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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—BULLETIN No. 27.

MILTON WHITNEY, Chief.

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EXPERIMENTS IN GROWING CUBAN SEED  
TOBACCO IN TEXAS.

BY

GEORGE T. McNESS and WALTER M. HINSON.



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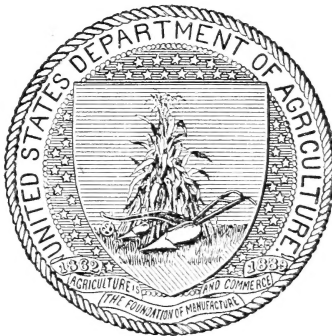


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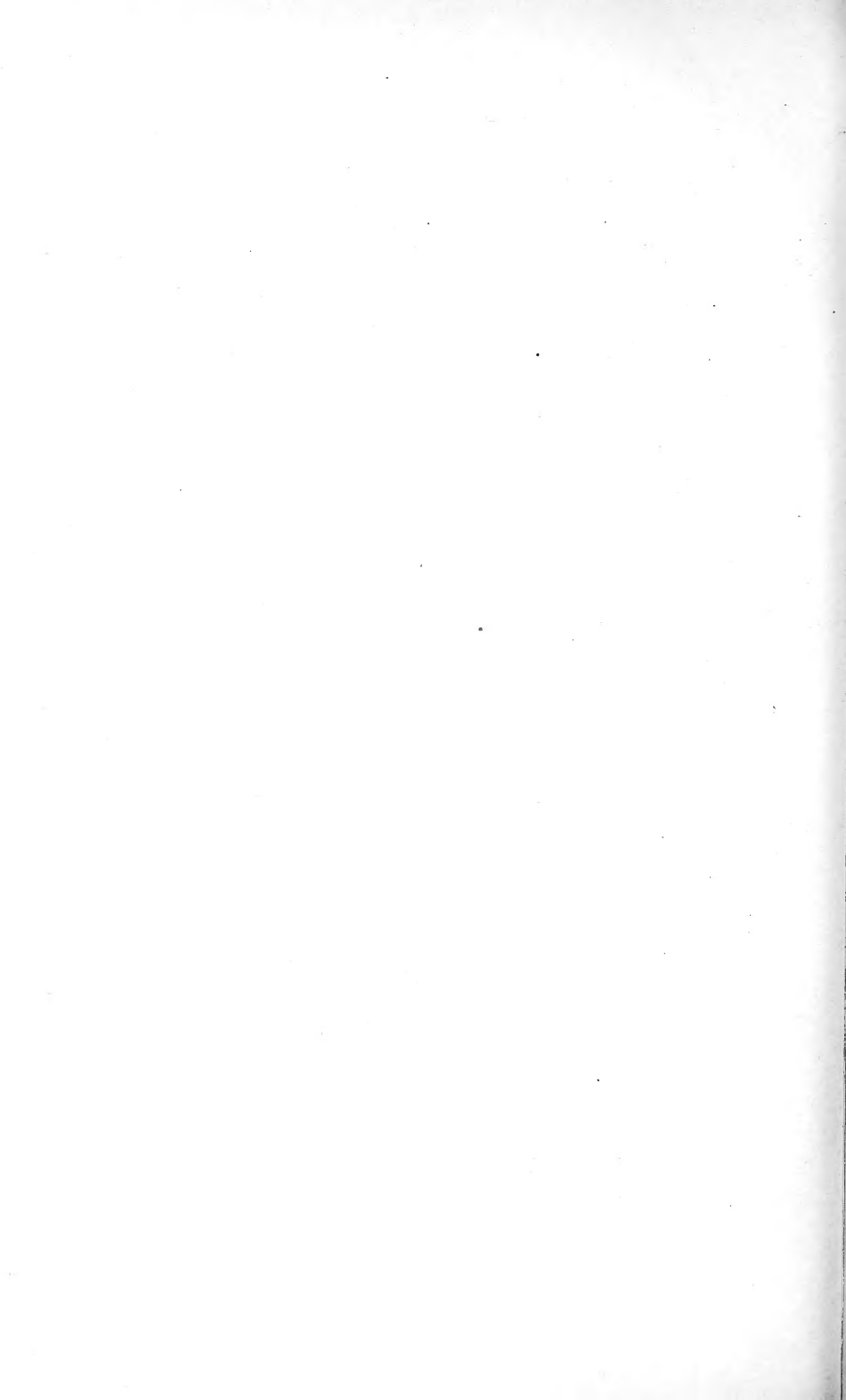
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GEORGE T. McNESS and WALTER M. HINSON.



WASHINGTON:  
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1905.



## LETTER OF TRANSMITTAL

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,

*Washington, D. C., February 9, 1905.*

SIR: I have the honor to transmit the manuscript of a report detailing the progress of the experiments in growing Cuban seed tobacco in Texas, and to recommend that this be published as Bulletin No. 27 of the Bureau of Soils.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*



## CONTENTS.

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|   | Page. |
|---|-------|
| Introduction.....                               | 7     |
| Climate.....                                    | 9     |
| Soils.....                                      | 13    |
| Experiments during 1902 and 1903.....           | 16    |
| Experiments during 1904.....                    | 20    |
| Manipulation of seed beds.....                  | 21    |
| Preparation of the fields.....                  | 24    |
| Setting out the plants.....                     | 25    |
| Cultivation and protection against insects..... | 26    |
| Topping, suckering, and harvesting.....         | 27    |
| Management of the curing barns.....             | 29    |
| Stripping and tying.....                        | 30    |
| Fermentation.....                               | 31    |
| Grading and baling.....                         | 34    |
| Cost of production.....                         | 34    |
| Results of the sale of the 1903 crop.....       | 41    |



# EXPERIMENTS IN GROWING CUBAN SEED TOBACCO IN TEXAS.

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## INTRODUCTION.

The production of a cigar leaf tobacco, either a filler or wrapper type, is not an untried industry in the South. A very desirable wrapper was produced in Gadsden County, Fla., for many years prior to the civil war. This was a handsome, spotted leaf in great favor with the trade and known as Old Florida tobacco. Its production, which had ceased by the close of the war, was not again attempted until some twenty-five years later, but the style in wrapper having changed in the meantime, the growing of this type of tobacco was abandoned, and in its place Sumatra wrapper was introduced, the production of which has proved eminently successful.

In 1884-85 several farmers of Gadsden County grew small patches of tobacco from seed imported from Cuba. Some of this tobacco was purchased by a large cigar-manufacturing concern of New York. The members of this company were so impressed with the good qualities of this leaf that they at once sent representatives to investigate the conditions where it was grown, with the result that they purchased and equipped plantations in Gadsden County. From this beginning the tobacco industry in this part of Florida revived, and it has continued to develop, extending into Decatur County, Ga. Sumatra and Cuban wrappers and Cuban filler are the types produced, some being grown under shade and some in open fields.

Following the outbreak of the Spanish-American war refugees from Cuba embarked in the production of tobacco at Fort Meade, Fla., where a leaf of much promise was produced. Some cigar tobacco has also been grown in other parts of Florida.

A few years ago the attention of the Bureau of Soils was called to a new tobacco industry in east Texas, where it was reported considerable progress had been made in growing a domestic filler leaf from Cuban seed. It was found that quite an extensive acreage was being planted around Willis, Montgomery County, and that several warehouses and cigar factories were in operation there.

An examination of the tobacco made by the Bureau expert showed that some of the leaf produced was of excellent quality, surpassing in aroma any domestic leaf examined up to that time, but that the crop as a whole, for reasons not determined, was not such as to warrant the prediction of any phenomenal development of the industry along the lines then being followed.

The matter was again given some study in 1899, when the Bureau was engaged in making a collection of domestic tobaccos for exhibition at the Paris Exposition. Included in this exhibit were a number of samples of the Texas tobaccos, and the marked superiority of some of the leaf was noticed, although, owing to the manner in which the collection had been made, it was impracticable to determine whether this quality was the result of the particular soil upon which the leaf had been grown, of the kind of seed used, of any special system of fertilization, or of care and skill in handling and curing.

In 1901 the Bureau made a survey of the soils around Willis, at the same time investigating the condition of the tobacco industry, and especially the relations of the quality of the leaf to the soil producing it. The tobacco interests were then found in a languishing condition. From a maximum acreage of 1,000 acres planted in 1898 the plantings had declined to 506 acres in 1899, and then to less than 100 acres in 1901, and the growers, although needing some crop, like tobacco, in which to specialize, had become very much discouraged. In the following year the investigation was carried further by a tobacco expert, who began experiments in growing tobacco which were not conclusive. The causes assigned by the Bureau's agent for the decline in the production of this crop were mainly two—the lack of knowledge among the growers as to the methods of handling the crop and the peculiar market conditions always to be met with in a trade so highly specialized as the tobacco trade. However, an important result of the soil survey and experiments around Willis was the discovery that the leaf grown on the type given the name Orangeburg fine sandy loam (a reddish or grayish sandy loam with a red clay subsoil) possessed a much finer aroma than the leaf grown on any other soil in the area.

Other surveys made during 1902, 1903, and 1904 have established the fact that the Orangeburg fine sandy loam is a soil of wide distribution in east Texas, as well as in the other Gulf and South Atlantic States. It is associated with other Orangeburg soils, of which the Orangeburg clay is also believed to be a good tobacco soil. In Anderson County alone 102,800 acres of the Orangeburg fine sandy loam and 35,904 acres of the Orangeburg clay were mapped. In Nacogdoches County, in an area of 100 square miles mapped around the town of Nacogdoches, 16,320 acres consisted of the Orangeburg fine sandy loam and 16,704 acres of the Orangeburg clay. In Houston County large



bodies of this sandy loam are found. In Alabama the Perry County survey showed 82,000 acres of Orangeburg sandy loam, also a desirable type for tobacco, while surveys in South Carolina, Georgia, Florida, Mississippi, and Louisiana have included areas of one or more of these types.

There is thus an ample area of soil suitable for the growing of cigar-leaf tobacco in Texas and other Southern States, and in Texas particularly, and the thought occurred that whatever deficiencies in the leaf formerly produced were due to an indiscriminating use of soils might at once be eliminated in the light of knowledge of soil adaptation gained during the Willis and subsequent surveys. Following out this idea, the Bureau in 1903 and 1904 conducted a series of tobacco experiments on the Orangeburg soils around Nacogdoches, Lufkin, Woodville, Crockett, and Giddings, Tex., and the succeeding pages embody a report of the conditions surrounding and the results achieved in these experiments.

The Bureau has every reason to feel encouraged over the results of these experiments. A cigar filler-leaf tobacco of superior quality has been produced, a leaf pronounced by the trade the finest filler so far grown in this country, while the prices received for the crop and a conservative estimate of the cost of production show that there is every opportunity for the commercial development of a new industry in a part of our country needing above all else a greater variety of staple products.

#### CLIMATE.

The climate of east Texas is well suited to the growing of tobacco. The winters are mild, and although "northers" (cold windstorms) sweep in from the north, freezing temperatures are comparatively rare, and periods of cold weather of short duration. The snowfall is light, and snow remains on the ground only a short time. The growing season is long, but the heat of summer is not so great as in some more northern interior points, and the temperature seldom rises above 100° F.

The Weather Bureau has established normals of temperature and precipitation—that is, has complete records, covering five years or more, for three stations in the immediate vicinity or within relatively short distances of the experimental fields, viz, at Nacogdoches, Palestine, and Huntsville, and has also records at Trinity covering three

years, from which means have been computed. The following table is compiled from the records of these stations:

*Normal monthly and annual temperature and precipitation for Weather Bureau stations in east Texas.*

| Month.         | Nacogdoches.      |                     | Palestine.        |                     | Huntsville.       |                     | Trinity. <sup>a</sup> |                     |
|----------------|-------------------|---------------------|-------------------|---------------------|-------------------|---------------------|-----------------------|---------------------|
|                | Temper-<br>ature. | Precipi-<br>tation. | Temper-<br>ature. | Precipi-<br>tation. | Temper-<br>ature. | Precipi-<br>tation. | Temper-<br>ature.     | Precipi-<br>tation. |
|                | °F.               | In.                 | °F.               | In.                 | °F.               | In.                 | °F.                   | In.                 |
| January.....   | 48.2              | 2.74                | 49.8              | 4.31                | 50.1              | 4.78                | 51.4                  | 2.73                |
| February.....  | 52.2              | 3.82                | 51.0              | 3.51                | 51.8              | 3.17                | 50.5                  | 5.24                |
| March.....     | 57.5              | 4.45                | 57.6              | 3.98                | 59.6              | 3.55                | 60.8                  | 4.94                |
| April.....     | 67.7              | 4.61                | 66.7              | 4.62                | 67.9              | 4.10                | 67.3                  | 2.29                |
| May.....       | 74.4              | 5.42                | 71.3              | 5.84                | 74.9              | 3.90                | 74.3                  | 4.29                |
| June.....      | 80.7              | 7.43                | 78.2              | 4.25                | 80.9              | 5.14                | 80.0                  | 3.72                |
| July.....      | 82.2              | 3.98                | 81.5              | 2.59                | 83.4              | 3.25                | 82.3                  | 4.33                |
| August.....    | 82.6              | 2.34                | 80.4              | 2.68                | 82.8              | 3.46                | 84.2                  | 2.25                |
| September..... | 75.8              | 4.80                | 75.7              | 3.25                | 77.4              | 3.23                | 76.5                  | 3.54                |
| October.....   | 67.8              | 3.95                | 66.5              | 3.22                | 69.0              | 3.10                | 67.9                  | 4.73                |
| November.....  | 59.1              | 5.60                | 56.2              | 4.45                | .....             | 4.23                | 60.4                  | 2.22                |
| December.....  | 48.0              | 4.24                | 51.4              | 3.81                | .....             | 3.58                | 50.9                  | 2.53                |
| Year.....      | 66.4              | 53.38               | 65.5              | 46.51               | .....             | 45.49               | 67.2                  | 42.81               |

<sup>a</sup> Mean for three years.

