U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF CUMBERLAND COUNTY, MAINE.

BY

CORNELIUS VAN DUYNE. IN CHARGE, AND M. W. BECK.

W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1917.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., October 10, 1916.

SIR: The field operations of the Bureau of Soils for 1915 included a soil survey of Cumberland County, Me. I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1915, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

FIGURES.

MAP.

SOIL SURVEY OF CUMBERLAND COUNTY, MAINE.

By CORNELIUS VAN DUYNE, In Charge, and M. W. BECK.—Area Inspected by W. E. McLENDON.

DESCRIPTION OF THE AREA.

Cumberland County, Maine, embraces an irregularly shaped area in the southern part of the State. Oxford, Androscoggin, and Sagadahoc Counties bound it on the north; Sagadahoc County and the Atlantic Ocean on the east; York County on the south and southwest; and Oxford County on the west. Its extremes of length and width are from the east side of Brunswick Town to the west side of Baldwin Town, in an east-west direction, 45 miles, and from Prouts Neck to the northern part of Harrison Town, in a southeast-northwest direction, about 40 miles. Its average length and width are approximately 35 and 25 miles, respectively. The county has a total land area of 853 acres, or 545,920 square miles. It includes 25 towns[1] and the city of Portland.

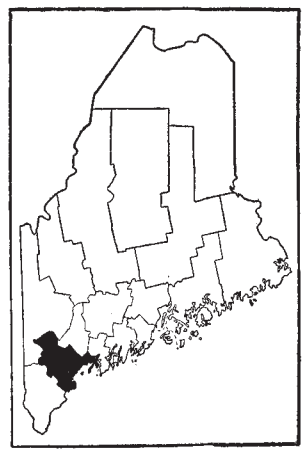

FIG. 1.—Sketch map showing location of the Cumberland County area, Maine.

The base map used in the survey comprises all or parts of the following quadrangles of the United States Geological Survey topographic map of the United States: Portland, Casco Bay, Gray, Freeport, Sebago, Norway, Bath, Buxton, Poland, Fryeburg, Kezar Falls, and Small Point.

The physiographic features of Cumberland County are those of an uneven country with little or no systematic arrangement of its hills, valleys, and plains, and an unusual combination of hills, lakes, and irregular seacoast. In general there is a gradual decrease in the elevation toward the southeast. The county comprises two rather distinct physiographic divisions separated by a rather irregular and in some cases an arbitrary boundary. This boundary leaves the north county line near the northwest corner of Pownal Town, extends southwestward a few miles and then swings up the east side of the Royal River Valley to near the county line.

[1] "Town" as used here and elsewhere in this report is synonymous with "township."

It follows the west side of the same valley to near its junction with Collyer Branch, where it turns up the latter valley to near North Gray and again swings southwestward and continues along the west side of Pleasant River Valley to the Gray-Windham line. Here it turns northwestward to Little Sebago and Sebago Lakes. The line leaves the latter lake near its outlet and follows the west side of the Presumpscot River Valley to the Windham Town line, along which it continues southwestward to the south county line. Its course is shown on the accompanying sketch map (fig. 2). The western division is the higher and more irregular. It comprises the western parts of the towns of New Gloucester, Gray, and Windham and all of the towns of Otisfield, Harrison, Bridgton, Sebago, Baldwin, Standish, Naples, Casco, and Raymond. The eastern division is the lower and less irregular and includes the remainder of the county.

The western division is characterized by rather large and high, broadly rolling hills with a smooth, curving outline; by valleys which are narrow in comparison with their depth and which have little or no valley floor and widely spreading valley slopes; and by streams that have deposited very little material along their courses. There are a number of exceptions to this general description. Crooked River flows in a valley which is entirely too large for the present stream. Fairly extensive deposits of stream-laid material form the valley floor and the slopes rise less gradually than in the majority of the valleys. The most prominent valley is the one in which Long and Sebago Lakes are located. This starts as a fairly narrow and deep valley at the north county line and gradually widens toward the south until it merges into the broad basin in which Sebago Lake lies. Several other smaller valleys also converge toward this lake. The elevation of the surface of the lake is 262 feet and the depth is reported as 400 feet, which shows that the lake occupies a rock basin extending below sea level.

