SOIL SURVEY IN THE CONNECTICUT VALLEY.

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INTRODUCTION.

In the present appropriation bill for the United States Department of Agriculture, Congress has specifically authorized the mapping of the soils of the principal tobacco areas of the United States. On the 1st of July, 1899, the Secretary of Agriculture authorized this work to be started in the Connecticut Valley. About three and a half months were spent in surveying the soils of a portion of the valley.

The area is comprised within north latitude 41° 40′ and 42° 17′, and west longitude 72° 30′ and 72° 45′. It extends from South Glastonbury, Conn., where the valley pinches together, northward for a distance of about 41 miles, to Bachelor Brook, in South Hadley, Mass., where the Mount Holyoke range of mountains completely separates it from the extension of the valley from Northhampton northward into Vermont. The valley has an average width of from 5 to 10 miles on either side of the Connecticut River. The area surveyed and mapped comprised approximately 400 square miles, or 256,000 acres.

The object of the work was primarily to investigate and map the different tobacco soils, but incidentally all soil areas were surveyed. Rather full notes were taken as to the general condition of agricultural practice in the valley, the condition of labor, the improved implements used, the construction of barns and other farm buildings, transportation, and other matters contributing to the agricultural features of the locality. Particular attention was paid to the kind of tobacco and the influence of the different soils upon the texture and quality of the tobacco. As this soil work, however, is but the basis of a very extensive and systematic investigation into the physiology of the tobacco, and into the possibilities of changing the type and character of the tobacco through cultural methods and fermentation by the tobacco expert of the division, many of these notes will be reserved for future publication by the division, enough only being given here to make the soil work intelligible and interesting.

One feature which has been very clearly recognized in the course of the survey is the continual and rapid encroachment of city and suburban development for summer residences and for industrial purposes.

Many extensive areas which were formerly considered agricultural lands are now built up or held for speculative purposes for residence or industrial pursuits.

TOPOGRAPHY OF THE VALLEY.

The Connecticut Valley is bounded on either side by hills rising to an elevation of 50 to 100 feet above sea level in the neighborhood of Hartford, and to a little over 500 feet in the northern extension of the area. The difference in the elevation of the river from the upper to the lower portion of the area is but slight, and few falls or rapids occur within this distance. Some water power, however, is developed at a few places along the river. The country is level or gently rolling, sloping gradually back to the high rounded hills and low mountains which form the boundaries of the valley. At places there are still well-defined terraces with sharp escarpments with elevations varying from 10 to 100 feet above sea level.

GEOLOGY.

The origin of the soils is partly glacial, which is seen in the great drumlins, or hogbacks as they are called, and the heterogeneous mass of bowlders, sand, and clay bordering the valley and derived from all sorts of rocks; and partly from a shallow glacial lake which is supposed to have spread out over the valley from a dam somewhere below Hartford. Into this lake sediment was brought by rivers and streams. This sediment was sorted over and spread out more or less evenly over the bottom of the lake. As is usual in such cases the deeper and quieter portions of the lake received the finer sand and clays, while the coarse sand and gravels were deposited near the shore line and near the mouths of rivers. These deposits were evidently laid down during the glacial epoch, as arctic plants and leaves are occasionally found in the thin layers of clay and shale, indicating a very different climate than that which now prevails.

After the lake was drained the Connecticut River and its tributaries commenced cutting a series of terraces through the valley. These terraces are not very well preserved, and can not be followed for any great distance, but they are very plain in certain parts of the valley. The character of the formations laid down in these two ways will be described more at length in connection with the soils.

CLIMATE.

The temperature of the Connecticut Valley ranges from 56° F. in May, to 61° in September, with an average of 70° in July, which is the hottest month of the year. The mean maximum temperature ranges from 69° in May to 82° in July, with a mean daily range of 20°. There is on an average about 4.5 inches of rainfall during each month of this

growing season, while the mean relative humidity during June, July, and August is about 70 per cent.

Comparing these conditions with the climatic conditions of the other tobacco districts of Cuba, Sumatra, Florida, and Pennsylvania, it would seem that the temperature is sufficiently high for the production of either a wrapper or filler leaf. The rainfall appears to be sufficient, provided it is well distributed during the season; but the daily range in temperature is much greater than occurs in either Cuba or Sumatra, and this very likely has a great deal to do with the character of the leaf. With so great a daily range it would tend to thicken the leaf and increase the body. This is counterbalanced, to a large extent, by the light, sandy character of the soil, which is naturally adapted to the production of a thin leaf, provided a rapid and uninterrupted growth can be maintained.

TOBACCO.

The most interesting and most prominent feature in the agriculture of the Connecticut Valley is the tobacco industry, which has given a world-wide reputation to the locality, and has provided work and sustenance to a large number of people.

Tobacco was introduced into the Connecticut Valley as a recognized farm crop in the early part of this century. It was early recognized that it differed greatly in its qualities from the Maryland and Virginia tobaccos. It had less nicotine, less body, and was not so well adapted to pipe smoking or to chewing. It is an interesting historical fact that the first cigars made in this country are reported to have been made in the Connecticut Valley about the year 1802. It may be said to have been the home of the domestic cigar tobacco, as it certainly was the home of the domestic cigar manufacturing.