While the data given in the foregoing table are not as complete as might be wished, they are believed to be fairly representative of the conditions as regards the temperature and rainfall of the region within which the present experiments were carried on. A table giving the actual rainfall in the different fields will be given later, but before leaving the question of general climatic features it will be interesting to compare the figures given above for the months of the growing season with similar data for Havana, Cuba, to see if there are here any broad differences that might indicate the impracticability of approximating a Cuban type of leaf.

*Comparative table of temperature and precipitation for six months of growing season, east Texas and Cuba.*

| Month.         | Palestine.        |                     | Nacogdoches.      |                     | Month.        | Havana.           |                     |
|----------------|-------------------|---------------------|-------------------|---------------------|---------------|-------------------|---------------------|
|                | Temper-<br>ature. | Precipi-<br>tation. | Temper-<br>ature. | Precipi-<br>tation. |               | Temper-<br>ature. | Precipi-<br>tation. |
|                | °F.               | In.                 | °F.               | In.                 |               | °F.               | In.                 |
| April.....     | 66.7              | 4.62                | 67.7              | 4.61                | October.....  | 78.1              | 8.49                |
| May.....       | 71.3              | 5.84                | 74.4              | 5.42                | November..... | 75.3              | 4.24                |
| June.....      | 78.2              | 4.25                | 80.7              | 7.43                | December..... | 71.4              | 1.93                |
| July.....      | 81.5              | 2.59                | 82.2              | 3.98                | January.....  | 70.3              | 2.32                |
| August.....    | 80.4              | 2.68                | 82.6              | 2.34                | February..... | 72.0              | 2.52                |
| September..... | 75.7              | 3.25                | 75.8              | 4.80                | March.....    | 73.2              | 2.50                |
| Six months..   | 75.6              | 23.23               | 77.2              | 28.58               | Six months... | 73.4              | 22.00               |

In respect of the averages for the six months, there is seen to be a close correspondence between the figures for Palestine and Nacogdoches and those for Havana. Examined month by month, however, there are differences which might have considerable effect in differentiating the character of the leaf. At Havana the temperature is equable, the extremes being only 8° F. apart, while in Texas there is a range of 15° F.; at Havana the rainfall is very much heavier during the first two months of the period and very much less in the third month, the remainder of the period more nearly approximating the Texas conditions.

The following table shows the mean monthly relative humidity for the growing season, as recorded at Havana and at Palestine:

*Mean monthly relative humidity.*

| Palestine.     |           | Havana.       |           |
|----------------|-----------|---------------|-----------|
| Month.         | Humidity. | Month.        | Humidity. |
| April.....     | 73        | October.....  | 78        |
| May.....       | 78        | November..... | 77        |
| June.....      | 76        | December..... | 73        |
| July.....      | 77        | January.....  | 76        |
| August.....    | 75        | February..... | 73        |
| September..... | 74        | March.....    | 71        |

These figures show a marked agreement, and indicate that the mean range of humidity is about the same in both regions. During the twenty-four hours at Havana, however, the relative humidity is higher for a longer period than at Palestine, the maximum reading being usually reached at 6 o'clock in the morning and the minimum at noon, while at Palestine the maximum is usually reached at 8 o'clock a. m. and the minimum at 8 o'clock p. m. In other words, the late afternoon and presumably a considerable part of the night are much damper at Havana than at Palestine. This fact would compensate to some extent the somewhat less precipitation at the former station than at Palestine during the latter part of the growing season.

We may safely conclude from the foregoing tables that whatever variability in the type of tobacco may take place there is no condition, either of temperature or moisture, inimical to the growing of tobacco, while sufficient similarity would seem to exist between the conditions in Cuba and in east Texas to warrant the assumption that, so far as climate is concerned, an approximation in type might be expected. And yet plants are so prone to vary with their environment, and so little is absolutely known of the relation of variations to climatic conditions, that any definite deductions from the necessarily superficial consideration of the question here given must be more or less speculative. It would probably be safer to conclude a similarity of climate

and other conditions from the similar character of the tobacco produced than to foretell a likeness in the leaf from the data at hand, and the figures are chiefly interesting as attesting a fact already determined empirically.

Turning now to local conditions during 1904, the early part of the season was unfavorable to the best development of the plants, especially at the north field, Nacogdoches County. High winds and cool, dry weather retarded the growth of the plants in the seed beds, while cool nights during the early part of May were unfavorable to their growth in the fields. Later in the season, and especially during the ripening period, heavy and prolonged rains caused the lower leaves of the plants to fire and hindered the maturing of the crops. For these reasons the yields from the different fields were considerably lower than they would be under a normally favorable season.

The appended table gives the actual precipitation from day to day during the growing season for each of the fields where experiments were in progress during 1904:

*Precipitation during growing season, 1904.*

NORTH FIELD, NACOGDOCHES COUNTY.

| Date.       | Inches. | Date.        | Inches. |
|-------------|---------|--------------|---------|
| Apr. 5..... | 0.10    | June 21..... | 1.29    |
| 16.....     | .07     | 22.....      | .26     |
| 22.....     | 1.00    | 28.....      | 1.20    |
| 24.....     | 2.00    | 29.....      | .28     |
| 29.....     | .07     | July 3.....  | .50     |
| May 4.....  | 1.18    | 4.....       | .60     |
| 6.....      | 1.45    | 5.....       | .60     |
| 29.....     | .03     | 18.....      | .18     |
| June 6..... | .07     | 19.....      | .67     |
| 8.....      | .49     | 22.....      | .63     |
| 10.....     | .37     | 23.....      | .62     |

EAST FIELD, NACOGDOCHES COUNTY.

|             |      |              |      |
|-------------|------|--------------|------|
| Apr. 5..... | 1.05 | June 22..... | 1.10 |
| 22.....     | 1.10 | 24.....      | .50  |
| 24.....     | 1.55 | 29.....      | .62  |
| May 3.....  | 1.27 | July 3.....  | .50  |
| 6.....      | 1.72 | 4.....       | 2.10 |
| June 6..... | .88  | 5.....       | .52  |
| 8.....      | .40  | 6.....       | .26  |
| 21.....     | 1.05 | 23.....      | 1.43 |

*Precipitation during growing season, 1904—Continued.*

## GIDDINGS FIELD, LEE COUNTY.

| Date.       | Inches. | Date.        | Inches. |
|-------------|---------|--------------|---------|
| Apr. 1..... | 2.65    | Apr. 30..... | 0.20    |
| 3.....      | .18     | May 4.....   | 1.36    |
| 5.....      | .08     | 6.....       | 1.07    |
| 22.....     | 1.95    | 17.....      | .52     |
| 23.....     | .66     | 27.....      | .30     |
| 24.....     | .17     | 30.....      | 4.45    |
| 29.....     | 1.43    | June 6.....  | 1.00    |

## CROCKETT FIELD, HOUSTON COUNTY.

|             |      |              |      |
|-------------|------|--------------|------|
| Apr. 1..... | 1.07 | June 21..... | 0.18 |
| 2.....      | .30  | 22.....      | .80  |
| 5.....      | .80  | 27.....      | .60  |
| 7.....      | .10  | July 3.....  | .20  |
| 21.....     | 1.75 | 4.....       | .70  |
| 24.....     | .60  | 5.....       | .05  |
| 25.....     | .35  | 6.....       | .25  |
| 30.....     | .20  | 14.....      | .20  |
| May 1.....  | .10  | 17.....      | .17  |
| 3.....      | 2.75 | 18.....      | .85  |
| 5.....      | 1.60 | 19.....      | .15  |
| 28.....     | 2.00 | 23.....      | .20  |
| 29.....     | .38  | 27.....      | .48  |
| June 5..... | .55  | 28.....      | .92  |

## SOILS.

As already mentioned, among the many soils of the Southern States those of the Orangeburg series have been found best adapted to the production of the Cuban seed tobacco. The two soils of this series used in the experiments in eastern Texas are the Orangeburg fine sandy loam and the Orangeburg clay. The surface soil of the former is a compact red sandy loam, containing considerable silt and ranging in depth from 10 to 20 inches, with an average depth of about 12 inches. The soil contains from 10 to 20 per cent of rounded iron concretions about one-fourth of an inch in diameter. The subsoil is a heavy sandy clay reaching to a depth of 3 feet or more. It contains a small quantity of quartz sand and a few quartz gravel, ranges from ocherous yellow to a deep red in color, and contains iron concretions similar to those found in the soil, although not in such large quantities. The subsoil usually has a peculiar dry, crumbly texture.

The Orangeburg fine sandy loam lies on the nearly flat tops of hills or ridges, and never extends far down their slopes. The drainage is always excellent. This is the result of free surface drainage, resulting from topographic position and a relatively free percolation of water

downward through the soil and subsoil, which is assisted by the presence of the iron concretions.

The soil in the Texas areas is believed to be derived from the thorough weathering of Tertiary clays, and in some localities, usually adjacent to areas of Orangeburg clay, the clays are underlain at a depth of 8 to 20 feet by a low grade of glauconitic material, indicating that the ultimate origin of the type may have been greensand of Eocene age. The iron concretions found in the soil, it is thought, have been gradually built by oxidation and leaching of iron in the soil, which acts as a cement between the grains of sand. Occasionally, though rarely, the concretions have the irregular form of iron crust, and such fragments sometimes weigh several pounds. The presence of these concretions is one indication of the adaptation of the soil to the production of a cigar leaf of fine quality.

The Orangeburg fine sandy loam, in addition to its special adaptation as a tobacco soil, is well adapted to general farming. It combines marked fertility with a fine friable texture, and is easily kept in good tilth.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type taken from the locality of the experimental field in the Nacogdoches area:

*Mechanical analyses of Orangeburg fine sandy loam.*

| No.  | Locality.                   | Description.                             | Organic matter. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|------|-----------------------------|--|-----------------|--------------------|---------------------------|------------------------------|----------------------------|---------------------------------|-------------------------|---------------------------|
|      |                             |  | P. ct.          | P. ct.             | P. ct.                    | P. ct.                       | P. ct.                     | P. ct.                          | P. ct.                  | P. ct.                    |
| 8347 | 2½ miles N. of Nacogdoches. | Brown medium sandy loam, 0 to 15 inches. | 0.58            | 0.56               | 1.34                      | 4.52                         | 30.84                      | 30.16                           | 26.46                   | 6.04                      |
| 8348 | Subsoil of 8347.....        | Red sandy clay, 15 to 36 inches.         | .29             | 1.26               | 1.40                      | 2.74                         | 18.86                      | 18.10                           | 23.10                   | 34.54                     |

The character and relative proportions of the principal plant-food constituents in this soil are shown in the following table, giving the results of a chemical analysis by the water extract method. The figures show the soil to be well supplied with all the essential elements with the exception of nitrates. The fact that no nitrates were found is without significance, as this element is capable of great and rapid variation from day to day, and another sample taken from the same boring at another time, only a short interval intervening, might show many parts per million of this element.

This soil was used in the 1903 experiment at Lufkin and Woodville,

and at Nacogdoches and Crockett in 1904. In all cases it was fairly typical, and contained more or less iron concretions, representing from about 10 to 20 per cent of the soil mass. The surface of these fields was slightly rolling and the drainage was excellent:

*Soluble salts in the soil and subsoil of the Orangeburg fine sandy loam, expressed in parts per million of dry soil.*

| Constituent.                            | Soil. | Subsoil. | Constituent.                              | Soil. | Subsoil. |
|---|-------|----------|---|-------|----------|
| Calcium (Ca).....                       | 5     | 5        | Bicarbonic acid (HCO <sub>3</sub> ) ..... | 50    | 43       |
| Magnesium (Mg).....                     | 16    | 15       | Nitrates (NO <sub>3</sub> ) .....         |       |          |
| Potassium (K) .....                     | 19    | 64       | Phosphoric acid (PO <sub>4</sub> ).....   | 21    | 10       |
| Sulphuric acid (SO <sub>4</sub> ) ..... | 52    | 102      | Silica (SiO <sub>2</sub> ) .....          | 41    | 36       |
| Chlorine (Cl).....                      | 37    | 43       |   |       |          |

The Orangeburg clay differs from the Orangeburg fine sandy loam mainly in having a very much shallower covering of lighter soil over the red clay subsoil, the latter often lying within reach of the plow, even with the shallow plowing practiced in this part of the country. A typical description gives the following profile: Soil, from 5 to 9 inches deep, a dark-red color, and ranging in texture from a heavy sandy loam to a clay loam; subsoil, a stiff, dark-red clay, generally reaching to considerable depths, though occasionally underlain by greensand marl at 3 feet. On the surface and mixed with the soil and subsoil are found varying proportions of iron concretions and fragments of weathered greensand marl. A few limestone fragments are also found in the subsoil.