The highest elevation in the county is in the western part of the town of Bridgton and is 1,920 feet. It is on the north end of Pleasant Mountain, which attains a higher elevation farther south, in Oxford County. The Saddleback Hills in Baldwin and Sebago Towns range from 1,100 to 1,407 feet on Douglas Hill, their highest point. These are the most prominent topographic features of the county and are especially conspicuous from the south and east. The Saco River lies only a few miles to the south and west, and a sandy plain and Sebago Lake are on the east and northeast. Bald Pate, 1,160 feet, and Fitch Hill, 1,143 feet, next in height, are in the extreme southern part of Bridgton Town. Another conspicuous hilly section is in the northern part of the town of Raymond and in the eastern part of the town of Casco. The elevation here ranges from 800 to 1,045 feet, the highest point being a rough and irregular

mountain mass known as Rattlesnake Mountain. Scribner Hill, with an altitude of 880 feet, is the highest point in Otisfield Town, and Summit Spring Hill, 883 feet, the highest in Harrison Town.

The eastern division extends inland from tide water to the line already described. It is an extensive plain, very irregular in outline, and studded with hills and ridges. This plain gradually rises from near sea level to a general elevation of 100 to 150 feet, with portions reaching a height of 250 feet or more. It continues for long distances up the main valleys and many of the smaller ones and covers either broad areas interrupted by hills or broad to narrow valley floors between high and fairly extensive areas of hilly country. The hills, which rise above its surface from 50 to 300 feet, are rounded in outline and vary widely in shape and size. The surface of the plain is undulating to gently rolling and is partly the result of erosion since the deposition of the material. Practically all the valleys have deposits of old valley-filling material, and a rather rolling valley floor of moderate width bordered by gentle slopes is common.

Prominent elevations within this division are Walnut Hill, 463 feet; Blackstrap Hill, 505 feet; Bradbury Mountain, 484 feet; and many others. Broad, flat areas of unusual size occur in the towns of Brunswick, South Portland, and Scarboro. In the towns of Freeport, Cumberland, and Yarmouth the hills attain heights of 200 to 250 feet. In the towns of Brunswick, Harpswell, South Portland, Cape Elizabeth, and Scarboro they range from 100 to 150 feet in elevation. These hills were islands when the general section was covered by the ocean.

The coast line north from Cape Elizabeth lighthouses is extremely irregular and is characterized by steep, rough, and rocky slopes or hills bordering the shore line. These are broken by fairly extensive areas or stretches of low-lying country intervening between the shore and the hills. South from the lighthouses the shore line is regular, low, and sandy. The coast line is typical of a "drowned coast." There are numerous long, narrow tidal estuaries along the coast, and a multitude of islands in Casco Bay. These islands, about 135 in number, range in size from a few to over 1,000 acres in extent and fall into three ranges having the same general northeast-southwest direction as the strike of the schistose and slaty rocks.

The unsystematic character of the present drainage is partly the result of the preglacial irregularities in the surface features of the section and partly the effect of the deposition of glacial drift in the preglacial channels. Practically all parts of the county are reached by surface drainage ways. Local flat areas are either sandy and drain through the soil or are wet and swampy. Most of the streams are short and follow rather irregular courses. In only a few instances are parts of the channels reduced to a low grade, so that the

stream flows through material deposited by itself. Tidewater streams are few and are confined mainly to the extreme southern part of the county. None of the larger streams are navigable.

Cumberland County lies between the Saco and Androscoggin River drainage systems. The two rivers drain portions of the county and form the west and north boundaries for distances of 20 and 12 miles, respectively. Between these systems lie the basins of the Presumpscot and Royal Rivers. The general direction of the drainage is southeast. The accompanying sketch map (fig. 2) shows the location and relative extent of the portions drained by the Presumpscot, Royal, Saco, and Androscoggin Rivers and by the Stroudwater and Nonesuch Rivers and other short coastal streams.