With the specialization which has since developed in all lines of tobacco industry the Connecticut tobacco has taken its place essentially as a wrapper leaf, and it is not used to any extent at the present time for fillers in domestic cigars. It is essentially a light wrapper, and when dark, heavy wrappers were in style, as periodically happened, especially before the wide introduction and extensive use of the ideal Sumatra wrapper, the cultivation of tobacco in these light soils of Connecticut was largely abandoned and the domestic supply of wrapper leaf came from the heavier soils of Pennsylvania. The torn, coarse, or inferior leaves are used as binders, while the trash and waste from the barn and cutting tables are exported mainly to England and brings from 1 to 2 cents per pound.

The characteristics of a good wrapper leaf, as described by Mr. Floyd,[1] are that it should have but little body, little aroma or flavor, should be very pliable so that it will stretch and cover well, and have good texture, grain, and style, in order that it will appear well on the cigar.

[1] Report No. 62, U. S. Department of Agriculture.

The leaves must be of uniform color and not too large, the 14 to 16 inch leaves being the most desirable sizes.

While the Connecticut tobacco has long been recognized by the trade as the most desirable domestic tobacco for wrapper purposes, yet the difference in price shows at once how the tobacco is regarded by manufacturers in comparison with the imported leaf. The Connecticut tobacco is worth, on an average, about 18 or 20 cents per pound; the Sumatra tobacco, imported exclusively for wrapper purposes, pays a duty of $1.85 per pound and sells on the market for from $2.50 to $3 per pound, duty paid. The Connecticut leaf is too large for an ideal wrapper, being often from 26 to 30 inches in length, the veins are very large, and only the tip of the leaf is suitable for high-priced cigars. Either on account of the physiology of the leaf or in the method of case sweating the desirable grain, color, and style are confined to the tip of the leaf, the lower half being glossy and very undesirable for wrapper purposes. This makes a great deal of waste, which can only be marketed in foreign countries at an exceedingly low price. Lastly, the tobacco is more highly flavored than is desirable for wrapper purposes and frequently masks the desirable qualities of the filler used in the cigar. These defects, as already stated, are to be made the subject of an exhaustive inquiry in the Division of Soils.

One of the objections urged by the manufacturers against the Connecticut tobacco, a fact which certainly largely reduces the price paid for the crop, is the unevenness of color and the poor grading as to color, length, and quality of leaf. In order to maintain a uniform brand of cigars, a manufacturer is forced to purchase a large amount of Connecticut leaf from which to select. Furthermore, on account of the difference in length and in texture of the leaves, there is considerable waste, which is difficult to estimate. It is hard to plan, therefore, for an economical use of the product when a purchase of this tobacco is made. This is not the case with the carefully sorted Sumatra.

One of the reasons which makes the quality of the leaf uncertain and varied is believed to be the method of fermenting in cases, the result of which is largely uncertain and dependent upon chance conditions, which are difficult to understand and impossible to properly control. It is believed by the tobacco experts of the Department that the bulk method of fermentation, as practiced in Florida and in Cuba, will give much more uniform and more desirable results.

The principal reason why the assortment and grading are not so closely done is the high cost of labor. There is so much demand for labor in the shops and factories that the farmer is forced to pay a high price for help. The most successful farmers, therefore, have been those who have cultivated small tracts of from 5 to 15 acres in extent and have made the crop by themselves, with such help as their families could supply, and with occasional hired labor. The Connecticut farmer has to pay about $1.50 per day, where the Florida planter pays about

50 cents per day for labor. It has always been found, however, that in the exhilarating climate of the North the more energetic laborers do so much more work in a given time and to so much better purposes that successful competition is possible in many lines along which at first sight the outcome would appear at least uncertain. It must be remembered, furthermore, that much of the most successful tobacco growing in Connecticut is done by the farmer and his family, so that a better system of fermentation and of sorting and grading could be done by them during the slack time of the winter months, when other work was not pressing, and without greatly increasing the actual expenditure of money in the production of the crop.

In Sumatra the cost of labor is very much less, even, than in Florida, and this is one reason why the Sumatra planters are able to give the extreme care to the assortment and classification of their tobacco. It must be remembered, also, that in a fancy assortment of well-cured and choice tobacco the price is largely speculative, as there is no sharp basis upon which to fix a commercial value. When from the superior excellence of the leaf the price goes beyond 30 cents per pound it is liable to increase in wider and wider units to $1, $2, and even $3 or $4 per pound, according to the fancy of the purchaser and the skill of the producer in working up a trade and supplying special demands. This has been shown in a very marked way in the development of the tobacco industry in Florida, where high prices are obtained by a few packers who understand the market requirements and can judiciously place their products, while a very low price is obtained by the average grower, who is less able or less willing to make the product required by the trade, and who is unable to make advantageous trade connections.

There is one interesting feature in regard to the tobacco industry in the Connecticut Valley, namely, that through the improved methods of planting and cultivating the crop the season of growth is being very materially shortened. In 1899 the growing season was about two weeks shorter than was ever known before. Tobacco set out the middle or last of May was fully matured by the middle of July.

SOILS.

The object of the soil survey is to classify and map the soils according to any condition which might influence the character of the vegetation, especially the character of the tobacco, the kind of crops adapted to the land, and the quality as well as the quantity of the crops grown. The soils of the Connecticut Valley have been classified in this way as a result of the season's work, and a map has been prepared, accompanying this report, showing the area and distribution of the various types of soils which were recognized. As before stated, this work will form the basis for a more extensive investigation of the Connecticut tobacco, and, pending such fuller investigation in regard to the character of the tobacco, only brief mention will be made at this time of the

relation of the soils to the character of the leaf which they produce. So many other questions enter in regarding the variety of seed used, the method of cultivation, fertilization, and fermentation, as well as the personal equations of the growers, that require the careful investigation and judgment of the tobacco expert, that only passing mention should be made at this time and in this connection of the character of the crop produced on the different soil areas.

