

**UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS**

In Cooperation with New York State College of Agriculture

**SOIL SURVEY
OF
ST. LAWRENCE COUNTY, NEW YORK**

BY

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of Agriculture, and F. B. HOWE and SALVADOR DIADATO
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*This number is the last Soil Survey Report
for the year 1925*

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By CLARENCE LOUNSBURY, in Charge, and H. G. LEWIS, U. S. Department of Agriculture, and F. B. HOWE and SALVADOR DIADATO, New York State College of Agriculture

COUNTY SURVEYED

St. Lawrence County is the extreme northwestern county of New York. St. Lawrence River, which separates the county from the Dominion of Canada, forms the northwestern boundary. The county is bluntly wedge shaped, with approximate extreme north and south and east and west dimensions of 60 miles. The total land area is 2,041 square miles, or 1,306,240 acres.

Quadrangles of the United States Geological Survey were used as a base map in mapping the soils of the county. The extreme southern and southeastern parts, comprising about one-third of the total area of the county, form a part of the State forest reserve and, as they are for the most part nonagricultural, were not included in this survey.

The minor details of the surface features of the county are partly the result of glacial action. The moving ice modified the former land surface but did not change the broad main features.

Physiographically the area included in St. Lawrence County constitutes parts of two belts. The first is the St. Lawrence lowland, a lowland belt extending northeastward from Lake Ontario and the lowland lying south of the latter in New York State. This is a northeastward extension of the great lowland plain of the Great Lakes region. It may be considered also a northward extension around the west side of the Adirondack Mountains of the great valley lowland of the Appalachians. The second belt is the Adirondack Mountains, the lower western part of which extends into the county.

The St. Lawrence lowland occupies the northwestern part of the county. Its width within the county is about 20 miles and its elevation ranges from 300 to 500 feet above sea level. In details of relief the belt consists of two parts. The northwestern part, lying along St. Lawrence River, is both smoother and lower than the southeastern part. Its smoothness is owing to the large size of the area underlain by lake-laid clays and glacial-outwash deposits burying the rocky but low ridges of limestone or sandstone which constitute the underlying bedrock. The lake-laid deposits were laid down on the beds of post-glacial lakes which covered a large part of



FIGURE 1.—Sketch map showing location of St. Lawrence County, N. Y.

the lowland. The southern part of the lowland is undulating or rolling. It includes near-shore lake-laid deposits, which are sandier and somewhat rougher than the clays. This part of the lowland is comparatively smooth, however, and can not be described as hilly. Some of the low hills, called drumlins, are made up of glacial material.

That part of the Adirondack Mountains extending over the boundary into the county consists of lower foothills. This is merely a hilly area, most of which, however, is too rough or too stony for cultivation. It was glaciated, and to this are due, in part at least, many of its topographic details and stony soils.

All drainage waters flow in a northerly direction and enter St. Lawrence River within or near the boundaries of the county. The streams are comparatively swift flowing in their upper courses, but their velocity is retarded after they issue into the smoother lower plain. Even on the plain, however, water power can be developed in places. The drainage system is generally thorough in the southern part of the area surveyed, but in the lower and flatter parts of the northern plain, especially those occupied by the heavier lacustrine soils, run-off is rather slow and sluggish. In numerous depressions scattered throughout most of the county deposits of peat and mucky material have been built up. All these deposits are poorly drained and in wet seasons are more or less overflowed. The larger of these depressions are occupied by lakes, among which are Black Lake, in the southwestern part, Yellow, Pleasant, Hickory, Mud, Trout, Sylvia, and Star Lakes in the western part, and Lake Ozonia in the eastern part of the county. Along the main streams power was formerly developed for small mills. It is now more widely developed for electricity.

St. Lawrence County was formed in 1802. Some settlement had taken place in 1749 and for a few years thereafter, when Father Piquet established a fortified post at the mouth of Oswegatchie River, the present site of Ogdensburg. The first important settlements were made in 1802 and 1803, when settlers from the central parts of the State and from Vermont located at Dekalb, Canton, Potsdam, Stockholm, Hopkinton, and elsewhere. Following 1803 settlement was rapid, and prosperity increased. In 1880, of the total population of 85,997, 72,894 were classed as rural. In 1920 the total population was 88,121, of which 56,706, or 64.4 per cent, were classed as rural. The average density of the rural population, which is greatest in the northern part of the county, is 21 persons to the square mile.

Ogdensburg, which in 1920 had a population of 14,609, is the largest town in the county and is an important trading and manufacturing point. Canton is the county seat. Gouverneur, in the western part of the county, is the center of the cheese industry and an important mining center. Marble has been quarried extensively in the vicinity, and one of the principal sources of talc in this country is found near by. Near Edwards zinc is being mined. Potsdam, in the east-central part of the county, is an important trading center and is the seat of a State normal school and a technical-engineering

school. Massena, in the northeastern part, has a thriving aluminum-manufacturing industry. Locally important villages are located throughout the county.

Good railroad transportation is available in nearly all parts of the county. Branches of the New York Central Railroad system serve most of the county. A line of the Rutland Railroad runs from Ogdensburg east, and a branch of the Grand Trunk Lines in New England connects Massena with Montreal. A number of hard-surfaced highways, a part of the State highway system, facilitate the movement by motor truck of commodities and local and tourist travel.

Nearly all the milk and a large part of the other dairy products marketed in the county are shipped to New York City. Some of the cheese has recently been marketed in Baltimore, Washington, and other eastern cities. Boston serves as a market for some of the dairy and miscellaneous products.

CLIMATE

The climate of St. Lawrence County, which is in the cooler part of the Temperate Zone, is marked by comparatively short mild summers and rather severe long winters. Climatic conditions vary slightly from the comparatively low elevations along St. Lawrence River to the higher altitudes in the southern part of the county. The mean temperature for the year at Ogdensburg is 44.4° F., and at Wanakena, just outside the area surveyed in the southern part of the county, is 41.2°. At Ogdensburg the average date of the last killing frost is May 6 and at Wanakena is May 26, and that of the first is October 5 at Ogdensburg and September 10 at Wanakena. This gives an average frost-free season of 152 days at Ogdensburg and 107 days at Wanakena. In some years the growing season is further shortened by cold, wet spring weather, which interferes with seasonal crop plantings.

The precipitation ordinarily is fairly well distributed and is sufficient for all crop needs. It is slightly greater during the last half of the year than during the first half. From December to March, inclusive, snow ordinarily forms a permanent cover over the ground, preventing deep freezing and protecting fall-sown crops and grass sod. From year to year there is some variation in the amount of precipitation, with occasional wet periods in the growing season, and in some years short periods of drought.

Tables 1 and 2, compiled from records obtained from United States Weather Bureau stations located at Ogdensburg and Wanakena, give detailed information of climatic conditions in widely separated parts of the county.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Ogdensburg

[Elevation, 258 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1921)	Total amount for the wettest year (1918)	Snow, average depth
December.....	° F. 22.0	° F. 65	° F. -27	<i>Inches</i> 2.39	<i>Inches</i> 1.79	<i>Inches</i> 2.30	<i>Inches</i> 11.3
January.....	16.5	65	-43	2.22	.69	1.84	13.4
February.....	16.8	55	-37	2.21	.60	3.16	16.3
Winter.....	18.4	65	-43	6.82	3.08	7.30	41.0
March.....	28.7	72	-17	2.40	2.14	1.42	10.1
April.....	43.7	86	0	2.13	2.75	1.94	2.7
May.....	56.0	93	20	2.90	.67	4.64	Trace.
Spring.....	42.8	93	-17	7.43	5.56	8.00	12.8
June.....	64.8	98	35	3.29	1.48	2.91	.0
July.....	69.8	97	40	3.07	2.18	4.96	.0
August.....	67.8	98	38	2.95	2.22	.89	.0
Summer.....	67.5	98	35	9.31	5.83	8.76	.0
September.....	61.2	93	30	2.91	1.58	6.20	Trace.
October.....	50.1	82	17	2.75	3.84	6.19	Trace.
November.....	35.7	70	-5	2.48	1.57	2.36	4.5
Fall.....	49.0	93	-5	8.14	6.99	14.75	4.5
Year.....	44.4	98	-43	31.70	21.46	38.81	58.3

TABLE 2.—Normal monthly, seasonal, and annual temperature and precipitation at Wanakena

[Elevation, 1,600 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1919)	Total amount for the wettest year (1917)
December.....	° F. 20.6	° F. 57	° F. -40	<i>Inches</i> 3.09	<i>Inches</i> 2.85	<i>Inches</i> 2.22
January.....	11.6	52	-37	2.82	1.30	3.29
February.....	15.2	56	-39	2.99	.89	3.35
Winter.....	15.8	57	-40	8.90	5.04	8.86
March.....	25.8	66	-26	3.27	3.48	5.14
April.....	40.2	86	-17	2.74	2.89	1.89
May.....	53.4	94	19	3.14	2.86	3.35
Spring.....	39.8	94	-26	9.15	9.23	10.38
June.....	60.2	93	27	3.49	1.41	4.30
July.....	65.6	100	35	3.92	3.09	3.97
August.....	60.0	94	31	3.42	3.48	3.36
Summer.....	61.9	100	27	10.83	7.98	11.63
September.....	55.4	90	23	3.14	4.76	3.28
October.....	46.8	85	8	4.03	4.75	7.09
November.....	32.7	68	-10	3.32	1.86	1.41
Fall.....	45.0	90	-10	10.49	11.37	11.78
Year.....	41.2	100	-40	39.37	33.62	42.65

AGRICULTURE

Since the earliest settlement in St. Lawrence County agriculture has been the most important industry, The first crops grown consisted almost entirely of those most needed for subsistence. According to early accounts, these included wheat, oats, corn, and potatoes. The settlers kept cattle and poultry, and for some years were practically self-sustaining. The production of potash, or "black salts," was carried on to raise ready money.

The settlement of the county continued steadily and substantially, and for the most part a fair degree of prosperity prevailed. From the generalized type of farming common in the first few decades interest turned to dairying, and more recently, especially in the last 50 years, dairy farming has become well established. With the establishment of this industry came an increase in the importance of grain and forage crops and a decrease in that of cereal grains.

The acreage and yield of the principal crops, as reported by the census, are given in Table 3. These figures show the trend of agriculture.

TABLE 3.—*Acreage and yield of principal crops in St. Lawrence County, N. Y., as reported by the census*

Year	Corn		Oats		Wheat		Rye	
	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>
1879.....	12, 249	295, 466	54, 654	1, 356, 239	17, 974	175, 102	3, 919	48, 116
1889.....	6, 804	202, 260	81, 384	1, 819, 626	9, 731	122, 763	1, 961	25, 794
1899.....	11, 356	329, 690	75, 023	2, 301, 690	3, 638	62, 100	674	10, 710
1909.....	9, 761	316, 811	74, 589	1, 972, 670	550	9, 188	311	4, 208
1919.....	2, 450	87, 690	46, 114	870, 752	3, 282	40, 060	209	2, 288
1924.....	542	16, 659	47, 003	1, 282, 073	509	10, 705	190	2, 471

Year	Barley		Buckwheat		Hay and forage	
	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Bushels</i>	<i>Acres</i>	<i>Tons</i>
1879.....	11, 302	196, 172	3, 085	38, 481	¹ 235, 354	276, 556
1889.....	5, 535	102, 233	1, 760	22, 409	¹ 259, 018	336, 347
1899.....	3, 680	99, 650	2, 951	37, 110	257, 438	364, 633
1909.....	2, 811	75, 975	2, 774	63, 916	195, 003	197, 200
1919.....	2, 001	37, 449	1, 790	26, 417	236, 314	349, 378
1924.....	1, 172	29, 440	1, 323	23, 671	272, 782	328, 000

¹ Hay only.

The acreage of corn grown for silage very greatly exceeds that of corn grown for the grain. Oats are universally grown, and the crop forms an important link in the crop rotation. The oats are utilized largely as feed for horses and other livestock. Buckwheat is grown in small fields or as a catch crop after an earlier-planted crop has failed.

Hay and forage crops are grown extensively and are relied on in supporting the dairy and livestock industries. In 1924, according to census figures, there were 31,325 acres of timothy alone, 203,338 acres of timothy and clover mixed, and 3,454 acres of clover alone. Hay production on many of the heavier soils, such as Vergennes clay loam, is important in the northwestern part of the county. Wild grass is cut from many of the swales and peat marshes. Grains, such

as a combination of oats, barley, and peas, are considered profitable when cut green.

Many farmers have grown alfalfa chiefly in an experimental way, and thus far it has not generally been regarded as successful. The varieties sown are said to winterkill, though failures may result in part from lack of suitable preparation of the soil. Hardy varieties, such as Grimm and Canadian Variegated, are adapted to the climate of St. Lawrence County and should succeed on suitable soils.

Potatoes are grown in small patches on practically every farm, mainly for home consumption. Root crops, such as rutabagas and turnips, are sometimes grown as forage, and in home gardens many vegetables for the home table are produced.

Fruit growing has never assumed any importance. Apple trees are found on most farms, but there are very few commercial orchards. Pears, plums, cherries, grapes, and bush fruits also are grown on many farms.

The production of maple sugar and sirup has for years been an important industry. "Sugar bushes" are widely distributed over the county. In 1919 the census reported a total of 725,054 maple trees, which produced 702,849 pounds of sugar and 94,702 gallons of sirup.

Among dairy cattle, those of the Holstein breed predominate, but the Ayrshire, Jersey, and Guernsey breeds are represented. The herds average about 15 cows, but in some there are 40 or 50 cows. In 1924 there were in the county, according to the census, 101,111 cows 2 years old or over. Of this total, 100,860 were dairy cattle. St. Lawrence County leads the State in the number of dairy cattle.

About two-fifths of the milk produced is disposed of as market milk and the remainder is sold to various factories. Fluid milk is sold from dairies having easy access to railroad lines which transport milk daily to New York City. Manufactured dairy products include cheese, butter, and condensed milk. The cheese and butter factories serve dairies more remote from the railroads. Most of the cheese is of the American or wash-curd type, but some Limburger, cottage, and Italian cheese is made. Several creameries are in operation in the county. Condensaries manufacture a part of the whole milk into condensed and evaporated products. A small percentage of the milk is made into ice cream. According to the report of the State department of farms and markets for 1924, 372,546,582 pounds of milk and 6,838,889 pounds of cream were marketed that year. Of this amount 100,002,743 pounds of milk were shipped or sold for human consumption.

The raising of hogs is not an extensive industry, and is carried on largely in the cheese-making sections, where milk by-products are available. The animals are of standard breeds.