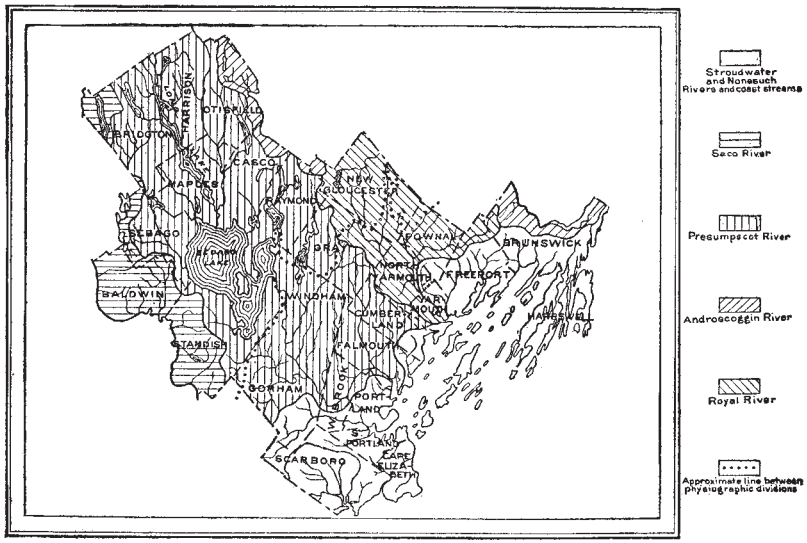

FIG. 2.—Sketch map showing drainage basins and approximate boundary between physiographic divisions.

The basin of the Presumpscot River includes the entire central part of the county from the coast northwestward to its northern limits. The river is about 22 miles in length from Sebago Lake to Casco Bay. From its beginning at the lake it flows southeastward over a rocky bed and has a succession of falls and rapids from the lake to Westbrook, where it turns in a northeasterly direction for a few miles and then at its junction with the Piscataqua River swings eastward to the bay. The latter and the Pleasant River are its chief tributaries from the north. Little River joins it from the south. Over thirty lakes are in its basin, including the large Sebago and Long Lakes. They have an important influence in the prevention of floods and other fluctuations in volume and greatly enhance

the value of the river as a source of water power. The basin has a length of about 40 miles and an average width of 12 miles, making its approximate area 480 square miles.

The Saco River drains a nearly continuous area from the extreme northwest corner of the county to the south side of the town of Standish, approximately 100 square miles. The tributaries are few in number and have steep gradients.

The Androscoggin River drains a narrow area of several square miles in Otisfield and Casco Towns and a similar one in the town of Brunswick. These total approximately 40 square miles.

The Royal River rises in Sabbathday Pond, flows northeast, and crosses into Androscoggin County. It turns quickly and, reentering the county, continues in a south to southeast direction until it empties into Casco Bay near Yarmouth. It is about 25 miles long. Chandler River is its largest tributary. Approximately 120 square miles of its basin lie within this county.

The Nonesuch and Stroudwater Rivers flow in a general easterly direction and drain about 120 square miles in the extreme southern part of the county. Other short streams flowing directly into the bay or ocean drain the remainder of the county. No deductions are made for the total areas of fresh-water lakes in the drainage basins.

With the exception of those of the last division, practically none of the rivers or streams have reached base level. Falls and rapids are fairly abundant, and their use for water power is already extensive. The presence of water power has had an important influence on the development of the county.

Lakes are numerous in the glaciated portion of the county. They are widely scattered and range in size from a few acres to upward of 50 square miles in extent. The largest are Sebago, Long, Highland, Little Sebago, and Crystal Lakes, and Panther, Rattlesnake, Raymond, Thomas, Brandy, and Peabody Ponds. The majority of these lakes and ponds are formed by dams of gravelly and sandy material across valleys.

