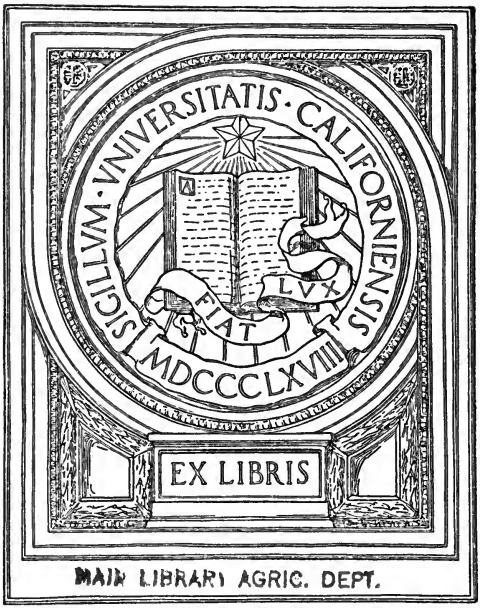

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CIRCULAR NO. 5,
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TOBACCO 10.

United States Department of Agriculture,

DIVISION OF SOILS,

Cooperating with the Connecticut (State) Experiment Station.

BULK FERMENTATION OF CONNECTICUT TOBACCO.

INTRODUCTION.

The Division of Soils has been interested for a number of years in the study of the tobacco soils of the Connecticut Valley and the quality of the tobacco produced on them. An historical review shows that the quality of the tobacco grown on the present tobacco soils has probably not been materially changed in the last fifty years; that the yield per acre has increased considerably through improved methods of cultivation and more judicious fertilization while the average price per pound is about as high at present as it has been for any considerable time during this period. The market demands, however, for the "style" of wrapper leaf have been uncertain and fluctuating between the dark, heavy wrapper of Pennsylvania and the light, thin wrapper of the Connecticut Valley. Just now the demand is for the light, thin wrapper. The introduction of the Sumatra tobacco in 1864—a thin, light wrapper leaf, with rich grain and exceptional style—and the enormous importations under a very heavy tariff seem to indicate that the market has determined that for some time to come this is to be the style of leaf that will be most in favor.

While there has never yet been an overproduction of desirable wrapper leaf in this country, the changing style has repeatedly favored one section to the disadvantage of another. The increasing importation of the Sumatra leaf and the development of the Sumatra type of wrapper leaf in some of our Southern States, which is selling for a high price per pound, plainly indicates that the Connecticut farmer should change the style of his leaf to conform more closely to the market demand if it can be done at a reasonable cost. Furthermore, there are undesirable qualities in the flavor of the Connecticut leaf which should be eliminated if possible, in order to produce a more desirable wrapper for the domestic cigar.

The investigations of the Division of Soils in Connecticut and the comparison of these soils and climatic conditions during the actual

growing season with the soils and climatic conditions of Sumatra, Cuba, and Florida seem to indicate that a type of leaf could be produced which would at least be more acceptable to the trade and bring a higher price per pound than the present product.

After Congress authorized the investigations the first thing to do was to make a careful survey of the soils of the Connecticut Valley, examine carefully the crops grown on each type of soil, note the influence of soil on the quality of the tobacco, and see what could be developed from the present leaf by the most improved methods of fermentation used in Sumatra, Cuba, and Florida. After that, if the product was not satisfactory, to try a radical change in the methods of planting, cultivation, curing, and fermentation in order to change altogether the character of the leaf.

Accordingly an accurate soil survey was made in the summer of 1899 of that portion of the Connecticut Valley between South Glastonbury, Conn., and South Hadley, Mass.—a distance of about 40 miles, with an average width of 10 miles, and embracing in all approximately 256,000 acres. Ten distinct types of soil were recognized and mapped, on a scale of 1 inch to the mile, and many notes were taken as to the influence of the different soils on the quality and style of the tobacco produced. This soil map, with the accompanying report, is now, by special act of Congress, being published.

The present circular deals with the efforts that have been made and the results attained in fermenting the Connecticut tobacco by the bulk method used in Sumatra, Cuba, and Florida.

THE ORDINARY METHOD OF FERMENTING IN CASES.