Sheep are kept on few farms. Favorite breeds are Hampshire and Southdown, but some Oxford and Cotswold are kept.

Horse breeding receives little attention. Many western horses have been imported. Animals of the Percheron and Belgian breeds probably predominate.

Poultry raising seems to increase in importance in connection with dairying. There are many flocks of well-bred chickens. Turkey raising has been important for years, and on many farms in the

northern part of the county is an important source of income. Ducks and geese are raised to some extent.

The production of cedar oil, a distillation product from cedar boughs, is a minor industry in some of the northern parts of the county. At present prices the business is not very profitable, but it affords ready income at odd times. The product is handled by local buyers, who ship it in metal drums to drug dealers in New York.

Table 4 gives the value of agricultural products in the county in 1919.

TABLE 4.—*Value of agricultural products in 1919*

Crops	Value	Livestock and livestock products	Value
Cereals.....	\$1,381,102	Animals sold and slaughtered (estimated).....	\$3,014,833
Other grains and seeds.....	12,614	Dairy products, excluding those for home use. . .	12,372,358
Hay and forage.....	9,972,973	Poultry and eggs.....	779,596
Vegetables.....	1,615,010	Wool.....	37,574
Fruits and nuts.....	134,109		
All other crops.....	466,668	Total.....	16,204,361
Total.....	13,582,476	Total agricultural products.....	29,786,837

The importance of the adaptation of soils to crops has generally been recognized. The smoother, heavier soils, such as those of the Vergennes and Madrid series, are recognized as being well suited to grass and hay crops and, consequently, to dairy farming. The more sandy, rougher, and more isolated soils, being less productive, are not so well developed. Most of the deserted or unoccupied farms are located on such soils.

Most well-established farms are equipped with buildings and machinery adapted to the general farm scheme. Many of the barns are of the basement type and are sufficiently commodious to house the hay and forage crops. Milking machines and other modern conveniences are coming into more common use. Silos are a part of the usual barn equipment. Tillage implements include plows of various types, harrows, pulverizers, seeders, and the usual haying and harvesting machines. Tractors are extensively used, though much reliance is still placed on horsepower. Motor trucks are used by many farmers in delivering milk and transporting various farm supplies.

Increasing attention is being paid to crop rotations. There has been some tendency in the past to allow grassland to remain in sod too long, and in some places there has been too much successive cropping. Less attention to rotation has been given on rented than on owner-operated farms. At present a 5-year rotation well adapted to a variety of soils and suited to dairy farming is in use. This rotation is as follows: Corn, 1 year; oats, with which timothy and clover are seeded, 1 year; and timothy and clover, 3 years.

Stable manure, which to a large extent meets the requirements of the soils, is the chief fertilizer used. Commercial fertilizers, especially superphosphate (acid phosphate), are used to a considerable extent on corn and oats. Of the mixed brands, a 2-8-10¹ combina-

¹ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

tion has been found suited to corn. The use of lime is not general, but some farmers apply it in an experimental way. The 1925 census reported that in 1924 fertilizers had been purchased for 2,856 of the 7,583 farms in the county at a total expense of \$152,494, or an average of \$53.39 a farm.

Farm labor at present is not plentiful or very reliable, as other industries offer more attractive wages and working hours. Monthly wages are from \$45 to \$50 with board, and day wages in haying, harvesting, and other busy seasons are from \$3.50 to \$4 with board. In 1924 the expenditure for labor, as reported for 4,191 farms, totaled \$895,496, an average of \$213.67 a farm.

Of the 1,728,640 acres in the county in 1925, 58.6 per cent was in farms. There were 7,583 farms, averaging 133.5 acres each. Some farms, particularly those on the more rolling and rougher soils, are larger, and many farms on the smoother and more highly developed soils range from 80 to 100 acres. In the past few decades the average size of farms has increased slightly.

In 1925 the census reported 79.5 per cent of the farms as operated by owners, 19.7 per cent by tenants, and 0.8 per cent by managers. Farms are rented mainly on the share basis.

In 1925 the average value of farm land was \$20.92 an acre. Of the value of farm property on the average farm 34.3 per cent is in land, 41.1 per cent in buildings, 10.2 per cent in implements and machinery, and 14.4 per cent in domestic animals. Values of improved lands range from \$40 to \$80 an acre and those of rough or poorly drained lands, suited chiefly for pasture, from \$15 to \$30 an acre.

SOILS

The soils of St. Lawrence County present many differences in texture, structure, color, and character of the soil-forming materials as well as in the modes of deposition.

The range in texture is from medium sandy loam, fine sand, fine sandy loam, loam, and silt loam to clay loam. More soils are loamy than are open and leachy. The heavier soils, for the most part, occur at comparatively low levels bordering St. Lawrence River, and the more sandy lands, although widely distributed, are prevalent in the southern part of the county.

All the soils have developed under a forest cover of mixed deciduous hardwoods and conifers, largely pine and hemlock. This fact accounts, in part at least, for the generally light soil colors prevailing in the better-drained soils. In the well-drained soils, climatic conditions have favored the formation of podsoils. The profile of these soils shows, essentially, the following layers: (1) A thin surface layer of leaf litter, mold, and humous soil; (2) a gray layer of mineral soil; (3) a brown or coffee-brown layer of mineral soil, in which the color is derived largely from organic matter; (4) mineral soil with little or no organic matter but showing evidence of surface weathering; and (5) the unweathered or parent material. The coloration indicated was not uniform, and in cultivated areas tillage operations have largely destroyed the original color arrangement. The color of surface layers under cultivation ordinarily runs from light brown to grayish brown. Soils showing this profile have been grouped in the Hermon, Colton, and Rubicon series.

In large areas the gray layer is thin or absent, but the brown layer is highly developed, though it is rarely indurated. Soils having such profiles are mapped in the Gloucester, Merrimac, Hinckley, Madrid, Dunkirk, Parishville, and Farmington series.

The color of poorly drained soils is dark, ranging from dark grayish brown to nearly black. The subsoils are distinctly mottled with gray, yellow, rust brown, and drab. The dark surface soil evidences the presence of organic matter. In soils intermediate between the well and poorly drained soils the upper part is similar to upper layers of the well-drained soils and the lower part is similar to corresponding layers of the poorly drained soils. The Vergennes soils represent this condition.

On the basis of the structure of the subsoil material, the soils of the county may be divided into three groups: (1) Soils of loose, friable consistence and open structure; (2) soils showing a slight compactness of the subsoil and not so open and porous as members of the first group; and (3) soils with a heavy compact subsoil. In the first group are included soils of the Colton, Merrimac, Rubicon, Saugatuck, and Hinckley series; in the second group those of the Gloucester, Hermon, Parishville, Madrid, Lyons, Whitman, Farmington, Ondawa, and Podunk series; and in the third group those of the Vergennes and Dunkirk series.

The presence or absence of lime carbonate in the soil assumes importance in establishing stands of clover and other legumes. All the soils show acid reactions in the surface layers, some are acid throughout all layers, and some contain lime carbonate in some part of the subsoil. From simple field tests, the soils of the county are divided into two groups on the basis of lime content. Soils containing no lime carbonate within a depth of 3 or 4 feet include members of the Gloucester, Hermon, Whitman, Merrimac, Hinckley, Rubicon, Saugatuck, and Parishville series, and those containing lime carbonate are grouped in the Madrid, Dunkirk, Vergennes, and Farmington series.

The parent soil material consists of deposits resulting from glaciation. The whole county was visited by at least one and probably by several advances of ice during the glacial period. These movements scoured the former land surfaces and after the retreat of the glaciers left deposits of varying character in the form of ice-laid and water-laid deposits. Some of the glacial materials appear to have been brought considerable distances and others to have been worked up from local rock formations. In the southern part of the area surveyed the material is largely ice laid in the form of ground moraines of varying thickness, and in the more northern part ice laid in the form of drumlins or water laid in the form of kames. The northern part of the county, within 15 or 20 miles of St. Lawrence River, was occupied by a part of glacial Lake Iroquois. Sediments ranging from sand and gravel to clay were laid down in the impounded waters, the coarse materials mainly along the southern limits of this lacustrine area and extending southward in and along the upland valleys. The scouring action of the ice is especially apparent in the western and southwestern parts of the county, where the soil mantle is noticeably thin and where, in places, rock is exposed. The rocks determine to some extent the character of the

soils in such areas. The bedrock in the area, outside the Adirondack region is mainly limestone.

First bottoms along streams represent the most recently laid deposits. They occur for the most part as narrow bands along some of the larger streams.

Since the glacial and lake-laid materials were deposited, soil-forming processes have been in operation. The most important of these are weathering, especially freezing and thawing, water percolation, oxidation, and drainage. The results have varied with the character of the parent soil-forming material, drainage, exposure, and slope.

Similarity in color, structure, and origin was the basis on which soils were classified in series. The soil type, the unit of mapping, is separated on the basis of the texture of the surface soil, that is, the proportion of the different-sized particles present, and is designated by the series name and a textural designation.

Soils derived from deep, unsorted glacial till material and containing no lime carbonate include members of the Gloucester, Hermon, Whitman, and Parishville series.

The Gloucester soils are characterized by brown or dull-brown surface soils grading into light-brown or yellowish-brown friable subsoils which, at a depth between 30 and 40 inches, commonly grade into brownish-gray unweathered material. Bedrock occurs in places at a slight depth. Granitic and quartzitic boulders and small stones are more or less abundant on the surface, through the soil, and in the substratum. Gloucester loam, with a shallow phase, and Gloucester rocky loam are mapped.

The Hermon soils are characterized by a surface 5 or 6 inch layer of gray mineral soil, the immediate surface of which generally contains organic matter. This rests on a 3 or 4 inch layer of deep-brown or coffee-brown slightly heavier material which owes its color largely to the organic matter present. The subsoil is very similar to that of the Gloucester soils. Hermon fine sandy loam, with a shallow phase, and Hermon stony fine sandy loam are mapped.

The surface layers of the Whitman soils are dark colored, and the subsurface layers are yellowish brown or light brown. The subsoils are mottled gray, yellow, brown, and purplish compact material not much heavier than the surface soil. The underlying material is the grayish stony till common within Gloucester soils. Large and small stones are commonly abundant on the surface and through the soil. Whitman stony loam is mapped.

The surface soils of members of the Parishville series are generally brown; the subsoils are yellowish brown or brownish yellow, friable, and somewhat heavier than the upper layers; and the substrata are light grayish-brown till. Boulders and smaller stones of granite, quartzite, and sandstone occur in varying quantities on the surface and through the soil. Parishville fine sandy loam and Parishville loam, with a shallow phase, are mapped in the county.

Soils derived from deep unsorted glacial-till material and containing some lime above a depth of 3 feet have been grouped in the Madrid and Lyons series.

The soils of the Madrid series consist of brown or dull-brown material grading below into light-brown friable but slightly com-

pact material beneath which, at a depth ranging from 24 to 30 inches, is light grayish-brown, gritty, friable, partly weathered material underlain by the substratum of gray stony and gravelly till. Many fragments of quartzite and granite are on the surface and throughout the soil. The subsoil commonly contains sufficient lime to effervesce with acid below a depth of about 30 inches. Madrid fine sandy loam and Madrid loam are mapped.

The members of the Lyons series have dark-brown surface soils and light-brown or yellowish compact subsoils mottled with yellow and rust brown and containing small concretions. The substratum consists of calcareous till. Crystalline rock boulders, sandstone, and quartzite occur on the surface and through the soil. The reaction is not everywhere alkaline. Lyons stony loam is mapped.

Slightly calcareous soil materials derived from thin glacial till on the surface and influenced by the underlying rocks have been grouped in the Farmington series. The surface layer of the Farmington soils is brown or dull brown. The next lower layer is brownish yellow. It is underlain, in most places at a depth ranging from 6 to 20 inches, by limestone. Limerock and other rocks occur in the soil. Farmington loam and Farmington rocky loam are mapped.

Soils of the Hinckley series have developed on stratified kames and eskers containing little or no lime. These soils have grayish-brown or dark grayish-brown surface soils underlain by light-brown or yellowish-brown material as light as or lighter than the surface soil in texture. Below a depth ranging from 24 to 30 inches are more or less stratified beds of grayish sand and gravel. These soils are derived from crystalline rocks. Hinckley fine sand and Hinckley gravelly loam are mapped.

Soils derived from lake-laid materials and outwash plains and containing some lime above a depth of 3 feet are classified in the Vergennes, Dunkirk, Allendale, and Granby series.

The soils of the Allendale series have dark-brown sandy surface soils containing some organic matter, and yellowish-brown sandy subsoils extending to a depth of 20 inches where the color becomes somewhat lighter and mottled with rust brown and gray. This is underlain, at a depth of about 30 inches, by light-gray or bluish-gray clay with yellowish and brownish mottles. The clayey substratum contains appreciable amounts of lime, but the upper horizons rarely show the presence of lime. Allendale fine sandy loam is mapped.

The Vergennes soils have grayish-brown surface layers, passing below into dull-bluish heavy clay mottled with rust brown, yellow, and gray. The substratum consists of beds of clay. In most places the subsoil clay is sufficiently calcareous to effervesce with hydrochloric acid. Vergennes loam, Vergennes silt loam, light-colored phase, and Vergennes clay loam, with a poorly drained and a shallow phase, are mapped in the county.

The Dunkirk series includes soils having brown or yellowish-brown surface layers, grading into firm and friable heavier claylike material. The substratum consists of clay or stratified clay, sand, and loamy materials. The subsoil is ordinarily sufficiently calcareous to effervesce with hydrochloric acid. Dunkirk fine sandy loam, Dunkirk loam, and Dunkirk silt loam are mapped.

The surface soils of members of the Granby series are dark gray or black, the subsurface soils are light-gray or light brownish-gray compact mottled material, and the subsoils are mottled gray, yellow, and rust-brown material. The substratum consists of stratified sand. The material below the surface layer is generally alkaline, and the lower layers commonly effervesce with hydrochloric acid. The water table lies at a depth ranging from 24 to 30 inches below the surface. Granby fine sandy loam is mapped in St. Lawrence County.

Soils derived from lake-laid and outwash materials and containing little or no lime to a depth of 3 feet are grouped in the Merrimac, Colton, Saugatuck, and Rubicon series.

The surface soils of members of the Merrimac series are grayish brown or brown. The subsoils are light brown and of no heavier texture than the surface soil. The substratum consists of stratified beds of sand or sand and gravel. All soil horizons are characteristically strongly acid in reaction. Merrimac cobbly loam is mapped.

