SOIL SURVEY OF WASHINGTON COUNTY, NEW YORK.

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DESCRIPTION OF THE AREA.

Washington County is one of the eastern tier counties of New York. It lies centrally some 200 miles from New York City and about equally distant from Montreal, Canada, and upon the main line of traffic between these two cities. It is situated between the

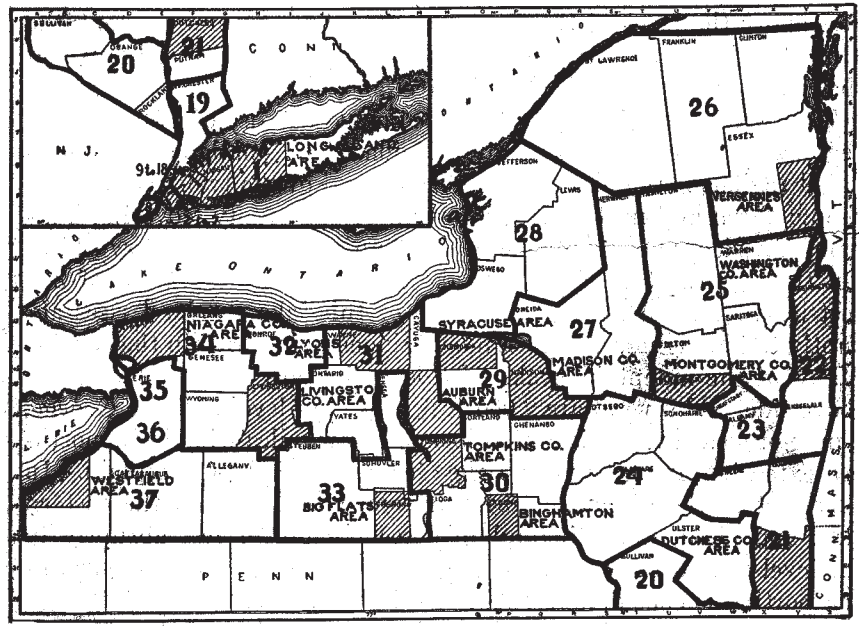

FIG. 3.—Sketch map showing location of the Washington County area, New York.

Hudson River and Lake George on the west and the State of Vermont and Lake Champlain on the east.

The land boundaries are Bennington, Rutland, and Addison counties. Vt., on the east, Essex County on the north, Warren and Sara-

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toga counties on the west, and Rensselaer County on the south. On the west the Hudson River separates the southern end from Saratoga County and Lake George separates the northern portion from Warren County. On the north and east Lake Champlain, East Bay, and the Poultney River separate the northern portion from Addison and Rutland counties, Vt. On the south the Hoosic River forms the boundary for some little distance, here separating Washington County from Rensselaer County. The southern, or rectangular, portion of the county has an average width of about 17½ miles, while the northern or interlake portion has a width of only 4 to 5 miles. Its length from north to south is about 60 miles. The total area of the county is 843 square miles, or 539,520 acres.

The topographic features are varied, the range in elevation being over 2,500 feet. The highest point, Black Mountain, is situated in the western part of Dresden Township, near the shore of Lake George. The height of this point is 2,665 feet above mean tide level, or 2,342 feet above the level of Lake George. The lowest point is along the Hudson River, at the southwestern corner of Easton Township and the county. This point is about 90 feet above sea level.

The physiographic features of the county consist of two elevated regions separated by a low valley region. The smaller of these elevated regions is the higher and more rugged of the two. It occupies the northern and northwestern portion of the county, covering Putnam, Dresden, and portions of Fort Ann and Whitehall townships. On the northwestern side lies Lake George, at an elevation of 323 feet above sea. All along the shore of this lake the land rises abruptly to the highest and most mountainous points within the county. Many of the mountain peaks of this region are 2,000 feet or more above tide, and several are 2,000 feet above the level of Lake George, a mile or so away. This region is only a few miles wide in its northern extension, lying between Lake George and Lake Champlain. In this portion the high lands become somewhat lower on the eastern side, and along Lake Champlain descend more or less abruptly to the level of that body of water 101 feet above mean tide. The southern portion is considerably wider. On the east and south it adjoins the Wood Creek Valley with a slope similar to that of the northern portion along the upper reaches of Lake Champlain. This region is strictly Adirondack in characteristics and comprises about one-fifth of the county.

The second of these highland regions lies in the eastern and southeastern parts of the county, principally along the line between Vermont and New York. This region is much less rugged, but considerably larger than the former. It extends along the entire eastern side of the county from the Poultney River on the north to the Rensselaer County line on the south. The elevation varies considerably.

In the northern part the higher hilltops are from 900 to 1,100 feet above tide, in the central part from north to south they are from 1,000 to 1,400 feet high, and to the south they rise somewhat higher, and then as the southern boundary of the county and the Hoosic Valley are approached the altitude becomes much less. The highest point in this upland region is Goose Egg Hill, in the northern part of White Creek Township. This point has an elevation of 1,940 feet. This elevated area is Green Mountain in its topography and characteristics. It is divided into several different parts by the narrow valleys of the Owl Kill, Batten Kill, Mettawee River, and their tributaries. These valleys have an elevation of 400 to 500 feet.

The valley region or district consists of three parts, the eastern side of the upper Hudson Valley, the western side of the upper Champlain Valley, and the low divide between them. The Hudson section is made up of narrow first bottoms along the river, having an elevation of 90 to 140 feet, and various flat and eroded terrace levels from 10 to 175 feet above the first bottoms. This section is a narrow belt some 3 miles wide lying between the Hudson River on the west and the Green Mountain upland on the east. It is divided into nearly equal parts by the Batten Kill. In it are included parts of Kingsbury, Argyle, Greenwich, and Easton townships and all of Fort Edward Township.

The Champlain section is narrow and of little importance areally or agriculturally. It extends along the eastern edge of Putnam and Dresden townships and consists of low swampy areas bordering the New York side of Lake Champlain and East Bay. Its elevation is only just above the level of the lake, 101 feet above tide, with some terraces rising up to about 200 feet along the shores of South Bay, which indents the Adirondack upland between Dresden and Whitehall townships.

The divide section is really two valleys, that of Fort Edward Creek at the southwestern end and that of Wood Creek at the northeastern end, the latter being much more extensive than the former. The watershed between these two valleys, which is also the watershed between the Champlain-St. Lawrence and Hudson valleys, is near Dunhams Basin at an elevation above sea level of only 147 feet. The Fort Edward Creek and upper Wood Creek end of this section is much wider than the lower Wood Creek end. Its width here is some 10 miles and consists of terraces rising to about 400 feet in elevation on the northwestern side and 200 feet on the southeastern side. Along the southeastern side there is a secondary valley, which is separated from the main valley by a range of hills from 200 to 600 feet in height. Along the northwestern side there is also a secondary valley. Two tributary valleys of this latter secondary valley indent the Adirondack upland, one of them joining the valley arm occupied

by South Bay, the two separating a comparatively small section of the upland from the main portion.

The lower Wood Creek end of this section is much more narrow. It really has no western side, the uplands rising directly from the creek itself. The eastern or southeastern side, however, varies from a mile or so in width in the vicinity of Whitehall to some 4 or 5 miles in the vicinity of Dewey Bridge and Comstock. The elevation of this portion of the valley section ranges from 120 to 140 feet above sea in first bottoms just above Whitehall to about 400 feet above sea in the wider portion of the terraces and hills. This part of the valley section is joined by the tributary valley of the Mettawee River just above Whitehall. This, the lowest pass between the Hudson Valley and the Champlain and lower St. Lawrence valleys, makes it the main thoroughfare between New York City and eastern Canadian cities.

The drainage of Washington County is accomplished by two systems—the Hudson and the Lake George-Champlain-St. Lawrence—whose waters reach the Atlantic Ocean at widely separated points. The Hudson River becomes the western boundary of the county soon after it emerges from the Adirondack Mountains, from Hudson Falls southward. The gradient of the Hudson for the 25 to 30 miles in which it forms the county boundary is greater than that of the nearly 200-mile course of the river to the southward. The 100-foot contour crosses the river at Thomson, a point about halfway along the Washington County boundary portion. From this point northward to the big bend of the river westward, where the county line extends overland to Lake George, a distance of about 15 miles, there is a rise of 121 feet, the largest part of which is at Bakers Falls, opposite Hudson Falls. There are waterfalls and dams for water-power purposes at Thomson, Fort Miller, Fort Edward, and Hudson Falls.

The Hudson receives three tributary streams from the Washington County side—Fort Edward Creek, Moses Kill, and the Batten Kill. The first of these is small and of little importance. The Moses Kill has its source in a swamp in southern Hartford and northeastern Argyle townships. It flows southwest along the base of the Green Mountain upland through North Argyle and Argyle to a point about 2 miles from the river in southern Fort Edward Township. It then takes a course parallel to the river, but in an opposite direction for about 3 miles, thence southwestward again, and empties into the river a few miles above Fort Miller. This stream has a fall of about 225 feet in its entire course and a comparatively small flow. Its upper course occupies one of the secondary valleys previously mentioned. The Batten Kill rises in Vermont and flows across the county in a general westerly direction. From the state line to a

point about halfway between East Salem and Shushan it flows in an old valley. At this point it turns abruptly and flows northward to the vicinity of Rexleigh, a distance of about 5 miles, in a more recent, narrow, V-shaped valley with rock-walled sides, and practically no bottom lands. Below Rexleigh it turns westward, passing East Greenwich, Battenville, Center Falls, Greenwich, and Middle Falls, and empties into the Hudson River at Clarks Mills. It enters the county at an elevation of 560 feet. The 100-foot contour crosses it at its mouth, thus giving a fall within the county of 460 feet, nearly all of which is utilized for power purposes, there being eleven dams and power plants located on it within the county. This stream receives the waters of many small tributaries, the principal ones being White and Black creeks, whose waters unite just before reaching the main stream, and Whitaker Brook, the outlet of Cossayuna Lake.

The Hoosic River, a tributary of the Hudson, forms the boundary of the southwest corner of White Creek and southeast corner of Cambridge Township. It receives the drainage of most of the southern end of the county. The principal tributary of the Hoosic from Washington County is the Owl Kill. This stream has its source in Lake Lauderdale, in Jackson Township, and follows a southerly course through Cambridge. It has a low gradient throughout its whole course, except for a half mile or so just above its mouth at Eagle Bridge. It occupies an old valley that was probably occupied by the Batten Kill before it was turned northward by a glacial dam between East Salem and Cambridge, the greater part of its length. It receives several small streams coming down from the uplands on both sides.

The entire northern end of the county is drained to the north through Lake Champlain and Lake George to the St. Lawrence Valley. Lake George receives no large streams from Washington County, but numerous small ones from the mountainous upland which borders it. Its waters reach Lake Champlain below Ticonderoga, in Essex County, just north of the area under consideration. The southern or upper end of Lake Champlain is little more than a deep river channel, which ends at the falls of Wood Creek, in the village of Whitehall. All along this channel numerous small creeks which receive the greater part of the waters of Putnam and Dresden townships flow into it. South Bay, a shallow arm of the upper end of this lake channel, receives a portion of the drainage waters of the upland parts of Dresden, Fort Ann, and Whitehall townships. Poultney River, the lower part of which is called East Bay, joins Lake Champlain at The Elbow, just below Whitehall. It forms the state as well as the county line to a point about 1 mile above Hampton. Carver Falls, at the northern end of Hampton Town-

ship, are 126 feet in height and are used to develop a large electric power. Above and below these falls the gradient of the stream is slight, particularly the East Bay portion.

Wood Creek has its mouth at Whitehall, where its waters fall through a narrow gorge into Lake Champlain. Its source is in the northwestern corner of Argyle Township. Halfway Creek, its chief tributary from the west, has its source in Warren County. It occupies one of the secondary valleys of the divide region and joins Wood Creek at Fort Ann. A considerable water power is developed on this creek at Kanes Falls, the waters being held in storage near West Fort Ann. Another branch of Wood Creek, the Mettawee River, enters Washington County from Vermont at Granville. It joins Wood Creek just above Whitehall. The Champlain Canal follows the valley of this creek from Smith Basin to its mouth.

At the time of its discovery the section of country now known as Washington County was inhabited by the Mohawk tribe of the Iroquois Indians. However, at the time of its settlement it was utilized only as a hunting ground by the Mohegans, probably by consent of the Mohawks, who had withdrawn to the region along the river which bears their name on account of the border warfare carried on against them by the Canadian Indians and their French allies.

The advent of the white man in the region antedates the settlement of the Dutch in the lower Hudson Valley by four years; in fact it antedates the discovery of the Hudson River itself by a few months. It seems that Champlain and his Indian allies invaded the northern limits of the county in 1609, fighting a battle with the Iroquois July 30 of that year at some point above the outlet of Lake George.

The first lands patented were in the southwestern corner of the county, in 1684, but no attempt was made at settlement for another half century. The fact that the region was the warpath in all the colonial wars prevented and retarded its settlement. The first changes from a wilderness began with the military operations of Queen Anne's war, between 1702 and 1713. During this conflict a military road was cut through the dense forests from a point opposite Schuylerville "up the east side of the river to Fort Edward and thence by way of Wood Creek to Whitehall, a distance of 40 miles. * * * Along this road three forts were erected," one at Schuylerville, one at Fort Edward, and one at Fort Ann.

Several large grants of land within the county were made about 1740. However, none of them were settled, although at this time one family, the first within the county, then resided at Fort Edward, trafficking with the Indians. This settlement, however, was not permanent, it being destroyed in 1744, during the first French war.

With the close of the various French wars and the conquest of Canada by the English this old fighting ground could be settled without apprehension for the safety of the settlers. Lands were now granted, not more than "a thousand acres to one person, and the grant was to be forfeited if within a reasonable time settlers were not located upon the lands and portions of them cleared and put under cultivation. An annual quit-rent of two shillings and sixpence sterling was imposed on every one hundred acres * * * and all pine trees suitable for masts for the royal navy * * * were reserved to the crown." Under these terms and the payment of various fees a considerable proportion of the county was obtained by the settlers, though several townships and large tracts in other townships were granted without charge to discharged officers and soldiers of the French wars.

The first permanent settlement was made on the "flats" along White Creek, where the village of Salem is now situated, by James Turner and Joshua Conkey. These men came from Massachusetts during the summer of 1761. They at once began clearing the land, working at this improvement during the summer seasons, returning to their former home in Massachusetts for the winters until 1764, when they removed their families hither and made their homes in this new country. Many other settlements were made about this time and immediately following.