The surface characteristics of the soil vary considerably. The large areas form high, evenly rolling land, while the smaller areas, which occur as narrow strips, are usually more rolling, and in places even hilly and broken. The surface drainage is for the most part excellent, except for a few slight depressions found in the gently rolling areas, where artificial drainage would be very beneficial.

The Orangeburg clay, like the fine sandy loam, is a residual soil derived through the weathering of greensand marl of Eocene age. The marl is locally called "shell rock," and outcrops in many places in all the typical areas of this soil in Texas, and in cuts a gradation from the unweathered underlying formation to the most thoroughly weathered surface soil may be readily traced. In some places an almost complete weathering has taken place to a depth of several feet. The greensand is rich in lime, phosphoric acid, and potassium, and has some value for use locally as a fertilizer.

The soil is rather inclined to be droughty, and deep plowing, and even subsoiling, is recommended to help in the conservation of moisture. The power to retain moisture would also be increased by plowing under green manuring crops, and this practice would aid in the

formation of nitrates, which, at least at the particular time the analyses given below were made, were in the soil in a much smaller quantity than any of the other plant food constituents.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Orangeburg clay, taken in the neighborhood of the experimental field at Nacogdoches:

*Mechanical analyses of Orangeburg clay.*

| No.  | Locality.                                | Description.                         | Organic matter. | Gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0.0001 mm. |
|------|--|--------------------------------------|-----------------|--------------------|---------------------------|------------------------------|----------------------------|---------------------------------|-------------------------|---------------------------|
|      |  |                                      | P. ct.          | P. ct.             | P. ct.                    | P. ct.                       | P. ct.                     | P. ct.                          | P. ct.                  | P. ct.                    |
| 8341 | 3½ miles E., 2½ miles N. of Nacogdoches. | Heavy red sandy loam, 0 to 7 inches. | 2.33            | 6.10               | 4.54                      | 3.90                         | 18.32                      | 29.72                           | 18.90                   | 18.28                     |
| 8342 | Subsoil of 8341.....                     | Friable red clay, 7 to 36 inches.    | 1.29            | .92                | 1.66                      | 1.88                         | 11.24                      | 25.70                           | 25.30                   | 33.28                     |

Chemical analyses of the soil and subsoil by examining the water extracts with colorimetric methods give the following results:

*Soluble salts in the soil and subsoil of the Orangeburg clay, expressed in parts per million of dry soil.*

| Constituent.                           | Soil. |          | Subsoil.                                 |          |       |
|--|-------|----------|--|----------|-------|
|  | Soil. | Subsoil. | Soil.                                    | Subsoil. |       |
| Calcium (Ca).....                      | 12    | 14       | Bicarbonic acid (HCO <sub>3</sub> )..... | 63       | 38    |
| Magnesium (Mg).....                    | 5     | 11       | Nitrates (NO <sub>3</sub> ).....         | 2        | ..... |
| Potassium (K).....                     | 110   | 30       | Phosphoric acid (PO <sub>4</sub> ).....  | 11       | 21    |
| Sulphuric acid (SO <sub>4</sub> )..... | 105   | 64       | Silica (SiO <sub>2</sub> ).....          | 41       | 36    |
| Chlorine (Cl).....                     | 46    | 37       |  |          |       |

Both the soils described contain enough potash salts to make them desirable for tobacco, and the chemical analysis of both compares favorably with those of the tobacco soils of Cuba, especially with the red soils in the Partidos district.

EXPERIMENTS DURING 1902 AND 1903.

Following up the investigation of the soils around Willis and a study of their relation to the tobacco grown in that vicinity, some of which, as already pointed out, possessed desirable qualities, the Bureau arranged to place a party of its experts in that locality to determine the possibilities of raising a larger percentage of leaf approaching the flavor and aroma of Cuban tobacco. The Bureau's experts commenced this work early in the spring of 1902. Arrangements were made with Mr. A. M. Carson, a prominent tobacco grower of Willis, whereby land, implements, and curing sheds were obtained.



A 10-acre field on a soil known as the Norfolk sand, was set with plants grown from imported Cuban seed. The transplanting from the seed bed to the field took place during the latter part of April, and up to the middle of May the plants made a satisfactory growth. On May 19 a severe storm swept over this section, doing considerable damage to all the standing crops. The injury done to the tobacco was so great that nearly the whole field had to be reset, and those plants of the original setting remaining received such a setback that they never fully recovered. The result was that the stand of plants over the entire 10 acres was very uneven.

In the early part of June the tobacco was topped, and about this time a weevil attacked the plants, causing quite a large number to die.

About June 11 the tobacco was harvested and hung in the barn to be air-cured. While this work was being conducted the Bureau was collecting in a central warehouse quite a number of crops of tobacco grown by farmers during the preceding years, some of this tobacco being four years old. The object of this work was to rehandle and bulk ferment these old tobaccos, so that they could be thoroughly examined by the Bureau and the history of any tobacco possessing merit could be traced, not only as to the section where it was grown but as to the particular kind of soil which produced it. The experimental crop grown by the Bureau was also fermented in this warehouse along with the other crops.

After the fermenting of this tobacco it was very closely examined, leaf by leaf, to determine whether it possessed any desirable qualities. The crop grown by the Bureau possessed no merit, being too thin and papery, and it was evident that the soil used (Norfolk sand) was not adapted to the growth of cigar fillers of the Cuban type. On examining the other crops, some leaves selected from a crop of tobacco grown by Messrs. Roberts & Reed on a red soil at Woodville, Taylor County, possessed a very high aroma and a general character resembling to a marked degree the leaf grown on the island of Cuba. With this small clue the Bureau outlined its future course of work in Texas. A soil-survey party was sent to east Texas, and located bodies of this red soil in Taylor and Nacogdoches counties, the larger areas of this particular type being found in Nacogdoches County.

In the spring of 1903 the tobacco party of the Bureau moved its headquarters from Willis to Nacogdoches, establishing branch stations at Lufkin, Angelina County, and Woodville, Taylor County. Cooperative experiments were entered into between the Bureau and the Nacogdoches Tobacco Association, of Nacogdoches; Mr. T. J. Davis, of Lufkin, and Messrs. Roberts & Reed, of Woodville, whereby 6 acres of tobacco were planted at Nacogdoches (4 acres on the Orangeburg sand and 2 acres on the Orangeburg clay) and 3 acres were planted at

Lufkin ( $2\frac{3}{4}$  acres on the Orangeburg sand and one-fourth acre on the Orangeburg fine sandy loam). At Woodville the Bureau planted  $3\frac{1}{2}$  acres ( $2\frac{1}{2}$  acres on the Orangeburg fine sandy loam and 1 acre on the Willis sand). These soils, with the exception of the Willis sand, represent the light, medium, and heavy types of the Orangeburg series, of which soils the Bureau now believes the Orangeburg fine sandy loam to be best adapted to the production of cigar tobacco.

The following terms of agreement, covering the experiments of this year (1903), were entered into between the Bureau and the individuals and firms just enumerated:

- (1) The necessary land shall be donated free of charge by the owner.
- (2) The owner of the land shall provide and pay for fertilizers in such quantity and kind as may be needed.
- (3) The owner shall break up the field and leave it in condition to be planted.
- (4) The owner shall furnish a team and implements at such times as may be necessary for the cultivation of the crop.
- (5) The owner shall deliver the cured tobacco to such warehouse as may be indicated by the Department of Agriculture.
- (6) The owner shall pay for fermenting, sorting, grading, baling (and for baling material) the tobacco.
- (7) The Department of Agriculture shall have entire control of the production and handling of the tobacco, and shall in no way be hampered or interfered with by the views or wishes of the owner of the land.
- (8) The Department shall control absolutely all labor in the cultivation of the crop, and shall provide and pay for all additional help needed in the cultivation, except such as is especially provided for above.
- (9) The Department shall supervise and direct the barn curing, fermentation, and grading, and shall have the right to offer the tobacco for sale and to sell the tobacco, subject to the minimum price which may be placed upon it by the owner. If the product is sold by the Department, the entire proceeds of the sale shall be turned over to the owner of the land, who thereby agrees to accept such sale and deliver the goods, subject to the ordinary laws of trade. If no sale is made by the Department, for any reason whatever, the owner of the land shall take the tobacco and arrange for its sale on his own account.
- (10) The Department shall not be held financially responsible in any way for the crop, nor does it guarantee any value for the crop when produced.

The tobacco grown at Nacogdoches, Lufkin, and Woodville under these agreements was planted during the latter part of April and the first ten days of May. At Nacogdoches the plants were set with a machine, while at Lufkin and Woodville they were set by hand. The advantage of machine setting was very marked, and an excellent stand of plants was obtained at Nacogdoches, while at the other places only a fair setting of plants lived, necessitating some resetting, and causing an uneven growth over the fields.

On the lighter soils about 15 loads of well-rotted manure were applied broadcast to the acre, and on the heavier soils 20 loads were used. In the case of each field the manure was plowed under and

allowed to decay some time before the tobacco was planted. During the first few weeks of the growing season the weather was very unfavorable, there being successions of dry, windy days. This retarded to a marked degree the growth of the tobacco, especially on the lighter soils.

At Nacogdoches the plants were set 14 inches apart and at Lufkin and Woodville 12 inches apart in the rows, which in all three of the fields were placed at an interval of 3 feet. Thorough and shallow cultivation was practiced. During the month of June the tobacco was topped, and harvesting commenced at Woodville on June 15, and at Nacogdoches and Lufkin during the first week in July. The tobacco was cut and speared upon laths, each lath holding from 7 to 9 plants, according to size. It was then hung in a building to be cured.

Owing to the lack of suitable buildings for curing, the work was done at a great disadvantage. At only one place (Woodville) could a regular cigar-leaf tobacco barn be found, while at Nacogdoches the tobacco was hung in one of the long, low cotton sheds common to the South, having a metal roof and very poor means of ventilation. At Lufkin the accommodations for curing were even worse than at Nacogdoches, the tobacco being hung in several small log cabins. In these buildings it was impossible to control either the moisture or the temperature, and as a result the tobacco was considerably damaged by pole sweat at Lufkin and too rapid curing at Nacogdoches. Only at Woodville were satisfactory curing results obtained.

The crops obtained from the different fields showed a very wide range in yield, owing, it is believed, to differences in the local weather conditions, in type of soil, and in the amount of fertilizer used. On the Willis sand only 400 pounds of tobacco to the acre was obtained. On the stronger and heavier Orangeburg soils as much as 760 pounds to the acre was secured, while the average yield for both the Orangeburg fine sandy loam and the Orangeburg clay was 510 pounds to the acre. The tobacco grown at Lufkin and Woodville, after being stripped, was packed in cases and shipped to Nacogdoches, where the Bureau had established a warehouse for the purpose of bulk-fermenting the leaf. These tobaccos were placed in bulk along with the crop of tobacco grown at Nacogdoches.

After the tobacco had been thoroughly fermented it was carefully examined, leaf by leaf, to determine its physical character, and the leaves from different parts of the plant were smoked to judge of its taste and aroma. In this way the product of the different fields was carefully compared, every available means being used to decide what leaf most closely approximated, in weight, texture, taste, and aroma, the leaf imported into the United States from Cuba, and thus to determine what soil, what method of cultivation, and what fertilization gave the most satisfactory results.

This close examination of the tobacco was conducted early in January, 1904, under the immediate personal supervision of the Chief of the Bureau, assisted by the writer and his aids. Upon a basis of the tests, using 20 pounds from each crop, the tobacco was classified into four grades, the proportion of each grade being shown in the table following. It will be noticed that a very large proportion of the crop is classified as of good aroma but insufficiently aged. This is to be expected under the conditions, as it is well known to handlers of cigar tobacco that the leaf should remain in bale at least a year after fermentation, in order thoroughly to ripen.