The method of fermenting the Connecticut tobacco in cases was described in Farmers' Bulletin No. 60 and in Report No. 60 of this Department, as follows:

> The fermentation, or sweating, is usually managed by the packers, and not by the farmers. The sweating is done in wooden cases, strongly put together, holding on an average about 300 pounds of tobacco. These cases are not tight, but have a space of one-half inch between the boards. A good crop in sweating loses from 10 to 14 per cent of its weight, and there must be sufficient ventilation to allow this moisture to escape. On the bottom of the box is put a layer of top leaves, or seconds, as the outside does not sweat readily. The leaves are well shaken out and packed with the butts outside and tightly pressed down to exclude the air as much as possible. The tobacco is piled into the box and pressed down with a moderate pressure, and then the top of the box is nailed on. The cases are then marked and piled up in the warehouse in rows 3 or 4 boxes high, for the sweat. Once at least during the season good packers turn the boxes upside down and put the top boxes at the bottom.
>
> The tobacco is cased in the fall or winter, and so remains through the next summer. The temperature of the warehouse is quite even during the winter. After the summer's sweat the operation is finished and the cases are opened and sampled. This is one year after the harvest. After sampling the tobacco is returned to the case without breaking the bulk, and remains in the case until it is wanted by the cigar manufacturer.

The whole process of fermentation in this operation is largely a matter of chance. It is not controlled, the temperature is not taken to note the progress of fermentation, and nothing is done, in point of fact, except to maintain the temperature of the room moderately uniform during the winter season. In some cases the fermentation is overdone and in other cases it is underdone. There is a strong feeling among the more intelligent planters that more information is needed upon the changes which take place in order that these may be carefully controlled.

The objections to this case method are obvious enough on careful consideration, and account, in a measure, for much of the criticism by the cigar manufacturers on the Connecticut leaf. The object of fermentation is to induce certain chemical changes in order to eliminate some of the undesirable qualities in the cured leaf; to develop desirable taste, aroma, grain, and style; to secure a uniform and desirable color, as well as to make the leaf thinner and more elastic. In much of the Connecticut leaf there is a "seedy" taste, undesirable to many smokers, which it has not been possible to entirely eliminate by any process of fermentation, but which is materially lessened by thorough fermentation.

By the case method of fermentation the hands of tobacco are lapped for about one-third of their length and the desirable color and grain have been developed chiefly in this portion, and it is this portion only which is suitable for good cigars. The rest of the leaf is often poorly fermented, sleek, and glossy, without grain or style, and is used only on low-priced cigars or sold as trash. The color of the leaf is also very far from uniform. The process requires from six to nine months from the time the tobacco is packed. Tobacco cased down in December does not begin to ferment until the warm weather of summer, and lies in the warehouse thus for months in an inactive condition, subject to changes of winter and spring weather, with much warm, damp, and foggy weather, which is liable to develop rot and mold of several kinds, which in certain seasons damage a large percentage of the crop. There is always much uncertainty when the tobacco is ready to be sampled as to whether it will be sound and whether it will really be sufficiently fermented. There is also the certainty that the outside layers of tobacco in each case will not be fully fermented. All this, of course, represents so much loss to the farmer when his crop is bought up by the packer. Then there is the cost of storage and insurance and the loss of interest on the investment, which for such a period amounts to considerable.

THE METHOD OF FERMENTING IN BULK.

The method of fermenting in bulk as used in Florida was tried, with some necessary modifications, in the fermentation of the Connecticut tobacco, in cooperation with the Connecticut (State) Experiment Station. This method, described in full in Report No. 62 of this Department, is essentially as follows:

The leaves are assorted as they are stripped from the stalk into three grades—bottom leaves, middle leaves, and top leaves—simply

to give to each the fermentation adapted to the grade of tobacco, the final assortment and close grading being made after the fermentation when the colors are properly developed and well set. For this method of fermentation the hands as originally made up should be tied with string or bast instead of with leaves, for the following reasons: (1) It saves a leaf for each hand bulked, as the tie leaf is practically destroyed; and (2) if the butt has to be dipped into water to "order" the hand before bulking, the tie leaf is liable to become soggy in the pile. After the fermentation and final assortment the hands are tied with a leaf in the usual manner.

The light, thin tobacco of the bottom leaves, which needs but little curing, should be put in small bulks of from 3,000 to 6,000 pounds. The medium to dark leaves from the middle of the stalk should be put in bulks of from 8,000 to 10,000 pounds, as more fermenting is required for the dark tobacco. The top leaves, which in Florida would be classed as fillers, should be put in bulks of from 10,000 to 15,000 pounds, as they need thorough fermenting, and the larger the bulk the more intense the heat of the pile. In fermenting a large crop the first grade to be handled is that from which the light wrappers are to be obtained, then the dark, heavy grade, and lastly the fillers.