The settlement of Washington County was made largely by people from the New England States, New Jersey, and southeastern New York, though a good many came from Scotland. The present population is made up largely of the descendants of these early settlers, though in the region of the slate quarries many Welsh have settled with the development of that industry. A considerable proportion of the people in the larger towns have also migrated hither with the utilization of the water powers for manufacturing purposes.

In the days before settlement the region now included in Washington County was a part of Albany County. It remained under this jurisdiction until March 12, 1772, when Charlotte County was organized, comprising what is now Warren, Essex, and Clinton, and parts of Franklin and Washington counties, N. Y., and a large portion of the State of Vermont. Immediately following the close of the Revolutionary war and the independence of the colonies the name was changed to Washington. This change in name was made April 2, 1784. Four years later, or March 7, 1788, all that portion west of Lake Champlain except what is now Warren County was set off as Clinton County. In 1790 all the portion of Washington County now included within the State of Vermont was set off, New York relinquishing all rights thereto. Cambridge and Easton townships were added February 7, 1791, and from this date, with the

exception of the cutting off of Warren County in 1813, when Washington County assumed its present boundary lines, no change has been made.

It is difficult to make any study of the population prior to 1813 on account of the many changes in the form and size of the county, but at that time it must have had nearly as large a population as it has had in recent years, for in 1810 there were 44,289 people living within the county as it was then constituted.

The present population, 47,376 (state census, 1905), is near the maximum, attained thirty years earlier. Putnam and Dresden townships, being rough and mountainous and containing no villages of any size, have the least population, and Fort Edward, Granville, Greenwich, Kingsbury, and Whitehall townships, each having villages with manufacturing industries, have the largest populations.

Hudson Falls, the largest of the villages, is joint county seat with Salem. It has a population of over 5,000. Here and at Fort Edward, which adjoins it on the south, are large paper mills. The combined population of these two thriving villages now probably exceeds 10,000. Whitehall, the port at the upper end of Lake Champlain, is the second largest village within the county. In size it nearly equals Hudson Falls. Besides the business incident to its being a lake port and the terminus of the Champlain Canal, it is a division point of the Delaware and Hudson Railroad, and there are also large silk mills located there. The third largest village, Granville, on the eastern border of the county, has been developed by the working of the large and numerous slate quarries in its vicinity. Here is located one of the greatest, if not the greatest, centers of production of roofing slate in the country. Greenwich is a thriving manufacturing town on the Batten Kill. Salem and Cambridge are flourishing villages, one of the two county court-houses being located at the former and a large seed warehouse at the latter. Agricultural implements are manufactured at both Cambridge and Greenwich. Other villages of local importance are Shushan, East Greenwich, Battenville, Center Falls, and Clarks Mills on the Batten Kill, Thomson and Fort Miller on the Hudson River, Fort Ann on Wood Creek, Middle Granville and North Granville on the Mettawee River, and Hartford, South Hartford, Argyle, West Hebron, North Easton, and Cossayuna located interiorly. A state's prison is being erected at Comstock for first-term convicts.

When the first surveys within the county were made, numerous Indian trails were so distinct that many of them were laid down on the maps of these surveys. These precursors of modern highways were followed during the intercolonial wars by the military roads. Later, turnpikes and corduroy roads were built, the latter particularly in the sections of the county occupied by clay land. The most promi-

nent of the turnpikes was that built through Cambridge, Salem, and Hebron and thence northward to the state line. These roads were constructed by private companies.

The county had not been long settled when work was planned to connect the Hudson River with Lake Champlain through the Wood Creek Valley. A private company began work on a canal for this purpose in 1794, but was compelled to abandon the project for lack of capital. However, thirty years later, the State built a canal over the same route in connection with the Erie Canal, which was opened for traffic in 1826. At present, active work is being carried on to make the old Champlain Canal a barge canal.

Railroad transportation was first afforded Washington County in 1846, when the Saratoga and Whitehall Railroad (now Delaware and Hudson) was completed to Whitehall from Fort Edward. Other railroads were built later, all of which now belong to the Delaware and Hudson, except the Greenwich and Johnsonville Railroad. This road has recently built a branch connecting Greenwich with the Delaware and Hudson at a point a few miles south of Salem. The Hudson Valley Railway Company have an electric line from Thomson to Fort Edward, thence to Hudson Falls, Glens Falls, and Lake George. A branch of this electric road extends also from Thomson to Greenwich.

Washington County is now well supplied with transportation facilities. The Champlain Canal connects Lake Champlain with the Hudson River and furnishes cheap transportation by water to Lake Champlain points, Montreal and Quebec on the north, and Troy, Albany, New York, and other cities on the Hudson. The Delaware and Hudson Railroad offers excellent facilities for shipping to northern points as well as connection with the mining region of eastern Pennsylvania. It also makes connection with the Rutland Railroad for Vermont and Canadian points and the Boston and Maine Railroad for Boston and eastern points. The Greenwich and Johnsonville Railroad also connects with the Boston and Maine. The Hudson Valley (electric) line furnishes fast and frequent service down the river and to Saratoga Springs and Lake George. During the summer season transportation lines are maintained from end to end of Lake George.

The public highways are only fair, though improved " state roads " are being built in various parts of the county.

Markets for the products of Washington County soil could scarcely be better. The seven largest villages contain approximately one-half of the county's inhabitants. The population of the smaller villages added to this makes considerably more than half of the people living within the county consumers rather than producers of the products of the soil. These manufacturing towns, together with Glens Falls,

a city of some 15,000 population just over the line in Warren County, which can not draw much from the region to the west on account of the mountainous, nonagricultural character of that region, make a most excellent near-by market for all of the quickly perishable produce of Washington County farms. Besides these good markets within or just outside the county, the transportation facilities make Troy, Albany, New York, Boston, the summer resorts on Lake George, and the mining towns of eastern Pennsylvania easily accessible, and they offer good markets for and receive a considerable proportion of the soil products of Washington County. At present there is not only the opportunity for increasing the production of the county, but in all these markets there is a demand for greater supplies of the products for which the soils, the climate, and the location of the county are adapted.

CLIMATE.

The climatic conditions prevailing in the region occupied by Washington County are characterized by a wide range in temperature between the summer months and the winter months, by a heavy snowfall during the winter, and by a rather heavy annual precipitation.

The variation in temperature ranges from an absolute minimum of from —26° to —36° F. to an absolute maximum of from 95° to 98° F., or a total variation between minimum and maximum of from 121° to 134° F. during the year. The mean temperature for the winter months is, however, only about 20° F., and for the summer months only about 65° F., or a normal variation of less than 50° F. The mean temperature for the spring and fall months is approximately the annual mean, the latter being about 45° F.

The precipitation, as a rule, is evenly distributed throughout the whole year, though occasionally some damage is caused either by excess or deficiency of precipitation at critical times during the growing season. During the early part of the growing season or the spring months about 9 inches of precipitation can be reasonably expected, or 3 inches for each month of that season, while for the remainder of the growing season—the months of June, July, and August—the rainfall is about 1 inch a month greater, or 12 inches for these three months.

While the mean annual precipitation amounts to about 40 inches, or a little less, there is quite a wide variation between the wettest and driest years. The least amount of precipitation for any one year during the past seventeen years was 28.9 inches, or nearly 1 foot less than the normal. The greatest amount of precipitation for any one year during the last eighteen years was 53.8 inches, or 13 inches above the normal. Thus the variation in total precipitation between

the wettest and driest years, as far as records have shown, is approximately 24 inches.

The snowfall for the region is heavy, its average annual depth being nearly 5½ feet. The greater part of this occurs during the months of December, January, and February.

The following tables, compiled from Weather Bureau records, give a detailed statement of available data bearing on temperature and precipitation:

Normal monthly, seasonal, and annual temperature and precipitation at Glens Falls, N. Y.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	24	65	−16	3.3	5.8	4.7	11.4
January	20	60	−36	2.9	1.9	2.4	16.4
February	19	51	−28	3.2	.4	1.9	19.9
Winter	21			9.4	8.1	9.0	47.7
March	31	73	−11	3.5	3.3	4.3	11.3
April	45	86	15	2.6	3.8	3.6	1.6
May	58	94	20	3.2	3.0	3.8	Trace.
Spring	45			9.3	10.1	11.7	12.9
June	67	98	36	4.0	2.6	6.2	.0
July	71	96	44	3.8	4.4	8.8	.0
August	68	95	38	3.9	4.7	5.4	.0
Summer	69			11.7	11.7	20.4	.0
September	61	94	24	3.6	2.8	1.2	.0
October	49	83	18	2.9	1.0	1.5	.1
November	36	73	4	3.1	1.3	10.0	3.7
Fall	49			9.6	5.1	12.7	3.8
Year	46	98	−36	40.0	35.0	53.8	64.4

Normal monthly, seasonal, and annual temperature and precipitation at Wells, Vt.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	23	60	−25	2.7	1.9	3.3	10.6
January	18	64	−22	2.3	2.0	3.4	14.9
February	18	58	−26	2.8	1.6	1.5	17.7
Winter	20			7.8	5.5	8.2	43.2
March	29	68	−10	3.2	1.6	3.9	12.5
April	41	80	10	2.4	1.4	3.2	2.9
May	55	89	22	3.3	2.7	5.6	.2
Spring	42			8.9	5.7	12.7	15.6
June	65	94	33	3.4	3.3	5.3	.0
July	69	95	40	4.1	2.4	10.1	.0
August	65	92	37	4.1	2.4	5.7	.0
Summer	66			11.6	8.1	21.1	.0
September	59	86	26	3.9	3.3	2.4	.0
October	48	80	16	2.9	3.7	1.3	.2
November	34	66	0	2.7	2.6	6.6	6.9
Fall	47			9.5	9.6	10.3	7.1
Year	44	95	−26	37.8	28.9	52.3	65.9

The average length of the growing season, or that period of each year in which immunity from killing frosts can be expected, is 152 days for each of the stations for which data are given, the average date of the latest killing frost in spring being May 8 at Wells and May 6 at Glens Falls, and the average date of the earliest in fall October 7 at Wells and October 6 at Glens Falls.

The longest growing season, as shown by the records, which cover the past eighteen years, was 208 days at the Wells station, and occurred in 1893. For the Glens Falls station the longest season free from killing frost was in 1896, and consisted of 181 days.

The shortest season at the Wells station occurred in 1897, and consisted of only 119 days; the shortest at Glens Falls was 128 days, and occurred in 1903. Thus it is seen that there is a considerable range from the average length of the growing season and a very wide range between the shortest and longest seasons for this region.

The table following gives the dates of the latest killing frosts in spring and the earliest in fall from 1892 to 1909, inclusive.

Dates of first and last killing frosts.

Year.	Wells, Vt.		Glens Falls, N. Y.		Year.	Wells, Vt.		Glens Falls, N. Y.	
	Latest in spring.	First in fall.	Latest in spring.	First in fall.		Latest in spring.	First in fall.	Latest in spring.	First in fall.
1892.....	May 1	Oct. 12	May 1	Oct. 12	1902.....	May 14	Oct. 10	May 14	Oct. 10
1893.....	Apr. 6	Oct. 31	(a)	(a)	1903.....	May 25	Oct. 19	May 25	Sept. 30
1894.....	May 15	Oct. 16	May 13	Sept. 26	1904.....	Apr. 24	Sept. 22	Apr. 23	Sept. 22
1895.....	May 14	Oct. 26	May 28	Oct. 10	1905.....	May 24	Oct. 7	May 2	Oct. 22
1896.....	Apr. 30	Oct. 9	Apr. 12	Do.	1906.....	May 21	Sept. 25	May 21	Oct. 12
1897.....	May 8	Sept. 28	May 8	Sept. 28	1907.....	May 29	Oct. 2	May 25	Oct. 9
1898.....	Apr. 19	Oct. 10	(a)	Oct. 10	1908.....	May 5	Oct. 3	May 5	Oct. 3
1899.....	May 14	Oct. 2	Apr. 11	Oct. 4	1909.....	May 3	Oct. 13	May 3	Oct. 13
1900.....	May 12	Oct. 17	May 11	Oct. 17	Average	May 8	Oct. 7	May 6	Oct. 6
1901.....	May 6	Sept. 20	Apr. 12	Oct. 5					

a No record.

Neither of the two Weather Bureau stations for which data are given are located within Washington County. Glens Falls is located at the upper end of the Hudson Valley, in Warren County, a few miles west of the Warren-Washington County line. The elevation of the observation station at this place is only 340 feet above sea level. The table given for this station is computed from records extending over the period from January 1, 1892, to December 31, 1909, or for eighteen years. The Wells station is at an elevation of 750 feet above tide and is located in Vermont just to the east of Washington County. The table given for this station is computed from records from January 1, 1893, to December 31, 1909, or a period of seventeen years.

It will be observed that both of these weather-observation stations are at relatively low altitudes. No records are available which will show the variations in temperature, precipitation, and frost occurrence in the different upland portions of the county or between the valleys and uplands.

AGRICULTURE.

The agricultural development of Washington County did not begin for a century and a half after its first visitation by the white man. Unlike many other sections of the New World, the aboriginal possessors of the lands of this region did not use them for farming. The whole region was "hunting ground." This was so, probably, on account of its being located along and in the natural pathway between the Hudson and St. Lawrence valleys, and, therefore, in the fighting ground of the Iroquois and their enemies, the Canadian Indians. With the settlement of the St. Lawrence Valley on the north and the settlement of the Hudson Valley to the south, the region still con-

tinued to be the scene of much fighting. Many times it was traversed by the contending colonial armies with their Indian allies. These facts prevented the settlement and development of the region, and gave to it the appellation "The Warpath of America." However, the conquest of the French colonies in Canada by the English put an end to this intercolonial strife, and the lands were taken up and their agricultural development begun.

The development of the land was one of the conditions on which the lands were granted; "the grant was to be forfeited, if within a reasonable time settlers were not located upon the lands and portions of them cleared and put under cultivation." The men taking up these grants and settling upon them cleared a small piece of land and sowed it to wheat. This done, they returned to their former homes in other and older settlements for the winter, returning the following spring with their families and making new permanent homes. Corn and vegetables were then planted for family use. At this time the nearest grist mill was at Stillwater, on the west side of the Hudson, some 30 miles distant from the first settlements in Washington County. The road to this mill was only a path through the woods, and those who were not so fortunate as to own a horse often carried their corn hither "in bags strapped to their backs," returning with the meal in the same fashion. The first grist mill within the county was located on Black Creek. In 1772 another mill was built at Fitch's Point, and there was one at Argyle and also at Galesville, now Middle Falls, "and these, it is believed, were the only grist mills in this section of country until after the Revolutionary war."