*Aroma of tobacco grown in 1903.*

| Crop.            | Good aroma.                       |                                     | Medium<br>aroma,<br>filler. | Poor<br>aroma,<br>second<br>quality<br>filler. |
|------------------|-----------------------------------|-------------------------------------|-----------------------------|--|
|                  | Filler with<br>sufficient<br>age. | Filler with<br>insufficient<br>age. |                             |  |
|                  | <i>Per cent.</i>                  | <i>Per cent.</i>                    | <i>Per cent.</i>            | <i>Per cent.</i>                               |
| Nacogdoches..... | 10                                | 84                                  | 6                           | 0  |
| Lufkin.....      | 11                                | 80                                  | 9                           | 0  |
| Woodville.....   | 11                                | 72                                  | 10                          | 7  |

This tobacco has since been packed and baled, and the Bureau, to ascertain the commercial value of the leaf and the opinion of the trade, has placed the product in the hands of a prominent broker for sale. Under the terms of the agreement the proceeds will go to the parties who cooperated with the Bureau in this work.

The following table shows the yield of different grades of tobacco on the several experimental fields:

*Character of tobacco from the several experimental fields, 1903.*

| Grade.             | Berger field.  |                  | Radcliff field. |                  | Lufkin field.  |                  | Woodville field. |                  |
|--------------------|----------------|------------------|-----------------|------------------|----------------|------------------|------------------|------------------|
|                    | <i>Pounds.</i> | <i>Per cent.</i> | <i>Pounds.</i>  | <i>Per cent.</i> | <i>Pounds.</i> | <i>Per cent.</i> | <i>Pounds.</i>   | <i>Per cent.</i> |
| Heavy filler.....  | 475            | 38.6             | 766             | 49.2             | 355            | 69.5             | 979              | 87.1             |
| Flimsy filler..... | 219            | 17.8             | 513             | 33.0             | 27             | 5.3              | 32               | 2.8              |
| Broken filler..... | 287            | 23.3             | 207             | 13.3             | 107            | 20.9             | 66               | 5.9              |
| Trash.....         | 250            | 20.3             | 70              | 4.5              | 22             | 4.3              | 47               | 4.2              |
| Total.....         | 1,231          | .....            | 1,556           | .....            | 511            | .....            | 1,124            | .....            |

#### EXPERIMENTS DURING 1904.

At the beginning of 1904 the Bureau had ascertained, through the two years' experiments already detailed, the types of soil upon which a tobacco nearly approaching the Cuban leaf in all its qualities, and surpassing any filler now being grown in the United States, could be successfully produced; but it seemed advisable to continue the experiments during the season of 1904 on these soils—namely, the Orangeburg clay and the Orangeburg fine sandy loam—to study further their

adaptation to filler tobacco, and to see if by different methods of fertilization and cultivation, and by eliminating such mistakes as the past year's work had shown, a still better leaf could be grown.

Mr. Walter M. Hinson, an expert of the Bureau, was placed in charge of this work, and he was aided by a corps of trained assistants. It was thought best to make this an independent experiment, so that the tobacco produced could be disposed of by the Bureau in such a way as to insure its being widely tested by the trade.

Headquarters were established at Nacogdoches, Nacogdoches County, Tex., where the Bureau had the previous year established a warehouse. Substations were also established at Crockett, Houston County, and at Giddings, Lee County. Each of these stations was placed in charge of an assistant expert, whose duties were to supervise and assist in the work of growing an experiment crop.

At Nacogdoches the Bureau leased for one year  $4\frac{3}{4}$  acres of land with the necessary curing barns. One and three-fourths acres of this land was situated about 2 miles north of Nacogdoches, and belonged to the type known as the Orangeburg fine sandy loam. This plot of land had the previous year been planted in corn. The remaining 3 acres—situated 3 miles east of Nacogdoches—were composed of  $1\frac{1}{2}$  acres of the Orangeburg fine sandy loam and  $1\frac{1}{2}$  acres of the Orangeburg clay. The Orangeburg fine sandy loam had previously been planted in cotton, while the Orangeburg clay had been used as a cornfield.

At Crockett the Bureau selected seven-eighths of an acre of the Orangeburg clay and  $2\frac{1}{8}$  acres of the Orangeburg fine sandy loam, while at Giddings  $1\frac{7}{8}$  acres were planted on the Orangeburg fine sandy loam and  $1\frac{1}{8}$  acres on a soil similar to the Norfolk sandy loam. No soil survey had been made around Giddings. The land selected was apparently of the Orangeburg type, or, as in the case of the last mentioned, was closely related to that series.

#### MANIPULATION OF THE SEED BEDS.

Before the location of the substations was determined upon, a general seed bed had been selected at Nacogdoches, and the work of clearing off the timber and cutting the wood into suitable lengths to be used in burning the bed had been begun.

This bed was situated one-half mile east of Nacogdoches, near a small stream of water, and was surrounded by a heavy growth of timber, which helped to cut off the cold north winds which are frequent in this country during the early spring. In other respects the location of this seed bed was favorable. It had a southern slope, which allowed the sun to shine upon it the greater part of the day, and the soil—the Orangeburg loam—contained plenty of humus, and was otherwise well adapted for growing plants.

There was quite a heavy layer of leaves and fine trash upon the surface of the land, which was cleared off before burning to allow the fire free access to the soil. After this trash had been removed and the wood for the fires had been well seasoned, preparations were made for the first burning of the soil, which was done in the latter part of January. Skids made of green pine poles were used to draw the fire on. These skids were placed upon the ground 3 feet apart, and the fire was built upon them. A strip of 300 square yards was first burned. The fire was then built on the upper side of the bed for a width of about 40 feet, and after it was burning well it was gradually pulled down the slope.

Care was taken not to let the fire die down, by continually placing on wood and brush. In moving the fire along the skids long poles with a fork at one end were used, and the fire was moved but a few feet at a time. This allowed a large amount of coal and ashes to collect upon the ground, which thoroughly burned the surface 3 or 4 inches deep. Afterwards the coals were raked off, leaving only a thick layer of ashes, which was immediately dug into the soil, and the bed raked to free the ground of all small roots. Cotton-seed meal was then applied broadcast at the rate of 800 pounds per acre, after which the bed was cross chopped to mix the fertilizer thoroughly with the soil and to cut all roots. It was then raked again to remove all roots and trash that had been brought to the surface by this last manipulation, leaving the soil in a smooth, well-pulverized condition.

The land was laid off into 3-foot beds, leaving a small walk way or water drain between each. These beds were built up above the level of the drains, so as to allow the water to pass off without doing any damage in case of heavy rains. Pine poles were cut and laid across these beds 3 feet apart, to act as a support for the cloth covering.

The first seed was sown on January 28, using 1 tablespoonful of seed to 100 square yards of bed, 300 square yards being sown on this date. The soil was then thoroughly packed by treading in the seed, and the bed covered with cloth to protect the young plants from cool nights and the ravages of insects. This cloth was 9 feet wide and as long as the beds, so that it was easy to remove and replace it whenever the beds needed watering or weeding.

The burning of the remainder of this seed bed was continued until 700 square yards had been prepared, and the sowing of the seed progressed until the last week in February, the last 200 yards being sown on February 29. This last sowing was not covered with cloth.

The seed sown first did not germinate well, and the bed was resown on March 1. The weather conditions were unfavorable during February and the early part of March, being unusually cold and windy, which retarded the growth of the plants. During this period the beds were kept watered and weeded, and whenever necessary a

mixture of Paris green and water was applied to free the plants from insects.

The seed sown on this bed, with the exception of 100 square yards which was sown with Florida Cuban seed, was imported Cuban seed from the Vuelta Abajo district. A sufficient number of plants was grown on these beds to plant 25 or 30 acres.

On account of the absence of running water in the vicinity of Giddings, in order to have a sufficient supply of water it was necessary that the seed beds there should be located on uplands, near tanks or ponds. One of the beds was placed near the tobacco field, close to a small tank. This bed consisted of 125 square yards, and was situated in a pasture, which was covered with a growth of small post oak. The other bed was placed near another tank, about one-half mile south of the experimental tobacco field. This bed was also covered with a growth of post oak. These beds were burned and prepared for seed in the same manner as the Nacogdoches bed, using cotton-seed meal as a fertilizer at the rate of 1,000 pounds per acre. Cold frames were made 9 feet wide and as long as the beds, using a 10-inch plank for these frames. The seed was sown in the bed first mentioned on February 14; while the other bed, consisting of 280 square yards, was sown on February 25 and 29. These beds were also covered with cloth.

During March the weather conditions were very unfavorable, there being a succession of cold, dry winds, which made it necessary to water the beds every day. After the seed came up a large percentage of the young plants died, necessitating resowing, which was done on March 16. The conditions for growing plants were so unfavorable that we were unable to secure a sufficient number in time for planting, and therefore plants for one-half the area cultivated at this station were shipped from Nacogdoches.

The seed bed at Crockett was also located upon uplands, the water supply being drawn from a well. The soil was clear of vegetation, having been cultivated the previous year in truck. The work here was begun the first week in February, and 380 square yards were prepared for burning. The bed was burned with limbs pruned from the trees of a near-by pear orchard, and the same methods were used for burning and preparing the soil for planting as were practiced at the other stations. Cold frames were used here, as at Giddings, and the bed was covered with cloth. The sowing of the seed was continued until February 20.

These beds were kept watered, and a good stand of plants was secured. The cloth was taken off on warm days and the beds weeded. The plants were also treated with Paris green once in every ten days, to prevent damage from insects. A sufficient number of plants were raised at Crockett to set 10 acres.

## PREPARATION OF THE FIELDS.

The first steps in fitting the soil for the reception of the plants were taken in Nacogdoches County the latter part of February, on the field situated 2 miles north of Nacogdoches, and hereafter known as the north field. This land had been planted in corn for several years, and had already been plowed into beds and the old cornstalks cut up and plowed under. Twenty loads of stable manure were applied to this field and plowed under with a 6-inch shovel plow, running the furrows at right angles to the first plowing, and stirring the soil to a depth of 8 inches, thus thoroughly incorporating the manure with the soil. The field was allowed to lie in this condition for several days, during which there occurred a good rain. After this all the cornstalks were raked off the field and carted away. In the latter part of March one-half acre of this field was laid off in 3-foot rows, and prepared for setting the plants, throwing the soil into beds with a turn plow turning four furrows to each row. Later on, about the 1st of April, two furrows were turned back into the water furrow, leaving a list 1 foot wide and above the level of space between the rows. This left the soil in good condition for transplanting. The remainder of this field was prepared in the same way, just before the time of transplanting, in order to have a good loose bed for the plants.

The  $1\frac{1}{2}$  acres of Orangeburg clay comprising the east field, situated about 3 miles east of Nacogdoches, was prepared in the manner outlined above, the land having previously been used as a cornfield. The  $1\frac{1}{2}$  acres of the Orangeburg fine sandy loam at this place had been planted in cotton for two years, and had a very heavy growth of cotton stalks on it. Work here was begun the first week in March; the cotton stalks were pulled up and burned, and the field plowed crosswise in a direction transverse to the cotton rows, turning the soil to a depth of 8 inches. A shovel plow was used for this. This plow does not expose the subsoil to the surface, and as it cuts a narrow furrow slice (about 5 inches wide), it leaves the surface of the soil in a smooth, well-filled condition. As the soil in this field seemed to be remarkably rich, and as the preceding crop of cotton had made a heavy growth, it was at the time thought to be unnecessary to apply any fertilizer, although later in the season this was found to be a mistake. Both of these areas were allowed to lie in this condition until the first week in April, when the clay area was prepared for setting the plants, the same method being used as on the other areas. The soil of both these fields was in good condition for receiving the plants. The clay area, however, was near a strip of woods which caused much damage to the crop during a succeeding drought.

The preparation of land in the Giddings fields was begun in the latter part of March. The  $1\frac{1}{2}$  acres on the Wilson farm, which had



been planted in cotton for several years, was prepared in the same way as the Orangeburg fine sandy loam of the east field at Nacogdoches. The growth of cotton stalks on this field was small. They were pulled up and burned, and the soil was then broken with a shovel plow. Thirteen loads of cow-pen manure were applied broadcast and plowed under, mixing the manure well with the soil. The field was allowed to lie in this condition for several days, when it was laid off in 3-foot rows and prepared for planting as in the case of the fields above described. Five loads of the same kind of manure as that plowed under were put in the drill and covered, making a list on which to set the plants. This final preparation of the land was kept up a few days ahead of the transplanting.

The smaller area of  $1\frac{1}{2}$  acres in the Knox field was prepared soon after the one described above. This field had been used as a pasture, and the soil was a little heavier than in the other field. It was covered with a large growth of weeds, which were broken down, raked into piles, and burned. The soil was prepared in the same manner as the larger area, 10 loads of cow-pen manure being used. Two-thirds of this was put on broadcast and one-third put in the drill. This field was also prepared for setting a few days ahead of the transplanting.

The work at Crockett was begun about the middle of March. The seven-eighths of an acre of Orangeburg clay was an old field which had been used as a pasture for several years. The soil was thoroughly broken up with a 6-inch shovel plow, being plowed and cross plowed to get it in a fine, pulverulent condition. The field was then bedded for rows 3 feet apart, and 500 pounds of cotton-seed meal and 500 pounds of cotton-seed hulls were drilled in by hand in the water furrow. A small shovel plow was used in the drill to mix the fertilizer with the soil. After this two furrows were turned back upon the fertilizer, making a list on which to set the plants.