The Colton soils have very thin brownish-gray or grayish-brown surface layers and grayish-white or light-gray subsurface layers. The subsoil consists of brown, compact, and in many places cemented materials which become lighter brown with depth. The substratum consists of loose friable stratified sand. All horizons show an acid reaction. These soils differ from the Merrimac in being more podsolized in the upper horizons. Colton fine sand, Colton sandy loam, and Colton fine sandy loam are mapped.

The members of the Saugatuck series have very dark grayish-brown, dark-gray, or black surface soils, and light-gray or grayish-white subsurface soils of the same texture. Below a depth ranging from 6 to 12 inches is a cemented loamy or hardpan layer of streaked yellow, brown, and dark-brown color, underlain by more or less cemented yellowish-brown material. The substratum consists of stratified sand. All layers are distinctly acid in reaction. Saugatuck fine sand occurs in the county.

The Rubicon soils have dark-brown or dark grayish-brown thin surface layers and light-gray or whitish subsurface layers underlain at a depth ranging from 6 to 10 inches by brown more or less cemented loamy and sandy material beneath which is light-brown or yellowish-brown friable gritty material. The substratum consists of stratified sand. All layers are characteristically strongly acid. In many places the podsolized development indicated is but rudimentary, and in cultivated areas it has been practically obliterated. Rubicon loamy sand and Rubicon loamy fine sand are mapped.

First-bottom lands consisting of stream-deposited materials and containing little or no lime to a depth of 3 feet are grouped in the Ondawa and Podunk series.

The Ondawa soils are characterized by dark grayish-brown or grayish-brown surface soils underlain by lighter-brown friable material beneath which is grayish more or less mottled and less friable material. The substratum consists of stratified sand and gravel. All horizons are more or less strongly acid. Ondawa fine sandy loam occurs in the county.

The Podunk soils have grayish or grayish-brown mellow surface layers and light brownish-gray or light-gray moderately compact mottled subsoils. Looser and more or less gravelly and stony substrata are characteristic. All layers are distinctly acid in reaction. Podunk loam occurs in the county.

Soils derived from accumulations of organic matter are mapped as peat. The areas of peat include some developments of muck, most of which is difficult to differentiate from the more distinct peat formations. The deposits vary in thickness.

Miscellaneous classifications of soil include meadow, made land, dune sand, and rock outcrop. These classes of soil include conditions not conformable to well-defined soil types.

In the following pages of this report the soils are described in full, and their agricultural possibilities are discussed; the accompanying map shows their distribution; and Table 5 shows their acreage and proportionate extent.

TABLE 5.—Acreage and proportionate extent of the soils mapped in St. Lawrence County, N. Y.

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent	
Gloucester loam.....	4,352	} 0.8	Dunkirk fine sandy loam.....	12,096	0.9	
Shallow phase.....	6,272		Dunkirk loam.....	7,424	.6	
Gloucester rocky loam.....	150,976	11.6	Dunkirk silt loam.....	17,088	1.3	
Hermon stony fine sandy loam.....	87,872	6.7	Granby fine sandy loam.....	53,824	4.1	
Hermon fine sandy loam.....	28,992	} 2.8	Colton fine sand.....	6,656	.5	
Shallow phase.....	7,168		Colton fine sandy loam.....	14,784	1.1	
Whitman stony loam.....	18,624	1.4	Colton sandy loam.....	17,408	1.3	
Parishville fine sandy loam.....	15,232	1.2	Merrimac cobbly loam.....	7,168	.6	
Parishville loam.....	9,344	} 1.2	Saugatuck fine sand.....	35,904	2.7	
Shallow phase.....	6,336		Rubicon loamy fine sand.....	31,232	2.4	
Madrid loam.....	145,600	11.1	Rubicon loamy sand.....	6,848	.5	
Madrid fine sandy loam.....	51,136	3.9	Ondawa fine sandy loam.....	8,704	.7	
Lyons stony loam.....	17,408	1.3	Podunk loam.....	3,968	.3	
Farmington loam.....	15,232	1.2	Peat.....	86,272	6.6	
Farmington rocky loam.....	24,384	1.9	Meadow.....	8,256	.6	
Hinckley gravelly loam.....	14,144	1.1	Dune sand.....	5,824	.5	
Hinckley fine sand.....	29,888	2.3	Rock outcrop.....	67,776	5.2	
Allendale fine sandy loam.....	68,160	5.2	Made land.....	448	.1	
Vergennes loam.....	39,424	3.0				
Vergennes silt loam, light-colored phase.....	32,576	} 2.5	Total.....	1,306,240	-----	
Vergennes clay loam.....	119,168		} 10.8			
Poorly drained phase.....	16,832					
Shallow phase.....	5,440					

GLOUCESTER LOAM

Gloucester loam has a surface soil 6 or 7 inches thick, of brown friable well-granulated loam. In virgin areas the 1 or 2 inch surface layer consists of dark grayish-brown gritty loam which when cultivated imparts a somewhat darker color to the material to plow depth. Between depths of 6 and about 24 inches is light-brown moderately loose gritty loam or heavy fine sandy loam which grades below into brownish-gray gritty light loam, becoming somewhat lighter colored at a depth of about 45 inches, where it assumes more the character of the underlying unweathered till. Tests show the reaction of all layers to be strongly or very strongly acid.

Throughout the soil and on the surface are various-sized more or less rounded fragments of granite, quartzite, and other rocks com-

monly found on the Gloucester soils. Most of these rocks have been removed from cultivated fields and placed in fence rows and piles.

This soil is inextensive and occurs almost entirely in two locations, one east of Colton and the other between Fine and Star Lake. It occupies slopes and some rather flat situations occurring at lower elevations than the associated stony and rocky soils. Drainage is good.

A large part of this soil is well suited to cultivation. Probably from 60 to 65 per cent of it is improved, and the remainder is in timber or brushy pasture land. The principal crops are corn, oats, and mixed hay. Dairying is the prevailing farming industry. Farm land commands from \$20 to \$30 an acre.

Gloucester loam, shallow phase.—The 2-inch surface layer of Gloucester loam, shallow phase, consists of dark grayish-brown friable loam which grades into deep-brown or dull-brown friable crumbly loam. This, at a depth of 6 or 7 inches, grades downward into light-brown or yellowish-brown somewhat more compact friable loam. Between depths of 25 or 26 inches and 45 or 50 inches is a brownish-yellow rather dense gritty loam or silty loam, commonly stained or mottled with brown, yellow, and gray, and in the lower part showing a noticeably gray cast. Bedrock in many places lies within 3 feet of the surface. In cultivated fields the surface soil is in most places dull grayish brown. Tests show the reaction to be strongly or very strongly acid throughout the soil. Small stones and bowlders of granite, gneiss, quartzite, and similar rocks are scattered over the surface and throughout the soil. Most of the larger stones have been removed from cultivated fields.

Gloucester loam, shallow phase, is comparatively inextensive. It occurs in the southern part of the surveyed area, between North Russell and Russell, and between Dekalb and Kents Corners.

The areas as a whole are comparatively smooth, undulating, rolling, or sloping, and are very well suited to cultivation. Good drainage is general, though in some of the depressed areas and level tracts subsoil drainage is somewhat deficient.

Probably 60 or 70 per cent of this soil is improved farm land. The remainder is in brushy pasture or timber. Maple and beech predominate in timber lots, but some elm, basswood, birch, and red haw are also seen.

Areas are used for general farming, in many places in connection with soils of the Vergennes and Dunkirk series.

GLoucester Rocky Loam

Gloucester rocky loam represents a condition or combination of conditions difficult to classify otherwise. Areas consist of rock outcrop, large detached bowlders, and many intervening small areas and strips of soil too small and of too irregular outline to indicate satisfactorily on a map of the scale used. The total area of arable soil fairly well suited for cultivation and for pasture is fairly large. Some of the soil is shallow, but in other areas it is of sufficient depth to mature crops fully, even in years of rather deficient rainfall. The rock, which consists chiefly of granite and gneiss with some syenite, may outcrop in low exposures projecting very little from the

general surface, or it may occur in prominent knobs or distinct escarpments. "Granite-knob country" is a term sometimes applied to such areas.

In mapping this class of land it was in many places difficult to distinguish from true rock outcrop on the one hand and Hermon stony fine sandy loam on the other. In many places boundary lines are drawn rather arbitrarily.

The soil materials of this class of land include Gloucester loam and Hermon fine sandy loam, shallow phase. Shallower areas also contain varying small quantities of residual material decomposed from the underlying rock. In places, as north of Gouverneur, some Vergennes soil, chiefly Vergennes silt loam and Vergennes clay loam, is included.

This soil is widely distributed in the southern and southwestern parts of the county. Some of the larger areas are south of Russell and Edwards, and smaller areas are farther west and as far north as Black Lake. The soil occurs at an elevation as low as 300 feet in the Black Lake region and in the more southern locations, as between Fine and Oswegatchie, it lies more than 1,500 feet above sea level.

Most of the small tracts suitable for cultivation are nearly level or somewhat sloping, but the presence of rock exposures gives them a rough, rugged aspect. Drainage is well established except in a few sags which act as pockets, retarding free run-off, or which receive seepage from higher elevations.

This soil furnishes pasture on dairy farms. Many tracts too small to show on the map are cultivated with adjoining soils. The timber growth is similar to that found on other Gloucester soils.

HERMON STONY FINE SANDY LOAM

The surface soil of Hermon stony fine sandy loam, to a depth of 3 or 4 inches, consists of gray friable fine sandy loam. This grades into deep-brown or light coffee-brown friable fine sandy loam which, at a depth of 7 or 8 inches, passes into light-brown or yellowish-brown compact but friable fine sandy loam. Below a depth of about 24 inches the material becomes grayer and more gritty and mealy, and with increasing depth it becomes faintly light grayish-brown compact rather mealy fine sandy loam. This material continues to a depth of 45 or more inches. The next lower material is definitely unweathered. Mixed with the soil and strewn on the surface are large quantities of angular and more or less rounded rock fragments varying in size from small gravel and cobbles to large bowlders weighing many tons. The fragments consist mostly of granites, gneiss, syenite, quartzite, and sandstone. Areas of rock outcrop are included in mapping and in places the general conditions approach those of true rock outcrop. All layers of the soil are everywhere strongly acid in reaction.

This soil is mapped mostly in the southeastern part of the surveyed area. Areas are rolling or hilly and in places are somewhat broken. (Pl. 1, A.) The elevations range, for the most part, between 900 and 1,500 feet above sea level. Drainage is well established, and areas on the stony slopes are somewhat droughty.

On account of its ruggedness this soil is little used for farming. Probably not much more than 10 per cent, chiefly the less stony areas, is cultivated. The greater part is in second-growth timber of maple, white pine, hemlock, beech, spruce, and poplar, with an undergrowth of sumac, blackberry, ferns, and wintergreen.

Dairy farming is prevalent on this soil. The usual crops of corn, oats, and mixed hay are grown, together with various minor crops as individual needs require. On some farms a fair degree of success is attained, but on others less prosperous conditions prevail. Maple sirup and sugar have some importance as cash crops. In places lumbering is still carried on to some extent, and forest products supplement the farm income.

A large part of this soil is valued chiefly for the forest it supports. The value of farming land ranges from about \$20 to \$40 an acre.

HERMON FINE SANDY LOAM

The surface layer of Hermon fine sandy loam, to a depth between 2 and 4 inches, consists of gray fine sandy loam which grades rather abruptly into deep-brown or light coffee-brown mellow well-flocculated fine sandy loam. Dark-grayish streaks, evidently marking the location of decayed tree roots, are present in many places. The material grades imperceptibly, between depths of 6 and 10 inches, into yellowish-brown mellow fine sandy loam which at a depth of about 20 inches is underlain by light grayish-brown rather gritty compact fine sandy loam of more single-grained structure. Between depths of 30 and about 50 inches, the material is dull brownish-gray compact rather gritty fine sandy loam. In most places the till substratum is several feet thick. On cultivation the surface soil to plow depth assumes a grayish-brown color resulting from the mixing of the surface layers. Varying quantities of pebbles, stones, and bowlders of granite or quartzite are present, though in most places not in sufficient quantities to hinder cultivation materially. All the soil layers give a strongly acid reaction.

Hermon fine sandy loam occurs in the southern and southeastern parts of the area surveyed, in scattered isolated areas associated particularly with Hermon stony fine sandy loam and rock outcrop. Most of it lies at a lower elevation than areas of these soils.

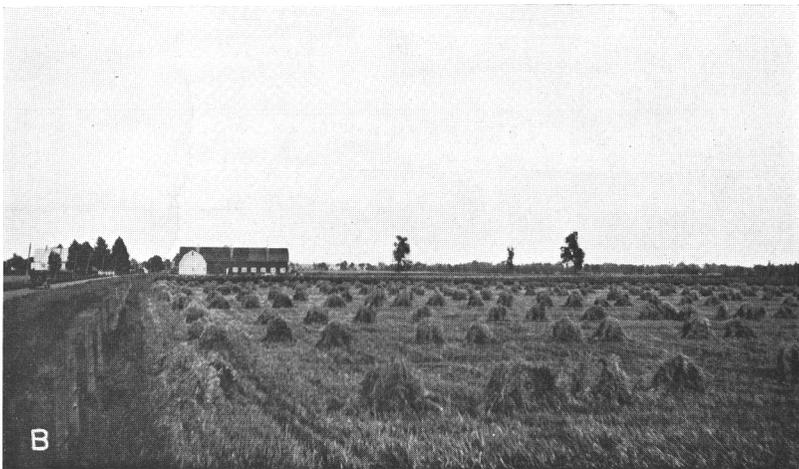
Most of this soil lies above the 600-foot elevation, and the relief ranges from rolling and sloping to somewhat hilly. Natural drainage is good. A few very small areas of poorly drained Whitman soils are included in mapping.

Although this is not an extensive soil it comprises a rather large proportion of the farming land in the districts where it occurs. Between 55 and 60 per cent is improved, and the remainder is in brushy pastures or in timber. Hard maple predominates in the tree growth, followed by beech, cedar, white pine, birch, poplar, and other species.

Dairying is the principal type of farming, and the crops grown are raised mainly to support this industry. Corn for silage, oats, and hay are the chief crops. Minor crops such as buckwheat, rye, and potatoes are grown to some extent. Moderate or good yields are obtained, depending on the methods used and general care exercised.