But little choice as to soil was made by these first settlers, though they commonly built their homes in the valleys and there began the agricultural development of the county. One notable exception to this general rule of selecting valley lands is shown by the following quotation: "The interval lands along Owl Kill * * * are said to have been originally little else than a marsh, traversed everywhere by beaver dams and overgrown with stupendous pines and hemlocks * * *. It is reported * * * that settlers at an early date were accustomed to pass by this dreary tract and go up among the mountains * * * preferring to buy the wild lands of those rugged hills at ten shillings per acre, when these were offered to them for four."

From the first settlement of the county flax was grown for family use. It was dressed, spun, and woven at home entirely by hand labor. This was the case up to the time of the war of 1812. During this war the high price of linen induced the farmers of Cambridge to cultivate flax on a commercial scale. James Whiteside grew the first crop of commercial importance at this time, planting 3 acres. The

production of this fiber proved profitable during the continuance of the war, and with the experience gained during that time he figured that "it would remunerate him as handsomely as any other product which he could grow upon his farm," even at the lower prices following the close of the war, "and therefore continued its cultivation," and "one and another in his vicinity began to follow his example." The flax crop continued to be one of the leading crops of the county until about 1880. The height of its production was reached about 1870, when 34,814 bushels of seed and 1,285,033 pounds of fiber were produced. Twenty years later, in 1890, the production had dwindled to 497 bushels of seed and only 11,715 pounds of fiber. Ten years later still, or in 1900, it had disappeared as a farm crop. The growing of flax was always confined largely to the southern part of the county.

The growing of potatoes has always been of great importance. As early as 1840 the production amounted to nearly a million bushels annually. By 1860 this production had increased to 1,148,430 bushels, the county then ranking second in potato production in the United States. During the decade 1860 to 1870 the production was increased by approximately 1,000,000 bushels, the county taking first place in the production of this crop. In 1880 the production had increased to 2,216,648 bushels, but the county had dropped to second place again. From 1880 to 1890 there was a falling off of 649,972 bushels in the production, the county ranking third according to the census figures for the latter year. The Twelfth Census (1900) shows a production of 285,454 bushels less than the production of the previous census year (1890), the production being 1,281,222 bushels, or nearly 1,000,000 bushels less than the maximum, twenty years previous. The county had now fallen to the sixteenth place in the production of potatoes, the decline being due to the double influence of decrease in production within the county itself and the greater development of other counties in potato production.

It is interesting to note that the introduction of both flax and the potato in Washington County was made by the Scotch-Irish settlers, who had come from settlements made by the same people in New Hampshire and Massachusetts. These settlers introduced these two crops in New England from their former homes in the north of Ireland.

The keeping of sheep for wool became an important form of animal husbandry in the county at an early date. The climate, topography, and soils were found to be peculiarly suited for this type of farm industry and the flocks rapidly increased in number and size. The quality of the wool was improved by the importation of Merino blood from the confiscated flocks of the Spanish nobles about 1810. Other importations of another strain of Merinos were made about

the same time. The crossing of the Merinos with the native stock produced sheep bearing a finer grade of wool than that of either parent. About 1825 some sheep of the Saxon blood were introduced. The descendants of these importations crossed with the hardy native stock form the flocks of the present. Early in the past century the sheep industry had assumed a position of prime importance. In 1825 the number within the county was considerably greater than 100,000, and ten years later, in 1835, there were 206,157 head of sheep on the farms of the county. The height of the industry was reached in 1845, when the total number of sheep within the county was 254,866 and the wool clip amounted to 579,056 pounds. At this time there were 64 sheep to every 100 acres of cleared land in the county. From this maximum there has been a decline in the number of sheep kept. This decline was most rapid between 1845 and 1850, the herds falling off more than 100,000 during that five-year period. The number of sheep in the county at the time of the taking of the last census (1900) was only about 75,000.

The importance of keeping sheep on the farms of Washington County to utilize the rugged hill pastures with thin soils was long ago recognized, for "a flock of sheep, requiring as it does but little time and attention during the busy period of the year, will occupy that portion of the farm which is least convenient for tillage, and thus add an important item to the proprietor's income. * * * Without increasing in any sensible degree its expenses, and without interfering with and hindering other operations, a limited number of sheep can be supported, mainly upon such portions of the farm as would otherwise be neglected and for the time valueless." This statement is just as true to-day as it was sixty years ago, when it was written by Doctor Fitch, and can not be too strongly brought to the attention of Washington County farmers.

Corn, oats, and rye have been staple crops in Washington County from its early settlement. By 1850 the production of Indian corn amounted to slightly more than a half million bushels annually, and it has since been maintained at about the same figure, though, of course, subject to quite a wide seasonal variation. The oat crop in 1850 had increased to 580,754 bushels, and ten years later to more than three-quarters of a million bushels. Since that time the production has varied but little from the latter figure, generally being greater rather than less, though in 1899 the production was only 603,170. The rye crop has always been of considerable importance, though never as important as corn or oats. As early as 1839 the yield in the county was nearly 150,000 bushels. The production remained more or less constant up to 1890, when it was 133,634 bushels, though in 1869 and 1879 it was only a little in excess of

100,000 bushels. For the last census year (1899) 93,360 bushels were reported.

The production of other cereals has always been small, their combined yield never reaching 100,000 bushels annually. Wheat, though grown much more extensively in former years than now, has always shown a small total yield. In 1839, 49,189 bushels were reported. Since that year the various census reports show a decrease in its production, there being only 3,300 bushels reported for the crop season of 1899. The production of buckwheat has varied from 30,000 to 60,000 bushels annually, while that of barley has been much smaller, varying from 3,000 to 15,000 bushels annually.

The total production of cereals has never been large compared with that of many other counties of the State. Since 1849 the total annual production of all cereals has exceeded 1,000,000 bushels. The maximum yield, 1,601,758 bushels, was attained in 1879, and the minimum, 1,105,940 bushels, was reached in the last census crop year (1899).

Stock raising and dairying have long occupied an important position in the agriculture of Washington County. There has, however, been a change in their relative importance, the number of dairy cows having increased, while the number of other cattle has slightly decreased. In 1850 there were 35,257 head of cattle in the county, 19,224 of which were dairy cows. In 1900 the total number of cattle had reached 40,590 and the number of dairy cows had increased to 23,257.

The value of all live stock in the county in 1900 was $2,010,871. The year previous the sales of live stock aggregated $340,867, and the value of animals slaughtered on the farms was $195,243. The value of all dairy products for 1899 was $735,354. Thus the combined value of live stock sold and slaughtered and of dairy products produced amounted to $1,271,464 for the census year. To this sum should be added the market value of the wool shorn, 364,490 pounds.

The production of fruit has always been on the basis of small farm orchards. Apples are the leading fruit, there being 165,448 apple trees in 1900. The value of orchard products for 1899 was $109,745.

The area of Washington County is 843 square miles, or 539,520 acres, of which 454,502 acres, or 84 per cent, was in farms in 1900. Of the acreage included within farms only 69 per cent, or 58 per cent of the total area of the county, or 314,993 acres, was then classed as improved farm land.

The present day agriculture of the county consists principally of dairying, sheep and stock raising, and potato production. Of the total area, 65 per cent is either forest, pasture, or wild land. Of the 314,993 acres of improved farm land, 175,988 acres, or 55 per cent, is in mowing and the ordinary farm crops, and 139,005 acres, or 45 per cent is in pasture sods. Approximately one-third of the

improved farm land, 107,486 acres, is devoted to grasses and clover. The average yield of these forage crops is low, there being only 86,869 tons harvested, or about three-fourths of a ton per acre. About 70,000 acres are given to plow land for grain and the intertilled crops. Oats has the largest acreage, approximately one-third of the plow land being planted to this crop, which gave a yield of 603,170 bushels, or 24 bushels per acre. Next to oats in acreage extent is Indian corn, with 17,685 acres, giving a yield of 462,810 bushels, or 26 bushels per acre. Potatoes are third in acreage, with a yield of 1,281,222 bushels, or 90 bushels per acre from 14,089 acres. Fourth in acreage is rye. Some 7,500 acres are sown to this grain, giving a yield of 12 bushels per acre, or a total of 93,360 bushels. Buckwheat has an acreage of 3,023 acres and a yield of 37,680 bushels, or 12½ bushels per acre. All other crops have acreages of less than 500 acres, and are consequently unimportant.

During the census year of 1899 the value of farm products not fed to live stock, less the expense for hired labor and fertilizers, amounted to $2,247,870, or a net income of 16 per cent on the valuation of farm land, buildings, live stock, and machinery. This income amounted to $605 for each farm within the county and $4.95 per acre for the total farm acreage, or $7.14 per acre for each acre of improved farm land.

The adaptation of soils to crops has been recognized only in a general way by the farmers of the county. The clay lands are quite generally in sod, either for mowing or for pasture, for which they are best suited. Many of the fields of light or thin soils are extensively utilized for the production of rye. Corn, oats, and potatoes are quite generally planted on soils in both the valleys and uplands best suited to them. The dairy farming is usually carried on on farms suited to that system of farming, the more hilly and rugged fields of the farms with the thin soils being used for pasture. Many of the dairy farmers own or lease a second farm or tract of land ill adapted to cultivation, which they use for summer pasturage for dry cows and young stock. Again, many of the hilly and rocky fields with thin soils are used as sheep pasture, about the only use to which they can be put. In fact, many of these fields would not be utilized for farm purposes at all but for the keeping of a flock of sheep in conjunction with other forms of farm industry. By far the greater portion of the Adirondack upland and large areas of the Green Mountain upland are not adapted to any of the ordinary crops, and are not used for or classed as farm lands. These areas are, however, utilized in a way for the production of forest products, the only crop to which they are naturally adapted.

Rotation of crops is not as systematically followed by the farmers as it should be to secure the best results. The large amount of rough, rocky, and mountainous land, together with the large acreage of clay

land, interferes with or prevents the establishment of any system or of any adequate system in some cases. However, these facts should not influence the practice of rotating crops on farms where this is practicable. Permanent sods are the rule rather than the exception on the clay lands and also on much of the thin and rocky soils of the uplands. The example of this almost universal practice seemingly influences the practices on those soils on which short-term rotations could and should be worked out, and there are fields which have been left in sod until the tame grasses have practically disappeared and mowing no longer proves remunerative.

The following rotations might well be considered and practiced on the various soils and for the different systems of farming:

For the clay soils the principal crop should be hay, either for feeding or sale, preferably the former. These soils are poorly adapted to any of the intertilled crops, but at least one such crop should be grown to prepare the soil for other crops. This necessity being taken into account, corn might be planted the first year followed by spring grain, either oats or barley, and seeding. For the seeding, alsike clover and timothy should be used, both being well suited to these heavy soils. The third, fourth, and fifth years the sod should be mowed, or possibly used for pasture the fourth and fifth or the fifth year. Fields on these soils should rarely if ever be kept in sod more than three years and never until the tame grasses have disappeared from the sod. They should be plowed while there is still a good sod to turn under, and they should not be continuously used for pasture on account of the close, dense soil, which will become still more compacted by the tramping of the stock over it.

On the thin soils potatoes could well be grown the first year, rye the second year with seeding to clover and mixed grasses, the sod land to be used for mowing one, two, or possibly three years. Following their use for the production of hay, these soils may or may not be used as sheep pasture. If not grazed too closely, this practice could well be employed in the place of the second and third year of mowing and be followed by potatoes, the droppings of the sheep serving as a partial top dressing.

The rotations for the light and gravelly soils of the deltas and terraces might be potatoes or corn, one year; winter grain, rye following the potatoes, or spring grain, oats following the corn, one year, seeding to clover and timothy with the grain in either case, and then hay for one or two years. Following the mowing of the sod the land might be returned to the first course of the rotation or used for one season as pasture either for dairy cattle or sheep. If the fields are to be used for pasture, the seeding should be to clover and mixed grasses instead of the clover and timothy alone. Providing the sod is good on these soils, the tramping of the stock, so

undesirable on the clay soils, is here desirable, helping to counteract the natural lightness and looseness of the soils and making them more retentive of moisture.

On the heavier of the first bottom soils corn or potatoes might be the crops for the first course of the rotation, oats with seeding to clover and timothy for the second, mowing for several years, but never until the sod becomes too poor and thin to produce a reasonably profitable crop. If the farm is operated as a dairy farm, a part of the corn should be for ensilage, and after mowing for a year or two the field can be used for pasture. In this system of farming a few acres could well be sown to oats and peas in the second year for feeding green to the milch cows during the late summer, when pastures are likely to be short owing to drought. However, these lands are too valuable in the production of intertilled grain and forage crops to be extensively used for pasture, unless they be subject to overflow. In this case they are then probably better suited for pasture, and should be so used permanently. If any sheep are kept, a portion of the land otherwise planted to corn should be used for root crops to furnish succulent feed during the winter months.

The money crop of the heavier soils of the upland should be Irish potatoes, which should always be grown in conjunction with some form of animal husbandry, here dairying or sheep raising. The rotation for these soils and for such a system of farming might be: First year clover sod turned down for potatoes, with some corn for ensilage if a dairy farm. If sheep are kept, a few acres otherwise planted to corn should be sown to some root crop, as ruta-baga turnips or mangel-wurzels, and an acre or so of cabbage. The second year oats could be sown as a cover crop for a seeding of clover and timothy, and a few acres could well be sown to oats and peas for feeding green to the dairy stock. The third year the fields should be mowed for hay. The fourth year the fields can be used for hay, pasture, or turned back to the first course of the rotation—potatoes. In any case it will be unwise to keep the land in sod for more than two years. After the potatoes and corn are harvested the first year rye may be sown as a winter cover crop and plowed under the following spring in time to sow oats.

These rotations, it will be observed, are very general, and consequently are not suitable for all soils and soil conditions existing within the different divisions of the county. Each farmer should work out from experience the rotation which is best suited to his system of farming, his soils, and his climatic, market, and soil conditions. Care should be taken in all cases to provide a place in the rotation for a legume of some kind as a means of improving the soil, and also for the production of grain and protein food crops to lessen the ex-

pense where such foods are purchased. Alfalfa should find a place on all farms having soils which are adapted to growing it, thus accomplishing both objects—soil improvement and the production of protein food for the stock. Another item of importance in this region, where so much land suitable for sheep pasture exists, is the growing in each system of rotation of roughage and succulent feed for the wintering of the flocks.