The other field at Crockett, consisting of  $2\frac{1}{2}$  acres of Orangeburg fine sandy loam, had been planted in cotton the year previous, and there was a very heavy growth of cotton stalks still standing. These were pulled up and burned, and the land prepared in the same manner as the smaller area. No fertilizer was used on this field before setting out the plants, but later in the season 1 ton of cotton-seed meal was applied. The two fields at Crockett were prepared for setting out the plants about the middle of April.

#### SETTING OUT THE PLANTS.

Transplanting was begun at the north field, Nacogdoches, on April 8, when one-fourth of an acre was set out. The plants were placed 10 inches apart in the row, and just before setting the lists were leveled off by means of a board attached to a plow, which left the soil in a loose, moist condition, so that the roots of the young plants would not

be injured by coming in contact with or by being set in the dry surface soil. The setting of plants was continued in this field up to April 30, and a good stand was secured, necessitating very little resetting. One-half acre of this field was set with plants grown from Florida Cuban seed, while in the remainder of the field plants grown from imported Cuban seed were used.

In the case of the east field, Nacogdoches, transplanting was begun on April 20, when one-half acre was set. The work of transplanting was continued every day in this field until completed. All of the plants were set by hand and watered, but owing to cool dry winds the stand was poor and was further reduced by cutworms and wireworms. This necessitated resetting, and the work was commenced on May 18, and eventually a good stand was obtained. On the Orangeburg fine sandy loam of the east field planting was not begun until May 9. About this time the climatic conditions were very favorable for this work, light warm showers falling every day. A very good stand of plants was obtained, and only a little replanting was done, from May 20 to May 25.

At Giddings, Lee County, the Wilson field was set on April 18, and the Knox field during the early part of May. Weather conditions were very favorable in this locality, there being a succession of light warm showers. Owing to the failure of a great part of the seed bed at this place, fully half of the plants were shipped from Nacogdoches. Very little damage was done by insects, and an excellent stand was obtained in both these fields.

At Crockett, Houston County, transplanting was commenced in the smaller field on April 19, and was completed on April 27. About one-half of the plants in this field were watered as set out, the remainder being set during a period of favorable moisture conditions. A good stand was secured in both instances. The larger area was planted during a period of two weeks, extending from April 27 to May 9. The greater part of this field was set under favorable conditions, only a small percentage of the plants needing to be watered. A good stand was obtained, but owing to the ravages of wireworms and damage caused by very heavy rains, almost all the plants were subsequently destroyed, and the field was replanted on May 20, when a good, healthy stand of plants was obtained.

The plants in all the fields were set 10 inches apart in the rows, which in every case were laid off with 3-foot intervals. The total acreage of tobacco set at all stations was  $10\frac{3}{4}$  acres.

#### CULTIVATION AND PROTECTION AGAINST INSECTS.

About ten days after the plants were set out they were given the first cultivation. The methods used were nearly the same at each station, and every field was cultivated thereafter once a week, whenever

the weather would permit. In the first cultivations small wing sweeps were used to run around the young plants, followed by a hand hoeing, except in the two fields at Nacogdoches, where a small-tooth cultivator was used. This was run between the rows, stirring the soil to a depth of 2 or 3 inches, breaking the crust that had formed upon the surface, and leaving the soil in a good condition for the sweep plow. In both cases, either where the small sweep plow or the cultivator was used, the middles were broken out with an 18-inch wing sweep plow. Later, when the tobacco was about 2 feet high, 18-inch sweeps were used altogether, turning three furrows to each row of tobacco. This was done every week until the plants had all been topped. It was found necessary at times on the clay land to use a shovel plow to loosen up the soil, as this type has a tendency to become packed and hard after rains. Every field was kept clean of grass and weeds, and the last cultivation was given each field just after the plants were topped, leaving the tobacco on a rounded bed with a water furrow between the rows deep enough to carry off the water after heavy rains.

The tobacco on each field was watched closely and poisons applied whenever necessary to keep down insects of all kinds. Soon after setting the plants Paris green mixed with cornmeal was placed around each plant to protect it from the cutworms. Later in the season, as soon as the plants had begun to grow, a lighter mixture was used for the bud worms. This mixture was sprinkled in the bud of each plant once a week until the plants were topped. After the plants were about 12 inches high, a mixture of water and Paris green was applied with a knapsack spraying outfit.<sup>a</sup>

#### TOPPING, SUCKERING, AND HARVESTING.

The flower bud appeared from seven to eight weeks after setting out the plants. The first topping was done at Nacogdoches, about June 5, exactly seven weeks after the first setting, and it was continued at different intervals upon the various fields until all the plants were topped. The necessity of going over the fields so many times was due to the uneven stand, caused by replanting, resulting in plants of different ages in the same field. The plants were topped rather high, leaving from 10 to 16 leaves on the plant, according to its individual character.

After the plants were topped suckers appeared at the junction of each leaf, and these were broken off as soon as it was possible to do so without injury to the plant.<sup>b</sup> The crops were suckered, on the average,

<sup>a</sup> For information on tobacco insects and means of control, see Farmers' Bulletin No. 120, by L. O. Howard, Entomologist, U. S. Department of Agriculture.

<sup>b</sup> Suckers appear on all types of tobacco after being topped, as it is an effort on the part of the plant to reproduce itself, and unless removed the quality of the leaf for manufacturing purposes will deteriorate.

every six days, and each field was gone over four or five times, a frequency due to the uneven toppings, the plants in the same row which did not require suckering one week, having been topped later, needing it the following week.

Harvesting was commenced at the north field, Nacogdoches, on June 20, when such plants as had reached the right stage of ripeness were cut and speared upon lath in the field, from 10 to 12 plants being placed on each lath. The laths were then placed upon racks built in the shady part of the field, and there the tobacco was allowed to hang until it wilted. As this field was situated 2 miles from the curing barn, it was necessary to haul the wilted tobacco on wagons with specially constructed racks on which the tobacco could hang without being damaged by the jolting of the wagon. This field was cut over several times as the tobacco ripened, and the harvesting was not completed until July 15.

The harvesting of the east field was commenced on July 1, and the same method was used as in the north field. This work was completed on July 30. In this field the climatic conditions were unfavorable during the growing season. During May and June the tobacco suffered from drought, and in the latter part of July excessive rains did much damage. The tobacco planted on the clay had suffered more from drought than that planted on the fine sandy loam. Quite a large number of the plants were stunted in growth and buttoned prematurely, and when the rains did occur these plants fired, making them of no commercial value, and therefore they were not harvested.

Topping began at Giddings on the Wilson farm on June 1 and continued until June 25. This crop was topped and suckered in the same manner as the two crops at Nacogdoches. Harvesting was begun on June 16 and completed on July 9, the greater part of the crop being gathered in June. The early tobacco on this farm made good growth, with the exception of that in one end of the field which appeared to be too wet during the first part of the season, although later it made a fair growth. About the middle of June the weather conditions became unfavorable, there being a succession of hot south winds which bruised the leaves and caused the plants to fire or ripen prematurely, and it was therefore deemed advisable to harvest this tobacco before it had fully matured. About one-fourth of an acre in this field was lost because of these unfavorable conditions.

The tobacco in the Knox field was harvested during July, but was cut before it had fully ripened. This was done to prevent the loss of the crop by firing, as, owing to the hot dry weather, some spots of the field had already begun to be affected in this way and were rapidly spreading.

At Crockett topping was begun about June 5 and continued to June 30. The same methods were used in topping and suckering as at the other stations. On the Orangeburg clay land harvesting was begun on June 20 and was completed on July 2, while on the Orangeburg fine sandy loam harvesting was not completed until a week later. The tobacco from the former field (seven-eighths acre) was hauled by teams to the curing barn, but that grown on the Orangeburg fine sandy loam was taken to the barn by hand, as the building was situated at one end of the field. The tobacco on the larger area made rather a slow growth, with the exception of about half an acre in the center of the field, the balance being good only in spots. About 1 acre of this field never reached maturity. Fertilizer was applied as a top dressing on the poorer spots in the field, and the tobacco started to grow, but it soon began to fire and die out. The remainder of the field made good tobacco and was well matured when harvested. The tobacco planted on the clay land made a much more rapid and even growth, but after topping the weather conditions changed and the crop suffered from an overabundance of rain. After gathering the first crop from this field a sucker crop was started, but only a small percentage of the suckers were of any value. These were allowed to grow, and were cultivated in the same way as the first crop. The plants were topped low, leaving five or six good leaves to mature on each plant.

## MANAGEMENT OF THE CURING BARN.

After the tobacco had remained on the racks in the field long enough to allow it to be handled without damaging the leaf it was hung upon the tier poles to cure. To prevent a too rapid curing about 6 inches of space was left between the laths hung in the top of the barn, while in the lower tiers more space was given between the laths to allow a freer circulation of air and, in case of rainy weather, to prevent pole sweat, which would occur if the tobacco were hung too close together.

At Crockett, Giddings, and the east field, Nacogdoches, all the ventilators were kept closed for the first few days to allow the leaf to undergo the first process of curing, which is indicated by a change from a green to a yellow color. At the north field, Nacogdoches, it was impossible to control the curing of the leaf, owing to the absence of suitable buildings for this work. The crops at this place were hung in a large cotton shed, which had previously been fitted up with tier poles; but owing to the favorable weather conditions during the curing season at this place the tobacco passed through the process of curing in fine condition. If the weather had been damp and rainy at this time, it would have been impossible, owing to the openness of the building, to have controlled the moisture conditions, and much damage from pole sweat must have resulted.

During the early part of the curing season at Giddings the climatic conditions were unfavorable. The weather was hot and dry, with warm winds, and there was a tendency for the leaf to cure too fast. After the tobacco had been in the barn three weeks the weather changed and was damp and rainy throughout the remainder of the curing season. This necessitated the building of small wood fires in the barn to cause a circulation of dry air and to prevent injury by rot or pole sweat.

At Crockett the curing season was favorable, fires being built for only a part of two days, while at the east field, Nacogdoches, the weather continued wet throughout July, which made it necessary to keep fires in the barn the greater part of the month.

As will be seen, no fixed rules for the manipulation of the barns were followed at any of the stations. In curing tobacco everything depends upon the condition of the weather and the character of the tobacco. However, in a general way, the following methods were observed: Whenever the weather was hot and dry, the barns were kept closed during the day and opened at night. During the day the tobacco becomes dry, while at night, with the ventilators and doors open, the tobacco becomes soft and pliable. When the leaf was cured, with the exception of the stem or midrib, the ventilators were kept open during the day, especially on the shady side of the barn. But in case there was a strong wind blowing the barns were closed to prevent the tobacco becoming wind whipped. Whenever there were frequent showers and very little sunshine, the barns were closed and small wood fires were lighted in parts of the barn until the damp weather was over. These fires were continued in every case as long as it was necessary to keep the tobacco in proper condition. The wood used gave off very little odor in the smoke. It is very important to avoid giving the tobacco any foreign odor.

The barn curing is complete when the midribs of the leaves have cured. The process of curing the leaf required from six to seven weeks.

#### STRIPPING AND TYING.

During the first damp weather after the tobacco had been thoroughly cured it was taken down. The night before the barns were opened, to allow free circulation of moist air, to put the tobacco in good "kase" or "order;" that is, in a soft and pliable condition like a kid glove. The tobacco was then stripped from the lath and the leaves picked off the stalks, making three grades—tops, middles, and sand or bottom leaves. This selection was made so that the tobacco could be better handled in the warehouse, as leaves from different parts of the plant, owing to their different character, require separate treatment in the fermenting and assorting houses. The leaves were then

tied into hands, containing from 40 to 50 leaves, and packed in boxes for delivery to the packing house. This work was commenced on August 15, and was completed at all the farms by September 10.

## FERMENTATION.

To obtain the best results in bulk fermenting tobacco the leaf should contain enough moisture to make the addition of water by artificial means unnecessary. When the tobacco is of a flimsy nature, as in the case of the sand or bottom leaves, it is necessary after the second turning of the bulk to add water in order to complete the fermentation of the leaf, as the moisture originally in the leaf evaporates during the process and the leaf becomes dry. The moistening is best accomplished by dipping the heads of the tobacco hands about 4 inches into the water and then shaking them well, thus distributing the water through the leaf, after which the tobacco is laid lightly in cases and allowed to remain for about twenty-four hours, by which time the moisture will have been taken up and the tobacco become uniformly soft. The tobacco should then be repacked in the bulk and allowed to ferment until thoroughly cured.