Cumberland County was organized in 1760 and originally included parts of the present counties of Oxford and Androscoggin. The descendants of the early and the later English settlers constitute a fairly high percentage of the urban and a very high percentage of the rural population of the county. The descendants of rather early French Canadian settlers form a minor part of the present population. Later immigrants, mainly Irish, German, Greek, Italian, and others, settled in the mill towns and cities and very few of them have engaged in farming. According to the census the population of Cumberland County was 86,359 in 1880, 90,040 in 1890, 100,689 in 1900, and 112,014 in 1910. In 1900, 75,929 were classed as urban and 24,760 as rural. In 1910, 86,426 were classed as urban and 25,588

as rural. The latter is 22.8 per cent of the total population. The density of the rural population is 30 persons per square mile. The urban population is composed mainly of the inhabitants of Portland, Westbrook, South Portland, and Brunswick. The above figures show that the population is gradually increasing and that the urban population is increasing more rapidly than the rural.

The rural population is fairly well distributed. In general, the eastern and southern parts of the county are the most thickly populated, while the northern part is the least so. The least populated sections are those of roughest topography and are found in the basin of Little Sebago Lake in Raymond, Gray, and Windham Towns; northeast, east, and southeast of Steep Falls; and in the vicinity of the Saddleback Hills and Rattlesnake Mountain. The summer population is greatly in excess of normal. All parts of the county are affected by this increase; the greatest is found along the coast and on the islands in Casco Bay and also on and near the lakes farther inland.

Portland, the county seat, is the largest city of the State. Its population in 1910 was 58,571. It has a good harbor of large proportions and is the most important transportation center and marketing and shipping point in the State. Westbrook, with a population of 8,281 in 1910, is an important trade and manufacturing center on the Presumpscot River about 6 miles northwest of Portland. South Portland, with a population of 7,471, is mainly a residential suburb of Portland. Brunswick, with a population of 5,341, located at the Pejepscot Falls, at the head of tidewater on the Androscoggin River, is the site of Bowdoin College and an important commercial and manufacturing center. Bridgton, with a population of 1,474; South Windham, 1,000; Freeport, 965; and Yarmouthville, 1,000, are smaller manufacturing villages whose sites were determined by the presence of water power. They are also marketing and shipping points for farm products. Gorham, the site of a State normal school, Harrison, North Windham, Gray, Casco, Steep Falls, Sebago Lake, Dunstan, Raymond, and Standish are residential villages and commercial centers of small sections. There are many other post offices and centers of rural population.

Prouts Neck, Scarboro, and Higgins Beaches, and Pine Point are favorite summer resorts south of Portland. Old Orchard Beach lies just south of the county line. Great and Little Diamond, Peak, Cushing, Long, Crotch, Great Chebeague, Busting, Bailey, and Orr Islands have a dense summer population. Harpswell Neck has a fairly dense settlement in summer.

Railroads, boat lines, and roads radiate from Portland in the southern part of the county. The greater part of the county is well supplied with railroads, which give excellent service to points in

Massachusetts, New Hampshire, and in other parts of Maine. The eastern and western divisions of the Boston & Maine Railroad connect Portland and Boston and intermediate points. The Worcester, Nashua & Portland Division of the Boston & Maine Railroad extends westward from Portland to New Hampshire points. The main line of the Maine Central Railroad extends northeastward and connects Portland, Brunswick, and intermediate stations with northern and eastern Maine points. The Lewiston Division leaves the main line at Royal Junction and continues northward, connecting Portland and local points with Lewiston and Auburn and other places in northwestern Maine. The Mountain Division of the same line extends northwestward from Portland to White Mountain points and beyond. This, together with the Bridgton & Saco River Railroad, a narrow-gauge line which connects Bridgton Junction with Bridgton and Harrison and intermediate points, serves much of the southern, western, and northern parts of the county. The Grand Trunk extends northward from Portland, its eastern and southern terminus, and connects Canadian, New Hampshire, and western Maine points with places in Cumberland County. Connecting lines of the Maine Central Railroad extend from Brunswick to Bath in Sagadahoc County and to Lewiston in Androscoggin County.