A, Hermon stony fine sandy loam landscape; B, an area of Farmington rocky loam northwest of Rossie



A, Hinckley fine sand with dunesand area in the background; B, an oat field on Vergennes clay loam

Corn for silage yields 8 or 10 tons to the acre, oats from 30 to 45 bushels, and hay 1 or 1½ tons. Most of the milk is marketed at cheese factories and creameries. Crop rotations consist ordinarily of corn, 1 year; oats, 1 year; and timothy and clover, 2 or more years. Barnyard manure is most widely used on the land though some commercial phosphate is applied. Applications of lime are made by some farmers.

Farming on this soil, as a whole, is rather backward at present. Many farms are worked by tenants, and others are unoccupied and are approaching a run-down condition. Although the land is of good natural productiveness, its comparative inaccessibility makes it undesirable.

Land values range from \$25 to \$50 an acre, depending on improvements, relief, and desirability of location.

Hermon fine sandy loam, shallow phase.—The surface soil of Hermon fine sandy loam, shallow phase, to a depth of about 8 or 9 inches consists of grayish-brown friable loose fine sandy loam. The surface 2-inch layer in virgin areas consists of dark-gray fine sandy loam underlain by light-gray or gray fine sandy loam or loamy fine sand. Between depths of about 8 and 16 inches is medium-brown rather loose fine sandy loam. This is underlain to a depth of about 30 inches by yellowish-brown compact loamy fine sand which grades below into light grayish-brown compact rather dense fine sandy loam continuous to a depth of 40 or 50 inches, where in many places it rests on granitic bedrock. Commonly the material a few inches above the underlying rock is brown or light brown in color. More or less rounded bowlders, gravel, and stones of granite, gneiss, syenite, and quartzite are present in moderate numbers in most places, on the surface and in the soil. All layers show a strongly acid reaction.

This soil is of small extent. It occurs in the vicinity of Hermon, extending in smaller areas northward toward Canton. It also occurs south of Fullerville Ironworks and in a few other places. The surface generally ranges from smooth, sloping, or rolling to somewhat hilly. Drainage is well established, and the looser and shallower areas are more or less droughty.

Areas near Hermon are well suited to farming, but many of the smaller and more isolated areas elsewhere are somewhat less favorable for cultivation. Probably 60 per cent may be considered improved land, and the remainder is in permanent pastures and timber.

Crops and farming practices are about the same as on Hermon fine sandy loam.

WHITMAN STONY LOAM

Characteristically, the 2 or 3 inch surface layer of Whitman stony loam is very dark grayish-brown or nearly black friable crumbly loam or mucky loam. This grades below into yellowish-brown or light-brown friable silty loam, commonly slightly mottled with brown at a depth of 5 or 6 inches, which gives way to rather dull-brown somewhat loose gritty loam streaked and mottled with deeper brown and gray. Below a depth of about 16 inches the material is predominantly light-brown very compact hardpanlike gritty loam mottled yellowish brown, brown, and dark purplish. Between depths of

26 or 28 inches and 40 or more inches is brownish-gray or light grayish-brown sticky moist coarse loam or sandy loam faintly mottled with brown or purplish. Strewn on the surface and throughout the soil are varying quantities of more or less rounded crystalline rocks and boulders.

Most of this soil is mapped in the southeastern part of the surveyed area in connection with the Gloucester soils and to some extent with the Hermon and Parishville soils. It occupies low, poorly drained positions. The areas range in size from a few acres to a hundred or more acres. Numerous areas too small to show on the map are included with the Gloucester and other related soils.

The relief ranges from nearly flat or somewhat undulating or hummocky to sloping. Poor drainage prevails, but varies in degree from place to place, some locations being wet for comparatively short periods and others for a large part of the year. In most places the water table is within about 30 inches of the surface. Along some of the stream courses passing through areas of this soil narrow bands of alluvium are included.

This soil is of comparatively little importance agriculturally. Its poor drainage and stoniness do not warrant, under present economic conditions, the expense of clearing it of stone and of draining it sufficiently for satisfactory crop production. Here and there small areas have been cultivated or used as hay land. However, the greater part is reserved as pasture land and to a considerable extent is occupied by brush and small trees, such as white birch, poplar, alder, spruce, hemlock, and white pine. Cleared areas afford fair pasturage of rather coarse grasses, white clover, and similar plants.

PARISHVILLE FINE SANDY LOAM

The surface soil of Parishville fine sandy loam, to a depth of 8 or 9 inches, is dull-brown or somewhat grayish-brown friable fine sandy loam of which the virgin surface soil, to a depth of about 1 inch, is dark grayish brown from the accumulation of vegetable matter. Below a depth of 8 or 9 inches is clean brown moderately compact fine sandy loam which grades below into yellowish-brown or brownish-yellow moderately loose friable gritty fine sandy loam or loamy sand. Below a depth of 28 or 30 inches the material becomes more gray and quickly grades into grayish-yellow gritty rather loose or incoherent fine sandy loam, which is underlain at a depth of 45 or 50 inches by grayish unweathered till, which ordinarily lies many feet below the surface. On the surface and through the soil are varying quantities of more or less rounded rock fragments, which in many places are sufficiently numerous to interfere with easy cultivation. Large boulders are not uncommon on the surface. The rocks are of granites, gneiss, sandstone, and quartzite. Land in cultivation has largely been cleared of the rock, but many pastured and timbered areas still have their original rock content. All layers are strongly or very strongly acid in reaction.

This soil occurs only in the east-central part of the county in a number of areas, mainly in a belt of country about 6 miles wide extending easterly from Potsdam. The areas are irregular, and some are a square mile or more in extent. The relief ranges from undulat-

ing or sloping to moderately hilly, and in many places the soil occurs as undulating low ridges. Drainage ordinarily is well developed.

Good average farming conditions prevail on this soil, especially on land adjacent to good roads. Probably more than half the total area has been brought into tillable condition. The remainder is used as permanent pasture or is in timber. Maple and beech predominate among the trees.

All the common crops ordinarily grown in connection with dairy farming give satisfactory returns. Oats frequently yield from 50 to 60 bushels to the acre and timothy and clover hay from $1\frac{1}{2}$ to 2 tons. Corn is grown almost entirely for silage and stover. Minor crops, such as potatoes and a variety of vegetable crops, are grown for home consumption. Buckwheat, rye, and barley are sometimes produced. Pastures of mixed grasses and white clover are usually good.

Barnyard manure is the chief fertilizer used, though some farmers use commercial phosphoric acid mixtures on the oats crop. Lime has been used to some extent.

Well-improved land of this kind is considered worth from \$40 to \$60 an acre, depending on the desirability of the particular farm.

PARISHVILLE LOAM

Parishville loam to a depth of about 8 inches consists of brown or dark-brown mellow crumbly loam. In undisturbed areas the 1 or 2 inch surface layer is very dark brown or very dark grayish brown. In many places the virgin soil to a depth of 8 or more inches is streaked with dark organic matter, evidently from decayed tree roots. The next lower material is brown slightly more compact friable loam which, below a depth of about 14 inches, grades into light-brown friable moderately compact loam. Below a depth of 28 or 30 inches is light-brown or light grayish-brown crumbly loam, commonly somewhat more moist than overlying layers and containing sufficient sandy and gritty material to give it the effect of being a little more porous. The light-grayish material continues downward in most places to an undetermined depth. The reaction in all places observed is decidedly acid throughout. More or less rounded rock of quartzite, sandstone, and granite is scattered over the surface and through the soil in sufficient quantity to interfere to some extent with cultivation. The larger stones have been removed from improved land.

Parishville loam occurs in association with the related Parishville fine sandy loam in the east-central part of the county. The areas are for the most part comparatively smooth, ranging from gently rolling to rolling or sloping. Drainage is normally good, but a few poorly drained areas of Whitman loam, because they are too small to separate, have been included in mapping.

This is a soil of good average productivity and is used successfully in the general dairy farming of the region. Probably between 50 and 60 per cent of its total area has been brought into tillable condition, the rest being reserved as permanent pasture and timber lots. Crops grown and farming methods are similar to those followed on Parishville fine sandy loam and similar associated soils. Probably because of the acidity of the soil satisfactory stands of clover are not

always obtained. To correct acidity and aid in improving the general fertility the application of lime is recommended once in each complete crop rotation.

Parishville loam, shallow phase.—The shallow phase of Parishville loam rests on bedrock at an average depth of 10 or 12 inches. The upper 6-inch layer is composed of brown loam or moderately fine sandy loam. This grades below into brown loam which in most places contains fragments of the underlying sandstone rock which has disintegrated through weathering. In deeper variations the material may be from 30 to 36 inches thick, and here the surface soil to a depth of 6 or 8 inches consists of medium-brown friable loam or fine sandy loam. This grades below into light-brown loam which becomes lighter in color as the underlying rock is approached. Rough fragments of the native sandstone and of glacial gravel and boulders of foreign origin are strewn on the surface of many of the more shallow areas. In places the soil mantle is so thin that rock outcrops and small flat rock ledges and escarpments are exposed.

The principal development of this soil is in the northwestern part of the county. Typical areas are between Brier Hill and Hammond. The greater part of the soil is flat, smooth, and somewhat undulating and is broken in places by outcropping ledges of rock.

Drainage is good or excessive, owing to the shallowness and comparative openness of the soil material. In some depressions the underlying rock forms basins. The rock and, in some places, accumulations of small amounts of lacustrine material retard the run-off and produce swaly conditions.

Because of its shallowness the soil is not capable of very profitable utilization. The shallower areas are used for what pasturage and timber they afford. Sugar maples grow in many places. The deeper areas, in seasons of well-distributed rainfall, produce fair or good yields of general crops. On most farms this soil occurs in association with other soils, generally of the Vergennes or Madrid series. The value of land of this kind is low.

MADRID LOAM

The surface soil of Madrid loam to an average depth of about 7 inches consists of brown or moderately dark-brown mellow loam. The surface layer in virgin areas generally is much darker than the material beneath, owing to the presence of undisturbed leaf mold and other vegetable matter. Below a depth of 7 inches the color becomes a little lighter, though the material is still brown loam. At a depth of about 18 inches the material grades into brownish-yellow compact loam, and below a depth of 24 or 25 inches there is yellowish-gray or light-gray compact loam which continues to a depth of 36 or more inches. The grayish substratum material resembles the original parent material and contains appreciable amounts of lime carbonate, which only rarely is present in the upper weathered and modified layers. Varying numbers of rounded stones and boulders of limestone, quartzite, and granite were scattered over the surface and through the soil in its virgin state. Most of these have been removed from the surface in cultivated areas. Some stony areas are almost stony loam, and are indicated on the map by stone symbols.

Madrid loam occurs throughout the northern part of the county. The most important and typical areas are in Canton, Potsdam, Madrid, Lisbon, Waddington, and Louisville Towns. The relief is rolling or moderately hilly, and many of the areas form elongated or drumlinlike ridges with axes following a general northeast-southwest direction. Most of the land is smooth and cultivable. The rolling relief and comparative openness of the soil material cause surface and internal drainage to be free. A few small areas of poorly drained Lyons loam were included in mapping.

Madrid loam is one of the most important soils in the county, and many of the best farms are located on it. Probably 80 per cent of its area is improved and used regularly for agriculture, and much of it is well developed and in an excellent state of fertility. General prosperity is indicated by the well-built and commodious farm buildings common on the soil. Most of the unimproved areas are in timber, consisting mostly of hard maple, beech, elm, oak, and such evergreens as cedar, pine, and hemlock. In many farm wood lots the growth is chiefly of maples, which are maintained as sugar bush.

The principal industry is dairying, and the crops produced are grown primarily to support this industry. Corn, mainly for silage or stover, oats, and hay constitute the chief crops. Corn for grain is not generally considered profitable, because of the difficulty in getting it planted sufficiently early in the spring to allow maturity and the inability to compete successfully with corn produced in the West. Oats are often grown with peas, or peas and barley, as a forage crop. Wheat was formerly a common crop but now is rarely grown. Potatoes, which are grown mostly for home use, give good results. Apples, cherries, other tree fruits, and bush fruits are grown to some extent.

Silage corn yields from 8 to 12 tons to the acre; oats from 30 to 60 bushels, averaging about 40 bushels; mixed hay from 1½ to 3 tons; and timothy from 1 to 2 tons. In favorable years the yields may be somewhat larger than those given and in unfavorable seasons somewhat less.

Four-year crop rotations, usually consisting of corn, first year; oats, second year; timothy and clover, third year; and timothy, fourth year, are in use. Stable manure is the fertilizer most commonly used. It is applied mainly when the sod is broken for corn. Some plowing is done in the fall, especially for oats.

Land values range from about \$50 an acre for less well-improved and less well-located areas to \$60 or \$80 for well-improved and well-located farms.

MADRID FINE SANDY LOAM

Madrid fine sandy loam has a surface soil, about 8 inches thick, of grayish-brown mellow fine sandy loam. In virgin areas the material at the surface is dark brown, owing to the organic matter present. Below a depth of about 8 inches is yellowish-brown compact friable fine sandy loam or silty fine sandy loam which with depth becomes more yellow or lighter colored and, at a depth of 18 or 20 inches, gives way to brownish-yellow firm fine sandy loam or gritty loam which in turn, at a depth of 28 or 30 inches, in most places becomes more gray, indicating an approach to the unweathered underlying

till. Below a depth of 35 or 40 inches the material is commonly grayish-brown compact moderately friable gritty loam. In some places the subsoil of compact dull-yellow fine sandy loam, or loamy fine sand, continues to a depth ranging from 36 to 48 or more inches. The sandier areas occur generally where the wind has accumulated a deeper sandy deposit, or at the base of slopes where the deposit may result from hillside creep. In places, some scattered boulders, gravel, and subangular rocks of varied origin but consisting chiefly of limestone, quartzite, and granite, are found on the surface and in the subsoil. These characteristically are not so plentiful as on the related Madrid loam. Tests with hydrochloric acid usually reveal appreciable amounts of lime carbonate in the subsoil below a depth of 25 or 30 inches. Where the subsoil is distinctly sandy, lime is rarely found above a depth of 4 or 5 feet. Surface layers are practically everywhere medium or strongly acid.

This soil occurs in close association with Madrid loam. The most typical areas are in Lisbon Town, and smaller, more scattered areas are in Canton, Potsdam, and Madrid Towns, and in a few neighboring towns.

Areas range from moderately to sharply rolling, and in places the hills are elongated into drumlin form. Some areas occur at the base of slopes below areas of Madrid loam. In most places the surface is sufficiently smooth and regular to allow free cultivation. Irregularities occur along and in the vicinity of streams and drainage ways. The rolling surface, together with the sandiness of the soil-forming materials, insures good surface and internal drainage. Small less well-drained depressions in which the soil is Lyons loam have been included in mapping.