A platform should be provided, raised 3 or 4 inches from the floor, with bulkheads at either end, the whole being covered with burlap. When completed the bulk should be 6 feet high and about 6 feet wide and 12 feet long—the width and length, however, depending upon the quantity of tobacco to be handled. The fermentation should be carried on in a room in which the temperature can be maintained uniformly between 75° and 85° F., and the atmosphere be kept quite moist. This can best be done by steam pipes, if a steam plant is available.

The bulk is built up and manipulated in the following way: Some trash tobacco is made quite wet by sprinkling and put in a pile in the fermenting room and covered with woolen and rubber blankets. After twenty-four hours the pile should be turned. The water should all have been taken up by the leaf and the leaf be quite pliable and warm. The pile then remains covered for two or three days, when it should warm up rapidly from the active fermentation.

The heavy dark wrappers and fillers will need to be put in order or cased down if not already sufficiently moist and pliable. To do this dip the butts in warm water for about 2 inches above the tie leaf or string and shake well. The tobacco is then put into cases or into a pile and covered and allowed to remain twenty-four hours to draw—that is, to absorb the water. No water stains should be apparent if the work has been properly done. The light wrappers should not be dipped in this way, as they should be fermented with the least possible amount of moisture. They can be brought into order by exposure to

a damp atmosphere or by interbedding with layers of the hot fermenting trash.

Start the bulk with a layer 8 inches deep of the hot fermenting trash tobacco. The good leaf is put on this in layers, pressed firmly down by hand, but without any other pressure. As the bulk is 6 feet wide each layer will require several laps, as the hands are put down in the way shingles are put on a roof. No mark or damage will occur where the butts rest on the lower leaves when the fermentation proceeds normally. When the bulk is 6 feet high it is well to cover with a layer 6 inches deep of the hot fermenting trash and then cover the top and sides with woolen and, if possible, with rubber blankets to keep the tobacco from drying out. The temperature of the room should be maintained at from 75° to 85° F., and the atmosphere be kept quite moist by escaping steam.

The bulk should remain from three to six days, according to the condition of the tobacco and the rapidity of the fermentation, when it should be turned or rebulked. In judging of the progress of the fermentation it is very helpful to know the temperature, at least in the middle of the bulk. In the light wrappers the temperature should reach about 120° F., when the bulk is ready to turn the first time. The fillers require a much harder fermentation and the temperature should reach 130° or 135° F. The temperature can be taken with an ordinary thermometer inserted into the middle of the bulk through a hollow bamboo or other tube, but a much more convenient way is to use the electrical thermometer recently devised in this Division.

The bulk is turned in the following way: Six or eight cases should be filled with tobacco taken from the top of the bulk and then set to one side. Then take tobacco from the old bulk and lay the foundation of the new, continuing until the bulk is about half removed. Take the tobacco from the six cases first removed from the top of the bulk and put on the new. Refill these six cases with the tobacco from the center of the old bulk, again setting these to one side. Proceed to take the remainder of the old bulk and put on the new until the old bulk is entirely removed. Then take the six cases that were taken from the center of the old bulk and put this tobacco on top of the new. Thus the top and bottom of the old bulk have become the center of the new one. The outside layers are also put in the center of the new bulk and the center layers of the old bulk become the outer layers of the new. The bulk should now remain about ten days, when the temperature should rise to about 115° F. for the wrapper and 120° F. for the filler. It should then be turned. After this it should remain about fifteen days, when, if the tobacco had sufficient moisture at the start, the wrapper leaf will be sufficiently fermented to assort and pack in bales or cases for the market. The color will be quite uniform over the leaf and well set after the fermentation, and the grading can be quite closely done.

The dark heavy wrappers and fillers may need reordering before the fermentation is complete, in which case they are dipped and put aside for twenty-four hours before being rebulked.

When the fermentation is completed, if it is not convenient to open the bulk to assort and pack the tobacco, the bulk should be torn down and rebuilt, in which condition the tobacco should keep for months without injury.

THE FERMENTATION IN BULK OF SOME CONNECTICUT TOBACCO.

In January, 1899, an attempt was made, in cooperation with the Connecticut (State) Experiment Station, to ferment some of the Connecticut tobacco in bulk according to the Florida method. The results were fairly satisfactory, considering the general character of the crop of that particular season. In December, 1899, the attempt was again made, in cooperation with the experiment station as before, but in a much more thorough manner. The results have been highly satisfactory, not only to ourselves, but to some of the largest and best informed packers and cigar manufacturers of New York, New Haven, and Hartford.