TRIASSIC STONY LOAM.

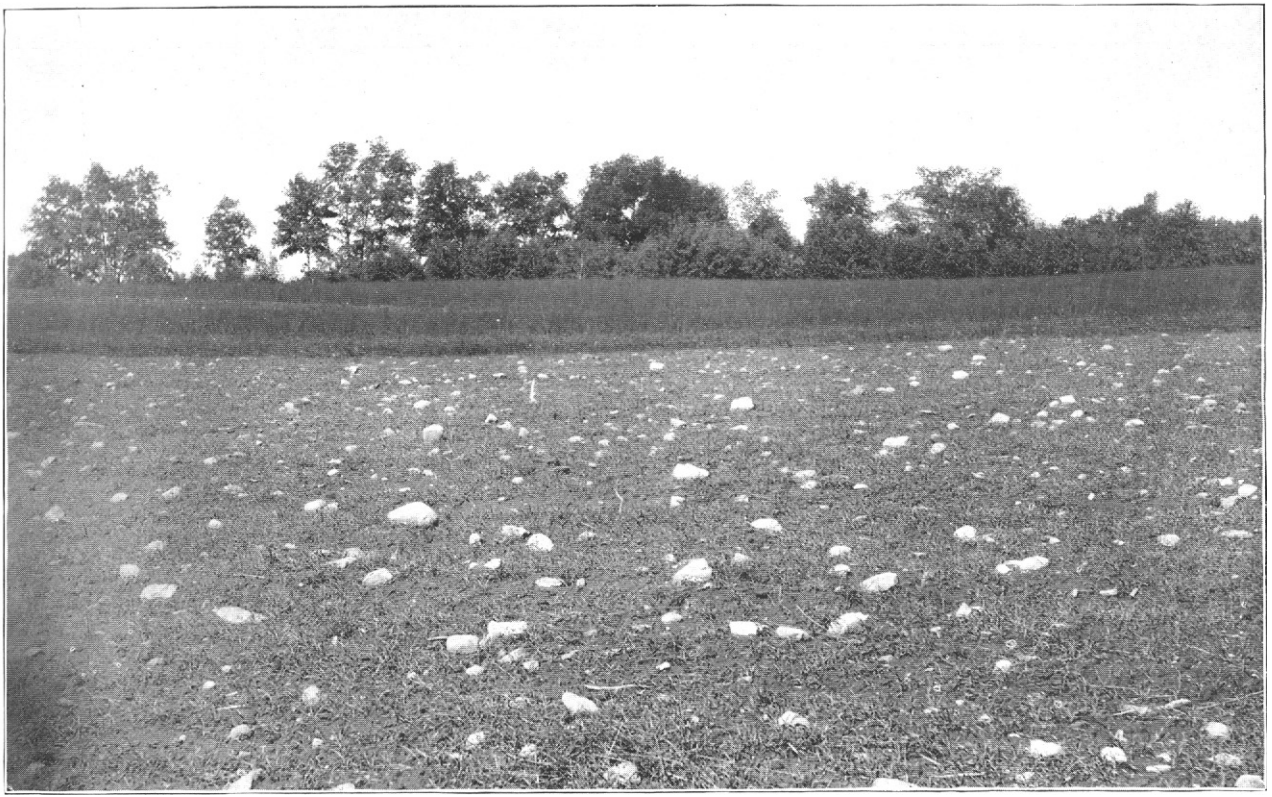
As already mentioned, the Connecticut Valley is bounded on either side, from the southernmost part of the area surveyed up to Westfield and Mill River, just below Springfield, by a glacial deposit consisting mainly of Triassic sandstone débris forming long lenticular hills, drumlins, or hogbacks, between which the surface is rolling and hilly, with a few long ridges and groups of rounded hills varying in elevation from 40 to 400 feet. A few areas of this glacial débris are scattered about in the valley proper, and from the fact that they are not covered with lake sediment it may be assumed that they were formerly islands in the glacial lake, or else the covering has since been removed by erosion.

The Triassic stony loam soils are fine sandy loams, dark Indian red in color, mixed with gravel and bowlders of all sizes and shapes, varying in size from an inch to 6 or 8 feet in diameter. The amount of gravel and undecomposed rock exceeds 5 per cent in all cases, and may exceed 50 per cent. In many cases fields are now comparatively free from these bowlders and large rocks on account of the numerous times they have been picked over and stones removed. Indeed, the surface of this geological area has been very greatly modified by the hand of man. Cultivated fields may contain only a few scattered stones, while the surface of the area surrounding the field may be covered with a mass of stones and bowlders. The stones, especially the smaller ones, and the fine gravel are derived principally from the Triassic sandstone and shales.

Tobacco is grown to a considerable extent in certain areas in the Triassic stony loams. It is considered a fat tobacco, and has an undesirable cinnamon color, but it is readily bought up at good prices for special market demands. The character of the tobacco is quite different from that grown on the other tobacco soils of the valley, and there is a long-standing controversy as to the relative merits of this and of the tobacco from other soils. The fact of the matter is that they are used largely in different channels, and are to a great extent bought up by different dealers. There are large tobacco centers around Day Hill, south of Poquonock, around Warehouse Point, Suffield, and Enfield street. The best development of the tobacco industry on this formation is probably around Suffield and Warehouse Point. The Havana seed is exclusively grown on this formation. The other areas outlined on the map have soils of fair condition, but are not farmed to any great

ESCARPMENT BETWEEN PODUNK FINE SANDY LOAM AND THE CONNECTICUT MEADOWS.