The character and condition of the soils, the markets, the transportation facilities, and the adaptation of the different soils to crops should all be considered in determining the system of farming and the rotations to be followed, and consequently the kinds, varieties, and relative proportion of the different crops, the fertilizer treatment, the tillage methods, and the systems of farm management to be followed.

The practices employed in the agriculture of Washington County, while fair, are not as progressive as they should be. This is reflected in the fact that as prices of farm produce have advanced in recent years, and both the distant and near-by markets have increased their demands, the farms have not responded to these demands and higher prices with increased supplies, but on the contrary have actually produced less in the aggregate than formerly. Of the four principal agricultural products of the county all but one show great declines from their maximum, according to the latest statistics available. In 1899 cereal production was approximately a half million bushels below its maximum reached in 1879. Potato production had fallen nearly a million bushels from the maximum during the same period of time. And the number of sheep was 175,060 less than the maximum of 1845. On the other hand the number of cattle was at a maximum in 1899, there being 5,710 more than in 1889, 2,372 of this number being dairy cows.

The use of commercial fertilizers is not extensive, only $29,960, or 6½ cents for each acre in farms, being expended for this purpose in 1900.

With modern methods of tillage, care, and fertilization there is no reason why the soils of Washington County should not be producing much more wealth than at any time in its history. This should be particularly the case during a period of high prices, such as has been experienced for a number of years.

Agricultural labor in the region is rather scarce. The manufacturing interests built up near all the more important water powers absorb a great deal of the labor that would otherwise turn to the farm for employment. This not only makes it difficult for the farmers to secure satisfactory help, but also difficult to keep efficient help permanently on the farm. The wages for farm hands vary

from $25 to $35 and board by the month and from $1.50 to $2 by the day. The expenditure for farm labor in 1899 was $449,850, or $121 for each farm.

The Twelfth Census shows that on June 1, 1900, there were 3,715 farms within the county, or one farm for every 12.3 inhabitants. At the same time the average size of the farms was 122.3 acres. A good many of these farms consist of several thousand acres. The mountainous character of portions of the county accounts for the large percentage classed as wild land, considerably more than 100 square miles. Of the total number of farms in the county, 2,629, or 70.8 per cent, were operated by their owners; 176, or 4.7 per cent, by part owners; 77, or 2.1 per cent, by owners and tenants; 61, or 1.6 per cent, by managers; 341, or 9.2 per cent, by cash tenants; and 431, or 11.6 per cent, by share tenants. Of the 3,715 farms, all but 22 were with buildings. It will be observed from the above figures that a larger percentage of the farms than usual are operated by owners, and that a remarkably small number are rented on the share plan.

The present valuation of the lands of the county varies from $5 to $300 per acre. The lowest priced lands are valued chiefly for their timber, and are worth little agriculturally. The highest priced lands are the Muck areas of the Fort Edward and Wood Creek valleys. These latter lands were swamps that the early settlers passed by. The present acreage value varies widely, owing to the great variation in the character of the different soils and the consequent variation in their adaptation to crops, to the great variation in topography, to location, and to the character of the improvements. The Twelfth Census places the value of farm land and improvements, except buildings, at $6,411,260, or $14.11 per acre. The same authority gives the value of farm buildings as $5,572,510, making the total real estate valuation, as it then stood, $11,983,770, or $26.37 per acre. This valuation is approximately the same as that given fifty years earlier by the Seventh Census, the valuation then being $11,958,955, or $26.31 per acre. In no census year between these two has the farm valuation been as low by nearly $5,000,000.

In the improvement of the agriculture of Washington County there are many things to be considered. Chief among these are drainage, the adaptation of crops to soils, the systematic rotation of crops, improvement of tillage methods, rational manurial and fertilizer practices, the improvement of permanent sods, and the improvement of seeds and stock.

The question of drainage is of fundamental importance, as no other improvement can be made permanent and efficacious without efficient internal as well as surface drainage. The close structure and fine texture of some of the soils of the county make drainage somewhat difficult but none the less important. It is certain that

much is lost annually on these soils through low crop yields and partial or complete crop failures as a result of poor drainage conditions alone. Therefore thorough drainage, both surface and subsurface, is essential on some of the soils and desirable on others before any stable improvement in their producing capacity can be brought about.

Many crops are grown on soils that are ill adapted to producing them, almost always with discouraging results. If these, as well as all crops, were planted on soils adapted to their production, the yield and quality would without question be improved, the unit cost of production lessened, and the profits therefore increased. In connection with this question of the adaptation of soils to crops comes the also important subject of the rotation of crops. It is an established fact that no permanently successful system of cropping or farming can be established and maintained without a rotation in the kind and character of the crops grown. Suitable rotations should be worked out and followed for each soil type and system of farming, bearing in mind at the same time that only crops to which the soils are adapted can be given a place in the rotation if the very best results are to be obtained.

Another important item in the betterment of the agriculture of the county is the question of tillage methods. As a matter of fact the first and most essential operation, plowing, is too often the most poorly performed. Perhaps the most important part of tillage for any crop is the preparation of the seed bed, and this can not be properly accomplished if the plowing is poorly done. Some of the soils of the county should seldom or never be fall plowed, while others can and should be plowed in the fall of the year. Again, some of the soils can be plowed and a seed bed prepared only within a narrow range of moisture content, while others can be handled under the widest possible range in moisture conditions. After land has been properly plowed greater care should be given than is usual at present in the further preparation of the seed bed, in order that the best possible conditions for the germination of the seed and for the early growth of the crop be provided. And later more careful cultivation of the intertilled crops should be practiced, especially with a view to maintaining the most favorable moisture conditions.

The fertilizer practice is another important matter for consideration in the improvement of Washington County agriculture. Much of the commercial fertilizer, for lack of definite information, is used without reference to its composition or to the soil and crop requirements. It is probable that in many cases as much benefit could be brought about in some other way by means at the farmers' command and without any cash outlay, as is required by the use of "phosphate."

In the consideration of this problem more economical handling of the stable manure from the dairies and flocks of sheep deserves attention. Many of the soils of the county are low in organic matter. This condition could be alleviated to a considerable extent by the careful husbanding and use of all stable manure.

In addition to the careful saving and use of the stable manure some crop should occasionally be grown and plowed under as green manure. For this purpose, clover sod is desirable, but if the crop is to be grown especially for this purpose, rye, buckwheat, or field peas are suitable. In such practice rye can be used to advantage, as it can be sown in the fall after some other crop has been harvested and plowed under in the spring before the time for planting another crop, thus losing no time or crop in the rotation. This practice will be found particularly desirable if the soils are such or the fields so located that washing takes place during the late fall, winter, and early spring. In this connection more leguminous crops should be grown, Canada field peas for green feed, forage, and grain, the clovers for hay and clover sod to plow under, and alfalfa for protein feed. All of these crops, except rye and buckwheat, are legumes and enrich the soil in nitrogen, the most costly of all the ingredients of commercial fertilizers.

In working out any scheme of fertilizer practice and especially where the growing of leguminous crops is practiced, the use of lime is often essential and may be the controlling factor between success and failure.

A large percentage of the lands of the county are in permanent pasture; therefore the improvement of sod land is not to be neglected. This work is new, but nevertheless important. These lands, unless in forest or land too rough and rocky to deserve even the name of sheep pasture, should be reseeded at intervals of a few years and if possible harrowed to distribute the droppings of the stock and to disturb the mosses and weeds. Some of this sod land should also receive an occasional light top dressing of stable manure.

The improvement of seed by selection and breeding should be considered by every farmer. If this were done the yield of crops could be materially increased in the course of a few years at an insignificant and unnoticed cost. Likewise the herds of cattle and flocks of sheep should be improved by introducing new and better strains of blood and by the general upbuilding through care in crossing and breeding, using in every case only sires of the best constitution and blood obtainable. Besides improving the quality of the live stock, the numbers of both cattle and sheep could and should be increased in order to utilize all of the rough pasture land, much of it now producing no income, and all of the forage grown, thus avoiding the sale of hay and straw and increasing the quantity of manure returned to the soil.

SOILS.

The soils of Washington County fall, according to their origin, and mode of formation, into four groups, namely, glacial drift soils, residual soils, lacustrine soils, and terrace and delta soils, the last two groups being water moved and deposited.

The first of these groups of soils is closely related to the second, for "* * * after all the chief part of these drifted soils has been only moved a short distance, and * * * they are far more closely related to the rocks on which they rest than to rocks foreign to this county." These drift or glacio-residual soils cover the larger part of the county, being the hill soils of the Green Mountain upland and of a portion of the Adirondack upland. In the Green Mountain upland portion of the county the drift soils rest upon and overlie the metamorphic rocks of Hudson River age, which are of various character, ranging from highly metamorphosed slates and shales to calcareous sandstones. The soils in this upland section of the county are the Dutchess stony loam, Dutchess silt loam, Dutchess slate loam, and the Cossayuna stony loam.

Though these soils are all of glacial origin, they are modified to a considerable extent by residual material from the underlying metamorphic rock of the Hudson series and to a large extent by soil-forming material from the same rocks moved only a short distance by the action of the glacial ice, as shown by the subangular outline of the rock fragments. This fact is also attested by the character and color of the soil-forming material, particularly in the shallower type of the Dutchess soils and of the Cossayuna stony loam. In the Adirondack upland region the Adirondack stony sandy loam is to a certain extent of the same character, though more or less modified by colluvial materials from Archæan rocks and also by local wash of the same materials. The Rough stony land of the valley region is also of the same character, modified to a small extent by clay deposits of lacustrine origin laid down over the bed rock of limestone. The Dover stony sandy loam, also overlying limestone, is also of the glacio-residual group, although less modified by residual admixture of material. This association with limestone, and the admixture of more or less calcareous material, distinguishes the Dover from the Gloucester series of soils found in New England and along the lower Hudson.

The soils of the second group, the residual, are of considerable extent, though only one soil type and Rock outcrop are recognized and only the soil type, Allis shale loam, can be considered as purely residual. This soil type, however, " is mostly geest, or a slaty gravel derived directly from the underlying rock," the Hudson River shales. The Rock outcrop areas consist of the rounded mountain masses of Archæan granites forming the Adirondack Mountains, with some of the loose rock itself and a little glacial material.

The lacustrine soils are of considerable importance from their wide extent. The soils falling in this class are three types of the Vergennes series—the Vergennes clay, the Vergennes black clay, and the Vergennes stony loam—Muck, and Marsh.

The Vergennes clay represents areas composed of the extremely fine sediments laid down in the glacial lakes Albany and Vermont. These two lakes are joined through the low pass of the Wood Creek Valley between the present Champlain and Hudson valleys. Similar soils were deposited to the northward on both shores of Lake Champlain in Vermont and New York, particularly on the Vermont side, and probably farther to the north in Canada in the Lake Vermont basin and to the southward on both the east and west sides of the Hudson River in the Lake Albany basin. The Vergennes black clay is simply the Vergennes clay occurring in such a topographic position that considerable quantities of organic matter have accumulated in the surface soil, giving it a deep black color. The Vergennes stony loam is made up of shallow deposits of these lake sediments overlying the country rock, together with exposures of the broken and solid rock itself. These clay soils have the highest clay content of any soils so far recognized and mapped in the United States.

The Muck is composed of materials of an entirely different character, though formed in lakes or ponds of comparatively recent time. This type consists largely of decayed and decaying organic matter from the growth of swamp vegetation in these recent shallow lakes and ponds. Though not of great extent, it is, when reclaimed, the most valuable soil of the county. Marsh comprises chiefly the mud flats along the upper end of Lake Champlain and along East Bay. It is only just above water level and is still undergoing most actively the processes of formation from the deposition of lake sediments each time the lake waters are high enough to inundate its surface. Some small areas of Marsh are in reality Swamp, being low, wet, and swampy areas in the uplands and timbered with water-loving species of trees and other aquatic vegetation.

The terrace and delta soils belong in two series, the Hoosic and the Ondawa. The former occupies the higher and older terraces and deltas and the latter the first bottom or the low and more recent terrace and delta areas. In the Hoosic series five types are shown in the soil map accompanying this report—the gravel, the gravelly sandy loam, the coarse sand, the fine sand, and the silt loam. Of the Ondawa series only two types are mapped, the fine sand and the silt loam.

All the terrace and delta soils are of post-glacial origin and have been formed by deposition from flowing waters. Those of the Hoosic series were laid down at a much earlier time than those of the Ondawa series, and with the exception of the fine sand and silt loam

types are of much coarser materials. These coarse-textured soils were deposited by swiftly flowing waters, which must have been of large volume. They are usually stratified and interbedded, the materials having come for the most part from regions outside of the county, though there is no evidence that any considerable proportion of them came from any great distance. These materials often overlay glacial drift, though they sometimes rest upon the country rock. In the delta areas they are underlain largely by lacustrine clays, showing here a more recent origin. The finer textured types of the series, the Hoosic fine sand and silt loam, have been deposited at the outer edge of the deltas or in other positions after the velocity of the water currents had been checked to such an extent that they could no longer carry any appreciable amount of the coarser textured materials. In the Ondawa series the silt loam type represents the deposits of fine materials from quiet flood waters upon recent or present flood plains, while the fine sand is of the slightly coarser materials laid down in the first bottom as small deltas or other positions by flowing flood waters, where conditions were favorable for the deposition of materials of the intermediate grades only.

The following table shows the relative as well as the actual extent of each of the soil types shown on the soil map accompanying this report:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Vergennes clay	92,992	17.2	Hoosic fine sand	7,168	1.3
Cossayuna stony loam	88,448	16.4	Hoosic coarse sand	6,080	1.1
Dutchess stony loam	75,456	14.0	Dover stony sandy loam	5,056	1.0
Rock outcrop	73,152	13.6	Hoosic silt loam	4,288	.8
Dutchess slate loam	44,480	8.2	Muck	3,712	.7
Hoosic gravel	31,232	5.8	Marsh	2,880	.5
Adirondack stony sandy loam	30,400	5.6	Ondawa fine sand	2,176	.4
Ondawa silt loam	23,040	4.3	Vergennes stony loam	1,280	.2
Rough stony land	14,720	2.8	Vergennes black clay	640	.1
Dutchess silt loam	12,800	2.4			
Allis shale loam	10,880	2.0	Total	539,520	
Hoosic gravelly sandy loam	8,640	1.6			

DUTCHESS STONY LOAM.