The entire crop from the experimental field at Poquonock, amounting to about 3,000 pounds of all grades of good leaf and about 1,900 pounds of trash tobacco from the sorting of several crops, were taken to the basement of the laboratory of the experiment station at New Haven, where a room had been fitted up for the fermentation. Steam heat was provided to maintain the room temperature at from 75° to 85° F., and a high relative humidity was maintained by allowing steam to escape into the room.

A platform, about 6 feet wide and 12 feet long with bulkheads at either end, was provided, the whole being covered with burlap. The platform was raised about 3 or 4 inches from the floor. The trash tobacco was made quite wet by sprinkling with warm water and then put into a conical pile in the fermenting room. It was allowed to remain for twenty-four hours. By this time all the water had been absorbed by the tobacco and there was no sign of water stain. The pile was turned and again covered with woolen and rubber blankets in order that the fermentation which had already set in might develop. The following table shows the temperature of the inside of the pile:

Date.	Time.	Temperature.
		° F.
Dec. 15...	Afternoon	95
Dec. 16...	Forenoon.....	114
Do....	Noon	117
Do....	Afternoon	119
Dec. 17...	Forenoon.....	128
Dec. 18...	.....do	131

This hot trash was then used in the construction of the bulk, as will be described.

The crop had already been assorted into six grades, as is ordinarily done in Connecticut before the fermentation, and as the total amount of tobacco was small all of these grades had to be put into the same bulk in order to make it large enough for the fermentation to develop properly. The assortment was as follows:

No.	Grade.	Pounds.
1	Long wrappers	1,289½
2	Short wrappers	547
3	Long seconds	375
4	Fillers	157½
5	Dark wrappers	449½
6	Top leaves	257½
	Total good leaf	3,076

All the grades except the first (long wrappers) needed "ordering." The butts were therefore dipped for about 2 inches above the tie into a tub of warm water, shaken out, and then put into cases or into a pile in a warm room for twenty-four hours to draw before being bulked. At the expiration of twenty-four hours there was no appearance of water and no water stains on any of the leaf so treated.

The tobacco was bulked on December 18 to 20 in the following way: A layer of the hot fermenting trash tobacco about 8 inches deep was put on the platform; the good tobacco was then put on this in layers pressed firmly down by the hands, but without any other pressure. The bulk was 6 feet wide, so each layer required five laps, laid down in the way shingles are put on a roof, but no marks or damage was found where the butts pressed against the lower leaves.

As the first grade of light wrappers was rather dry to ferment well and it was not advisable to dip them, layers of the hot fermenting trash leaf were interbedded with them as far as the supply would go.

The bulk when completed was 6 feet high and about 12 feet long. A layer of trash was put on top and the whole was covered with woolen and then with rubber blankets. Electrical thermometers, such as were recently devised in this Division, were inserted in various parts of the bulk, so that the change in temperature could be noted as the fermentation proceeded.

The bulk at the Experiment Station, having been put down on December 18 to 20, was turned on December 22, a day or two earlier than was necessary, in order to see the condition of the leaf. It was again turned on January 2. On January 18, or just thirty days after the bulk was first put down, the fermentation was completed and the tobacco should have been sorted at once and graded according to color and length of leaf, or rebuilt into another bulk until this work could conveniently be done. As a matter of fact, the bulk was allowed to remain undisturbed until February 1, in order that it might be inspected by tobacco dealers. It was then put in cases and sent to Hartford to be sold.

The following temperatures were obtained near the middle of the bulk in the first wrappers at 9 a. m. of each date.

Date.	Temperature.	Date.	Temperature.	Date.	Temperature.
	°F.		°F.		°F.
Dec. 19	88	Dec. 29	115	Jan. 9	108
Dec. 20	98	Dec. 30	115	Jan. 10	107
Dec. 21	111	Dec. 31	115	Jan. 11	107
Dec. 22	118	Jan. 1	*a* 114	Jan. 13	105
Dec. 22 (3 p. m.)	*a* 120	Jan. 3	94	Jan. 14	105
Dec. 23	86	Jan. 4	96	Jan. 15	104
Dec. 24	92	Jan. 5	99	Jan. 16	104
Dec. 25	97	Jan. 6	101	Jan. 18	103
Dec. 26	104	Jan. 7	104	Jan. 23	100
Dec. 28	112	Jan. 8	105		

a Bulk turned.