The old terraces are sometimes very sharply marked.



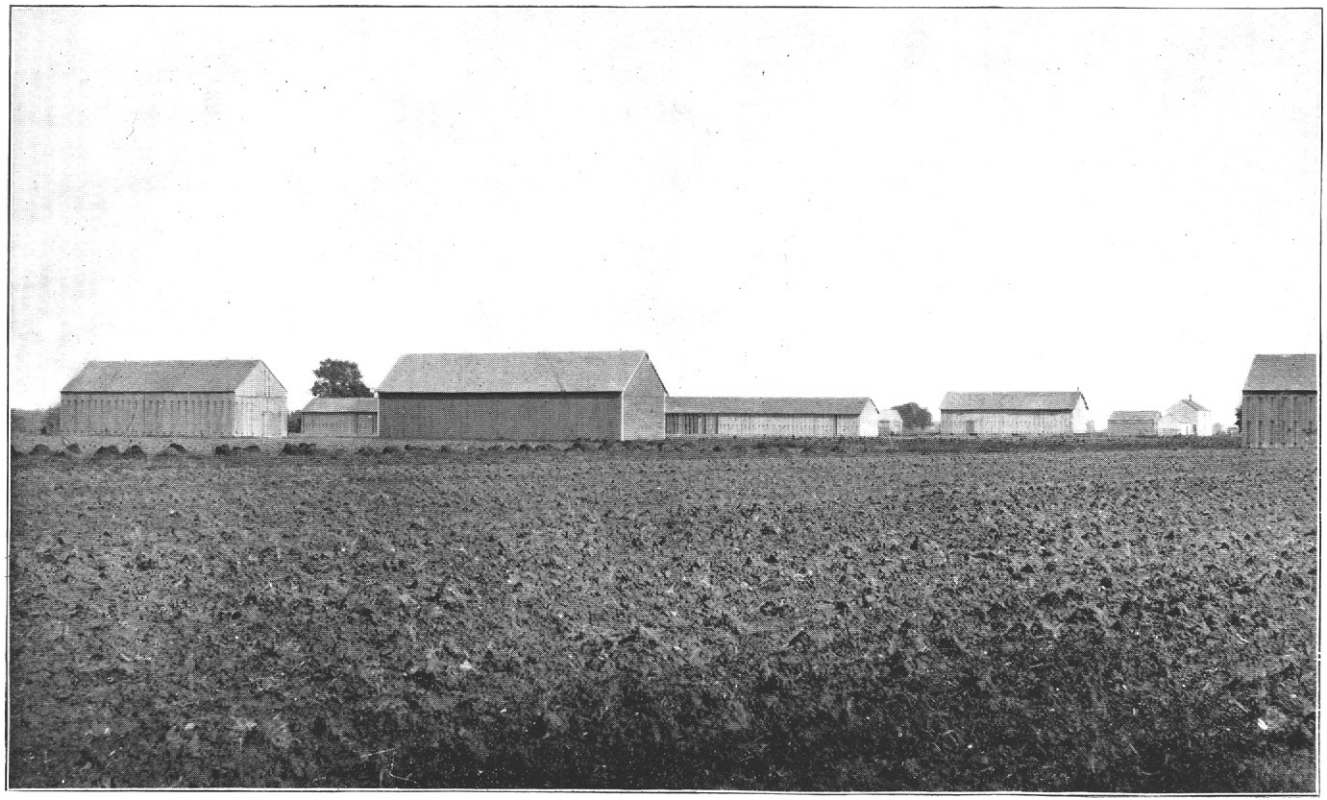
TRIASSIC STONY LOAM.

These stones are picked off year after year to provide for cultivation.

A DRUMLIN OR HOGBACK OF THE HOLYOKE STONY LOAM.

WINDSOR SAND SHOWING OLD CORN ROWS COVERED WITH FOREST GROWTH.

The sand is so porous that the rain sinks into it as rapidly as it falls.



PODUNK BROADLEAF TOBACCO AREA.

Report No. 64, U. S. Dept Agr.

THE HARTFORD SANDY LOAM.

Report No. 64, U. S. Dept. Agr.

A TYPICAL TOBACCO BARN OF THE CONNECTICUT VALLEY, 180 FEET LONG.

extent. They are given up mainly to pasture lands, meadows, and orchards. The following table gives the mechanical analysis of the Triassic stony loam subsoils:

Mechanical analyses of subsoils of Triassic stony loam.

(Fine earth.)

Diameter.	Conventional names.	4211. Bloomfield, ½ mile S.	4212. Enfield.	4201. Hazardville, 1½ miles S.
Millimeters.		*Per cent.*	*Per cent.*	*Per cent.*
2 to 1	Gravel	2	12.45	5.26
1 to 0.5	Coarse sand	3.35	11.86	8.66
0.5 to .25	Medium sand	8.60	13.98	18.83
.25 to .1	Fine sand	31.25	14.78	21.00
.1 to .05	Very fine sand	34.22	17.51	18.83
.05 to .01	Silt	4.35	8.20	8.70
.01 to .005	Fine silt	6.20	8.67	5.30
.005 to .0001	Clay	6.57	10.23	10.87
	Loss at 110° C	1.36	1.04	1.01
	Loss on ignition	2.03	1.69	1.77

HOLYOKE STONY LOAM.