To support the bulks a platform should be made, 5 feet wide and from 12 to 14 feet long, raised about 4 inches from the floor of the fermenting room. At the ends of this platform are placed headboards, 5 feet wide and 7 feet high. Such a platform will hold from 5,000 to 6,000 pounds of tobacco. After covering the platform and headboards with paper the bulking is begun by laying the two outer rows, placing the butts of the hands even with the edges of the platform, and allowing the tips of the leaves to point to the center. Then another row is begun on each side, allowing the heads to rest two thirds of the length of the leaf from the butts of the first row, keeping the tips pointing to the center. A third row is made on each side in the same manner. This will make six rows across the width of the platform, or sufficient to cover the floor. The second tier is laid in the same manner, and this process is continued until the bulk has reached a height of 6 or 7 feet, or until 5,000 pounds of tobacco have been bulked. When the bulk is completed, the top is covered with ordinary cotton blankets or burlap, and over these rubber blankets are placed. The tobacco is allowed to remain in bulk from ten to twelve days, the actual time being governed by the character of the leaf and condition of the tobacco, which latter is indicated by a thermometer placed in the bulk.

Ordinarily the temperature of a bulk increases from 1° to 3° C. every twenty-four hours, and this is allowed to continue until 45° C. is reached, when the tobacco is taken down, well shaken, and rebulked, building the new bulk as the old one is taken down. This process is repeated until the active fermentation of the leaf ceases.

To rebulk tobacco the handler should proceed as follows: Take off the first two layers from the bulk and place them in cases. Then take the tobacco from the old bulk and lay the foundation of the new one until the old bulk is half removed. Place the two layers that were set aside in the new bulk, and refill the cases with two more layers of the old bulk, and set these aside until the remainder of the old bulk has been packed on the new. Then place the two tiers of hands on the new bulk and cover it with blankets to keep the top of the bulk from drying out. In this way what was the inside of the old bulk has become the outside of the new, and what was the outside of the old bulk has become the inside of the new bulk. In this way every part of the bulk will receive the same amount of fermentation.

The bulk method, as above described, was used in fermenting the tobaccos grown in the 1904 experiments, the first bulk being built September 9. It contained the sand leaves and the middle leaves of the crops grown at Nacogdoches, Giddings, and Crockett—in all about 5,000 pounds of tobacco. The temperature of the bulk increased from 2° to 3° C. every twenty-four hours until September 12, when it reached 44° C. From that date it fell gradually until September 19, when the bulk was taken down, each hand thoroughly shaken out, and the tobacco rebulked. Owing to the size of the bulk two thermometers were used, one being placed in the sand leaves and one in the middle leaves, so that it could be determined how the fermentation of each class of tobacco was progressing. On September 21 the new bulk had reached a temperature of 35° C., which continued to rise until September 28, from which date until October 3 it fell until it registered 40° C. On October 3 and 4 the bulk was taken down for the second time and rebulked. At this time the second or sucker crop, grown at Crockett, was added to the bulk. On October 13 the temperature had only reached 40° C., and remained at about that point until October 18, when it fell 1 degree. This indicated that a certain amount of moisture had evaporated from the tobacco, and that the fermentation was progressing satisfactorily.

From October 18 to October 22 the bulk was again taken down and rebulked. The sand leaves of all the crops had by this time become dry, although the color of the leaves had not undergone much change. It was therefore thought advisable to dip the tobacco in water so the leaf could heat up quickly and a change in the color be brought about. As a result of this operation the temperature of the bulk increased more rapidly, and on November 1 it had reached 50° C. It continued at this temperature for five days, or until November 6, when the temperature rose 1 degree. It declined to 50° C. again on the succeeding day and remained stationary until November 9, when it gradually fell to 44° C., reaching that figure on November 12. The tobacco had by this time



taken on a finished appearance, and the raw odor which was noticeable when the bulk was first turned had entirely disappeared, the tobacco at this time having a sweet, aromatic smell, which indicated that the process of fermentation was nearly completed.

On November 15 the bulk was turned for the last time. All the tobacco was sprayed lightly, and on November 28 the temperature had risen to 43° C., remaining stationary until November 29, when it fell gradually until December 5, on which date the thermometer registered 40° C. On this date the middle leaves on the north-field and east-field crops were taken out of the bulk to be graded, as this tobacco had become thoroughly fermented.

The following table gives the temperature of the bulk during fermentation. In the early part of the process two thermometers were used, but after October 21 another was inserted in the bulk. These thermometers are designated in the table as "A," "B," and "C."

*Temperature of bulks during fermentation.*

| Date.     | A.  | B.  | Date.                   | A.  | B.  | Date.             | A.  | B.  | Date.              | A.    | B.    |
|-----------|-----|-----|-------------------------|-----|-----|-------------------|-----|-----|--------------------|-------|-------|
|           | °C. | °C. |                         | °C. | °C. |                   | °C. | °C. |                    | °C.   | °C.   |
| Sept. 8.. | 39  | 35  | Sept. 19 <sup>a</sup> . | 40  | 42  | Sept. 30..        | 41  | 40  | Oct. 11..          | 39    | 40    |
| 9..       | 42  | 38  | 20..                    | 35  | 35  | Oct. 1..          | 41  | 40  | 12..               | 39    | 41    |
| 10..      | 43  | 40  | 21..                    | 35  | 35  | 2..               | 40  | 39  | 13..               | 40    | 41    |
| 11..      | 44  | 41  | 22..                    | 36  | 37  | 3 <sup>a</sup> .. | 40  | 39  | 14..               | 40    | 41    |
| 12..      | 44  | 42  | 23..                    | 38  | 38  | 4..               | 32  | 35  | 15..               | 40    | 40    |
| 13..      | 43  | 42  | 24..                    | 40  | 39  | 5..               | 32  | 35  | 16..               | 40    | 40    |
| 14..      | 42  | 43  | 25..                    | 41  | 40  | 6..               | 33  | 37  | 17..               | 40    | 40    |
| 15..      | 42  | 43  | 26..                    | 42  | 40  | 7..               | 35  | 38  | 18 <sup>a</sup> .. | 39    | 39    |
| 16..      | 41  | 42  | 27..                    | 44  | 41  | 8..               | 36  | 39  | 19 <sup>a</sup> .. | ..... | ..... |
| 17..      | 40  | 42  | 28..                    | 44  | 42  | 9..               | 37  | 39  | 20 <sup>a</sup> .. | ..... | ..... |
| 18..      | 40  | 42  | 29..                    | 42  | 41  | 10..              | 38  | 40  | 21 <sup>b</sup> .. | ..... | ..... |

| Date.        | A.  | B.  | C.  | Date.                 | A.    | B.    | C.    | Date.        | A.  | B.  | C.  |
|--------------|-----|-----|-----|-----------------------|-------|-------|-------|--------------|-----|-----|-----|
|              | °C. | °C. | °C. |                       | °C.   | °C.   | °C.   |              | °C. | °C. | °C. |
| Oct. 22..... | 38  | 35  | 35  | Nov. 6.....           | 51    | 43    | 41    | Nov. 21..... | 34  | 34  | 44  |
| 23.....      | 40  | 35  | 35  | 7.....                | 50    | 44    | 41    | 22.....      | 38  | 37  | 44  |
| 24.....      | 44  | 36  | 35  | 8.....                | 50    | 43    | 41    | 23.....      | 40  | 38  | 45  |
| 25.....      | 48  | 36  | 36  | 9.....                | 50    | 43    | 40    | 24.....      | 42  | 39  | 45  |
| 26.....      | 49  | 38  | 36  | 10.....               | 48    | 42    | 41    | 25.....      | 44  | 40  | 45  |
| 27.....      | 46  | 40  | 36  | 11.....               | 46    | 41    | 41    | 26.....      | 44  | 41  | 45  |
| 28.....      | 45  | 41  | 37  | 12 <sup>a</sup> ..... | 44    | 40    | 41    | 27.....      | 43  | 41  | 45  |
| 29.....      | 45  | 41  | 38  | 13.....               | ..... | ..... | ..... | 28.....      | 43  | 41  | 45  |
| 30.....      | 44  | 38  | 38  | 14.....               | ..... | ..... | ..... | 29.....      | 43  | 41  | 44  |
| 31.....      | 44  | 38  | 38  | 15.....               | 28    | 28    | 30    | 30.....      | 42  | 41  | 43  |
| Nov. 1.....  | 50  | 39  | 39  | 16.....               | 28    | 28    | 30    | Dec. 1.....  | 42  | 40  | 42  |
| 2.....       | 50  | 41  | 40  | 17.....               | 28    | 28    | 32    | 2.....       | 42  | 40  | 42  |
| 3.....       | 50  | 41  | 40  | 18.....               | 29    | 29    | 36    | 3.....       | 41  | 40  | 42  |
| 4.....       | 50  | 41  | 40  | 19.....               | 30    | 30    | 40    | 4.....       | 41  | 40  | 42  |
| 5.....       | 50  | 42  | 40  | 20.....               | 31    | 32    | 43    | 5.....       | 40  | 40  | 41  |

<sup>a</sup> Bulk turned.

<sup>b</sup> Third thermometer put in bulk.

## GRADING AND BALING.

After it had been thoroughly fermented the tobacco was assorted into three grades, namely, heavy, flimsy, and broken filler. The first two grades represented perfect leaves, the only difference in the leaves being that those classed as heavy filler contained more body than those placed in the flimsy grade. The broken filler consisted of imperfect leaves from both the heavy and light leaves, which because of this condition would not command as high a price as the other two grades.

These grades were again divided, according to length of leaf, as follows: The first grade contained all leaves 16 inches long, the second 14 inches, and the third 12 inches. In this classification the 14 and 16 inch lengths represent the most desirable leaf. After the tobacco had been graded and sized it was tied into hands containing from 40 to 50 leaves, according to the length of the leaf. Four of these hands were tied together into carrots; that is, four hands of equal length were tied together, the heads being even, and the tobacco wrapped from head to tip with Cuban bast. Each of these carrots weighed from 1 to 1½ pounds, according to the size of the leaf, texture, etc. As soon as a sufficient number of carrots were made they were packed 80 in a bale made of yajuas bark, this being the trade package for all southern-grown filler tobacco.

The bales of tobacco were stacked in piles 5 bales high and kept in a warm room to allow the leaf to undergo the process of aging. Each week the position of the bales was reversed until the tobacco had become well aged.

## COST OF PRODUCTION.

The cost of production of the several crops grown in the 1904 experiments varied from 19.3 cents per pound in the case of the north field, Nacogdoches, to 26.4 cents in the case of the east field. The Giddings crop was produced at a cost of 19.7 cents, and the Crockett crop at 21.3 cents. The higher figure for the east field is due in part to a lower rate of yield, but an extraordinary expense of \$54.15 for rent of curing barn is the chief cause of the greater cost of production in this instance. Eliminating this item would reduce the cost per pound to 24.4 cents, or about 3 cents per pound more than the average cost for all the crops. The rent of barns in the case of the other fields was included in the rent of the land.

Owing to local differences in the climatic conditions, as well as to the different types and state of productiveness of the soils, there was quite a wide range in the rates of yield in the several fields. The heaviest yield, 749 pounds, was obtained from the north field at Nacogdoches, from the Orangeburg fine sandy loam, which had been maintained in good condition during earlier cultivation, and had received an application of stable manure for several years past, during

which it had been planted in corn. The lowest rate of yield, 518 pounds, was obtained from the Giddings field. Part of this field, as already stated, had been used for cotton, and from the appearance of the stalks was not in a very productive condition.

The total production from the  $8\frac{3}{4}$  acres harvested was 5,461 pounds, or an average yield per acre of 624.1 pounds. The total cost of production was \$1,180.78, or 21.6 cents per pound.

There is no doubt whatever that the farmer can grow this tobacco at a much lower cost than in these experimental crops, in which all the labor and teams were hired at very liberal prices, a cash rental paid for the land and barns, and much experimental work performed by the Bureau's own force, which is charged at the uniform rate of 10 cents per hour, and materially increases the cost of production as given in the following tables. It is believed that the farmer having all the facilities on his plantation can grow this tobacco at a cost not exceeding 10 cents a pound. In fact, an estimate based upon the foregoing statement of expenditures and other data gathered during the progress of this work in Texas indicates that the tobacco can be produced, under normal conditions, and with a minimum yield of 600 pounds, for less than 10 cents a pound.

