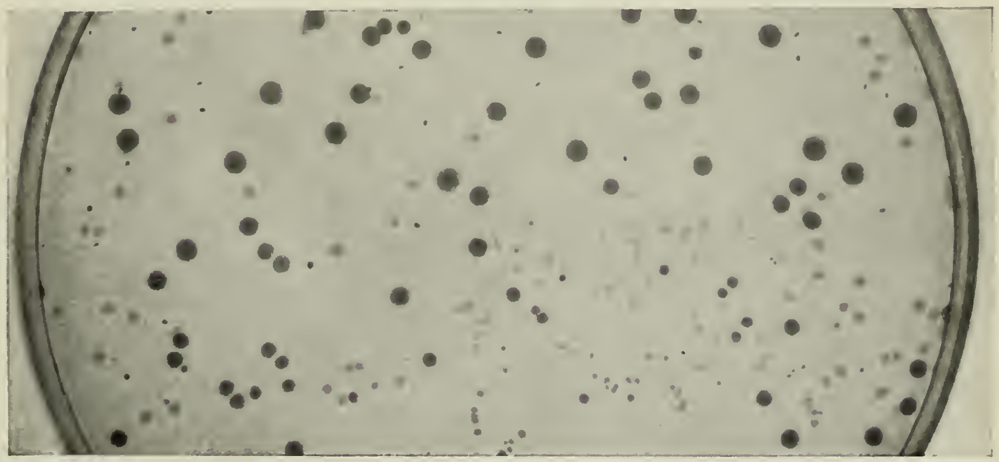

FIG. 2.—AGAR PLATE COLONIES OF THE CALLA ORGANISM GROWN AT 38° C.

FIG. 3.—COLONIES OF THE CALLA ORGANISM IN TEST TUBES.

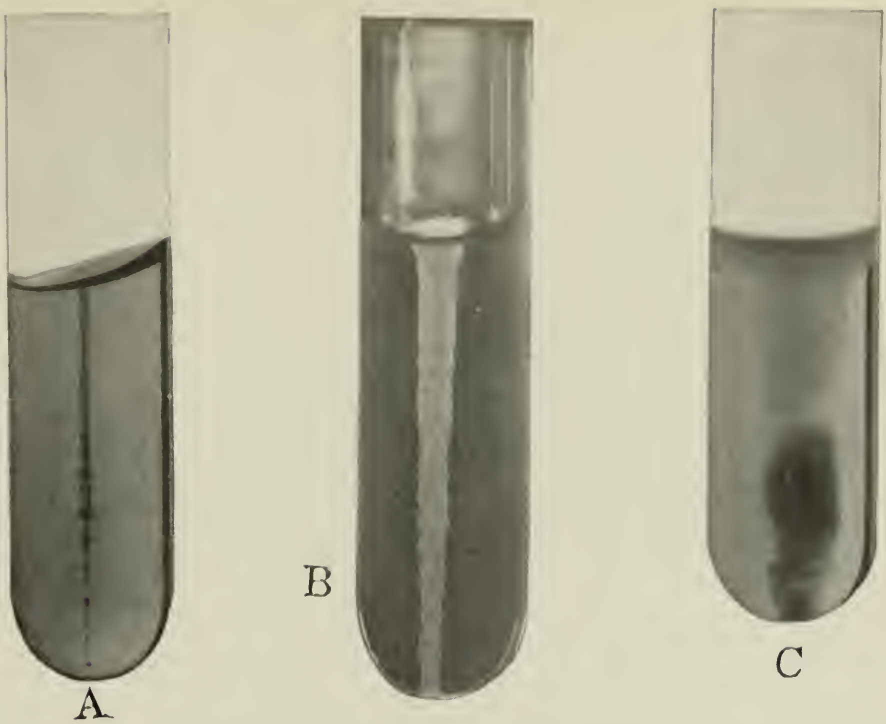

FIG. 1.—STAB CULTURES OF THE CALLA ORGANISM IN GELATIN.

FIG. 2.—RAW EGGPLANT INOCULATED WITH THE CALLA ORGANISM. (NATURAL SIZE.)

FIG. 1.—RAW RADISH THREE DAYS AFTER INOCULATING PIECES 2 AND 3 WITH THE CALLA ORGANISM.

FIG. 2.—SIDE VIEW OF PIECES 1 AND 2 NINE DAYS AFTER INOCULATING NO. 2.

EFFECT OF CALLA ORGANISM ON CUCUMBER: A, INOCULATED; B, CONTROL.