The hills bounding the northern extension of the area examined, with elevations from 240 to 500 feet above sea level, are likewise glacial deposits, but formed of diabase, crystalline, and metamorphosed rocks. The surface of the country of what may be called the foothills is rolling with steep slopes and containing many lenticular hills and groups of rounded hills. The surface is rough, and in places large masses of bowlders are lying as they were piled by the ice, and with hardly any perceptible disintegration. Many of the slopes are entirely covered with these bowlders. The soil is a sandy loam, containing from 10 to 50 per cent of gravel and bowlders, ranging in size from 1 inch to 12 or 15 feet in diameter. The following table gives the mechanical analysis of the fine earth of a sample of Holyoke stony loam:

Mechanical analysis of subsoil of Holyoke stony loam.

Diameter.	Conventional names.	4203. Ashleyville, 2 miles S.
Millimeters.		*Per cent.*
2 to 1	Gravel	3.05
1 to 0.5	Coarse sand	3.85
0.5 to .25	Medium sand	8.22
.25 to .1	Fine sand	11.53
.1 to .05	Very fine sand	29.82
.05 to .01	Silt	21.26
.01 to .005	Fine silt	6.45
.005 to .0001	Clay	12.20
	Loss at 110° C	1.54
	Loss on ignition	2.35

The soils are derived entirely from the glacial débris. The soils are not fertile, and are not farmed to any great extent. There are occasional patches of corn, oats, and rye, but no tobacco. They are mainly given up to stony pastures and orchards.

WINDSOR SAND.

The generally accepted idea of the origin of the soils of the valley proper has already been referred to. It is supposed that during glacial times a dam extended across the valley below Hartford, forming a shallow lake of considerable extent, and comprising all of the area which has been surveyed this season. The streams collecting the drainage from the surrounding country emptying into the lake brought sediments, which were sorted over and deposited in different places, according to the direction of the currents, the depth of the lake, and the velocity of the water. The coarser sands and gravels would be deposited near the shore line and the mouth of the streams, while the finer sands and clays would be deposited off shore, and in deeper and quieter portions of the lake.

As the level of the water of the lake was lowered from time to time well-marked shore lines, constituting terraces, were formed out of the material which had previously been deposited, and out of fresh material which had been emptied into the lake. This gave rise to a series of terraces, more or less well preserved at the present time, but greatly cut up and modified by recent stream action, and by the meanderings of the Connecticut River.

The Windsor sand represents what is supposed to be the original bottom of the old glacial lake in its shallowest parts. The soil is composed of yellowish-red or brown sand, resembling a coarse sharp building sand, and containing less than 5 per cent of clay. The material contains about 5 per cent of coarse gravel, ranging in size from 2 to 10 mm. in diameter. This gravel content increases to some extent in the subsoil. In places this formation is 40 feet deep. The following table gives the mechanical analyses of four samples of Windsor sand:

Mechanical analyses of subsoils of Windsor sand.

Diameter.	Conventional names.	4210. Bloomfield, 2 miles SE.	4198. Windsor Locks, 3 miles SW.	4199. Hubbards Corners, 1½ miles NW.	4200. Chicopee, 2 miles SW.
Millimeters.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
2 to 1	Gravel	4.98	8.00	2.52	14.30
1 to 0.5	Coarse sand	11.31	15.83	12.32	26.28
0.5 to .25	Medium sand	33.41	39.90	39.29	30.35
.25 to .1	Fine sand	33.75	22.21	27.92	9.55
.1 to .05	Very fine sand	10.82	6.56	7.30	6.02
.05 to .01	Silt	2.09	3.20	4.33	4.66
.01 to .005	Fine silt	1.03	1.20	1.62	2.73
.005 to .0001	Clay	1.65	2.25	3.15	4.87
	Loss at 110° C	.50	.45	.48	.50
	Loss on ignition	.80	1.06	1.84	1.47

The soils are coarse and inclined to be leachy or droughty, but, like many soils of this character, are generally somewhat moist beneath the top few inches of dry sand throughout the most severe drought. The soils are good representative truck soils and are used for this purpose in some parts of the area.

In favorable seasons a very fine quality of thin-leaved silky tobacco is produced on these soils, the finest probably that is produced on any of the soils of the valley, but the season has to be just right, and such favorable conditions hardly occur more than two years out of five. If a crop by any means can be kept growing rapidly and continuously, it will produce a fine silky leaf excelled by none of the other soils in the valley. In average seasons, however, the growth is liable to be checked by changing weather conditions, and the plant is small and produces a leaf which is thick and strong. It is desirable to plant early on these lands and give constant and thorough cultivation.

The Windsor sand comprises a large part of the Windsor Plains in the towns of Windsor, Bloomfield, East Granby, and Windsor Locks, as well as a small area in East Hartford. The surface of the area in Connecticut is level or gently rolling, ranging from 100 to 180 feet in elevation. The area in Massachusetts is much larger and covers in all about 30 square miles. It is largely developed in the towns of Agawam, West Springfield, Springfield, Chicopee, and Long Meadow. The surface is much more rolling than in Connecticut, and ranges in elevation from 100 to 240 feet.

For the most part the area of Windsor sand is not very extensively cultivated at the present time. In Agawam there is some truck farming, a few peach orchards, and some tobacco grown. East of Springfield the area is rapidly building up in the extension of the city. In Connecticut there are but few houses, deep sandy roads, and many old and unsuccessful fruit farms. Many areas which were formerly cultivated are now grown up in the characteristic forest growth of pine. The soil is so open and porous and offers so little resistance to the entrance of rain water that the surface hardly washes at all, and there are old corn rows running through the forests and well preserved, upon which the trees must be at least 50 to 80 years old. Many of the old furrows thrown up in the original measurement of the land are still plainly distinguishable.