This soil is extensively used for general farming. About 65 or 70 per cent of its area is improved and tillable. Other parts are largely timbered with about the same species seen on Madrid loam. Crops grown are the same as are grown on Madrid loam and similar soils of the region. The soil is easily worked, and, as a rule, dries out readily in the spring and following rains. It is generally productive, though some of the deeper sandy areas are inclined to be somewhat droughty. Good agricultural practices prevail, and profitable crop yields are obtained.

Land values are about the same as for Madrid loam.

LYONS STONY LOAM

The surface soil of Lyons stony loam to a depth of 2 or 3 inches consists of dark-brown or dark grayish-brown compact moderately friable loam which grades below into grayish-brown or dull-brown compact loam slightly mottled in many places with yellow and deeper brown. Below a depth of about 8 or 9 inches is grayish compact loam noticeably mottled with brown, yellowish brown, and gray. With increasing depth the general color becomes lighter, and in most places the mottling becomes more pronounced. At a depth of 30 or 40 inches the material is gritty light-grayish loam mottled with brown and various shades of yellow. The surface soil and subsoil contain varying amounts of rounded boulders and rock fragments, largely quartzite, granite, and limestone. Some areas, especially those more directly associated with Madrid fine sandy loam, are more

noticeably sandy than a true loam. The soil is more or less acid throughout.

This soil occurs in the northern part of the county in association with Madrid loam and, to a less extent, Madrid fine sandy loam. It occupies shallow draws and basins below areas of these soils. The surface is sloping, undulating, or in places nearly level. Drainage is characteristically poor, and seepy places mark slopes and sags. Shallow depressions often hold surface water for considerable periods of time following rains.

Owing to the deficient drainage and stoniness of this soil, it is almost all retained for pasture or timberland. Probably not more than 1 or 2 per cent of its area is cultivated. Cedar is characteristic in the tree growth, and some spruce, hemlock, pine, birch, poplar, soft maple, and other deciduous trees are to be seen.

This soil furnishes very good pasturage and, as water is plentiful in most places, can very conveniently be utilized as permanent pasture. Some of the better-drained areas are cultivated with a fair degree of success.

FARMINGTON LOAM

The 4 or 5 inch surface layer of Farmington loam consists of brown or slightly dark-brown gritty mellow loam. This is underlain by brown gritty loam which at various depths within 3 feet of the surface rests on limestone rock. The upper part of this rock is commonly somewhat disintegrated, and in the more shallow areas many angular rock fragments occur in the soil mantle and on the surface. Rounded boulders and gravel of foreign origin are present in many places. Included in mapping are many small areas of rock outcrop and narrow ledges of rock too inextensive to differentiate as rock outcrop. The upper soil layers do not everywhere effervesce with hydrochloric acid, but the lower layers, marked by the presence of partly disintegrated rock, commonly show the presence of lime.

The principal development of this soil is within a mile of St. Lawrence River between Ogdensburg and a point south of Morris-town. A few other areas are in the northwestern part of the county, and some are elsewhere.

Areas are for the most part smooth, slightly undulating, or sloping. Some of the slopes are marked by ledges or escarpments where abrupt changes in level are found. As a rule, drainage is thorough. The shallowness of the soil material limits the water-holding capacity to such an extent that the soil is droughty. A few temporarily swaly places occur where seepage originates from rock escarpments.

The deeper areas of this soil make fairly good farming land, especially in seasons of well-distributed rainfall. The shallow areas at best are too droughty to be cropped satisfactorily. For this reason a rather large part of the soil is in pasture or woodland. Probably 30 per cent may be considered improved. In dry seasons grass and other crops on the shallower areas dry up and give unprofitable returns, and under ideal rainfall conditions yields are not usually so sure as on deeper soils. Some early potatoes, strawberries, and other quick-growing truck crops are grown.

FARMINGTON ROCKY LOAM

Farmington rocky loam includes areas in which there are numerous exposures of limestone and many areas too small and irregular to show separately on the map. The shallower areas are mainly Farmington loam, and strips between areas of rock outcrop may be Vergennes clay loam or Vergennes silt loam. This soil differs from rock outcrop in that many areas are arable or afford sufficient pasturage to have some agricultural value. (Pl. 1, B.) The relative areas of rock outcrop and of land having agricultural possibilities are about the same as exist in Gloucester rocky loam. From place to place the rock varies in composition, in the western part of the county being dolomite and in the vicinity of Gouverneur and Dekalb being marble. Calcite is found in places.

Most of this soil occurs in the western part of the county. As a whole, areas are moderately rugged, and the crags of rock present a rather forbidding appearance when considered for agriculture. Drainage is generally good, though in a few of the depressions there are swales or imperfectly drained areas.

In general, farming is in a thriving condition where this soil occurs. As dairying is the only farming industry, effective use is made of this land as pasture and range for cattle. The areas suitable for tillage, together with those of adjoining soils, are sufficient to produce the required amounts of grain and forage. Crops appear thrifty, and good yields are obtained. Timothy and clover make good stands, and it appears that the limy wash from the limestone has an appreciable influence in maintaining the fertility.

HINCKLEY GRAVELLY LOAM

Hinckley gravelly loam as mapped represents a variety of soil conditions and includes areas which are gravelly, stony, and sandy. A typical average area may be composed of the following layers: (1) A 5-inch surface layer of dark grayish-brown friable fine sandy or gravelly loam; (2) a 5-inch layer of brown or light-brown friable loose fine sandy or gravelly loam; (3) light-brown or yellowish-brown loose fine sandy material containing abundant coarse gravel, continuous to a depth of about 26 inches; and (4) light grayish-brown gritty fine sandy material in which gravelly material is intermixed and more or less interbedded, continuous to a depth of 45 or more inches. The gravel is in most places largely quartzite, with some granite and gneiss. All layers show strong acid reactions, except where there is a small number of limestone gravel in the parent material. Here the reaction may be neutral or alkaline below a depth of 2 or 3 feet. These areas are associated with the Madrid soils and are found mainly in the northwestern part of the county. Some areas, such as the one west of Oswegatchie, are decidedly stony and even rocky. The large stones and boulders present are igneous.

This soil occurs in association with the Merrimac soils and to some extent with others, as morainic deposits, kames, lateral morainic dumps, and rough outwash formations. Typical areas are a few miles northeast of Edwards and extending up Oswegatchie River into Fine and eastern Pitcairn Towns. The relief ranges from roll-

ing and hilly to rough and broken. Many slopes are steep. Drainage is well established and in most places is excessive.

Very little of this soil is used for cultivated crops. The remainder is timbered land or more or less cleared pasture land. The unfavorable surface relief and droughty condition preclude any intensive development. The selling price is low.

HINCKLEY FINE SAND

Typically Hinckley fine sand ordinarily has about a 5-inch surface layer of dark-brown or dark grayish-brown loamy fine sand. In places the material between depths of 5 and 7 inches is lighter-gray or light-gray fine sand. This is underlain to a depth of 10 or 12 inches by brown or dull-brown slightly compact but incoherent loamy fine sand which grades below into brownish-yellow incoherent fine sand which, in turn, below a depth of about 24 inches, assumes a brownish-gray color which continues downward many feet. In places throughout the soil are quartzite gravel and some cobbles or larger boulders. In some places there is interbedding with coarser or finer materials. All soil layers are characteristically strongly or very strongly acid.

Hinckley fine sand occurs typically in association with the Merri-mac and Colton soils, mainly in the southern part of the area surveyed. Notable developments occur in the southeastern parts of Fowler and Fine Towns. Another rather large development is southwest of Parishville. (Pl. 2, A.)

The relief is characteristically rough, broken, or steep. The soil occurs where the more violent action of glacial waters has caused outwash soil formations to be laid down. Numerous included small benches and smooth areas which could not be shown separately consist of Colton fine sand or Colton fine sandy loam. Many elevated areas or areas exposed to the sweep of winds are in a more or less raw condition and, were they sufficiently developed or large enough, would be indicated as dune sand. Thorough drainage prevails, and in most places the soil is rather droughty.

This soil is of small agricultural importance. Probably 20 per cent of the better areas are cultivated, more or less regularly, with fair success. Perhaps another 30 per cent or more has been cleared and used for pasture, and the remainder is in mixed second-growth timber of maple, elm, wild cherry, pine, hemlock, and other trees. On the poorer areas grass is thin, and briers, coarse weeds, sorrel, and moss form the natural vegetation. Last of Oswegatchie a rather large area is under cultivation. Many areas once cultivated are now used only for pasture or mowing lands. Some are being reforested with pine, spruce, and other trees of economic value. Most of these areas could profitably be utilized for forestry.

ALLENDALE FINE SANDY LOAM

The surface soil of Allendale fine sandy loam is dark-brown or dark grayish-brown mellow fine sandy loam about 8 inches thick. This is underlain in most places by brown compact fine sandy loam containing some deeper-brown mottles. With increasing depth the

general color becomes somewhat lighter, and below a depth of 18 or 22 inches the material becomes yellowish-brown or brownish-yellow compact fine sandy loam varied with rust-brown and grayish mottles. This sandy material grades, at a depth of 28 or 30 inches, into light-gray or bluish-gray firm clay with yellowish and brownish mottles. This material continues downward many feet. As a rule, the compact clay subsoil contains appreciable amounts of lime carbonate. Upper soil layers rarely show the presence of lime. In some places the heavy subsoil lies at a depth of 18 or 20 inches and in others it occurs about 36 inches from the surface. The surface and soil are practically free from stone and rock fragments.

This soil occurs in scattered areas throughout the northern part of the county where the Vergennes soils have developed. Representative areas are in the vicinity of Ogdensburg, west of Brier Hill, and south of Raquette River near Massena. The relief is generally level or somewhat undulating. In places there is some slight unevenness, and hummocks occur. In such places many of the intervening minor depressions have a shallow sandy covering, and the heavy clay material lies at or close to the surface.

As a whole drainage is somewhat deficient. The compact subsoil retards the ready downward percolation of water, and the nearly level or gently sloping relief hinders a free escape of surface waters. Digging surface ditches improves the general drainage situation in many places.

This soil is used for general farming. Probably 75 per cent of it is improved, and the remainder is in brushy pasture or timber. Elm, maple, poplar, birch, ash, and cedar are common species of trees.

The farm crops common to the region are successfully grown. Corn, chiefly for silage and stover, oats, and hay are the chief crops. In the vicinity of Ogdensburg some miscellaneous truck crops are produced. Corn for silage yields 8 or 10 tons to the acre, oats from 30 to 60 bushels, averaging between 35 and 40 bushels, mixed hay from 1½ to 3 tons, and timothy from 1 to 2 tons. Pasturage is good during the frost-free season. Stable manure is practically the only fertilizer used.

Land values vary considerably, depending on whether associated soils are superior or inferior. From \$40 to \$50 an acre is considered usual for less well-located farms, and from \$60 to \$70 for some of the better-located and improved farms.

VERGENNES LOAM

The surface soil of Vergennes loam, to a depth of 6 or 7 inches, consists ordinarily of brown or grayish-brown loam. This grades into lighter-brown somewhat more compact heavy loam which, at a depth of 8 or 10 inches, grades into dense rather sticky loamy clay predominantly bluish gray in color, but containing mottles of yellow, rust brown, and gray. With increasing depth the color becomes lighter, and in many places there are streaks of sandy and gritty material between depths of 30 and 40 inches. In places the characteristic heavy subsoil does not occur above a depth ranging from 24 to 30 inches. In most places at a depth of 18 or 20 inches there is moderate effervescence with acid. More pronounced action is obtained deeper in the subsoil.

Most of this soil occurs in the northern part of the county, within 15 or 20 miles of St. Lawrence River, and within the 500-foot contour level. A large area is in Lisbon Town, and a few areas occur on river terraces along Raquette River near Massena. The relief ranges from nearly level to somewhat undulating. Natural drainage in general is rather inadequate, especially in the flatter areas where the dense subsoil lies comparatively near the surface. The loose consistence and light texture of the surface layer facilitate drainage and aeration and make cultural operations easier than on the heavier soils.

This is a desirable soil and is extensively used for dairying and general farming. Between 75 and 80 per cent is improved, and the remainder is in brushy pasture or mixed timber.

About the same crops are grown as on the related silt and clay loam soils, and results are similar. Farming methods and general values do not materially differ from those of the other Vergennes soils.

VERGENNES SILT LOAM, LIGHT-COLORED PHASE

The surface soil of Vergennes silt loam, light-colored phase, to a depth of about 6 inches consists of grayish-brown or dull-brown mellow silt loam. This grades below into light-brown or yellowish-brown heavy silty loam or silty clay loam which, at a depth of 12 or 14 inches, gives way to dull-drab or bluish-gray compact plastic silty clay noticeably mottled with yellow, rust brown, and gray. With increasing depth the color generally becomes lighter and the material heavier and more plastic. The substratum consists of dense mottled yellowish-gray clay. Typically the soil is free of stones and gravel, though in some places there is an admixture of drift material. Adjacent to rock outcrops there are in places some scattered angular crystalline rock fragments. Certain areas have a somewhat more loamy surface soil than typical and represent an approach to the associated Vergennes loam.

Vergennes silt loam, light-colored phase, is associated with other Vergennes soils, especially Vergennes clay loam and Vergennes loam. It occurs in many narrow bands within areas of rock outcrop and of Gloucester and Farmington rocky loams. Typical areas are in the region between Gouverneur and Dekalb. Very little of the soil is in the northeastern part of the county.

Areas are uniformly level or undulating. Many occupy valley floors, especially in the rock outcrop and rocky loam areas. Most of the land lies at an elevation between 400 and 500 feet above sea level. Fair or good drainage generally prevails, but the low position and moderate slopes, together with the compactness of the subsoil, retard drainage in many places.

This soil is used chiefly in connection with dairying and general farming. Many farms composed chiefly of it include large areas of rocky loam, rock outcrop, or other soil types. Probably more than 80 per cent of the land is improved and used in crop production or as pasture land. Timber growth includes elm, soft maple, oak, pine, and other trees.

Corn for silage, oats, and hay are the chief crops. Other crops, such as barley, wheat, peas, and potatoes, are grown to some extent. Silage corn ordinarily yields from 8 to 12 tons to the acre, oats from

35 to 60 bushels, averaging about 40 or 45 bushels, and hay from 1½ to 2 tons, depending on the season and age of the sod. This is excellent grass and pasture land but is not so well suited to potato and other root crops. Stable manure is practically the only fertilizer used.