The following statements give a detailed account of the actual expenses incurred by the Department in the production of Cuban seed filler leaf tobacco on each of the four experimental fields:

*Nacogdoches—North field.*

|  |         |
|--|---------|
| Seed .   |         |
| Labor, 150 hours, at 10 cents an hour .....                                | \$15.00 |
| Team hire, 35 hours, at 10 cents an hour .....                             | 3.50    |
| Fertilizer, 1 sack cotton-seed meal, at \$1.25 .....                       | 1.25    |
| Tools—axes, wedges, rakes (cost \$4), good for two years .....             | 2.00    |
| Tools—weeding hoes, buckets, watering cans (\$2.10), good for two years .. | 1.05    |
| Tools—hatchets, wire, nails (\$1.30), good for two years .....             | .65     |
|  | 23.45   |
| <hr/>  |         |
| Preparing land:  |         |
| Fertilizer, 18 loads stable manure, at \$1 a load .....                    | 18.00   |
| Teams, 65 hours, at 10 cents an hour .....                                 | 6.50    |
| Labor, 85 hours, at 10 cents an hour .....                                 | 8.50    |
|  | 33.00   |
| <hr/>  |         |
| Transplanting:   |         |
| Labor, 130 hours, at 10 cents an hour .....                                | 13.00   |
| Team hire, 110 hours, at 10 cents an hour .....                            | 11.00   |
| Tools—buckets, baskets, dippers, barrels (\$2.20), good for two years .... | 1.10    |
|  | 25.10   |
|  | 25.10   |

<sup>a</sup> In the recapitulation only one-half the cost of this seed bed is charged against this field, the remainder forming an item in the expenditures for the east field.

## Field culture:

|  |               |
|--|---------------|
| Labor, 260 hours, at 10 cents an hour .....                            | \$26. 00      |
| Team hire, 140 hours, at 10 cents an hour .....                        | 14. 00        |
| Tools—plow stock, sweeps, shovels (\$2.40), good for three years ..... | . 80          |
| Paris green .....  | 5. 00         |
| Corn meal (used with Paris green) .....                                | 3. 85         |
|  | <u>49. 65</u> |

## Suckering and harvesting:

|  |               |
|--|---------------|
| Labor, 500 hours, at 10 cents an hour .....                  | 50. 00        |
| Team hire, 85 hours, at 10 cents an hour .....               | 8. 50         |
| Tools—tobacco knives, spears (\$2), good for two years ..... | 1. 00         |
| 2,000 tobacco sticks (\$6), good for three years .....       | 2. 00         |
|  | <u>61. 50</u> |

## Curing and stripping:

|   |               |
|---|---------------|
| Half cord pine wood, at \$3 a cord .....      | 1. 50         |
| Labor, 330 hours, at 10 cents an hour .....   | 33. 00        |
| Team hire, 6 hours, at 25 cents an hour ..... | 1. 50         |
|   | <u>56. 00</u> |

## Other expenses:

|   |               |
|---|---------------|
| Rent of 1 $\frac{3}{4}$ acres of land .....           | 7. 00         |
| Lumber for barns (\$26.46), good for four years ..... | 6. 61         |
| Nails, hinges, tacks, etc .....                       | 2. 50         |
|   | <u>16. 11</u> |

*Recapitulation of expenditures at north field.*

| Item.                          | Total cost.     | Cost per pound on 1,311 pounds. |
|--------------------------------|-----------------|---------------------------------|
|                                | <i>Dollars.</i> | <i>Cents.</i>                   |
| Raising plants .....           | 11. 72          | 0. 8                            |
| Preparing land .....           | 33. 00          | 2. 6                            |
| Transplanting .....            | 25. 10          | 1. 9                            |
| Field culture .....            | 49. 65          | 3. 8                            |
| Suckering and harvesting ..... | 61. 50          | 4. 7                            |
| Curing and stripping .....     | 56. 00          | 4. 3                            |
| Other expenses .....           | 16. 11          | 1. 2                            |
| Total .....                    | 253. 08         | 19. 3                           |

*Nacogdoches—East field.*

|  |       |              |
|--|-------|--------------|
| Seed bed:  |       |              |
| One-half cost of Nacogdoches seed bed.....                             |       | \$11.73      |
| Preparing land:  |       |              |
| Fertilizer, 16 loads stable manure, at \$1 a load.....                 | 16.00 |              |
| Team hire, 85 hours, at 10 cents an hour.....                          | 8.50  |              |
| Labor, 135 hours, at 10 cents an hour.....                             | 13.50 |              |
|  |       | <u>38.00</u> |
| Transplanting:   |       |              |
| Labor, 200 hours, at 10 cents an hour.....                             | 20.00 |              |
| Team hire, hauling, 70 hours, at 30 cents an hour.....                 | 21.00 |              |
| Team hire, plow teams, 65 hours, at 10 cents an hour.....              | 6.50  |              |
| Tools—buckets, baskets, dippers, plowers (\$3.35)—good for two years.. | 1.67  |              |
|  |       | <u>49.17</u> |
| Field culture:   |       |              |
| Labor, 495 hours, at 10 cents an hour.....                             | 49.50 |              |
| Team hire, 105 hours, at 10 cents an hour.....                         | 10.50 |              |
| Paris green and corn meal.....   | 8.20  |              |
|  |       | <u>68.20</u> |
| Suckering and harvesting:  |       |              |
| Labor, 565 hours, at 10 cents an hour.....                             | 56.50 |              |
| Tools—tobacco knives, spears (\$2), good for two years.....            | 1.00  |              |
| Team hire, 92½ hours, at 10 cents an hour.....                         | 9.25  |              |
| 2,000 tobacco sticks (\$6), good for three years.....                  | 2.00  |              |
|  |       | <u>68.75</u> |
| Curing and stripping:  |       |              |
| Labor, 272½ hours, at 10 cents an hour.....                            | 27.25 |              |
| Team hire, 45 hours, at 10 cents an hour.....                          | 4.50  |              |
|  |       | <u>31.75</u> |
| Other expenses:  |       |              |
| Rent of 3 acres of land.....   | 18.00 |              |
| Rent of barn, two months and five days, at \$25 a month.....           | 54.15 |              |
| Lumber to prepare barn (\$7), good for two years.....                  | 3.50  |              |
| Nails and hinges.....  | .50   |              |
|  |       | <u>76.15</u> |

*Recapitulation of expenditures at east field.*

| Item.                         | Total cost. |        |
|-------------------------------|-------------|--------|
|                               | Dollars.    | Cents. |
| Seed bed.....                 | 11.73       | 0.9    |
| Preparing land.....           | 38.00       | 2.9    |
| Transplanting.....            | 49.17       | 3.8    |
| Field culture.....            | 68.20       | 5.3    |
| Suckering and harvesting..... | 68.75       | 5.3    |
| Curing and stripping.....     | 31.75       | 2.4    |
| Other expenses.....           | 76.15       | 5.8    |
| Total.....                    | 343.75      | 26.4   |

*Giddings field.*

Seed bed:

|   |         |
|---|---------|
| Labor, 72½ hours, at 10 cents an hour.....                                | \$7. 25 |
| Team hire, 10 hours, at 10 cents an hour.....                             | 1. 00   |
| Tools—axes, hoes, rakes, buckets, cloth (\$24.25) good for three years... | 8. 08   |
| Tools—barrels, pipe fixtures.....   | 2. 20   |
| Fertilizer, 100 pounds cotton-seed meal.....                              | 1. 25   |
|   | <hr/>   |
|   | 19. 78  |

Preparing land:

|   |        |
|---|--------|
| Fertilizer, 33 loads manure, at \$1 a load.....                       | 33. 00 |
| Team hire, 85 hours, at 10 cents an hour.....                         | 8. 50  |
| Labor, 152½ hours, at 10 cents an hour.....                           | 15. 25 |
| Tools—plows, sweeps, shovels, hoes (\$8.25) good for three years..... | 2. 75  |
|   | <hr/>  |
|   | 58. 50 |

Transplanting:

|  |        |
|--|--------|
| Labor, 240 hours, at 10 cents an hour.....                       | 24. 00 |
| Team hire, hauling, 40 hours, at 20 cents an hour.....           | 8. 00  |
| Tools—barrels, baskets, buckets (\$1.50) good for two years..... | . 75   |
| Express on plants.....   | 4. 60  |
|  | <hr/>  |
|  | 37. 35 |

Cultivation:

|   |        |
|---|--------|
| Labor, 380 hours, at 10 cents an hour.....              | 38. 00 |
| Team hire, 70 hours, at 10 cents at hour.....           | 7. 00  |
| Tools—sweeps (\$0.80) good for two years.....           | . 40   |
| One knapsack spray pump (\$3) good for three years..... | 1. 00  |
| Paris green and corn meal.....                          | 4. 00  |
|   | <hr/>  |
|   | 50. 40 |

Suckering and harvesting:

|  |        |
|--|--------|
| Labor, 540 hours, at 10 cents an hour.....                     | 54. 00 |
| Team hire, hauling, 80 hours, at 25 cents an hour.....         | 20. 00 |
| Tools—tobacco knife, 2 spears (\$1.50) good for two years..... | . 75   |
| 4,000 tobacco sticks (\$18) good for three years.....          | 6. 00  |
|  | <hr/>  |
|  | 80. 75 |

Curing and stripping:

|  |        |
|--|--------|
| Labor, 315 hours, at 10 cents an hour.....       | 31. 50 |
| Team hire, 10 hours, at 10 cents an hour.....    | 1. 00  |
| Tobacco boxes (\$2.75) good for three years..... | . 92   |
|  | <hr/>  |
|  | 33. 42 |

*Recapitulation of expenditures at Giddings.*

| Item.                         | Total cost.     | Cost per pound on 1,425 pounds. |
|-------------------------------|-----------------|---------------------------------|
|                               | <i>Dollars.</i> | <i>Cents.</i>                   |
| Seed bed.....                 | 19. 78          | 1. 4                            |
| Preparing land.....           | 58. 50          | 4. 1                            |
| Transplanting.....            | 37. 35          | 2. 6                            |
| Cultivation.....              | 50. 40          | 3. 5                            |
| Suckering and harvesting..... | 80. 75          | 5. 7                            |
| Curing and stripping.....     | 33. 42          | 2. 6                            |
| Total.....                    | 279. 20         | 19. 7                           |

*Crockett field.*

## Seed bed:

|   |              |
|---|--------------|
| Tools—cloth, rakes, hatchet (\$23.18), good for three years ..... | \$7.73       |
| Fertilizer, 100 pounds cotton seed meal .....                     | 1.25         |
| Labor, 80 hours, at 10 cents an hour .....                        | 8.00         |
|   | <u>16.98</u> |

## Preparing land:

|   |              |
|---|--------------|
| Fertilizer, one-fourth ton cotton-seed meal and one-fourth ton hulls..... | 6.50         |
| Labor, 117½ hours, at 10 cents an hour.....                               | 11.75        |
| Team hire, 95 hours, at 10 cents an hour.....                             | 9.50         |
|   | <u>27.75</u> |

## Transplanting:

|   |              |
|---|--------------|
| Labor, 380 hours, at 10 cents an hour .....                           | 38.00        |
| Team hire, 115 hours, at 10 cents an hour .....                       | 11.50        |
| Tools—plows, hoes, barrels, buckets (\$2.85), good for two years..... | 1.42         |
|   | <u>50.92</u> |

## Cultivation:

|  |              |
|--|--------------|
| Labor, 375 hours, at 10 cents an hour .....          | 37.50        |
| Team hire, 115 hours, at 10 cents an hour.....       | 11.50        |
| Tools—plows, hoes (\$2.85), good for two years ..... | 1.42         |
| Fertilizer, 1 ton cotton-seed meal.....              | 34.40        |
| Paris green and corn meal.....                       | 4.00         |
|  | <u>88.82</u> |

## Suckering and harvesting:

|  |              |
|--|--------------|
| Labor, 530 hours, at 10 cents an hour.....                 | 53.00        |
| Team hire, 30 hours, at 25 cents an hour .....             | 7.50         |
| Tools—tobacco knife, spears (\$2) good for two years ..... | 1.00         |
|  | <u>61.50</u> |

## Curing and stripping:

|   |              |
|---|--------------|
| Labor, 467½ hours, at 10 cents an hour.....               | 46.75        |
| Team hire, hauling, 20 hours, at 20 cents an hour.....    | 4.00         |
| Tobacco boxes (\$3.60) good for three years.....          | 1.20         |
| 5,000 tobacco sticks (\$17.50) good for three years ..... | 5.83         |
|   | <u>57.78</u> |

*Recapitulation of expenditures at Crockett.*

| Item.                          | Total cost. | Cost per pound on 1,425 pounds. |        |
|--------------------------------|-------------|---------------------------------|--------|
|                                |             | Dollars.                        | Cents. |
| Seed bed .....                 | 16.98       |                                 | 1.2    |
| Preparing land.....            | 27.75       |                                 | 2.0    |
| Transplanting .....            | 50.92       |                                 | 3.6    |
| Cultivation .....              | 88.82       |                                 | 6.2    |
| Suckering and harvesting ..... | 61.50       |                                 | 4.3    |
| Curing and stripping .....     | 57.78       |                                 | 4.1    |
| Total.....                     | 304.75      |                                 | 21.3   |

*General summary, showing areas planted and harvested, yields, and cost of production.*

| Field.           | Area planted. | Area har-<br>vested. | Total pro-<br>duction. | Total<br>cost.  | Average<br>yield per<br>acre. | Cost per<br>pound. <sup>a</sup> |
|------------------|---------------|----------------------|------------------------|-----------------|-------------------------------|---------------------------------|
|                  | <i>Acres.</i> | <i>Acres.</i>        | <i>Pounds.</i>         | <i>Dollars.</i> | <i>Pounds.</i>                | <i>Cents.</i>                   |
| North field..... | 1.75          | 1.75                 | 1,311                  | 253.08          | 749.0                         | 19.3                            |
| East field.....  | 3.00          | 2.25                 | 1,300                  | 343.75          | 577.0                         | 26.4                            |
| Giddings.....    | 3.00          | 2.75                 | 1,425                  | 279.20          | 518.0                         | 19.7                            |
| Crockett.....    | 3.00          | 2.00                 | 1,425                  | 304.75          | 712.0                         | 21.3                            |
| Total.....       | 10.75         | 8.75                 | 5,461                  | 1,180.78        | 624.1                         | 21.6                            |

<sup>a</sup> The cost of production per pound given in the above table is for the barn-cured product and not for the fermented leaf. An additional cost of about 6 cents a pound must be added to give the cost of the finished leaf. As the fermentation of tobacco is a separate business from that of growing and not generally practiced by the farmer, this Bulletin has not gone into the details of the cost of this part of the work.