The soil of the Dutchess stony loam is a light-brown loam with a high content of shale fragments and some rounded stones. It is from 6 to 8 inches deep and rests upon a subsoil of light-yellow loam, varying in depth according to the position of the underlying bed rock. This often comes to the surface and makes the areas of cultivable land irregular. The soil is not difficult to cultivate, except that the outcropping rock limits the actual area of cultivable land within the fields.

The Dutchess stony loam occurs throughout the eastern side of the county in extensive areas. It is hilly to mountainous in topography and has excellent surface drainage. Notwithstanding this the soil seems to hold large amounts of moisture and underdrainage would without question prove beneficial over considerable areas of the type.

In origin the Dutchess stony loam is the result of glaciation of the underlying Hudson shales. By far the greater proportion of the soil material has been derived from these rocks, though there are some scattered fragments of rock formations foreign to the locality. The rocks found in the soil are largely local, as is attested by the fact that fences built of the stones removed from the fields are almost all of the highly metamorphosed formations of the region.

The native vegetation consists of various species of oak, elm, hard maple, and white birch. Practically all of the original forests were removed long ago. However, much of the type is now covered with forest of second-growth timber, largely of the original species.

The Dutchess stony loam is particularly well suited to sheep raising. The rougher portions make excellent sheep pastures, and there is nearly always enough easily arable land on farms of this type to grow forage for winter feeding. The Dutchess stony loam is better suited for this type of farming than for dairying on account of the expense in delivering milk to the factories or shipping points. Besides, the rough pasture land is better suited to sheep than to dairy cows. A good many sheep are kept on farms of this soil type, but the number could be considerably increased without materially increasing the labor item of farming. Dairy farming is also carried on to a considerable extent.

There are a few apple orchards, which do very well considering the scant attention and care given them. Orcharding could well be extended on the deeper soil areas on the basis of the farm orchard.

Much of the Dutchess stony loam should be reforested to varieties of trees suited to the soil and climatic conditions, and those areas now in forest should be managed under modern forestry methods. Taking into account the low agricultural value of considerable areas of the type and its poor adaptation for tilled crops, no other use to which it can be put would give as great returns over a long term of years as would its use for forest products.

The principal crops grown on the Dutchess stony loam, with the yields, are: Hay, one-half to 1½ tons, oats 20 to 30 bushels, corn 20 to 40 bushels, potatoes 50 to 100 bushels, and buckwheat 10 to 15 bushels per acre.

Agricultural methods and conditions prevailing over a large portion of the Dutchess stony loam are poor. Prices of tracts of land within this type vary from $8 to $25 an acre, according to location, improvements, and the percentage of arable land.

The following table gives the results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Dutchess stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21644	Soil	7.4	12.9	4.3	7.4	12.4	37.6	17.7
21645	Subsoil	4.5	11.1	4.7	7.4	11.4	37.3	23.2

DUTCHESS SILT LOAM.

The Dutchess silt loam to a depth of 6 or 8 inches consists of a light-brown to grayish silt loam, containing varying amounts of shale and rounded stone fragments. The subsoil is lighter in color, varying from a light-gray to a drab. In texture it is a true loam. It contains, as does the surface soil, a considerable quantity of local shale and rounded rock fragments of foreign origin. The subsoil extends to a depth considerably greater than the 3-foot section, the country rock in no case being near the surface.

This soil is easily tilled. No difficulty should be experienced in the preparation of a satisfactory seed bed with a reasonable expenditure of time and labor. All subsequent tillage can be satisfactorily done; the rock content of the soil or bed rock never interferes with its proper performance. The extent of the type is not great, being about 20 square miles. The principal areas occur along the eastern side of the county in the townships of Granville, Hebron, Hartford, Argyle, Salem, and White Creek. In all cases it is closely associated with the Dutchess stony loam. It occupies rounded hills of the drumlin type, with practically no steep waste land. The topography insures adequate surface drainage. However, some of the more level areas would be appreciably improved by underdrainage.

In origin the type is identical with the Dutchess stony loam, and the method of formation, though not identical, is similar. The material of which the soil is made is glacial and largely from the local rocks, but was deposited as lateral moraines or drumlins, forming a deep mantle over the country rock, rather than as a ground moraine or shallow mantle covering the country rock thinly.

The Dutchess silt loam is particularly well adapted to corn, potatoes, oats, and hay. Its depth and ease of cultivation makes it much better adapted to the intertilled crops than the stony loam type. It is also well adapted to apple orcharding. The crops grown are corn, oats, and hay, the mowing sod usually being of clover and timothy. Potatoes grown on the clover sod always yield well, from 100 to 225 bushels being secured per acre. Corn does not usually do so well, as

on some of the other soils, the yield ranging from 25 to 40 bushels per acre. As a grain crop oats do especially well, the yield being anywhere from 35 to 50 bushels per acre. New mowing sods generally cut from 1 to 2 tons of hay per acre, though 1 ton or less is the rule for fields long in sod.

The agricultural conditions and cultural methods are much better over areas of this type than over the Dutchess stony loam. When a farm contains both types the silt loam always constitutes the plow land and is seldom used for pasture. Agriculturally it is widely different and the conditions are better because the soil is deeper and the structure better, both taken together permitting better and more thorough cultivation with the same amount of labor expenditure. These facts are all reflected in better fields, better farms, better equipment, and a better general appearance.

The average results of mechanical analyses of the soil and subsoil of this type are given in the following table:

Mechanical analyses of Dutchess silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21642, 22457.....	Soil.....	3.2	6.9	3.4	8.3	5.6	53.6	18.9
21643, 22458.....	Subsoil.....	6.7	7.4	3.9	8.9	12.9	39.1	20.6

DUTCHESS SLATE LOAM.

The soil of the Dutchess slate loam is a very light brown to pale-yellow silty loam. The subsoil is similar to the soil, though more yellow in color. Both soil and subsoil are similar to the Dutchess stony loam. The soil consists of only a very thin mantle covering the country rock. It occurs throughout the eastern part of the county, closely associated with the other Dutchess types and to some extent with the Cossayuna stony loam, where it occupies mountainous positions. It covers all of the higher parts of the Green Mountain upland and consists of rolling hill tops, steep slopes, and rolling upland. The natural surface drainage features are good, owing to this rough topography.

In origin and formation the slate loam differs from the stony loam and silt loam in that the foreign glacial material is less in evidence and there is a considerably greater proportion of residual material included. However, all of its area has been subject to the action of glacial ice.

The native forest growth consisted of oaks, some sugar maple, elm, white birch and hemlock, white pine, and various other species of soft woods. A large part of its area is now covered by second-growth timber of little value.

Only two recommendations can be made for the utilization of this soil—the grazing of sheep and forestry. It is likely that reforesting the entire area would in the end be the most profitable plan; that is, planting the cleared and thinly forested areas with varieties of trees adapted to the region and caring for the present second-growth timber according to approved methods of forestry.

Practically no agriculture exists on the Dutchess slate loam except for pasturage of sheep, though here and there are small irregular fields cleared, on which some farm crops are grown. The chief value of the type is in the timber it carries. Its selling price is extremely low and there is little or no demand for it.

HOOSIC GRAVEL.

The Hoosic gravel consists of a mass of fine gravel and large stones, commingled with a varying but usually small percentage of fine earth, which to a depth of 6 or 8 inches is of a brown color. The gravel and stones are much rounded and waterworn, and often cover much of the surface. The subsoil to a depth of 36 inches or more is a loose, open mass of light-brown to yellow gravel. The structure of the whole section is loose and open. The large quantity of gravel and stones present makes cultivation difficult.

The Hoosic gravel is quite widely distributed, though the total area is not large. It occurs in the valleys of the Green Mountain upland section of the county, principally in the valley of Batten Kill. Its topography is rather flat, the areas occurring as terraces. However, on account of the gravelly character of the soil the natural drainage, both surface and underground, is generally good, and, in many cases, somewhat excessive.

The Hoosic gravel is a stream deposit of coarse materials, consisting largely of rock foreign to the locality. The variation in the force of the currents from which the material was deposited accounts for the variation in the size of the stones in different areas, some areas containing the larger gravel and cobbles, while others are composed more largely of smaller gravel and have a higher proportion of fine earth. In one area at least there is evidence that the stonier character of the type is due to the cutting down of a higher terrace and the reworking of its gravels, the water currents being just swift enough to remove most of the fine material and a considerable percentage of fine gravel and not swift enough to carry away the coarser gravel and stones.

The original forest growth, consisting of white pine and oak, has all been removed, but some portions of the type are now being naturally reforested with pine.

The Hoosic gravel, where more loamy, is adapted to corn, potatoes, oats, rye, clover, alfalfa, etc. The lighter and stonier areas, though

suitable for forestry, are poorly adapted to the ordinary farm crops. The principal crops grown and the yields secured are as follows: Corn, 30 to 50 bushels; potatoes, 75 to 150 bushels; oats, 35 to 45 bushels; rye, 10 to 15 bushels; hay, one-half ton to 1½ tons per acre.

Land composed of the Hoosic gravel has considerable range in value, which depends mainly on the proportion of stone present. Lighter, stonier areas bring from $4 to $10 an acre, while for the better, more loamy land $10 to $40 an acre, with an average of about $25 an acre, represents the ruling prices. The improvements and agricultural conditions vary with the location and character of the soil. Near villages buildings are good, even though the soil be light and very gravelly, but away from the villages they are only fair even on the better phases of the type and poor on the poorer phases.

The following table shows the results of the mechanical analyses of fine-earth samples of the soil and subsoil of the Hoosic gravel:

Mechanical analyses of Hoosic gravel.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Percent.*
22451	Soil	23.6	42.3	8.0	7.9	3.5	7.2	6.5
22452	Subsoil	22.3	33.9	5.7	5.9	5.2	16.0	10.8

HOOSIC GRAVELLY SANDY LOAM.

The soil of the Hoosic gravelly sandy loam is a brown gravelly sand to gravelly sandy loam from 4 to 6 inches in depth. The subsoil is light-brown to yellowish-brown or gray material, somewhat more sandy than the soil and extending to considerable depths. The gravel content of both soil and subsoil is generally high, the fragments ranging in size from fine gravel to medium cobbles. The soil of this type is easily cultivated, even immediately after heavy rains.

The largest area of the Hoosic gravelly sandy loam occurs in the divide between Batten Kill and Owl Kill, on the south side of the delta of Batten Kill. An area is also found in an old delta of the Mettawee River, where it comes out from the Green Mountain upland into the valley divide section. There are small scattered areas along various other streams of the county. The surface is relatively level and the loose, open structure and coarse texture gives good drainage, both surface and underground.

Like the other types of the series, the Hoosic gravelly sandy loam, which has been formed by stream action, occurs as terraces along the stream courses or as deltas where the streams formerly flowed into glacial lakes. The original forest growth consisted largely of white

pine. At present where there is any forest it is largely of white birch and poplar.

Owing to the loose, sandy, gravelly nature of this soil type it is unsuited to general farming, but its open structure, permitting ready drainage, and the fact that it warms up early in the spring makes it well adapted to truck crops, such as melons, cucumbers, and small fruits, especially strawberries.

One crop, cucumbers, deserves special mention. These are grown both for market and for seed, and in either case prove very profitable, yielding from $100 to $300 per acre. This crop is grown principally on the Batten Kill delta area. Strawberries are successfully grown on the Mattawee delta area, finding ready sale locally or at Troy or Albany. On the heavier phase of the type corn, oats, potatoes, rye, buckwheat, and hay are grown. In the order of their importance the general farm crops with the yields, are: Potatoes, 150 to 200 bushels; corn, 20 to 35 bushels; oats, 20 to 40 bushels; rye, 10 to 15 bushels; buckwheat, 5 to 15 bushels; and hay, one-half ton to 1½ tons per acre.

Cultural methods upon the Hoosic gravelly sandy loam are as a whole the reverse of what they should be for its most successful utilization. In many cases a crop is planted, poorly cared for, harvested, and the field then left without a crop for several years, when the same process is repeated. Such fields are almost devoid of organic matter, and the yields, even after the field lies fallow, are small. Such a method is particularly harmful for a soil of light character; it not only reduces the organic matter so necessary for crop production, but at the same time puts the soil into such a condition that it conserves little moisture, and crops consequently suffer more severely from drought. Instead of this practice green crops should be grown and turned under, thus increasing the organic soil constituents and making it possible for the soil to hold more moisture. With this plan and the liberal use of stable manure yields of such crops as are adapted to the type could be secured annually instead of once in two, three, or four years, as at present. The condition of the farming class upon this soil varies. Where the methods have been adapted to the soil and planned to conserve organic matter and to improve the moisture-holding power the farmers are prosperous, but the contrary is the case over much of the area of the type.

The selling value of the Hoosic gravelly sandy loam varies greatly. The lighter, looser areas, where poorer methods of farming have been practiced, are held at about $5 an acre. The better phases, where better methods and conditions prevail, are held at $30 an acre. The land in the neighborhood of areas growing cucumbers most successfully is valued at $8 to $15 an acre.

Below are given the average results of mechanical analyses of fine-earth samples of the Hoosic gravelly sandy loam:

Mechanical analyses of Hoosic gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21614, 21622, 22453.	Soil.....	7.0	25.6	12.2	13.8	8.8	20.6	12.1
21615, 21623, 22454.	Subsoil.....	13.9	42.6	15.0	11.3	3.4	7.3	6.2

HOOSIC COARSE SAND.

The Hoosic coarse sand consists of 4 to 6 inches of light-brown coarse to medium sand resting on a subsoil of a light-brown to yellow sand of the same texture as the soil. This subsoil usually extends to a depth of many feet. There is, however, an underlying stratum of clay, which is generally buried so deeply that it has no influence upon the soil, though in a few local areas it comes near enough the surface to have some influence on moisture conditions. The sand grains of both soil and subsoil are angular and sharp rather than rounded. Some small gravel is often scattered over the surface of the soil and disseminated through both soil and subsoil. The type is easily cultivated and can be handled under the widest possible range of moisture conditions.

Two principal areas of the Hoosic coarse sand occur, one at the village of Hudson Falls and one around the village of Bald Mountain. The surface is level to undulating, and has an elevation of 200 to 300 feet above tide. The light texture and loose structure of both soil and subsoil make the natural drainage excessive.

This type has originated through the deposition of the coarser sands brought down by former flood waters of streams and deposited as deltas in the glacial lake which once occupied the valley section of the county.

The native vegetation consists of stunted pine and oak and some poplar, with a scant growth of sand grass and blueberry bushes.