Very little land of this kind is changing hands at present (1925). The average value is between \$50 and \$60 an acre. Somewhat higher prices prevail for more highly improved and better-located land.

VERGENNES CLAY LOAM

In virgin areas Vergennes clay loam consists of the following layers: (1) A surface layer of rather compact dark grayish-brown or dark-brown clay loam 5 or 6 inches thick the surface covering of which is slightly darker to a depth of about one-half inch owing to accumulations of leaf mold and vegetable residue; (2) dense tenacious dull-bluish and rust-brown mottled loamy clay; (3) below a depth of about 22 or 23 inches a dense bluish-gray silty clay layer mottled with rust brown and yellowish brown; and (4) below a depth of 36 inches dense brittle light-gray or bluish-gray clay slightly mottled with yellowish brown. In most places this clay continues downward for many feet. Under cultivation the surface soil has a uniform dark-grayish color. Locally the color is lighter, owing to loss of the original humus content. On drying, the surface soil, especially in pastures, tends to crack irregularly and consequently dries out rapidly. When wet the soil material is very sticky and adhesive and is especially apt to bake hard and remain in a lumpy condition if worked. When cultivated at the optimum moisture content the soil readily breaks down into a satisfactorily mellow condition. This soil is free of stones and boulders throughout most of the areas, but in a few outlying situations some granite boulders or cobbles are to be seen.

The surface layers in most places have a more or less acid reaction. At a depth ranging from 12 to more than 20 inches sufficient lime is present in most places to cause effervescence with hydrochloric acid.

In some localities, as between Gouverneur and Dekalb, the surface soil approaches silty clay loam or silt loam in many places, especially in localities where Vergennes silt loam, light-colored phase, occurs. In a few small tracts in some of the broader flatter areas the surface soil approaches clay or loamy clay in texture.

This soil is most extensive in the northern and northwestern parts of the county. A fairly typical area, however, is in the extreme northeastern part between Helena and Nyando, and some areas lie along the lower parts of Raquette and Grass Rivers.

Areas are prevailingly smooth and very slightly undulating. The soil occurs at comparatively low elevations, most of it lying lower than adjoining areas of Madrid or other drift soils. Where the relief is somewhat undulating or uneven fair or good surface drainage prevails, but in the flatter areas the run-off is slow following spring thaws and rainy periods. Owing to the imperviousness of the clay subsoil, underdrainage is slow, giving rise to the mottled dull poorly oxidized subsoil.

Vergennes clay loam is extensively used in general dairy farming. The better-drained more easily tilled areas are utilized in crop production and for hay, and the more poorly drained less-desirable tracts are generally used for pastures. Probably 70 per cent of the area is tillable land. Some of the land supports a timber growth of elm, maple, and pine.

The crops grown consist principally of corn for silage, oats, and hay, which are produced as subsistence crops for dairy cattle and work animals. (Pl. 2, B.) This is one of the best hay soils in the county, and hay is frequently an important source of farm income. Pastures are good and grazing excellent. A number of minor crops, as alfalfa, barley, wheat, and potatoes, are grown by many farmers. Silage corn yields from 4 to 8 tons to the acre, oats from 30 to 50 bushels, and hay from 1 to 3 tons, depending on the season and the fertility of the soil.

In general, fairly good agricultural practices are followed. The value of suitable crop rotations is recognized. A system in which corn is followed by oats and then by grass, consisting of timothy and clover, allows a 4-year or 5-year rotation. Some plowing is done in the fall if the weather is favorable and other farm work allows. The only fertilizer used is stable manure. This is generally utilized to good advantage, being either applied to sod ground as made or stored in compost heaps for top-dressing.

Land of this kind ranges in price from \$50 to \$80 an acre, depending on the condition of improvements and on location.

Vergennes clay loam, poorly drained phase.—The poorly drained phase of Vergennes clay loam has a surface soil of brownish-gray or grayish-brown clay loam or loamy clay from 4 to 6 inches thick. Brownish-yellow and gray mottles appear in this layer. The surface soil is underlain by drab or light-drab compact dense clay mottled with yellow, yellowish brown, and gray. With increase in depth the color of this layer generally becomes lighter, and in many places at a depth ranging from 30 to 36 inches the material is dull plastic gritty grayish clay containing mottles of yellow and brown. On drying, the surface soil usually cracks into irregular small patches which allow further downward drying. Few stones or gravel are found either on the surface or throughout the soil.

Areas of this poorly drained soil occur alone or in association with areas of typical Vergennes clay loam, Vergennes silt loam, light-colored phase, or Vergennes loam. Where associated with Vergennes loam the texture is somewhat lighter than typical, but such variations are not sufficiently extensive and important to be separated in mapping. A few small areas occur as narrow bands along drainage ways in first-bottom positions. The larger areas are north of Black Lake, and smaller ones are scattered here and there in the general area occupied by the Vergennes soils. A few of the larger areas contain from 200 to 300 acres.

This soil is smooth and generally level. It occupies depressions and slightly lower positions than the typical soil. Drainage is poor, and in wet seasons water frequently remains on the ground for a long time. Because of deficient drainage very little use is made of this poorly-drained soil except as pasture land and to some extent as hay land. Some areas support a timber growth consisting prin-

cially of maple, elm, and oak, with some cedar and pine. Where artificial drainage can be provided, much of the soil can be improved and will compare favorably with areas of the typical soil.

Vergennes clay loam, shallow phase.—The surface soil of Vergennes clay loam, shallow phase, is identical with the surface soil of Vergennes clay loam. It ranges in depth from a few inches to about 36 inches and rests directly on the underlying rock. The surface material consists of dull-brown or dark grayish-brown clay loam to a depth of 5 or 6 inches, where it grades into heavy compact bluish-gray clay containing light-gray, yellow, and brown mottles. In many places just above the rock is an inch or more of brownish gritty material which has weathered from the rock. In some of the shallower places the soil material is much more loamy, browner, and gritty. This indicates a mixture of considerable residual material weathered from the rock. Such soils resemble Farmington loam or Parishville loam, shallow phase. Most of this shallow soil is underlain by the Potsdam sandstone.

Soil of this kind occurs almost exclusively in the northwestern part of the county, where the deposition of the lacustrine clays was of comparatively short duration. Much of the soil is compact and represents a transition from typical Vergennes clay loam to rock outcrop.

Areas are generally level, slightly sloping, or undulating. Drainage is well established in most places, though the proximity of the underlying rock retards the ready downward escape of water. For this reason the soil is backward in spring and soggy after rains. In dry seasons, owing to the slight depth to which water can be held, the soil is likely to be rather droughty.

Vergennes clay loam, shallow phase, is fairly well suited to about the same crops as the typical soil. Many of the areas are kept in pasture or hay. In seasons of well-distributed rainfall crops usually give satisfactory returns, though in general yields are much less than on Vergennes clay loam.

DUNKIRK FINE SANDY LOAM

To a depth of about 2 inches in virgin or wooded areas, Dunkirk fine sandy loam consists of dark-brown fine sandy loam modified in most places with leaf debris and shrub or grass roots. Continuing to a depth ranging from 8 to 10 inches is faint grayish-brown mellow fine sandy loam which in the next 3 or 4 inches becomes yellowish brown and grades into paler loose friable fine sandy loam. At a depth of 20 inches, or slightly below, the material grades rather abruptly into light grayish-brown or dull olive-gray loamy clay, which commonly breaks into roughly columnar fragments. The material is moderately friable. In many places some yellowish or brownish stains or concretions have accumulated. This layer may continue to a depth ranging from 35 to 40 or more inches. It is underlain in most places by somewhat more porous compact loam or gritty clay loam, generally of light grayish-brown color modified by brownish mottles and small brittle brown concretions. When dry, this material crumbles readily. In places layers of grayish sandy material may be present.

In cultivated areas the surface soil assumes a grayish-brown color. Although presumably of lacustrine origin this soil in places contains material in the upper layers suggestive of a drift origin, and some of it appears to be more or less water-modified drift.

This soil is ordinarily moderately or strongly acid in its upper layers. In many places the heavier subsoil material is neutral or alkaline, and in other places sufficient lime is present to cause effervescence with acid.

Moderate amounts of stone, as sandstone, gneiss, and quartzite, occur on the surface. These have been removed from improved land to facilitate cultivation.

This soil occurs in a belt extending south from the area of Vergennes soils and north from the higher-lying Gloucester soils on the south. Most of it is in Fowler Town, in Elm Creek Valley between Edwards and Hermon, in northern Russell and southern Canton Towns, in Pierrepont, southern Potsdam, and northern Parishville Towns, in southern Stockholm Town, and in Lawrence Town. It is distributed in many scattered areas, most of them ranging from one-fourth to one-half mile in extent and few exceeding 1 square mile.

This soil occupies benchlike or valley-floor positions ranging in elevation from 500 to 650 feet. Areas are generally smooth, ranging from level or undulating to moderately rolling. Surface drainage is good in most places, but in some of the flatter areas internal drainage, owing to the compactness of the subsoil, is retarded.

This is good general-farming soil, and good results are obtained from it. Probably about 70 or 75 per cent of it is improved as tillable land, and most of the remainder is potential arable land which at present supports a timber growth of maple, elm, wild cherry, beech, and other trees. Corn, oats and other small grains, and hay yield well. Good stands of clover are obtained in most places.

DUNKIRK LOAM

The 9 or 10-inch surface soil of typical Dunkirk loam consists of dull grayish-brown friable loam. This material is underlain by light-brown or light grayish-brown compact silty loam, somewhat mottled in many places with yellow and yellowish brown. Below a depth of about 20 inches is compact rather plastic silty or loamy clay, generally light brownish gray mottled with gray, yellow, and brown. In many places at a depth ranging from 40 to 45 inches mixed sandy and gravelly light brownish-gray material occurs. The soil is ordinarily distinctly acid throughout, but in some places the subsoil is neutral or slightly acid. The surface soil and to some extent the subsoil contain some rounded stones and small bowlders common to the soils in this general region.

Dunkirk loam is comparatively inextensive, the areas occurring chiefly east of Potsdam toward Hopkinton and north of Nicholville. Two areas of this soil are northeast and southwest of North Russell.

Areas are generally level, undulating, or slightly rolling. Most of the soil lies at elevations of less than 700 feet. Drainage is generally good, though in many places internal drainage is somewhat deficient.

Land of this kind is used successfully for general farming in connection with dairying. Approximately 70 per cent is improved as tillable land. In forested areas maple, beech, and elm are characteristic trees.

DUNKIRK SILT LOAM

In virgin or uncultivated areas the surface layer of Dunkirk silt loam, to a depth of 1 or 2 inches, is dark grayish-brown silt loam. This is underlain by light-brown or yellowish-brown crumbly flocculent silt loam. Between depths of about 5 or 6 inches and about 20 inches is lighter yellowish-brown slightly more compact silty loam which tends to break along horizontal as well as vertical and diagonal cleavage lines and breaks down into a crumbly friable condition. Below a depth of 20 inches there is dull light-brown or light grayish-yellow compact friable silty loam which breaks into small flaky aggregates and roughly globular pellets. Toward a depth of 30 inches some faint gray and yellow mottles impart a somewhat lighter color. Between depths of 30 and more than 45 inches is decidedly compact silt loam, generally of light-grayish color mottled with gray, rust brown, and yellow, and in many places with some dull bluish or drab. This material also breaks along horizontal and diagonal planes and readily crumbles and breaks down into small angular aggregates. The grayish silty substratum, which in some places is varied with fine sand or loam, continues downward to an undetermined depth. The cultivated surface soil is ordinarily dull brown or grayish brown in color. In most areas the soil is decidedly acid throughout, but in some places the lower layers are neutral or slightly acid and very rarely are alkaline. Some glaciated rock occurred on the surface in most places, though in such small quantities that it has nearly all been removed from cultivated fields. Less stone is present on areas in the western part of the county than in the eastern part.

This soil, like Dunkirk fine sandy loam, generally occupies an intermediate position between the heavier Vergennes soils to the north and the higher-lying Gloucester and Hermon soils to the south. Important areas lie west of Sylvia Lake, in the vicinity of Fowler, and near and northeast of Edwards. Other areas are between Hermon and Edwards, near Pierrepont, north of West Parishville, near Parishville Center, east of Southville, and south of Lawrenceville. The largest area, comprising 5 or 6 square miles, is northeast of Edwards. Other areas range from one-half square mile or less to about two square miles in extent.

Areas are generally level, undulating, or somewhat rolling. The soil generally occupies valley floors or benchlike positions. In most places surface and internal drainage, especially in areas with a pronounced slope, are good. Some of the flatter and depressed areas are less thoroughly drained.

Dunkirk silt loam is extensively used in general farming. Most of it is easy to cultivate and is good farm land. Probably 85 per cent of it is improved. In forested areas, maple is the predominant tree growth with some beech, elm, and other trees.

In connection with dairy farming a large part of the land is kept in hay and pasture. Corn for silage, oats, and occasionally barley, rye, and buckwheat are grown. Corn yields from 7 to about 10 tons of

silage, oats from 50 to 60 or more bushels of grain, and timothy or timothy and clover from 1 to 2 tons of hay. Red clover, presumably because of a lack of lime in the soil, does not always thrive. Alsike clover is grown with better success by many farmers. Pastures of mixed grasses and white clover are ordinarily good.

Rotations, fertilization, and tillage operations are the same as on similar soils. Stable manure is the principal fertilizer used. The buildings and the general fertility of farms appear to be about the average for the county. Land values range from \$40 to \$50 an acre. Land of this kind, together with other soils of the Dunkirk series, could be profitably improved by applying from one-half to 1 ton to the acre of lime, in the form of ground limestone, once in a rotation.

GRANBY FINE SANDY LOAM

The surface soil of Granby fine sandy loam generally consists of dark-brown or dark grayish-brown loam or fine sandy loam from 6 to 8 inches thick. This is underlain by grayish fine sandy loam, in most places mottled or streaked with yellow and brown. This material is in turn underlain at a depth of 14 or 16 inches by grayish-white loamy fine sand similarly mottled. At a depth of about 24 inches there is generally a brownish-gray loose sandy loam layer more or less mottled with brown, yellow, and gray and containing a few fine gravel to a depth of 45 inches. Cuts and excavations reveal strata of grayish unweathered clay material in many places at lower depths.