*Estimated cost of growing a commercial crop of 10 acres of Cuban seed filler upon a well-equipped farm.*

Permanent investment:

|  |          |
|--|----------|
| 10 acres of land, at \$10 an acre.....           | \$100.00 |
| 500 yards seed-bed cloth, at 3 cents a yard..... | 15.00    |
| Tools—plows, hoes, spray can, etc.....           | 23.75    |
| Tobacco sticks, 18,000, at \$3.50 per M.....     | 63.00    |
| 20 boxes, at 25 cents a box.....                 | 5.00     |
| Barn, 40 by 100 feet.....                        | 600.00   |
|  | 806.75   |

Operating expenses:

Seed bed—

|   |        |
|---|--------|
| 10 ounces tobacco seed, at 50 cents an ounce..... | \$5.00 |
| Labor, 30 days, at 75 cents a day.....            | 22.50  |
|   | 27.50  |

Preparing land—

|  |        |
|--|--------|
| 100 loads manure, <sup>a</sup> at 25 cents a load..... | 25.00  |
| Hauling manure, at 50 cents a load.....                | 50.00  |
| Team hire, 20 days, at 50 cents a day.....             | 10.00  |
| Labor, 25 days, at 75 cents a day.....                 | 18.75  |
|  | 103.75 |

Transplanting—

|  |       |
|--|-------|
| Labor, 30 days, at 75 cents a day..... | 22.50 |
| Team hire, at 50 cents a day.....      | 1.00  |
|  | 23.50 |

Cultivation—

|  |       |
|--|-------|
| Labor, 100 days, at 75 cents a day.....    | 75.00 |
| Team hire, 25 days, at 50 cents a day..... | 12.50 |
|  | 87.50 |

<sup>a</sup> Although the Bureau used stable manure in these experiments wherever it was possible, it is believed that a larger yield of tobacco can be obtained by the use of 1,200 pounds of cotton-seed meal and 200 pounds of high-grade sulphate of potash, which will give about 73 pounds of nitrogen, 20 pounds of phosphoric acid, and 98 pounds of potash to the acre. On the basis of a yield of 600 pounds of tobacco to the acre, which is lower than the average yield obtained by these experiments, the cost of the production by using this fertilizer would be 10½ cents per pound.



## Operating expenses—Continued.

|   |         |
|---|---------|
| Poisoning—  |         |
| 30 pounds Paris green, at 20 cents a pound .....                | \$6.00  |
| 5 bushels corn meal, at 60 cents a bushel.....                  | 3.00    |
| Labor, 14 days, at 75 cents a day .....                         | 10.50   |
|   | \$19.50 |
| Harvesting—   |         |
| Labor, 60 days, at 75 cents a day .....                         | 45.00   |
| Hauling, 10 days, at \$1.50 a day.....                          | 15.00   |
|   | 60.00   |
| Stripping and tying—  |         |
| Labor, 100 days, at 75 cents a day .....                        | 75.00   |
| Deterioration in tools, sticks, and cloth during year.....      | 15.00   |
| Interest on investment, at 10 per cent.....                     | 80.67   |
| Total operating expenses.....                                   | 492.42  |
| Value of 6,000 pounds of leaf tobacco, at 15 cents a pound..... | 900.00  |
| Operating expenses.....   | 492.42  |
| Profit over operating expenses .....                            | 407.58  |
| Per cent of profit on permanent investment (\$806.75).....      | 50.5    |

## RESULTS OF THE SALE OF THE 1903 CROP.

In order to ascertain the opinion of the trade as to the qualities and commercial value of the tobacco grown in Texas, and to determine the possibilities of establishing its production upon a commercial scale, the Bureau deemed it advisable to place the crop of 1903 upon the market. Arrangements were made with Mr. Herman G. Vetterlein, of Philadelphia, to undertake the sale of this tobacco. In the fall of 1904 the Department issued a catalogue showing the number of bales of the various grades of tobacco in its possession, and these catalogues, with samples of the leaf, were widely distributed. The Department had no interest in the proceeds of the sale, all money received less the broker's commission of \$1 per bale being turned over to the owners of the tobacco at Nacogdoches, Lufkin, and Woodville.

The first tobacco taken was a part of the crop grown at Woodville, Tex., 5 bales of heavy filler of this crop being sold at 40 cents per pound to a firm of manufacturers, who requested that 15 bales additional should be reserved for their use. Sales of single bales continued throughout the fall and winter of 1904, and by the middle of January, 1905, all the tobacco had been disposed of.

Judging from the letters received by the Department from various firms purchasing the tobacco, it seems to have given satisfaction, although some complain that it is not as aromatic nor as smooth as the Cuban leaf. In nearly every case the manufacturers agree that the leaf is the best domestic filler they have ever tested, and predict a future for it if produced at reasonable prices. There was one exception to this opinion, in the case of a firm who did not think the quality of the leaf as good as the tobacco now being grown in Pennsylvania.

In the New York Tobacco Leaf, of November 30, 1904, the following statement appeared from the firm of S. R. Moss & Co., who are large cigar manufacturers in Lancaster, Pa.:

S. R. Moss & Co., manufacturers, recently received samples of Havana seed tobacco from the Government experiment stations in Texas, with the request that they be made up into cigars and their quality tested. William Levy, superintendent of the factory, one of Lancaster's leading authorities on tobacco, made the samples up into cigars, and all who have tested them speak in terms of praise of the article. Mr. Levy has no hesitancy in declaring that tobacco like these samples would take rank in the trade for fillers.

The following letters have been received from Hettermann Bros. Co., Louisville, Ky.; L. P. De Mouche, manager of the Nacogdoches Cigar Company; and Otto Eisenlohr & Bros., of Philadelphia, Pa. The report of Mr. H. G. Vetterlein on the sale of the leaf is also given:

LOUISVILLE, KY., *March 5, 1905.*

DEAR SIR: In receipt of yours of the 1st. Yes; we had several samples from Mr. Vetterlein of the tobacco grown in Texas, and we find it good tobacco; and the continual experimenting, we should think, would convince the farmers that they grow good tobacco, and would also convince the manufacturer that the tobacco grown in that State is of very good quality and will make a very satisfactory cigar.

If there is any other particular question you would like to have answered, command us.

Very truly yours,

HETTERMANN BROS. CO.

Mr. MILTON WHITNEY, *Washington, D. C.*

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NACOGDOCHES, TEX., *March 6, 1905.*

DEAR SIR: Your letter received and contents fully noted. I have thoroughly tested the Nacogdoches tobacco, and the more I find out about the goods the better I like it. I have been working hard experimenting, and as you know I have worked in all the tobacco grown in the United States and, notwithstanding that this country is in its infancy, I predict that with experienced men for curing the tobacco, we will beat Havana within five years.

Yours, truly,

LOUIS P. DE MOUCHE,  
*General Manager Nacogdoches Cigar Company.*

MILTON WHITNEY,

*Chief of Bureau, Washington, D. C.*

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PHILADELPHIA, PA., *March 2, 1905.*

DEAR SIR: Your communication of the 1st instant at hand and contents carefully noted.

In reply to same, would say that we have given the tobacco of which you speak a thorough test. We find, however, that the quality is not good enough to use as a substitute for Havana tobacco, in fact it is hardly equal to the filler tobaccos which are grown in the better sections of Pennsylvania.

We have only worked a small portion of the bale. The remainder we still have in stock and will eventually work it with the other seed fillers.

Trusting that this information will be of service to you, we are,

Yours, very truly,

OTTO EISENLOHR & BROS.

Mr. MILTON WHITNEY,

*United States Department of Agriculture, Washington, D. C.*

PHILADELPHIA, PA., *February 23, 1905.*

DEAR SIR: The tobacco raised in Texas under the supervision of the Bureau of Soils, being now sold, I would herewith report that while there was a very complete and thorough distribution of the catalogues calling attention of the manufacturers of cigars and dealers in leaf tobacco to the experiments made in the above-mentioned State, the demand for samples to test the merits of this tobacco was not as great as one would expect, and this can readily be accounted for by the fact that the manufacturers of cigars are loath to take up anything new or different to what they have been using, for fear of injuring their established brands of cigars, the results of years of work and expense.

However, various bales and samples have been sufficiently distributed to warrant the statement that the Department has succeeded in raising a superior piece of filler tobacco, part of it being smooth and mellow in taste and flavor, and part of it being with a trifle more body, but both being very suitable for mixing with Habana or even using it entirely clear, and with the continuance of the care in raising and handling of it, and with the natural improvement that one would expect in its continual production, in the end it should find a position in the market where its merits should create a satisfactory demand.

To secure this desirable result it will be necessary for the growers to be satisfied with small profits in the beginning, and prices should be made accordingly, so as to invite purchasers.

Inclosed you will find a statement of how the tobaccos raised by your Department have been sold, and with kind regards, I remain,

Yours, truly,

HERMAN G. VETTERLEIN.

Prof. MILTON WHITNEY, *Washington, D. C.*

*Statement of tobacco grown in Texas under the supervision of the Bureau of Soils, and sold by Herman G. Vetterlein.*

Nacogdoches Tobacco Company, Nacogdoches, Tex.:

Berger crop—

|   |           |           |
|---|-----------|-----------|
| 11 bales, 858 pounds net, at 28 cents ..... | \$240. 24 |           |
| Commission, at \$1 per bale .....           | 11. 00    |           |
|   |           | \$229. 24 |

Radeliff crop—

|   |         |         |
|---|---------|---------|
| 13 bales, 1,206 pounds net, at 30 cents ..... | 361. 80 |         |
| Commission, at \$1 per bale .....             | 13. 00  |         |
|   |         | 348. 80 |

Roberts & Reed, Woodville, Tex.:

Roberts & Reed crop—

|  |         |         |
|--|---------|---------|
| 1 bale, 62 pounds net, at 30 cents .....   | 18. 60  |         |
| 5 bales, 463 pounds net, at 40 cents ..... | 185. 20 |         |
|  |         | 203. 80 |
| Commission, at \$1 per bale .....          | 6. 00   |         |
|  |         | 197. 80 |

Bale No. 3, 114 pounds net, retained by Department.

J. F. Davis, Lufkin, Tex.:

Davis crop—

|  |        |         |
|--|--------|---------|
| 1 bale, 72 pounds net, at 40 cents .....   | 28. 80 |         |
| 4 bales, 339 pounds net, at 30 cents ..... | 94. 92 |         |
|  |        | 123. 72 |
| Commission, at \$1 per bale .....          | 5. 00  |         |
|  |        | 118. 72 |

|             |  |         |
|-------------|--|---------|
| Total ..... |  | 894. 56 |
|-------------|--|---------|

It will be noticed that the prices received for this tobacco range from 28 to 40 cents a pound. These prices are for the finished product, and cover not only the original cost of growing the tobacco, and the expense of fermenting, sorting, and packing, but also the shrinkage in weight and other losses incident to these operations.

The Department does not deem it advisable for the farmer to attempt the fermentation and packing of his tobacco. It believes that it will be much better for him to sell his crop at 15 cents a pound in the bundle, direct from the curing barn, to the leaf dealer or warehouseman, than to incur the extra expenses and stand the risk of loss of the crop through lack of experience in fermenting the tobacco.

The Department, having demonstrated by the investigation set forth in this report that a good domestic filler tobacco can be grown on the Orangeburg soils in east Texas, issued in January, 1905, a circular giving a brief outline of the work and showing the opportunities for the production of a cigar leaf tobacco in east Texas; and this season (1905) about 150 acres are being grown on the Orangeburg soils in Nacogdoches, Anderson, and Houston counties by the farmers. A firm having large interests in the tobacco business in Chicago, Ill., and Gadsden County, Fla., has agreed to purchase from the growers at a remunerative price all the tobacco produced, as soon as it shall have been barn cured. It therefore appears that in the course of a few years, if the industry be conducted on a conservative basis, the growing and packing of tobacco can become an important industry of east Texas.