HARTFORD SANDY LOAM.

The Hartford sandy loam occupies by far the largest extent, and plays the most important part in the tobacco industry in the Connecticut valley. It extends from Glastonbury to South Hadley, and covers in all an area of over 80 square miles. A portion of it is probably the undisturbed old lake bottom, but there are also more recent river-cut terraces. The formation occurs in broad terraces, which are very level in places and gently rolling in others. The formation is found at elevations ranging from 30 to 260 feet above sea level. The soils are red, brown or yellow, medium grade sandy loams, about 12 inches deep, underlaid with yellow sands, containing little or no organic matter. The soil is a grade finer than the Windsor sand, as is apparent from the analysis, and is correspondingly stronger, and decidedly safer as an agricultural soil. The deposit varies in depth from about 3 feet to 20

feet. It differs again from the Windsor sand in having no gravel, or but a mere trace of very fine gravel in a few places. The following table gives the mechanical analyses of five samples of Hartford sandy loam:

Mechanical analyses of subsoils of Hartford sandy loam.

Diameter.	Conventional names.	4204. Windsor, SW.	4205. East Long Meadows, 2 miles NW.	4214. Burnside, ½ mile SW.	4213. South Windsor, 2 miles E.	4215. Burnham, 1 mile E.
Millimeters.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
2 to 1	Gravel	2.20	0.00	2.23	Trace.	4.11
1 to 0.5	Coarse sand	7.51	.31	7.73	6.84	11.83
0.5 to .25	Medium sand	33.50	2.84	25.25	42.86	29.20
.25 to .1	Fine sand	32.05	63.10	29.00	33.00	24.45
.1 to .05	Very fine sand	13.50	29.15	25.40	7.73	12.72
.05 to .01	Silt	4.47	1.15	3.45	2.63	3.48
.01 to .005	Fine silt	1.75	.96	2.10	1.70	3.28
.005 to .0001	Clay	2.78	1.42	3.22	3.50	5.20
Loss at 110° C.		.80	.50	.77	.75	2.95
Loss on ignition		1.30	.90	1.27	1.54	2.81

The general crop of Connecticut seed-leaf tobacco is grown on these soils. This represents what may be called the typical tobacco soil of the Connecticut Valley, and the safest and therefore the best soil at least for the seed-leaf variety. Corn and potatoes do well on these soils, and about Hockanum and south of Willow Brook, in East Hartford, considerable truck farming is carried on. Southwest of Hazardville the soil for some reason appears less coherent, and drifting sand dunes are common. The yield of tobacco on this soil varies from 1,500 to 2,000 pounds per acre, or even a little more. The average price of the crop is about 18 cents a pound, but the lands are heavily fertilized. Labor is high and the crop as a whole is expensive to make. Tobacco is grown mainly in small fields of from 3 to 10 acres, 15 acres being an unusually large tract. There are many large areas of this still undeveloped upon which a good quality of tobacco can be produced:

PODUNK FINE SANDY LOAM.

The Podunk fine sandy loam represents river cut terraces, ranging in elevation from 20 to 80 feet above sea level. There is in all an area of only about 7 or 8 square miles of this in the area surveyed, and of this only about ½ square mile in East Hartford has contributed largely to the fame of the Connecticut Valley in the production of the broad-leaf variety, which differs in many essential characteristics from the Habana seed-leaf grown on the Hartford sandy loam. The surface of the areas are level or very gently rolling. The soil is a dark-brown sandy loam, about 12 inches deep, and of most excellent tilth. The subsoil is a dark-brown sandy loam of the same texture as the soil, but differing in color, as it has less organic matter. The following table gives the mechanical analyses of two samples of Podunk fine sandy loam:

Mechanical analyses of subsoils of Podunk fine sandy loam.

Diameter.	Conventional names.	4206. Agawam, 1 mile NW.	4216. South Windsor, ½ mile NE.
Millimeters.		*Per cent.*	*Per cent.*
2 to 1	Gravel	0.00	0.50
1 to 0.5	Coarse sand	.07	1.51
0.5 to .25	Medium sand	1.53	7.96
.25 to .1	Fine sand	41.80	23.27
.1 to .05	Very fine sand	49.00	41.82
.05 to .01	Silt	3.43	9.15
.01 to .005	Fine silt	1.02	6.32
.005 to .0001	Clay	1.70	4.40
	Loss at 110° C	.66	1.92
	Loss on ignition	1.08	3.68

The soils are a grade finer in texture than the Hartford sandy loams, and while well drained are strong, safe, and productive. The areas are all thickly settled, and, with the exception of that in the town of Agawam, are very highly cultivated and well cared for. The South Windsor and Naubuc districts, particularly, are famous broad-leaf tobacco areas.

The broad-leaf variety is heavier and has a thicker leaf than the seed-leaf, is generally darker in color, and is a better leaf for cutting purposes. It has not the undesirable "seed" flavor of the Habana seed-leaf, and is preferred by many smokers. It yields more per acre than the Habana seed on the Hartford sandy loams, but, with all, it has a rougher look in the cigar. For this reason it is not in such good favor with many cigar manufacturers as the finer, silkier Habana seed grown on the Hartford loams. It is considered better by the farmers in this Podunk region to plant tobacco continuously rather than to use a rotation. There are fields which have been continuously in tobacco for twenty-five years, and which it is claimed are as productive and produce as fine tobacco as at any period of their cultivation. This broad-leaf variety is grown to a limited extent upon the small area of Hartford sandy loam east of Connecticut River, near South Windsor, but, with this exception, it is confined to the Podunk soil. Corn and potatoes do well on this soil. The Agawam area has not been very successfully farmed for the past few years, for some unexplained reason, and there is a chance of development there which should certainly arrest the attention of tobacco growers.