The Connecticut tobacco is not supposed to have any desirable filler leaves for domestic cigars, but this year's experience has shown that the short top leaves, if properly fermented, will make a fairly good filler and that it will even pay to pick out such heavy-bodied top leaves from what is commonly classed as trash and ferment them for filler goods. Some of these heavy-bodied leaves were thoroughly fermented with very good results. Of course the flimsy wrapper leaves will not make a desirable filler with any method of fermentation.

OPINION OF DEALERS.

Samples of the fermented tobacco were sent to three of the largest packers of Connecticut tobacco in New York City and to one expert packer of Hartford. Two of the New York houses sent members of the firm to New Haven to inspect the tobacco in the bulk, as did the Hartford firm and also one of the large New Haven cigar manufacturers. They were all much pleased with the results. They pronounced the leaf perfectly sound in every respect, the color very desirable and even, the whole leaf perfectly fermented and having the appearance of old tobacco, while the grain was perfectly developed and the style excellent. The burn was also good. Great surprise was expressed by all of these gentlemen that no damage had been done to the body of the leaf where the butts of the next layer above rested upon it. The bulk was carefully examined by them, but no single leaf could be found on which butts rested that showed the least discoloration, bruise, stain, or other sign of damage.

Some of the top leaves of the trash which had been heavily fermented were rolled up into smokers and pronounced very good. Some of this was made into "booked fillers" and submitted to two cigar manufacturers and two dealers in leaf tobacco in New York City and to one leaf dealer in Philadelphia. The reports from all sources were that it was very satisfactory. The estimation of the value of this booked filler from the various sources varied from 15 cents, the

lowest, to 18 cents, and, in one case, to 30 or 40 cents per pound, while the heavily fermented scrap, consisting mainly of the thin, trashy leaves, was valued at about 7 cents per pound.

As a result of the inspection of the leaf in bulk two of the New York firms and the Hartford firm at once arranged to have some of their present stock fermented in the same way, and careful instructions were given them as to the proper method of procedure. It was the general expression that more had been gotten out of the leaf than had ever before been attained, and that the method would entirely supersede the present case method of fermentation.

The bulk fermentation can best be done by the large packers, rather than by the farmers, as suitable arrangements for fermenting can be made more economically, and much better results can be obtained with large quantities than with small crops.

This work, while thoroughly satisfactory so far as the present style of leaf is concerned, has demonstrated that the Connecticut leaf needs to be radically changed to accord with the present market requirements. As the soil and climatic conditions are considered adapted to a style of leaf more closely corresponding to the best standards, an experiment has been planned, in further cooperation with the Connecticut Station, in which the attempt will be made to change the character of the leaf by a radical change in the method of planting, cultivation, and after treatment.

MARCUS L. FLOYD,
Tobacco Expert, Division of Soils.

This circular, approved by Prof. Milton Whitney, Chief of Division of Soils, in charge of tobacco investigations, and by Dr. E. H. Jenkins, Director of the Connecticut (State) Experiment Station, is ordered to be printed.

JAMES WILSON,
Secretary of Agriculture.

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RECENT PUBLICATIONS OF THE DEPARTMENT ON TOBACCO.

Bulletin No. 11, Division of Soils—Tobacco Soils of the United States, a Preliminary Report upon the Soils of the Principal Tobacco Districts. By Milton Whitney, Chief of Division of Soils.

Farmers' Bulletin No. 60—Methods of Curing Tobacco (revised edition). By Milton Whitney, Chief of Division of Soils.

Farmers' Bulletin No. 82—The Culture of Tobacco. By Otto Carl Butterweck.

Farmers' Bulletin No. 83—Tobacco Soils. By Milton Whitney, Chief of Division of Soils.

Report No. 58—Cultivation of Tobacco in Sumatra. By Emile Mulder.

Report No. 59—Curing and Fermentation of Cigar-leaf Tobacco. By Oscar Loew, of the Division of Vegetable Physiology and Pathology.

Report No. 60—Temperature Changes in Fermenting Piles of Cigar-leaf Tobacco. By Milton Whitney and Thos. H. Means, of the Division of Soils.

Report No. 62—Cultivation of Cigar-leaf Tobacco in Florida. By Marcus L. Floyd, of the Division of Soils.

Report No. 63—The Work of the Agricultural Experiment Stations on Tobacco. Abstracted by J. S. Schulte, of Office of Experiment Stations, with Introduction and Comment by Milton Whitney, Chief of Division of Soils.

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