This Granby soil occurs through the northern part of the county in association with the Vergennes soils and to some extent farther south in association with the Merrimac or other lacustrine soils. Areas are nearly level or somewhat sloping and generally lie at a slightly lower level than the adjoining soils. Deficient drainage causes the soil to be undesirable for agriculture. The land receives the surface drainage from the adjacent higher-lying areas and, because of its low flat position, the run-off is slow.

On account of poor drainage, this land is used almost entirely as pastures and timbered areas. A few of the better-drained areas are cultivated with a moderate degree of success. Some of the land is reserved for mowing, but it yields a rather inferior grade of mixed hay. Perhaps from 3 to 5 per cent of the total area may be regarded as improved. Most of the land supports a timber growth of poplar, birch, ash, soft maple, some elm, pine, cedar, oak, and other trees. In many areas drainage could be improved to allow more extensive utilization, but under present economic conditions this does not seem advisable.

COLTON FINE SAND

The surface layer of Colton fine sand, to a depth of 4 or 5 inches, is grayish or grayish-brown loamy fine sand. In timbered areas there is a surface layer, 1 or 2 inches thick, of dark-gray somewhat loamy material, and a subsurface layer 3 or 4 inches thick of light-gray fine sand. Beneath the upper soil layers and continuing for 8 or 10 inches is deep-brown or coffee-brown loamy fine sand or fine sandy loam, somewhat compact in the upper part, but ordinarily crumbly

and friable. In the lower part of this layer the material grades abruptly into light-brown loamy fine sand which with depth becomes yellowish brown and rather loose, but is moderately compact in its natural position. At a depth of about 32 inches the fine sand is of light yellowish-brown or brownish-gray color. It becomes more gray at a depth of 45 or 50 inches and continues to an undetermined depth. The soil ranges from strongly to very strongly acid throughout.

Colton fine sand is generally associated with Colton fine sandy loam and other members of the Colton series. Typical areas are in northern Pitcairn Town, between Edwards and South Edwards, west of Pyrites, and about 2 miles east of Hermon. Little of this soil occurs toward the eastern part of the county.

The different areas have generally a smooth level or somewhat undulating surface and occur in bench positions, many low but some high, as the one near Pyrites. Drainage is excessive, and droughty conditions prevail, except in seasons of more than average rainfall.

The agricultural value of the land is low, and probably not more than 20 per cent is cultivated, though one-half or two-thirds is cleared and has been cultivated but is now in pasture. Maple is the predominant timber growth, but some ash, beech, and basswood grow on slopes and in ravines. Owing to its droughtiness and low fertility, this soil produces low yields of the usual crops of corn, potatoes, oats, buckwheat, and grass. Pastures are sparse and weedy with sorrel, mullein, moss, and various other coarse plants. The selling value of this land is low.

COLTON FINE SANDY LOAM

The surface soil of Colton fine sandy loam consists of grayish-brown or dark grayish-brown loose mellow fine sandy loam, usually underlain at a depth of about 6 inches by a layer of grayish-white or light-gray leached fine sand about 2 inches thick. Where the gray layer is present it is generally underlain by an inch or two of dark grayish-brown or variegated brown and black moderately friable fine sandy loam which, at a depth of 9 or 10 inches, rests on deep-brown or light coffee-brown rather compact fine sandy loam, in places slightly cemented though mostly readily crushed in the fingers. Below a depth ranging from 10 to 18 inches is light-brown or yellowish-brown loose friable fine sandy material. With increase in depth the color changes to light gray and at a depth of 32 or 34 inches the material is light-yellowish, brownish-gray, or light grayish-brown loamy fine sand which continues downward for many feet. In a few places gravel or coarse sand occur in the subsoil or substratum. Typically there is very little gravel or stone on the surface or throughout the soil. Most of the soil is acid throughout. Many of the areas in Pitcairn Town are alkaline even in the surface or subsurface layers. This condition may be owing to the presence of dolomite limestone, which outcrops in many of the areas.

Colton fine sandy loam occurs in the southern part of the area surveyed, in association with the Gloucester and Hermon soils. The principal areas are in Pitcairn Town and in the southeastern part of Edwards Town. Some areas are in Russell, Pierrepont, Colton, and Parishville Towns. The soil occupies low bench or terrace posi-

tions, and areas are level or gently undulating. In places some unevenness is caused by low knolls or slightly broken slopes leading to drainage ways. Drainage is well established, and in places having lighter-textured surface soils or more porous subsoil materials there is a tendency to droughtiness.

The larger part of the soil, possibly 70 or more per cent, has been brought under cultivation at some time, but a part of the less fertile land is being allowed to grow up in brush or timber. Some tracts are being reforested, largely to pine or spruce. Naturally timbered areas support a stand of second-growth white pine, hard maple, beech, wild cherry, yellow poplar, and other trees.

The farm crops common to the county are grown, as a rule producing low or average yields. Corn for silage yields from 4 to 8 tons, oats from 25 to 30 bushels, and mixed hay from 1 to 1½ tons to the acre. Sometimes buckwheat, which yields about 20 bushels, and rye, yielding from 8 to 12 bushels to the acre, are grown. Potatoes and other vegetables grown on a small scale give good results. Many of the areas in Pitcairn Town give better than average yields, and where the soil is sweet and otherwise in good tilth excellent stands of red and alsike clover and of timothy are obtained.

The prevalent farm practices are followed by most farmers. The usual 3-year to 5-year rotation is commonly practiced, especially on the better areas. Fertilizers are mainly stable manure, which is applied to the corn ground and to some extent to the grain or hay fields.

The value of this soil ranges from \$35 to \$40 an acre. In less desirable locations the selling price is \$10 or \$12.

COLTON SANDY LOAM

The surface soil of Colton sandy loam is gray or slightly brownish-gray loamy rather loose sand about 5 inches thick. In timbered areas the 1 or 2 inch surface layer is commonly dark grayish brown or grayish black, owing to an accumulation of leaf and other tree débris. Below a depth of about 5 inches is the zone of highest concentration, which consists of deep-brown or light coffee-brown somewhat compact sandy loam. Between depths of about 8 and about 28 or 30 inches the material grades into light-brown loose loamy medium-textured sand which becomes more yellowish brown in the lower part. Below a depth of 30 inches is yellowish-brown loamy sand which gradually becomes more grayish brown with depth, especially at depths between 45 and 50 inches. The soil is invariably strongly or very strongly acid throughout.

This soil occurs in a number of isolated areas throughout the southern part of the area surveyed. Most of the areas range from one-half to 1 square mile in extent. Typical areas are in the vicinity of Degrasse and Colton and south of Hopkinton. The soil occurs in comparatively low bench and valley-floor positions, and, save for some irregularities near drainage ways, is nearly level or slightly undulating. Drainage is well established, and the open structure and coarse texture frequently cause droughty conditions.

Probably from 60 to 70 per cent of the land is classed as improved, though at present perhaps not much more than half of this acreage

is in cultivation, the remainder being utilized as pasture or fallow. Timbered areas support stands of hard maple, white pine, beech, yellow poplar, hemlock, and other trees.

This is not a very desirable farming soil and is usually farmed in connection with more productive soils. It is easy to cultivate, but yields, even in seasons of well-distributed rainfall, are not very profitable. The crops common to the county are grown to some extent. Besides corn, oats, and hay, rye and buckwheat are grown on small acreages. Less desirable areas are probably better suited to forestry than to farming. The value of the land is low, ranging from \$10 to \$15 an acre.

In handling this soil care must be exercised in maintaining the supply of organic matter, which can best be done by growing green cover crops and using stable manure. Applications of lime are essential in obtaining satisfactory clover stands.

MERRIMAC COBBLY LOAM

To a depth of about 5 inches the surface soil of Merrimac cobbly loam is dark grayish-brown friable gritty loam or sandy loam. In timbered areas the upper part of the surface layer is dark grayish or grayish black owing to an accumulation of decayed leafy matter. Between depths of 5 and 9 or 10 inches brown or bright-brown friable loam, mixed with rounded cobbles and small stones, occurs. This layer is in turn underlain to a depth of 22 or more inches by brown friable sandy loam which is more gritty and cobbly in the lower part. Below this layer and continuing to a depth of 45 or more inches is light-brown or yellowish-brown gritty gravelly loam or sandy loam which is more gravelly and cobbly than the layer above. The loose gravelly material evidently forms the substratum to a depth of many feet. The surface is more or less strewn with cobbles, most of which do not exceed 5 or 6 inches in diameter. In many places where the cobbles are very numerous they have been cleared from the fields and piled into fence rows. In a few of the smaller areas toward the eastern part of the county larger-sized stones are present and the material is in reality a stony sandy soil. The cobbles are mainly quartzite, but some are granite or gneiss. Soil tests show the soil to be strongly or very strongly acid throughout.

Most of this soil, which is comparatively inextensive, is associated with Colton sandy loam. The principal areas are in eastern Pitcairn Town, southeastern Edwards Town, and along Oswegatchie River in the vicinity of Fine. A few other areas occur farther northeast, mainly in Parishville and Lawrence Towns.

Areas are generally smooth and slightly undulating, which is characteristic of a terrace soil. The loose consistence and gravelly texture of the soil allow free downward drainage, and consequently the land is somewhat droughty. In seasons of liberal and well-distributed rainfall, crops usually mature satisfactorily.

Probably more than one-half the total area of this soil is improved as tillable land. Maple is the predominant tree and some sugar bush of the original stand is found. Beech and elm are also common.

General farming is followed in connection with dairying. The common crops give fair or good yields. Some farmers specialize in hog raising.

SAUGATUCK FINE SAND

In undisturbed areas the surface material of Saugatuck fine sand ordinarily consists of 2 or 3 inches of dark-brown or nearly black loamy fine sand, which under grass cover is bound together by grass roots. Beneath this is a 4 or 5 inch layer of loose incoherent light-gray or grayish-white fine sand which is leached of organic matter and other coloring substances. This layer grades rather abruptly into a concentrated layer, continuous to a depth of 18 or 20 inches, which consists of cemented loamy fine sand streaked with various colors ranging from brown or yellowish brown to dark brown or black and which forms a hardpan. The cementation is not uniformly hard, and when moist the material is sufficiently brittle to crush in the hands. This layer grades down into compact and in many places slightly cemented yellowish-brown fine sand mottled with rust brown, yellow, and dark gray. Between depths of about 30 and at least 45 inches the material is yellowish-brown or light-brown fine compact loamy fine sand, faintly mottled in most places with yellow and gray. In nearly all areas the lower part of the soil is water-logged, the water table standing in most places at a level of about 24 inches.

Newly cultivated areas have a streaked whitish and dark appearance. This is caused by light-colored leached sand which has been brought to the surface and which where thoroughly mixed by continued cultivation assumes a dark grayish-brown color. Many of the shallow depressions to a depth of a few inches consist of mucky material, and here the light-colored leached layer may not be so well developed. The soil is strongly or very strongly acid throughout.

This soil occurs in the northeastern part of the county, most of it in a belt about 6 miles wide north of a line extending from Waddington through Norfolk and Brasher Falls easterly to the Franklin County line. The areas range from about 2 miles in width to elongated strips and irregular areas more or less broken by areas of other soils, principally the Vergennes and Madrid soils.

Areas are prevailingly flat but in places are undulating or slightly rolling. Locally the surface is uneven, irregular hummocks a foot or two high alternating with corresponding depressions.

The comparatively low flat position, hardpan layers, and compact substratum cause poor drainage. Many of the depressions are swaly and support various marsh grasses and shrubs. The unfavorable drainage causes the soil to be soggy in wet periods and very dry in droughty periods.

Saugatuck fine sand has a low agricultural value, and very little profitable use is made of it. Some of the better-drained areas have been cleared and cultivated, but large areas which have been cleared of the original growth of pine and hemlock have grown up with white birch, poplar, various small shrubs, briars, ferns, wintergreen, and moss. Not more than 15 or 20 per cent of the land is cultivated.

Corn, oats, buckwheat, and a few other crops return moderate or low yields. Perhaps the most suitable use for this land is as pas-

ture. This soil is not in demand and is worth only a few dollars an acre. It is acid throughout.

Cultivation of the surface layer tends to produce a lighter-brown color, though deeper plowing brings up the white leached sand producing the streaked, spotted effect noticed on many of the fine sand areas.

Many areas of this soil occurring in close association with the Madrid and Vergennes soils have less well-developed leached, concentrated, or hardpan layers and are stronger and more productive than the typical soil. Where found adjoining the Vergennes soils, as east of Waddington, lacustrine clays characteristic of the Vergennes soils may underlie the sandy mass at a depth of 40 or more inches.

RUBICON LOAMY FINE SAND

The surface soil of typical Rubicon loamy fine sand where in grass or cultivation is dark-grayish loamy fine sand from 6 to 7 inches thick. The dark color is owing to the presence of organic matter and the grayish cast to an admixture of whitish quartz grains. This layer changes abruptly into grayish-white loose incoherent fine sand, evidently nearly pure quartz. Beneath this sand, at a depth ranging from 10 to 14 inches from the surface is the subsoil of compact coffee-brown fine sandy loam which in places is indurated, constituting a hardpan. This layer is about 8 or 10 inches thick and is of varying density, the upper parts being more indurated and dark brown or nearly black in color, and the looser materials having a brown and yellowish-brown cast. Below this layer the material is brown and yellowish-brown loamy fine sand mottled in many places with gray. It is compact, and many lenses of loosely cemented sand are present. Between depths of about 30 and 45 or more inches, the material consists of moderately compact loamy fine sand slightly mottled with brown, yellow, and gray. In some cuts, the lower part of the subsoil to a depth of 8 or 10 feet showed cross-bedding of various grades of sand, fine gravel, and here and there some very fine sandy or silty material.

In most of the areas drainage is fairly well established. The flat surface, however, tends to retard surface run-off, and the compact concentrated layer, together with sluggish drainage conditions in the substratum, renders drainage in general somewhat deficient. In many places the water table occurs at a depth of 40 or 45 inches.

This soil is successfully used in general farming. At least 60 and perhaps 65 per cent is improved as tillable land, and a large part of the remainder is utilized as pasture land. Characteristic timber growth includes elm, maple, white pine, and ash.

Cultivated crops consist largely of corn and oats with an occasional crop of rye and buckwheat. Mowing lands are sown to timothy and clover, but clover does not do especially well. Fields of other grasses are reserved for pasture. Only moderate crop yields are generally obtained, though from 40 to 50 bushels of oats and from 1½ to 2 tons of hay are common on the better areas. Pastures are ordinarily good. Fertilization consists largely of the use of animal manures and an occasional green-manure crop.

Land values range from about \$30 to \$50 an acre.