CONNECTICUT MEADOWS.

The Connecticut meadows occur as narrow strips on either side of the Connecticut River from Holyoke south to Long Meadow, Mass., and from Warehouse Point to South Glastonbury, Conn. There are smaller areas along the various tributaries of the Connecticut River. This represents the present flood plain of the Connecticut River and its tributaries, being built up at the present time by deposits from the flood

waters. The river will finally build up this terrace so high that it can no longer spread over it, and new terraces will be constructed at lower levels. The surface of the meadows is generally higher along the river bank and, of course, better drained there. There is a gentle slope down to the scarp connected with the upland or next higher terrace, and this area immediately below the upland is frequently wet and swampy. The meadows are all subject to overflow at time of very high flood, but in spite of this there is considerable farming on them, although at some risk of the loss of the crop. Surface of the meadows is level or gently rolling, with occasional old stream channels or run-ways in them. The surface of the meadow is from 5 to 20 feet above sea level at Hartford and from 40 to 80 feet above sea level at Springfield and Holyoke. The material of which the soils are composed has been brought in by the rivers at flood time, but there is no evidence of stratification, probably on account of the wind and rain action between the comparatively long periods between the floods. The character of the material is very uniform throughout all the areas. It is very fine sand and silt, being uniform in places to a depth of 10 feet and over, resembling loess in many of its characteristics. It is a grade finer than the Podunk fine sandy loam. The soil is from 16 to 18 inches deep, contains a large amount of organic matter, consists mainly of very fine grades of sand and silt with but little clay, and is considered extremely fertile and productive. The subsoil is grayish in color, but otherwise hardly different from the overlying soil. The following table gives the mechanical analyses of four samples of subsoil from the Connecticut meadows:

Mechanical analyses of subsoils of Connecticut meadows.

Diameter.	Conventional names.	4207. Chicopee, 2½ miles N.	4217. Hartford, ¾ mile SE.	4218. S. Windsor, ½ mile NW.	4219. Windsor, ½ mile SE.
Millimeters.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
2 to 1	Gravel	0.00	0.00	0.00	0.00
1 to 0.5	Coarse sand	Trace.	Trace.	Trace.	.00
0.5 to .25	Medium sand	0.37	0.21	0.36	.31
.25 to .1	Fine sand	6.87	1.50	2	1.77
.1 to .05	Very fine sand	50.86	19.55	14.78	9.79
.05 to .01	Silt	28.49	33.67	36.50	30.25
.1 to .005	Fine silt	6.60	28.54	27.17	29.47
.005 to .0001	Clay	3.35	9.50	13.40	19.11
	Loss at 110° C.	1.10	2.60	2.50	4.13
	Loss in ignition	2.60	4.75	3.54	5.31

Generally the meadow soils produce a dark, heavy, low grade of tobacco. When dark cigars were in style, as they were fifteen or twenty years ago, these meadow lands produced a tobacco which was much more in favor than it is at the present time. Very good tobacco can be grown on high meadow land if it be well drained, but there is an almost universal prejudice against it and it brings a low price from the mere association with the name of meadow land. There is an area of high meadow land west of East Windsor hill which is never overflowed

by the river, resembling the Podunk fine sandy loam and classed with it, upon which there is a very good quality of tobacco produced, but which suffers from the mere association with the name of meadow land.

A large proportion of the Connecticut meadows is used only for grass, several crops being cut in the course of the year. Areas where very well drained are used for corn and potatoes, and in some cases for celery and general truck farming. Below Merrick the meadows are diked to keep out the high water and insure the land from overflow, but this is the only place where this has been done to any extent.

The Connecticut meadows, Podunk fine sandy loam, Hartford sandy loam, and Windsor sand represent four important and representative soils of higher and higher average elevation and of coarser and coarser material, which represent the most extensive and most important soil areas in the valley. The difference in texture of these soils is very marked and very apparent to the eye, and this difference in texture determines to a large extent the relation of the soils to crops, and particularly to the quality of the tobacco produced.

ENFIELD SANDY LOAM.

On either side of the valley, in terraces around the hills of the Triassic stony loams and filling up depressions at elevations ranging from 80 to 240 feet, there is a fine sandy deposit, resembling the Hartford sandy loam, directly over the Triassic stony loams which occurs at a depth of about 2 feet below the surface. The outward extension of the terraces grades into the Hartford sandy loam, where the Triassic stony loam is 3 feet or more below the surface. The underlying Triassic stony loam provides a retentive subsoil, and these soils retain moisture better and are rather stronger than the Hartford sandy loams, which they resemble in other respects. The following table gives the mechanical analysis of a sample of Enfield sandy loam:

Mechanical analysis of subsoil of Enfield sandy loam.