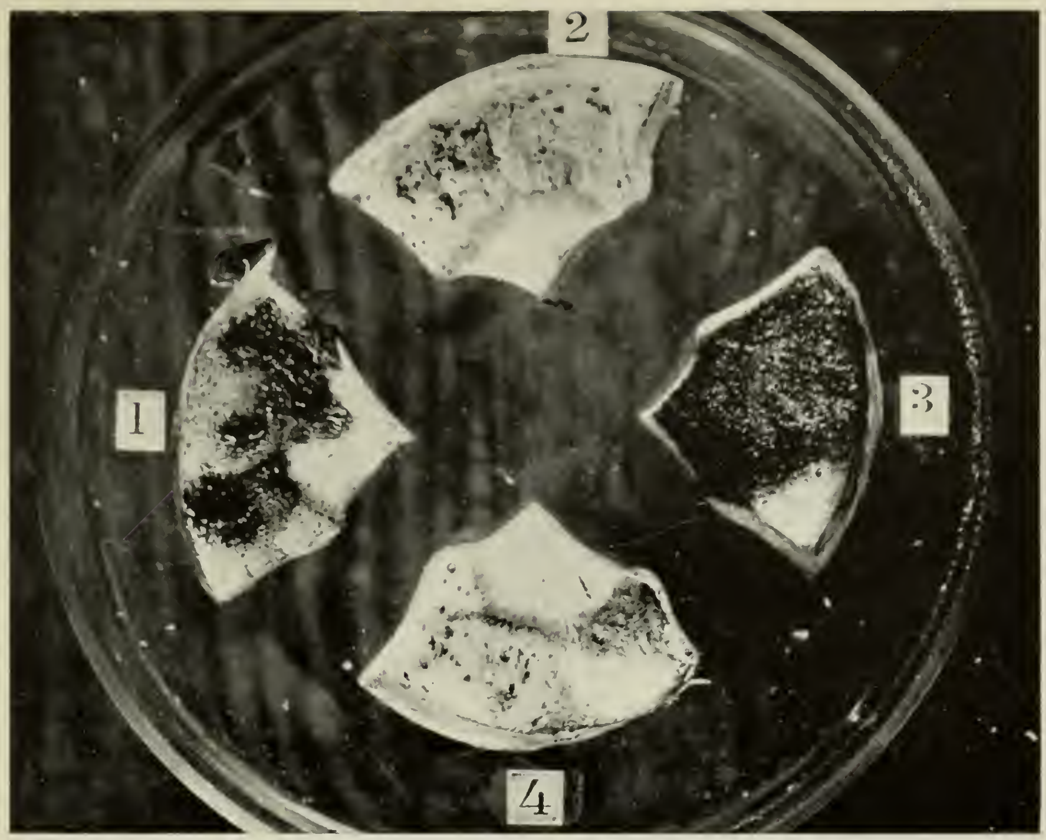

FIG. 1.—RAW PARSNIP THREE DAYS AFTER INOCULATING PIECES 1 AND 3.