Where a sufficient moisture content can be maintained the Hoosic coarse sand is adapted to the production of early truck crops, strawberries, the vine crops, etc. It is, however, but little used for agriculture, except for kitchen gardens. Away from the villages it consists of barren plains. It has a low agricultural value. The average price probably does not exceed $10 an acre.

The table following gives the results of mechanical analyses of the soil and subsoil.

Mechanical analyses of Hoosic coarse sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21616	Soil	6.3	25.6	18.4	27.5	7.1	7.1	7.7
21617	Subsoil	7.7	23.4	17.7	30.8	8.9	6.5	4.9

HOOSIC FINE SAND.

The soil of the Hoosic fine sand consists of a light-brown fine sand to light fine sandy loam from 6 to 8 inches deep. The subsoil to a depth of 3 feet and more is a very light-brown or yellow fine sand to light fine sandy loam. The variations in texture are so slight and occur within such short distances that no attempt was made to map them separately. No difficulty is experienced in cultivating this soil.

The Hoosic fine sand occurs in the delta of Batten Kill, where it is associated with the Hoosic coarse sand, and along Halfway Creek, in southwestern Fort Ann Township. Its topography is level to rolling and the drainage features are excellent though not excessive, as in case of the coarser textured types of the series. It is in all cases a delta or terrace formation and represents one of the finer grades of materials carried down by streams and deposited as they flowed into glacial lakes.

The Hoosic fine sand is well adapted to early truck crops, such as lettuce, radishes, early cabbage, beets, spring onions, cucumbers, squash, cantaloupes, strawberries, raspberries, blackberries, etc. These crops could well be grown not only early but during the summer to supply the summer hotels and camps of the Lake George region. Corn, oats, potatoes, rye, and clover and timothy also do well. The yields of these crops are: Corn, 40 to 50 bushels; oats, 30 to 50 bushels; potatoes, 75 to 150 bushels; rye, 10 to 20 bushels, and hay, 1 ton to 1½ tons per acre.

Dairy farming is followed to some extent, though the type is not as well suited to this use as are several other soils of the county. It should be utilized to a larger extent in the production of the special crops, enumerated above. In growing any crops care should be taken to increase the content of organic matter by the application of stable manure and the plowing under of legumes.

The conditions prevailing over the Hoosic fine sand are good as a rule, though on many farms capable of much betterment. Land values vary quite widely, according to character of the buildings and location of the land with respect to towns and shipping points. The prices ordinarily range from $30 to $60 an acre.

The table given below shows the average results of mechanical analyses of representative samples of the soil and subsoil:

Mechanical analyses of Hoosic fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21620, 21626.....	Soil.....	0.4	4.9	8.9	27.3	31.0	18.6	8.7
21621, 21627.....	Subsoil.....	.2	4.1	10.4	32.9	32.3	13.2	6.5

HOOSIC SILT LOAM.

The soil of the Hoosic silt loam is a silt loam of a light-brown color, varying in depth from 6 to 12 inches. The subsoil from 12 to 36 inches is a compact silt loam, generally pale yellow in color. The surface soil is usually friable and mellow, but the subsoil is more compact and impervious. Cultivation is not difficult, though affected by the character of the subsoil.

This soil type is not of wide extent. It occurs in small scattered areas in the valleys of the county. Its topography is flat to gently undulating, and the surface drainage fair. The internal drainage, however, is slow and inefficient.

The Hoosic silt loam forms deltas and terraces, and has, like the other types of the series, been formed by water action in all cases. It represents some of the finest of the materials deposited by streams in the glacial lakes.

Grass and grain are naturally the best crops for this soil. Where drained, potatoes and corn should also do well. The crops most generally grown at present are hay, potatoes, corn, and oats. The average yields are: Hay, 1 ton to 2 tons; potatoes, 100 to 150 bushels; corn, 25 to 40 bushels; and oats, 30 to 40 bushels. Cultural methods employed and agricultural conditions are only fair. The land varies in price from $20 to $30 an acre.

VERGENNES STONY LOAM.

The Vergennes stony loam consists of shallow deposits or pockets of clay or clay loam overlying the solid or broken granite, sandstone or limestone rock. The depth of the clay deposits is extremely variable. They are occasionally several feet deep, and again the rock itself is exposed in ledges and ridges without any soil covering whatever. Practically the whole area appears as rough, rocky land, with a scant covering of soil material. For the most part the loose stone in the soil and scattered over the surface consists of sharp fragments, while the fine earth consists of material similar to that forming the Vergennes clay.

Areas of the Vergennes stony loam are found only along the east side of Putnam Township, in the northern part of the county. They are small and consist of low hills and ridges. The natural drainage is fair.

Agriculturally the Vergennes stony loam is of little value except for pasture. It is adapted to this purpose, though better adapted to forestry than to farming. It is cultivated only in small areas, corn, potatoes, oats, and hay being grown. The yields of these crops are: Corn, 30 bushels; potatoes, 60 to 80 bushels; oats, 20 to 25 bushels; and hay, three-fourths ton per acre.

The agricultural conditions are poor, as would be expected on such a rough, rocky soil, and the value of the land ranges from $18 to $20 an acre.

VERGENNES CLAY.

The surface soil of the Vergennes clay consists of 6 to 10 inches of heavy gray to dark chocolate-colored clay. The subsoil is a heavy, plastic clay of dark-drab or rich chocolate color. Both soil and subsoil have a dense, close structure, as well as a fine texture. A silt phase of the type is found in which the soil is a silty clay loam or silty clay. Areas of this character are so intimately associated with the true clay that their separation as a definite soil was not considered feasible. In many places where the heavy clay predominates and the surface soil is shallow, the upturned furrows upon exposure become light gray to white and give rise to the term "white-faced clay." Where the section has not been disturbed by tillage or by plant roots, the clay has a horizontal laminated structure, due to the processes involved in its formation. There are also structure planes across these laminæ.

The Vergennes clay is the most difficult soil to till in the whole region. The fine texture and the dense, close structure precludes the handling of this soil, except within a very narrow range of moisture conditions. If plowed only a little too wet or a little too dry, the result is a mass of clods, which no amount of subsequent tillage can reduce. Fall plowing is inadvisable, as the surface then puddles and makes the preparation of a seed bed almost impossible without replowing. Even after the fundamental operation of cultivation (plowing) has been performed all other operations of soil stirring must be carefully timed as to moisture conditions in order to secure beneficial rather than harmful results.

The Vergennes clay is one of the most extensive soil types of the county. It occurs throughout the valley section of the county, extending up the Hudson River from the Rensselaer County line to Fort Edward, thence through the Wood Creek Valley to Whitehall, and down Lake Champlain to the Essex County line. It comprises

the largest part of Fort Edward and Kingsburg townships and considerable areas in Easton, Greenwich, Argyle, Hartford, Fort Ann, and Whitehall townships, and small areas in Hampton, Dresden, and Putnam townships, and in all covers an area of 92,992 acres. The silty phase previously mentioned occurs notably southeast of Fort Edward and near Crandell Corners.

The physiographic position and topographic features are such that drainage over practically the entire area is inadequate. Along the Hudson River the type occupies flat-topped terraces. In the Wood Creek Valley it covers the flat to gently undulating valley floor. Along the shores of Lake Champlain and South Bay it again assumes terrace positions. Its elevation varies from about 100 feet, as the lower limit, to about 400 feet, though the greater part of the area lies between 150 and 300 feet above sea. This terrace and valley bottom topography, together with the small change in elevation, makes natural surface drainage slow and insufficient even at the best. Most of the cultivated fields are plowed in very narrow "lands," the "dead furrow" serving as an open ditch to remove excess surface moisture. Besides this poor surface run-off, the internal movement of water is slow and can not be readily improved on account of the dense, close structure and the extreme fineness of the soil particles. All these factors make the drainage of this soil exceedingly poor. Care should be taken to improve the surface drainage as much as possible, and artificial underdrainage should be installed in all cultivated areas. To do this would be expensive, but not more so than the results would warrant. The great benefit of underdrainage would be not merely the removal of the excess water itself, but also the lengthening of the season in which the soil can be handled, the more thorough tillage methods possible, and the consequent better control of the moisture conditions in times of drought as well as excess.

The Vergennes clay is derived from the weathering and alteration of lacustrine deposits of fine glacial detritus. Contemporaneously with and following the retreat of the glacial ice which covered the whole region there were left in the Hudson and Champlain valleys extensive bodies of water. These glacial lakes were joined through the Wood Creek Valley, the valley divide section of the county, and in them were deposited the fine sediments, whose erosion, alteration, and weathering has formed this clay soil. In the Hudson Valley section and in the region of Fort Edward Creek and Moses Kill these clays rest upon the Hudson River shale. These shales often extend above the clays, having never been covered or else having been swept bare of the clay by water action. In the Halfway and Wood Creek valleys they rest for the main part upon limestone,

though in this region and along Lake Champlain they often overlie either granite or the Potsdam sandstone.

The native forest growth consisted of chestnut, maple, white oak, white pine, poplar, etc.

The Vergennes clay is especially adapted to the production of hay, of which it yields from 1 ton to 2 tons per acre. The best yielding fields are usually of timothy and alsike clover, the soil being much better adapted to this species of clover than to red clover. Though it can not be considered a corn soil in its natural state, excellent crops of that grain can be grown. The average yield of corn, however, is not over 30 bushels per acre. Oats usually give a good yield, about 40 bushels per acre. While these yields are for the typical clay, the silty phase does considerably better, corn yielding from 60 to 80 bushels, oats from 40 to 50 bushels, rye from 25 to 30 bushels, and hay seldom less than 2 tons per acre.

Farming practices on this soil are not as good as they should be. This, taken with the naturally poor physical properties of the soil, curtails production not a little. The large area of the type and its agricultural possibilities make its improvement one of the important factors in the agriculture of the county. At present there is either no systematic rotation practiced, or the rotation is so long that the soil is not much benefited. As before stated, plowing should be done when the soil has just the right moisture content, so that clodding may be reduced to a minimum. More organic matter should be incorporated in the soil, with a view to improving both its structure and its ability to hold moisture during droughts. This will give better tilth, reduce clodding, and make cultivation practicable under a wider range of moisture conditions. Increasing the organic-mater content will also reduce the liability of puddling where the land is plowed in the fall. Such improvements can be brought about by using the land for different forms of animal husbandry, instead of producing forage crops and hay for sale as such, by establishing shorter rotations, including more leguminous crops, such as alsike clover for hay and field peas for grain or for feeding green, and by turning under some green manuring crop. In addition to the practice of stock raising or dairying and the practice of rotation and green manuring greater care should generally be taken in all the farm operations, particularly in the preparation of the seed bed and subsequent cultivation, which because of the difficulty in handling this heavy clay soil are apt to be inadequate. Careful restriction of the soil to those crops for which it is adapted will also tend to make farming upon it safer and more profitable.

Agricultural conditions on the areas of Vergennes clay are variable. As a whole they are only poor to fair, though on individual farms they are often excellent. The improvement of the soil, as indicated

above, would materially improve conditions, and there is no reason why all the poorer farms should not approach in crop yields and profitableness the best now found.

Land values in the Vergennes clay areas now range from $20 to $40 an acre for that in the poorer conditions to $75 or $100 an acre for land of the more silty phase or farms with the better buildings and other improvements.

Below are given the results of mechanical analyses of soil and subsoil of the typical Vergennes clay:

Mechanical analyses of Vergennes clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21630	Soil	0.1	1.8	2.0	3.7	0.9	22.6	69.0
21631	Subsoil	.4	.7	.5	.9	.4	28.4	68.6

VERGENNES BLACK CLAY.

The soil of the Vergennes black clay consists of from 6 to 12 inches of heavy black clay, very sticky and tenacious when wet, but granular and friable when containing the optimum quantity of moisture. The subsoil is a heavy, plastic clay of the same general character as the soil, though the color, instead of uniform and black, is drab slightly mottled with brown.

The type is found only in limited areas in low-lying positions or basinlike depressions. Artificial drainage is always beneficial and generally necessary for successful cultivation.

In origin of material the soil is similar to the Vergennes clay, being derived from the Champlain-Albany clays. The processes of formation have differed, the black clay being developed in poorly drained or swampy places. It is distinguished from the clay chiefly by the greater content of organic matter.

This type of soil is well adapted to corn and hay, of which excellent yields are secured. The agricultural conditions are fair. Prices are not high for such a soil, ranging usually between $25 and $30 an acre.

The following table gives the results of mechanical analyses of representative samples of the soil and subsoil:

Mechanical analyses of Vergennes black clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21640	Soil	0.0	0.3	0.5	2.9	0.8	33.3	62.2
21641	Subsoil	.0	.1	.4	6.2	3.2	24.0	66.0

ONDAWA FINE SAND.

The surface soil of the Ondawa fine sand consists of a gray to light-brown fine sand, from 4 to 6 inches deep. The subsoil is similar to the soil in texture, though somewhat lighter in color. Certain areas have a more loamy and slightly darker surface soil from 6 to 8 inches deep. In this loamy phase the subsoil to 2 or 3 feet in depth is also a loamy fine sand, but below this consists of a yellowish fine sand. The sandy texture and loose structure of this soil render cultivation easy, and it can be handled under a wide range of moisture conditions.

The areas of Ondawa fine sand are all small. They occur as narrow first bottoms of the Hoosic and Hudson rivers and along the New York shore of East Bay. The surface is level to slightly undulating and drainage conditions are fairly good, though much of the type is subject to overflow.

The Ondawa fine sand is the coarsest of the recent alluvial deposits. It occurs in small delta formations and as local deposits from the swifter-moving flood water.

This type of soil is adapted to the early truck crops and to corn, potatoes, and clover. It is used for all the general farm crops. The yields on the lighter phases are: Potatoes, from 50 to 60 bushels; oats, about 30 bushels; rye, from 15 to 20 bushels; and corn, from 25 to 35 bushels per acre. Clover and timothy usually give a yield of 1 ton to 1½ tons per acre. The yields on the loamy phase are usually somewhat larger, potatoes yielding from 100 to 150 bushels; oats, 30 to 45 bushels; rye, about the same as on the light phase; corn, 30 to 50 bushels; and hay, from 1½ to 2 tons. These yields could be appreciably increased by better tillage methods, by more care in manuring and fertilizing, and by a more frequent use of legumes in the cropping systems. These practices would result in a higher organic content of the soil, which would be reflected in an increased crop-producing power.