Diameter.	Conventional names.	4202. East Hartford, E.
Millimeters.		*Per cent.*
2 to 1	Gravel	4.22
1 to 0.5	Coarse sand	5.05
0.5 to .25	Medium sand	7.75
.25 to .1	Fine sand	10.43
.1 to .05	Very fine sand	43.60
.05 to .01	Silt	13.53
.01 to .005	Fine silt	4.86
.005 to .0001	Clay	5.57
	Loss at 110° C.	1.82
	Loss on ignition	3.22

A very good quality of Habana seed-leaf tobacco is grown to a limited extent on these soils, especially around Melrose, Osborne, Wapping, and south of Poquonock. The characteristic feature of this soil as distinguished from the Hartford sandy loam is the occurrence of the Triassic stony loam at a depth of from 12 to 24 inches. The areas along the eastern part of the valley are generally thickly settled. In other parts of the valley there are large areas still uncleared and uncultivated.

SUFFIELD CLAY.

The Suffield clays occur principally at Windsor, East Windsor, and Suffield, with occasional small areas along the scarp between the Connecticut meadows and the upland. These soils are found at elevations varying from 40 to 220 feet above tide. The surface is gently rolling, except along the scarps, where the slopes are liable to be quite steep. The soils are heavy clay loams, grading down into drab clays with exceedingly poor drainage, making the surface cold and wet. The following table gives the mechanical analyses of two samples of Suffield clay:

Mechanical analyses of subsoils of Suffield clay.

Diameter.	Conventional names.	4208. Suffield.	4209. Riverdale, W.
Millimeters.		*Per cent.*	*Per cent.*
2 to 1	Gravel	0.00	0.00
1 to 0.5	Coarse sand	.29	.00
0.5 to .25	Medium sand	.40	.00
.25 to .1	Fine sand	.73	.15
.1 to .05	Very fine sand	5	11.27
.05 to .01	Silt	32.57	38.58
.01 to .005	Fine silt	29.10	24
.005 to .0001	Clay	25.65	23.50
	Loss at 110° C	2.17	1.10
	Loss on ignition	3.53	1.50

The Suffield clays have little value as agricultural lands, and are mostly given up to grass and pasture. There are large areas which are not cultivated at all, and growing up in a tangled mass of worthless underbrush. Around Springfield, Holyoke, and Hartford there are large brickyards making brick of this clay. No tobacco is grown in any part of this area, as the soils are entirely unsuited to this crop.

ELMWOOD LOAM.

The Elmwood loam occurs in large areas around Hartford, Windsor, and South Hadley. The soil consists of a deposit of fine yellow sandy loam, about 24 inches deep, overlying laminated drab clays, similar in all respects to the Suffield clays. The clay is a deep lake deposit, while the overlying sand is a shallow lake or river deposit. The following table gives the mechanical analysis of a sample of Elmwood sandy loam:

Mechanical analysis of subsoil of Elmwood sandy loam.

Diameter.	Conventional names.	4220. Elmwood, 3 miles N.
Millimeters.		*Per cent.*
2 to 1	Gravel	0.00
1 to 0.5	Coarse sand	0.45
0.5 to .25	Medium sand	3.76
.25 to .1	Fine sand	17.53
.1 to .05	Very fine sand	59.82
.05 to .01	Silt	7.03
.01 to .005	Fine silt	4.65
.005 to .0001	Clay	4.00
Loss at 110° C		1.40
Loss on ignition		1.90

The surface of the ground is rolling and hummocky. The soil is found at elevations varying from 20 to 80 feet above sea level at Hartford, and from 160 to 200 feet at South Hadley. Around Hartford the Elmwood loam gives fairly good grass and pasture lands, but is not cultivated to any extent except for small garden patches. North of Hartford it is neither cleared nor cultivated. The area around Hartford is rapidly being built up in the suburbs of the city. A few small areas have been cultivated in tobacco, above Windsor, but the soil is not adapted to tobacco cultivation.

CONNECTICUT SWAMP.

Considerable swamp land and wet meadows occur scattered over the entire valley at various elevations. They occur generally along the scarp between the Connecticut meadows and the upland and along a large number of small streams flowing into the Connecticut River. Again in the hollows between hills and slopes, where there is poor drainage, these upland swamps are liable to occur from any cause where the drainage is poor and the soil almost impervious to water, with swampy, wet conditions as a characteristic feature. No matter at what elevation they may be found these are all classed as Connecticut swamps. The swamps are all of fresh water and they are all at present too wet for cultivation. Some of the areas can be easily drained, while others immediately along the river could not be reclaimed except at great expense. Most of them along the river are wet throughout the year. Some of them are sufficiently dry during the summer so that the coarse, rank meadow grass produced may be mowed and saved for rough forage. The character of the soils of these areas has not been determined. They are very small in extent and of little agricultural importance. Many of them represent merely obstructed drainage areas which by underdrainage could readily be reclaimed.

COMPARISON OF THE TEXTURE OF THE SOILS.

The following table gives a clear idea of the texture of the soils of the Connecticut Valley, and explains to a great extent the distribution of crops and the difference in the characteristics of the tobacco grown on the different soil areas:

Windsor Plains, 65 per cent gravel to medium sand, 30 per cent fine and very fine sand.

Triassic stony loam, 35 per cent gravel to medium sand, 40 per cent fine and very fine sand.

Enfield sandy loam, 17 per cent gravel to medium sand, 55 per cent fine and very fine sand.

Diabase stony loam, 15 per cent gravel to medium sand, 40 per cent fine and very fine sand.

Hartford sandy loam, 65 per cent medium to fine sand, 90 per cent medium to very fine sand.

Podunk loam, 10 per cent fine sand, 90 per cent fine and very fine sand.

Connecticut meadows, 50 per cent very fine sand, 80 per cent very fine sand and silt.

Suffield clay, 35 per cent silt, 50 per cent fine silt and clay, 25 per cent clay.

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