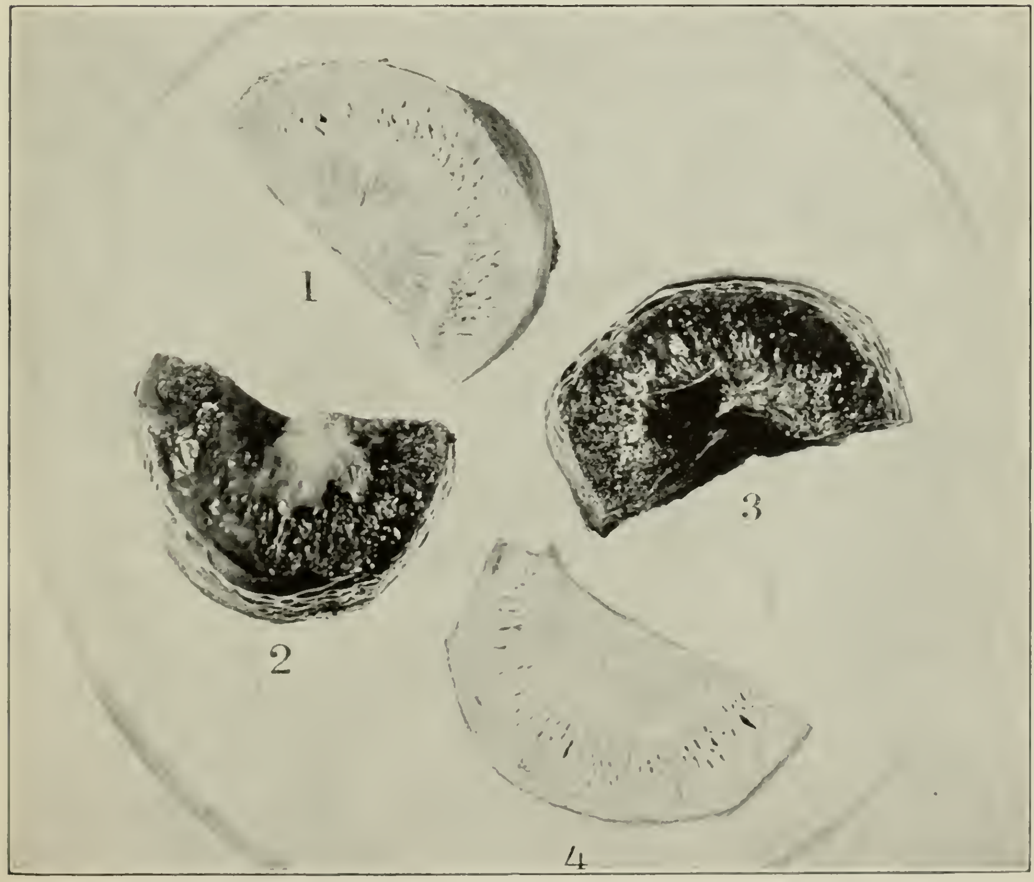

FIG. 2.—RAW CARROT THREE DAYS AFTER INOCULATING PIECES 2 AND 3.

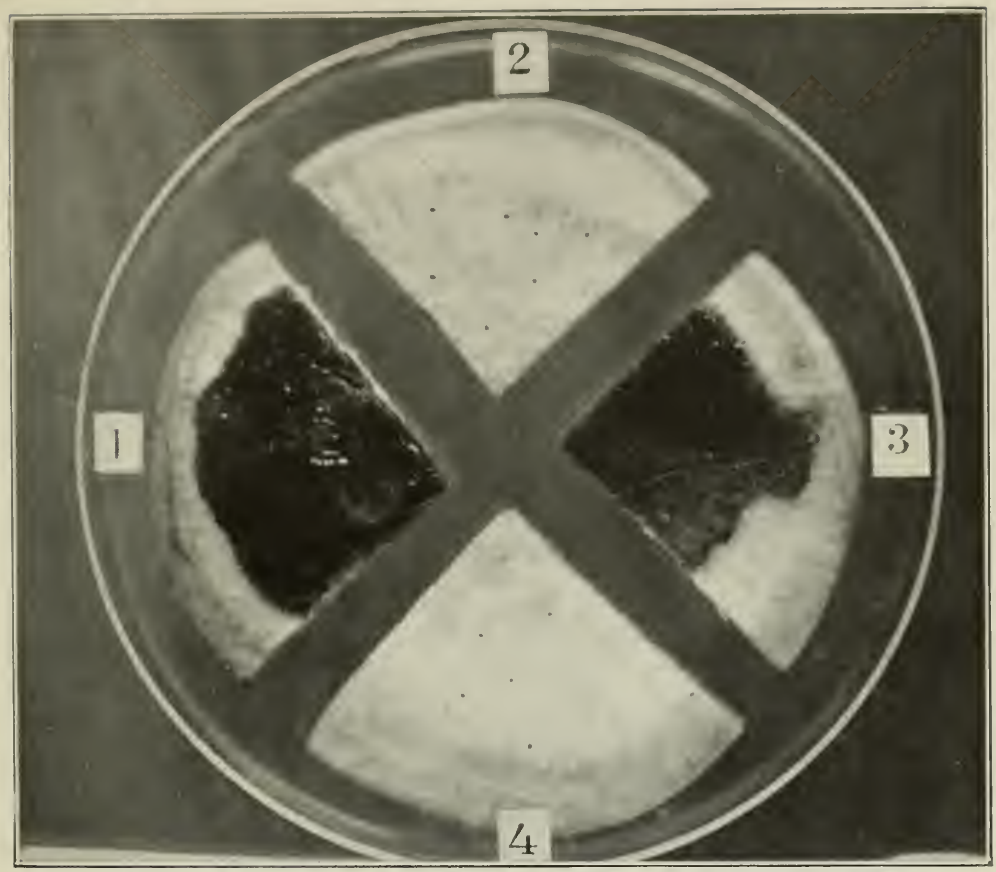

FIG. 1.—RAW TURNIP THREE DAYS AFTER INOCULATING PIECES 1 AND 3.

FIG. 2.—GREEN FRUIT AND BRANCH OF TOMATO: NO. 2, INOCULATED; NO. 1, CONTROL. (ONE-FOURTH NATURAL SIZE.)

SMALL CALLA PLANT, ABOUT TWO-THIRDS NATURAL SIZE.