The agricultural conditions prevailing on areas of the Ondawa fine sand are only fair. The price of land varies from $20 to $50 for the light phase and from $50 to $100 an acre for the loamy phase, according to the condition and number of farm buildings.

The average results of mechanical analyses of typical samples of soil and subsoil of the Ondawa fine sand are given in the following table:

Mechanical analyses of Ondawa fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21636, 21638.....	Soil.....	0.3	2.4	4.7	33.2	42.6	10.0	6.8
21637, 21639.....	Subsoil.....	.3	2.1	4.6	38.7	41.6	6.8	5.8

ONDAWA SILT LOAM.

The soil of the Ondawa silt loam is a dark-brown silt loam 10 to 14 inches deep. The subsoil to a depth of from 2 to 4 feet consists of material similar to the surface soil in every respect except the color, which is lighter, being gray to pale brown. As a rule the deep subsoil consists of beds of gravel. A variation of the soil is found in which the gravel comes to or near the surface. This gravelly phase, however, is not uniform and occurs so irregularly and in such small areas that no attempt was made to map it as a separate soil type. Both soil and subsoil are mellow and friable, and the type is easy to cultivate. An excellent seed bed can be prepared and all subsequent cultivation carried on under a considerable range of moisture conditions and with a moderate expenditure of time and energy.

The Ondawa silt loam occurs as first bottoms along many of the streams of the county, both large and small. The principal areas are along White Creek from the state line to its junction with Batten Kill, along Batten Kill from Battenville to Rexleigh, and above Shushan, along Owl Kill south of Cambridge, along the Mettawee between Granville and Middle Granville, along Wood Creek and the Mettawee River at their junction above Whitehall, along the Poultney River up and down from Hampton, and along the Hudson River and lower course of Moses Kill.

Occurring as it does as first bottom representing the present or recent flood plains of the streams, the topography is level and elevated only a little above mean water level. Contrary to what would be expected from its low position and level surface the natural drainage is good, the deep subsoil of gravel aiding in the removal of excess water. Water is always found in these gravels, supplying to some extent subirrigation. Water for domestic use is secured by driving a 12 or 16 foot length of pipe down into these gravel beds.

The materials from which the Ondawa silt loam has been formed are derived from the glacial and residual materials of the uplands of the region. These are washed into the streams, which flowing rapidly in flood times are capable of carrying large amounts of fine earth materials in suspension. When these streams overflow their banks the velocity of the currents is slackened to such an extent that much of their load is dropped and the formation of the soil under discussion is the result.

The Ondawa silt loam is one of the most productive types of the county. It is well adapted to general farming and dairying. Excellent crops of grass, both for hay and pasture, are grown and the yields of corn and potatoes are satisfactory. A factor favoring dairy farming is the character of the drainage, which not only insures excellent forage crops, but at the same time a moisture supply from

the underground water modifying the effects of excessive drought and giving excellent pasturage during the entire season.

The principal crops grown are corn, potatoes, oats, rye, and hay. Corn will yield from 50 to 75 bushels of shelled corn; potatoes from 150 to 200 bushels; oats from 40 to 50 bushels; rye from 15 to 20 bushels; and hay from 1½ to 2½ tons per acre. The hay generally consists of clover and timothy.

The usual rotation practiced on this soil is corn or potatoes, followed by rye or oats, followed by clover and timothy. The grass land is usually allowed to remain in sod as long as it will produce a paying crop of hay. That this is unwise is shown by the fact that many fields of this soil only cut about 1 ton of hay per acre, when they should cut not less than 2 tons if the rotation was shorter and the management of the soil and seeding properly done.

Dairy farming is quite common on the Ondawa silt loam and on such farms the stable manure is all used, though little or no care is taken to prevent loss through leaching. The manure is almost always thrown out under the eaves of the stable where it washes and leaches, thus losing half or more of the fertilizing value before being spread on the fields. The actual loss of fertilizing material from this careless handling of stable manure is greater in value than the entire amount expended for commercial fertilizers.

Agricultural conditions on the Ondawa silt loam are the best in the county. Most of the farms contain considerable areas of the hill soils, which are generally used for pasture, though some hay and intertilled crops are grown on them. The farm buildings are located in the valleys on the Ondawa silt loam, and on account of the difficulty in hauling manure back to these hill lands it is nearly always used on the valley soil. Besides, about all the improvements made on these farms are on this valley soil and thus its condition is naturally better than the hill soils.

Farms containing the Ondawa silt loam bring higher prices than any other farms of the county except those including Muck. From $75 to $100 an acre is the ordinary valuation, and even a higher value is given where the buildings and improvements are extensive or where the tracts are small and lie near villages and shipping points.

The following table shows the results of mechanical analyses of representative samples of the soil and subsoil of the Ondawa silt loam:

Mechanical analyses of Ondawa silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
22455	Soil	0.4	1.1	1.1	3.9	6.4	70.0	17.1
22456	Subsoil	.2	.8	.9	4.5	12.8	66.6	15.9

COSSAYUNA STONY LOAM.

The surface soil of the Cossayuna stony loam is a distinctive brown, yellow or snuff-colored friable loam, with a depth of 8 or 10 inches. The subsoil, which is of the same material, though of a lighter brown color, as a rule extends to depths greater than 3 feet, though often the country rock is near the surface. Both soil and subsoil contain considerable small shale gravel and small and large weathered fragments of calcareous sandstone, together with some bowlders of foreign origin. The rocks are often so abundant that the fences around many fields have been made from them as they have been removed from the field. A significant fact is that about one-half the rock material in these fences is calcareous sandstone. The type is easily tilled.

Areas of Cossayuna stony loam are most generally developed in the central part of the county. The type extends from the southern border of the county northward to the vicinity of Carver Falls on the Poultney River, and by far the largest proportion of it occurs in the townships of Easton, Cambridge, Jackson, Greenwich, Salem, Argyle, and Hebron. It consists of rolling uplands and low hills from 500 to about 1,000 feet in elevation, with few sharp peaks. The rolling topography makes natural surface drainage very good, though underdrainage would materially improve many fields, particularly in the less hilly portions of the type.

The origin and formation of the Cossayuna stony loam are particularly interesting. While the whole region has been glaciated, and this soil is made up of glacial till, it is characterized by material from the disintegration of a local sandstone formation. This sandstone is calcareous and also ferruginous. "The most striking peculiarity about this rock is that wherever portions of it are covered by the soil and exposed to the roots of vegetables it loses the lime which it contains, and thereby becomes changed to a porous and more or less friable stone, commonly of a snuff yellow color, but sometimes brick-red, the inside of the stone remaining compact and unchanged; and over whole fields the disintegrated matter from this rock imparts here a red and there a yellow color to the soil * * *."

The following table shows the composition of the original rock and its weathered product:

Constituent.	Original rock.	Weathered product.
	Per cent.	*Per cent.*
Silica	53	91
Peroxide of iron	6	5¼
Carbonic acid	15	Trace.
Lime	13	Trace.
Magnesia	5	Trace.

This weathered rock material gives to the soil its characteristic color. Although the sandstone is local in its occurrence, the commingling of material from it with the foreign glacial soil-forming materials accounts for the extension of the type over areas where the country rock is of an entirely different character.

The native forest growth consisted largely of white pine and oak, practically all of which has been removed. There are, however, a small amount of second-growth timber, mostly hardwoods.

The Cossayuna stony loam forms the best farming section of the county, and the largest part of it is cleared and under cultivation. Its topography of rolling hills and ridges, with few steep slopes, makes it possible to utilize nearly all of the section covered by it for cultivated farms. The type as a whole is suited to general farming and dairying. It is well adapted to nearly all the general farm crops, such as potatoes, corn, oats, and hay. The excellence of this soil for red clover should make potatoes the money crop of farms located on it. It might also be well, at least in many cases, to introduce wheat into the rotation, seeding to clover with the wheat instead of with the spring cover crop, oats, in order to secure a better clover sod to turn under for the potatoes.

Among the fruits adapted to the Cossayuna stony loam are apples and cherries. Commercial orchards do not exist, and it would likely be unwise to make extensive plantings of apples, but every farm should have a few acres of orchard. If these were well cared for, they would considerably augment the income of the farm, besides furnishing fruit for family use. As to varieties adapted to this type of soil, the Northern Spy and Baldwin should do well. If one wishes to develop a special trade in apples, the Fameuse or Snow and McIntosh would also be good varieties to plant.

It is believed that alfalfa should succeed on well-drained fields of this soil providing all requirements, such as liming, inoculation, etc., are carefully carried out. Attempts to grow alfalfa have resulted up to this time in failure. It is not unlikely that the drainage conditions have been unfavorable to success.

At present, dairy farming is carried on quite extensively on the Cossayuna stony loam, the milk being delivered to shipping stations, skimming stations, or to cheese factories. The principal crops grown, with the range in yield per acre, are: Potatoes, 100 to 150 bushels; corn, 25 to 40 bushels; oats, 30 to 40 bushels; rye, 10 to 15 bushels; buckwheat, 15 to 25 bushels; and hay, 1 ton to 1½ tons.

The cultural methods in use are good, though not nearly so good as they should or could be. The stable manure on both the dairy and sheep farms is all utilized, but more care should be taken in protecting it from the weather in order to realize its full value in soil im-

provement. Commercial manures are used, though without special reference to the kind of soil or crop.

The agricultural conditions prevailing on farms of the Cossayuna stony loam are of the best in the county. Farm buildings are usually commodious and comfortable, and well cared for; altogether, there is the appearance of prosperity. Farms of this soil type, including improvements, are valued at from $30 to $60 an acre, according to condition, situation, and improvements.

The following table gives the average results of mechanical analyses of fine-earth samples of soil and subsoil:

Mechanical analyses of Cossayuna stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
20830, 21632.....	Soil.....	2.8	7.4	3.4	7.1	15.9	43.4	19.9
20831, 21633.....	Subsoil.....	5.6	9.8	3.4	7.9	15.9	38.6	18.8

ROUGH STONY LAND.

The Rough stony land of Washington County consists of those areas in the valley section of the county which are too rough and stony and have a soil too thin to be arable. The soil of these areas, where there is any, varies from a rather light loam to the heavy Vergennes clay material. It occurs either as a shallow surface covering or in small pockets, and only in these pockets has it any considerable depth. The stone content consists of sharp angular fragments of limestone. The jagged bed rock of limestone itself comes to the surface in ledges, ridges, and rough, uneven areas.

The areas of Rough stony land are little suited for agricultural occupation, and their limited use for grazing and for forest production forms about their only value.

ROCK OUTCROP.

A large portion of the Adirondack upland consists of a region thinly covered with soil and interspersed with areas of broken rock or of the bare solid rock itself, occurring often in steep cliffs and ledges. This has been mapped as Rock outcrop. The topography as a whole is rough and mountainous, and the elevation varies from 323 feet, the level of Lake George, to 2,665 feet above tide on the peak of Black Mountain, the highest elevation in the county. The soil, where any exists, is a stony sandy loam, which, where it could be separately mapped, is shown as the Adirondack stony sandy loam. The rocks of the region are the "unstratified rocks of the primary range of northern New York." These are "a granite and gneissoid

rock * * *, nearly destitute of mica, and composed largely of feldspar, which is mostly of a gray or reddish color."

This whole region is a wild forested country and nonagricultural in character. It can best be utilized for forestry, and it should be set aside for this purpose.

The present condition is best expressed by quoting Doctor Fitch, as his statement is just as true now as it was sixty years ago. He says:

> This primary tract at the north end of this county well illustrates how much the character of a country depends upon its geology and topography. Although this tract is in direct proximity with a highly cultivated district, nearly all of it is still in a state of nature, the meager soil of its rugged hillsides having discouraged all attempts to reclaim it. It is a lumbering * * * tract, and such it will continue to be, its sparse population obtaining their food more from the adjoining district than from the soil on which they reside. It is a most inviting district to the mineralogist and a most repulsive one to the agriculturist.

Land values in the region mapped as Rock outcrop are based upon the timber and not upon the land for any other use. They are low, as most of the timber of value has been cut, the present forest being second and third growth.

ADIRONDACK STONY SANDY LOAM.

The surface soil of the Adirondack stony sandy loam consists of a stony fine sandy loam, brown to yellowish brown in color, with a depth of about 5 inches. It carries a varying but generally large quantity of gravel, stones, and bowlders. The subsoil, like the soil, is a stony fine sandy loam. The color, however, is somewhat lighter, being a yellowish to light brown. It varies greatly in depth, from a few inches in some localities to several feet in others, and always rests upon the Archæan rock in place. It is also more or less completely filled with gravel, stones, and bowlders. But for the high stone content this soil could be easily tilled.

The Adirondack stony sandy loam occurs only in the rougher parts of the Adirondack upland between the valleys of lakes George and Champlain. The topography varies from gently rounded hills to the roughest and steepest parts of the region, but the type more often occupies slope or foothill positions rather than more elevated parts of the region. The stony sandy character of both soil and subsoil gives an open structure favorable to rapid drainage, and upon some slopes the drainage is excessive and the conditions droughty.

The Adirondack stony sandy loam is the combined result of glaciation, residual disintegration of the country rock, and the gravitational movement of material down steep slopes. In some areas the local wash of fine materials has also played a part in the formation of the type.

Formerly the areas of this soil were heavily forested with white pine, hemlock, maple, beech, spruce, etc. At present by far the largest portion of it is still in forest, though much of the original growth has been removed. The area that can be cultivated is small, and owing to topography and position only in small and irregular-shaped fields. Where the soil is of good depth it is well adapted to potatoes and corn. As a whole, however, it is much better adapted to forestry than to farming. Large areas are owned by lumber companies and in such case no attempt is made at cultivation. It is likely that reforestation is the best use of the type. Where the forests are not too dense some grazing is afforded in the early part of the season, but lack of moisture curtails its use for pasture later in the season.

Land values are usually based on the timber an area carries rather than its agricultural possibilities. Such areas are held at from $5 to $12 an acre. Areas better suited for farming are held considerably higher, from $12 to $20 an acre.

The following table shows the results of mechanical analyses of fine-earth samples of soil and subsoil:

Mechanical analyses of Adirondack stony sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21610	Soil	2.2	7.8	6.9	20.7	20.3	28.2	13.1
21611	Subsoil	2.8	6.9	6.9	22.5	23.3	23.5	14.0

DOVER STONY SANDY LOAM.

The Dover stony sandy loam consists of from 8 to 10 inches of a brown sandy loam more or less filled with small glacial stones and bowlders. The subsoil is a light-brown to yellow sandy loam of the same character as the surface soil, and carrying more or less rock fragments similar to those in the soil. The type is easily cultivated, except for the interference of stones.