RUBICON LOAMY SAND

In virgin areas the surface soil of Rubicon loamy sand to a depth of about 3 inches is very dark grayish-brown sandy loam, the grayish effect being produced by an admixture of whitish sand. This layer grades into gray loamy sand, which at a depth of about 8 inches gives way to chocolate-brown or dark-brown compact sandy loam. Between depths of about 11 and 15 inches brown and yellowish-brown varicolored sandy loam is indurated into a more or less resistant hardpan. This grades into brown or light reddish-brown loamy sand, which in turn, at a depth of about 30 inches, is underlain by lighter reddish-brown or yellowish-brown loamy sand which continues to a depth of at least 45 inches and in many places to an undetermined depth.

Cultivation causes the surface soil to assume a grayish-brown or dark-gray color which varies according to the original supply of organic matter and the subsequent care in replenishing this constituent.

Many areas show no particular induration in the upper part of the subsoil, though evidence of the concentration of substances leached from the surface soil is present.

Tests show that the soil material is more or less acid in most places. In a few places, as near Sanfordville, the reaction was neutral or alkaline.

This soil is comparatively inextensive. It occurs in the eastern part of the county, chiefly within the angle formed by lines drawn from Potsdam to North Lawrence and to Nicholville.

In general, drainage is fairly well established, though on some of the flatter areas the run-off is slow. The dense subsoil layer, where present, retards the internal water movement. Some of the higher-lying areas, being of looser material, are excessively drained.

In general this is fair or good farming land. Most of it, perhaps 85 per cent, is improved and utilized under the usual farm practices. General dairy farming gives fair or good returns in most places. Some farms in the more droughty areas are in a run-down or backward condition and are therefore less prosperous.

ONDAWA FINE SANDY LOAM

The surface soil of Ondawa fine sandy loam ordinarily consists of dark-brown or dark grayish-brown friable fine sandy loam. Between depths of about 6 or 7 inches and about 14 inches is brown or grayish-brown moderately loose fine sandy loam which in the lower part may be faintly mottled with deeper brown and dark gray. This layer grades into a more compact layer of fine sandy loam plainly mottled with gray, yellow, and rust brown and containing small soft concretions in many places. At a depth of 28 or 30 inches this material gives way to light brownish-gray compact fine sandy loam mottled with dark brown and dull rust brown. This grayer material may extend downward many feet, or in places there may be coarser sandy or gravelly material and here and there muck or peat deposits. As a rule the soils are more sandy, looser, and better drained near the stream courses and heavier, more compact,

and less well drained farther back. The soil is acid or strongly acid throughout.

A heavier phase of soil occurs in a few small areas along Oswegatchie River between Richville and Dekalb. This consists of smooth light-brown silt loam or loam which in virgin areas is somewhat darker on the surface. The upper layers grade into somewhat more compact but moderately friable silty or loamy material. These areas are fairly well drained and are utilized for general farming.

Ondawa fine sandy loam occurs along some of the major streams in the northern part of the county. Some of the larger areas are along Oswegatchie River between Richville and Dekalb and farther down the river in the vicinity of Rensselaer Falls and Heuvelton, along Grass River between Canton and Morley and 3 or 4 miles below Madrid, and along St. Regis River between Buckton and Brasher Falls. Many smaller areas occur at other points along the lower courses of these rivers and Raquette River.

The areas commonly border the streams on both sides where the stream is straight and on but one side within bends where the stream is more meandering. Most of the areas occur as narrow strips ranging in width from a few rods to one-fourth mile. The tracts are smooth and typically slope slightly away from the stream bank. Drainage is generally fair or good but is rather deficient along the upland side of the areas. The water table in these places is usually between depths of 18 and 24 inches.

Probably 80 per cent of this land is cleared and used to some extent for cultivated crops but chiefly for pasture. The better-drained areas are well suited to corn, oats, and hay, and pasture grasses produce good stands on most of the less well-drained areas.

PODUNK LOAM

To a depth of about 8 inches Podunk loam generally consists of gray or grayish-brown loam or fine sandy loam. The surface layer to a depth of 1 or 2 inches is dark grayish in color. Between depths of 8 and about 24 inches the color becomes lighter, usually brownish light gray, and the material is mealy, slightly compact, more or less sandy, gritty loam. With depth the material may become more compact light-gray fine loam or very fine sandy loam. Between depths ranging from 30 to 35 inches and the depth of the substratum the material is looser, consisting of brownish light-gray fine loam or fine sandy loam. Rust-brown, yellow, and bluish-gray mottles and small brownish concretions are present below the surface soil. The texture of this soil and to some extent the coloring vary widely from place to place, depending on drainage conditions and the swiftness of the waters that laid down the deposits. Stony or gravelly areas are common, and various quantities of small stones are mixed with the soil in most places. Ordinarily the reaction is distinctly acid throughout the soil.

This soil occurs in a number of small first-bottom areas along the streams issuing from the country occupied by Gloucester and Hermon soils in the southern part of the area surveyed. Typical areas are east and southeast of Canton along Little River, Grannis Brook, and Tracy Brook, and south of Hopkinton. Smaller widely scattered areas are in various parts of the county.

The tracts are generally smooth or slightly hummocky, but some are uneven, having been cut by old stream channels. Drainage is rather poor. Probably 75 or 80 per cent of the land is cleared and used mainly for pasture. A small acreage of better-drained land less subject to overflow is cultivated to some extent, and good results are obtained from the general crops. Timothy hay thrives and provides satisfactory pasturage.

PEAT

Peat consists principally of organic matter in various stages of decomposition, deposited under poor drainage conditions. The areas in St. Lawrence County appear to have originated in ponds, shallow lakes, or in places where water originally remained for long periods. Evergreen and deciduous trees, and various shrubs, ferns, reeds, and mosses, especially Sphagnum moss, evidently formed an important source of material for the peat deposits, most of which are woody peat. Peat in St. Lawrence County ranges in thickness from 10 inches to at least 18 or 20 feet. In some small irregular-shaped areas, the material is well decomposed and contains more or less mineral substances, causing it to resemble muck.

The peat examined in Wheeler Marsh, about 5 miles southeast of Parishville, was about 8 feet thick and consisted of 1 or 2 feet of brown Sphagnum moss peat grading into brown woody peat of fragmental and granular material more or less mixed with embedded limbs and trunks of trees. Between depths of 7 and 8 feet the material was grayish-brown well-decomposed woody peat which was somewhat sandy in the lower part and rested on medium or coarse gray quartz sand. The vegetation consisted predominately of spruce and tamarack, together with heath and Sphagnum moss.

A deposit of peat in the marsh northeast of Gouverneur near Battle Hill School is approximately 19 feet thick. The surface layer consists of dark-brown woody partly fragmental material. Between depths of about 1 foot and about 6 feet the material is brown, woody, and granular. From 6 to 12 feet it is woody and coarsely granular and ranges from yellowish brown to brown in color. A reddish cast, presumably from cedar trees, is noticeable at a depth of 12 to 13 feet where the material is finely fragmental, woody, rather dry, and well decomposed. At a depth ranging from 13 to 15 feet brown or dark-brown fibrous material from sedges and rhizomes and possibly reeds is present. From 15 to about 18 feet the material is dark-brown and somewhat fibrous in the upper part and woody with twigs in the lower part. This layer grades into brown granular woody material which rests on grayish silty or sandy clay containing roots. The clay also contains flakes, probably mica, and sufficient lime is present to cause free effervescence with acid. Vegetation consists chiefly of maple, ash, and hemlock, together with an undergrowth of cattail and osmunda, or cinnamon fern.

Areas of peat are fairly well distributed except in a belt of country bordering St. Lawrence River for some 5 or 6 miles. Among the more important areas are the ones along Fish Creek between Kings Corners and Pope Mills, southwest from Black Lake near Hammond, 4 miles northeast of Gouverneur, in Wheeler Marsh in

eastern Parishville Town, in northeastern Madrid and northwestern Norfolk Towns, and in the Indian Creek basin east of Rensselaer Falls.

Most of the peat areas remain unimproved and support a varied marsh vegetation. On many areas there are stands of white pine, spruce, hemlock, or tamarack, and various deciduous trees. Small areas here and there have been cleared to furnish pasturage or for use as mowing lands. In only a very few places has peat been brought under cultivation. In Hermon Town about one-half mile south of Barnum School a number of acres are cultivated with fairly good returns, but the low position of the areas renders corn susceptible to damage by frost. Some attempt has been made to utilize peat for fuel and other purposes.

MEADOW

Meadow includes poorly drained soils of such miscellaneous origin, texture, and structure that they were difficult to classify. They occupy first-bottom or low positions and are subject to overflow. In wet seasons they may hold water on the surface. The surface material in many places is mucky, and small areas of peat have been included in mapping. Some of the meadow is cleared, but a large part of it is in timber or brush. Black ash, willow, tag alder, various shrubs, and coarse swamp grasses are the characteristic vegetation. A few areas are mowed for hay, but meadow is largely in pasture, which seems the best use for it. Most of the areas are small and widely scattered.

DUNE SAND

Dune sand consists of barren areas of sand which have been more or less blown and drifted by the wind. Most of the sand is fine in texture and yellow or brownish yellow in color, causing the dune-sand areas to stand out conspicuously. The sand is excessively drained and, except during rainy periods, is thoroughly dry on the surface.

Dune sand occurs mainly in small areas in association with Hinckley fine sand and the outwash-plain soils in the northeastern part of the county. Some isolated areas have developed since the county was settled and occupy land which was once cultivated. Such an area is just southeast of Fullerville Ironworks. The best use for dune sand would seem to be for forestry, as such use would protect adjoining lands from drifting and would give a profitable return.

ROCK OUTCROP

Rock outcrop is a classification given to those areas which are predominately rock exposures appearing as flat or sloping areas or ledges and escarpments. Rock outcrop differs from Gloucester rocky loam chiefly in its greater area of exposed rock. Here and there depressions contain shallow deposits of glacial debris, some of which has disintegrated from the rocks. The soil present is mainly Hermon or Gloucester material, chiefly loam or fine sandy loam. In some of the deeper small depressions muck or peat has accumulated.

The principal rocks are granite and gneiss, together with some limestone and sandstone. The surfaces of most of the rocks have become more or less rounded from the grinding movement of glaciers. Some of the ledges and escarpments are craggy, rough, and in some places precipitous.

Most of the rock outcrop occurs throughout the southern and western parts of the surveyed area, in irregular strips ranging from one-fourth to one-half mile or more in width and in broad areas 2 or 3 miles wide. The wider areas are east of Gouverneur, extending easterly and northeasterly beyond Trout Lake. A large area lies south of Edwards in Edwards Town.

Some of the rock outcrop areas afford scant pasturage, but for the most part the land is occupied by brush and small timber. White birch, poplar, and some maple are common. Many of the broader areas which have been swept by fire present a barren, desolate appearance.

MADE LAND

Made land is composed of excavated materials, most of which have been dredged from Grass River below Massena and from the power canal connecting St. Lawrence River and Grass River at Massena. The material is composed of claylike sediments from the river deposits and bluish clays from the canal deposits. These deposits are in a more or less raw condition, having not yet developed a soil mantle. They support a sparse growth of weeds and coarse grasses. The material has a high lime content and effervesces freely with acid. In places lime nodules are numerous.

In its present condition, made land is not very promising for agricultural purposes. Doubtless grass can in time be established to furnish satisfactory pasturage.

SUMMARY

St. Lawrence County, which borders St. Lawrence River, is the extreme northwestern county of New York. The southern and southeastern parts of the county, which form a part of the State forest reserve are not included in the area surveyed.

Topographically the county falls into two main divisions, the northern low belt, some 20 miles wide, which consists of lacustrine and outwash-plain deposits, together with intervening drumlin drift deposits; and the southern and more elevated part, a portion of the declining northerly edge of the Adirondack upland. The northern smoother division ranges in elevation from about 300 to 500 feet, and the southern more rugged area reaches a maximum of 1,800 feet.

Drainage has a northerly trend and is tributary to St. Lawrence River. Most of the land in the southern part of the area surveyed has good natural drainage, but much of the lacustrine lands to the north are more or less deficiently drained.

According to the census of 1920 the population was 88,121, 56,706, or 64.4 per cent of which was rural. The county is fairly well served with railroads, and the important towns are connected with improved highways.

New York City is the principal market for fluid milk. Cheese, butter, and miscellaneous dairy products are disposed of in this and other eastern cities.

St. Lawrence County is in the cooler part of the Temperate Zone. The average frost-free season is about 150 days for most of the county. The precipitation is well distributed.

Farming is centered in the dairy industry, and crops grown are utilized to support this industry. The chief crops, in the order of their acreage, are hay, oats, barley, and buckwheat. Hog raising is carried on mainly in the cheese-making districts. Poultry raising is of some importance. Little attention is paid to the raising of sheep and horses.

In 1925 the average size of farms was 133.5 acres. More than 75 per cent of the farms were operated by owners. The average value of farm land then was \$20.92 an acre.

The soils of the county range in texture from clay and silt loams to the looser sands and stony soils. The better-drained virgin soils, which were originally timbered, are light in color; the more poorly drained soils, including peat, are dark.

A typical virgin soil profile has a surface layer of more or less decomposed organic matter overlying a grayish subsurface layer, which is underlain by a more or less compact brownish layer giving way to lighter-colored material. Over much of the county, the gray layer is either thinly developed or missing. However, the brown layer is developed over the entire area.

The soils of the county are grouped into 18 series, each including one or more soil types, and 5 miscellaneous classes of land.

The soils derived from deep unassorted glacial-till material and containing little or no lime carbonate include members of the Gloucester, Hermon, Whitman, and Parishville series. Similar soils, which contain some lime carbonate, are mapped in the Madrid and Lyons series.

The Farmington soils consist of thin glacial till overlying limestone rock. They tend to be droughty. The Hinckley soils have developed on stratified kames and eskers.

Soils derived from lake-laid materials and outwash plains and containing considerable lime carbonate in the subsoil or substratum are classified in the Vergennes, Allendale, Dunkirk, and Granby series. Soils similarly derived but containing little or no lime carbonate are grouped in the Merrimac, Colton, Saugatuck, and Rubicon series.

First-bottom lands, consisting of stream-deposited materials and containing little or no lime to a depth of 3 feet, are grouped in the Ondawa and Podunk series.

Besides peat there are miscellaneous classifications of meadow, made land, rock outcrop, and dune sand, none of which is of agricultural importance.

[PUBLIC RESOLUTION—No. 9]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture"

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]

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