Areas of this type are found only in the region of Vaughns and Kingsbury. They consist topographically of hillocks. "These hillocks, mostly outliers of the Lower Silurian limestone, rise from a rather uniform level of 280 to 380 feet to elevations of from 25 to 50 feet above the surrounding surface." The natural drainage is good. The origin of these hillocks is glacial, for "their drift-covered surfaces indicate that the ice mass * * * on melting left its unassorted debris on the region."

The Dover stony sandy loam is well adapted to the production of corn, potatoes, oats, hay, small fruits, and the smaller tree fruits. Corn yields some 75 to 100 bushels of ears; potatoes from 100 to 200

bushels, oats 35 bushels, and hay 1½ tons per acre. The agricultural conditions prevailing over areas of this soil are good. The selling price of the land ranges from $10 to $20 an acre for rough pasture fields up to $75 an acre for the better fields suitable for production of intertilled crops.

Below are given the average results of mechanical analyses of the fine-earth of soil and subsoil of the Dover stony sandy loam:

Mechanical analyses of Dover stony sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21612	Soil	1.8	7.2	12.2	29.4	30.4	5.6	12.6
21613	Subsoil	3.4	8.6	9.2	23.2	24.1	19.4	11.7

ALLIS SHALE LOAM.

The surface soil of the Allis shale loam is a brown loam from 3 to 6 inches in depth, containing a varying percentage of fine shale chips. The subsoil, which varies in depth, depending upon the nearness of the underlying rock to the surface, is somewhat lighter in color than the soil, generally being a light brown or yellow. It is frequently stained with iron, and like the surface soil contains a varying but large percentage of shale fragments. The soil as a whole varies widely in depth. Some areas are deep, while other areas are very shallow, being formed really by outcrops of the shale rock itself and consisting merely of a mass of the shale chips or slaty gravel with very little fine earth. With proper care the Allis shale loam forms a good seed bed and can be maintained in good physical condition.

The Allis shale loam occurs as small and large areas scattered through the southeastern end of the divide section and along the Hudson section of the valley region. The largest areas are found in the vicinity of South Hartford, in southwest Hartford Township, extending thence to Moses Kill, in Fort Edward Township.

The topography varies from isolated knobs to rolling and hilly semiuplands. The higher hills have an elevation between 300 and 400 feet and the lower areas lie about 100 feet above tide. The natural surface drainage is excellent, while internal drainage is good.

The Allis shale loam is a residual soil. Its occurrence here is accounted for by the fact that swift water currents have swept the areas occupied by it bare of all glacial débris, whether moraine or water deposited. The shale rock thus left without any superficial covering has been subjected to postglacial weathering. The weathering, the action of heat, cold, water, plant and animal life, etc., has

resulted in the formation of a shale loam from the Hudson River shales or slates. This formation is described by Dr. Fitch as follows:

> This slate is a black or bluish color, and is generally a shale rather than a slate, breaking and crumbling when exposed to the air into small angular fragments, forming what has been well designated as "slaty gravel" * * *. It dissolves into soil more readily than most of the other slates of the county * * *.

The original forest growth consisted principally of oak and pine. In cultivation the type is adapted to the production of oats, rye, potatoes, and corn. The crops grown, with yields in favorable seasons, are: Potatoes, 75 to 100 bushels; oats, 30 to 50 bushels; corn, 25 to 40 bushels; rye, 10 to 15 bushels; beans, 5 to 10 bushels; and hay, one-half to 1 ton per acre. In the production of these or any crop it must be remembered that often the area of the fields is really made smaller by the occurrence within them of local areas or spots where the shale rock comes to or so very near the surface that in the aggregate there is often quite a percentage of land on which there is no crop. For hay, timothy is usually grown, as the clovers do not thrive. Where dairies are kept the stable manure is used and crops are somewhat better. Stable manure is commonly used as fertilizer for potatoes. Commercial fertilizer is applied with the oat crop in order to insure a stand.

The agricultural conditions prevailing over the areas of the Allis shale loam are poor, though capable of improvement. More stock should be kept and more frequent use made of green manuring to increase the organic-matter content of the soil. The value of the type varies from $10 to $25 an acre, depending upon the closeness of the shale rock to the surface, improvements, and topographic features.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of the Allis shale loam:

Mechanical analyses of Allis shale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21634	Soil	14.4	13.1	3.7	4.9	13.5	25.7	24.6
21635	Subsoil	14.3	17.1	3.7	5.8	7.5	34.1	17.3

MUCK.

The Muck found in Washington County varies considerably. In color it is brown to black. The texture of the surface soil, the depth of which is generally determined by its darker color, is as a rule finer than that of the subsoil. The subsoil is usually browner in color and less decomposed than the surface soil, in many cases the vegetable

fiber being still intact. The depth of the Muck deposits varies from a few inches to many feet.

Areas of Muck are numerous. They vary in size from areas too small to be shown in the map to tracts several square miles in extent. There are two areas of considerable size, one between Dunham Basin and Smith Basin and one at the head of Moses Kill. All the areas occupy relatively low positions and are naturally swampy in character, the poor drainage being responsible for the formation of this soil. Water-loving plants flourish in such areas and the high organic content of the soil is due to the growth, death, and decay of successive generations of this rank vegetation. More or less mineral material has been mingled with the organic matter. A great part of the former has been washed or blown into the depressions from the surrounding higher-lying soil areas.

The natural drainage of the Muck is deficient, though the greater proportion of the total area can be drained. In almost all cases the increased value of the land would be many times the cost of draining. When properly reclaimed Muck areas now worthless for agriculture become the highest-priced lands of the whole region. The largest area of Muck occurring in the county, that one lying between Dunham Basin and Smith Basin, is cleared, drained, and cultivated. Practically all other areas are in their original wild, swampy condition.

Muck soil is a special-purpose soil, being best adapted to such crops as celery, onions, lettuce, etc. In Washington County the areas are not utilized for special crops, the principal products being hay, potatoes, and corn. Potatoes and corn are only grown upon the well-drained areas, while hay is frequently the only return from the areas inadequately drained. Muck is rarely used for pasture, except where well drained, on account of the danger of the animals miring.

The ordinary yield of potatoes on this soil ranges from 150 to 350 bushels per acre, according to the quality of the soil and the thoroughness of drainage and cultivation. In the Wood Creek Valley are fields that have produced for many years from 250 to 350 bushels per acre without manure or commercial fertilizer. Corn yields from 40 to 75 bushels and hay from 1 ton to 2½ tons per acre. Manures, either stable or mineral, are rarely used.

On the drained areas the agricultural conditions are very good, though as previously stated the undrained areas are in a wild, undeveloped condition. The Muck land is valued at $50 or less up to $300 an acre, according to its location with respect to shipping points and the extent to which it has been improved by drainage and clearing.

MARSH.

All along the channel of Lake Champlain, from Whitehall northward to the county line and for some distance up East Bay, are areas

which are only just above the level of the water. These areas consist of a heavy mud, more or less filled with organic matter, and support a luxurious growth of cat-tail, reeds, rushes, and other aquatic plant life. There are no trees, the land being nothing more than a wet prairie. Just north of Cambridge is an area of sticky, gravelly, sandy loam, covered with a dense growth of white birch and other softwood trees. Another small area between Cambridge and Shushan in the present bottom of Batten Kill has a sandy soil, and is covered with white pine, white birch, etc. These areas, together with some small areas scattered about in the upland regions of the county with variable soil condition, have been mapped as Marsh. None of these swampy areas have any present agricultural value.

SUMMARY.

Washington County (area 539,520 acres, or 843 square miles) is one of the eastern tier counties of New York, having the Hudson River, lakes Champlain and George, and the State of Vermont for boundaries. Its topographic features vary from rolling to mountainous, the elevation ranging from about 90 to 2,665 feet.

The drainage is north, through lakes George and Champlain to the St. Lawrence River and south by the Hudson River to New York Bay. The largest stream of the county is Batten Kill, a tributary of the Hudson.

The first permanent settlement in the county was made at Salem in 1761. The present population, 47,376 (state census, 1905), is near the maximum reached in 1875. Hudson Falls, the largest village, is joint county seat with Salem. Other villages of importance are Fort Edward, Whitehall, Granville, Greenwich, Cambridge, and Fort Ann.

Transportation facilities are excellent. The Delaware and Hudson Company and the Greenwich and Johnsonville Railroad, making connections with the Boston and Maine, and the Hudson Valley electric line furnish an outlet for rail shipments, and the Champlain Canal and Lake Champlain furnish outlets for water shipments.

The annual mean temperature is about 45° F., the mean for the winter months being about 20° F., for the spring months about 43° F., for the summer months about 68° F., and for the fall months about 48° F. The average annual precipitation lies between 35 and 40 inches. The rainfall is usually well distributed throughout the year. The length of the growing season averages 152 days.

The production of flax and potatoes and sheep husbandry have played important parts in the agricultural development of the county. The production of flax reached 34,814 bushels of seed and

1,285,033 pounds of fiber in 1870. Flax is not grown at present. Washington County early attained prominence as a potato-producing county, taking second rank in the counties of the United States in 1860, first rank in 1870, and second rank in 1880. Since 1880 the production has declined about 1,000,000 bushels and the county is outranked by 15 other counties of the country. Washington County should now produce as large a quantity of potatoes as ever. Sheep, for their production of wool, were also of importance at an early date, the soils, topography, and climate being particularly suited to this form of animal husbandry. As early as 1845 more than 250,000 head were kept and the wool clip was more than 500,000 pounds. In 1900 the number of sheep had decreased from this maximum to about 75,000. It is believed that the grazing of sheep on the rugged hills with thin soils forms one of the best uses to which they can be put.

The present agriculture consists principally of dairying, sheep and stock raising, and general farming. The leading products are hay, oats, rye, potatoes, wool, dairy products, and live stock. Though the quantity of these products is considerable, there is opportunity for the production of much larger quantities.

Of the total area of the county 84 per cent was in farms in 1900, and of this only 69 per cent, or 58 per cent of the total area of the county, was improved. The valuation of the farm lands and improvements without buildings in 1900 was $6,411,260, or $14.11 an acre. With buildings in the same year the valuation was $11,983,770, or $26.37 an acre. This valuation just exceeds that of the census of 1850, and no census between these two shows as low a farm valuation by nearly $5,000,000. Present prices of farm lands vary from $5 an acre or less for the rougher and thinner soil areas to $300 an acre for some of the muck lands.

Less than $30,000 was expended for commercial fertilizers in 1900. Much stable manure from dairy herds and sheep and other stock is used. It is not usually cared for so as to retain its full value as a fertilizer.

Farm labor is usually efficient though somewhat difficult to secure, the manufacturing interests absorbing much of the available supply. Wages are, as a rule, good.

The chief needs for improvement of agriculture are drainage, adaptation of crops to soils, rotation of crops, better cultural methods, rational manurial and fertilizer practices, improvement of permanent sods, and the improvement of seeds and stock by breeding and selection.

The soils vary from extremely heavy clays to very light gravels and sands. In origin they are glacial, glacio-residual, residual, lacustrine, and alluvial. Seventeen soils, most of which fall in four series,

besides Muck, Marsh, Rough stony land, and Rock outcrop, are recognized and mapped.

The Dutchess soils and the Cossayuna stony loam occur in the Green Mountain upland throughout the eastern portion of the county.

The Dutchess silt loam is adapted to corn, potatoes, and hay. Apple orchards should also do well on this type. Its depth of section makes it well suited to the intertilled crops. The Dutchess stony loam is well adapted to sheep farming, stock grazing, and potato production. Much of the steeper and rougher areas with the thinner soil covering should be reforested. The Dutchess slate loam occupies mountainous positions and is suited only for sheep pasture and forestry.

The Cossayuna stony loam is one of the best, if not the best, soil types of the county. It is well adapted to the production of potatoes, corn, oats, and hay, and is also suited to apple orcharding on the scale of a good-sized farm orchard. Alfalfa should also succeed with careful attention.

The Hoosic series comprises the noncalcareous high terrace and delta soils, which occur more or less throughout the county, but particularly in the region of the Dutchess soils of the upland. Five types occur, the gravel, gravelly sandy loam, coarse sand, fine sand, and silt loam. The light soils of this series, where not too leachy and deficient in moisture, are adapted to corn, potatoes, rye, and clover among the general farm crops, and to early truck crops, such as strawberries, cucumbers, cantaloupes, etc. Over some areas alfalfa should also succeed. The silt loam of the series is suited to grass and grain production and where well drained to corn and potatoes.

The Ondawa series includes the low terrace or first bottom soils found in all parts of the county, except much of the Adirondack upland. The fine sand is suited to early truck, corn, potatoes, and clover, where well enough drained. The silt loam is one of the most productive soils of the county. It is excellent for hay, pasture, corn, potatoes, etc. Alfalfa should, it is believed, succeed on this type where drainage conditions are good and other requirements are made favorable.

The Vergennes series is made up of the lacustrine soils of the county. They are located in the valley section of the county, extending from the southwestern corner of the county along the east bank of the Hudson River to the northern end of the county along the west shore of Lake Champlain. Three types are mapped, the stony loam, the clay, and the black clay. The first of these is small in extent and is of little value except for pasture and forestry. The clay is extensively developed. It is a difficult soil to handle, but excellent for grasses and alsike clover. It is good for oats and rye. A silty phase

is well suited to the growing of corn and potatoes. The black clay, a type of small extent, is suited to corn and hay production.

Of the miscellaneous soil types, the two stony sandy loams, the Adirondack and Dover, are adapted to corn, potatoes, oats, hay, small fruits, and some of the truck crops, though the former, occurring in the Adirondack upland and at higher altitudes, would likely be best utilized for forestry purposes. The latter occurs in the Valley section of the county and at much lower elevations. The Allis shale loam is almost purely a residual soil, occurring within the divide and Hudson sections of the valley region. It is adapted to the production of oats, rye, potatoes, corn, and hay. The Muck is utilized where drained for the production of potatoes on a large scale. It is better adapted to celery, onions, lettuce, carrots, and spinach, which are not grown. The Rough stony land, really the outcrop of a limestone formation in the valley divide region, and Rock outcrop, the almost bare granitic rocks of the Adirondack upland, are largely nonagricultural and valuable only for the scant pasture they afford and for forest products. Marsh is the low, wet prairie along the shore of Lake Champlain, and is not at present suited to any agricultural product.

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