In addition to the steam lines already mentioned, there are a number of electric lines radiating from Portland and Brunswick. The Portland & Saco Electric Railroad extends southwestward from Portland to Saco, in York County. Electric lines connect Gorham and South Windham with Westbrook and Portland. The Portland & Lewiston Interurban extends northward from Portland across Falmouth, Cumberland, Gray, and New Gloucester Towns. Another electric line connects Portland, Yarmouth, Yarmouthville, Freeport, and Brunswick. From the latter city a line extends eastward to Bath in Sagadahoc County and northwestward to Lewiston. The latter crosses the river at Brunswick and is outside of Cumberland County the greater part of its length. These electric lines connect all the cities and larger towns in the eastern and southern parts of the county. They maintain an efficient passenger and, in most cases, express service between local points. Parts of Otisfield, Naples, Casco, Raymond, and Gray Towns, north and northeast of Sebago Lake, are without adequate railroad service.

Daily passenger and freight boats connect Portland with many points along the coast. Both day and night boats ply between Portland and Boston, another line between Portland and New York City. Other boat lines connect Portland with Bath, Rockland, eastern Maine, and the maritime ports. A frequent and efficient boat service is maintained in the summer season between Portland, South Harpswell, and the numerous islands in Casco Bay; a much less frequent

service is afforded during the remainder of the year. During the summer months a boat line also maintains passenger and freight service between Sebago Lake Station, Naples, Bridgton, Harrison, and intermediate points on Sebago and Long Lakes. In addition, many ocean-going and coast freighters carry an enormous tonnage of freight to and from Portland.

The sections not reached by railroads are connected with railroad points by stage lines which carry passengers, express, and mail. Daily and in some cases bi-daily stages connect South Casco, Raymond, and North Windham with South Windham; Naples and intermediate points with Mattocks or East Baldwin; and Casco and other points with Poland in Androscoggin County. Automobiles are used on these routes, except in winter.

The roads of Cumberland County are good. For a hilly country roads are numerous and are kept in good repair. Many of them have been surfaced with sand and gravel. Little or no crushed rock is used on the county roads. A concrete and macadamized road is completed from Dunstan near the south county line northeastward through Portland, Yarmouth, and Freeport to Brunswick. Other main automobile routes have been much improved over the average of the county roads. Sand and gravel for road construction are abundant. Further improvement would add to the ease of transportation and to the value of the farm lands.

All sections of the county are reached by rural free delivery routes and telephone lines. The municipal water supply of Portland is obtained from Sebago Lake and is delivered to parts of Cumberland, Falmouth, Westbrook, Gorham, Windham, Scarboro, Cape Elizabeth, and South Portland Towns. Transmission lines for power and lighting purposes are numerous, and practically all the villages and, in some sections, the country roads and farmhouses are lighted by electricity. The county has an excellent school system. Good graded and high schools are maintained in all cities and villages. The country districts are well supplied with efficient schools.

As the rural population is only 22.8 per cent of the total, and as that includes the population of a number of the smaller villages, the proportion of the people actively engaged in farming does not exceed 20 per cent. Therefore there are adequate local markets for nearly all farm products within the county. Portland and other cities and the larger villages afford good markets at all seasons. Excess crops, such as hay, some milk, and apples, go by boat or rail to Boston, which is only 114 miles distant by rail. The influx of people during the summer months assists greatly in giving local markets for the crops of the county.

CLIMATE.

The accompanying table is compiled from the records of the Weather Bureau station at Portland. It shows the normal monthly, seasonal, and annual temperature and precipitation of that part of the county. The figures are typical of a fairly wide belt along the coast, but doubtless do not give a correct idea of the conditions prevailing at higher elevations 25 to 35 miles back from the coast.

Normal monthly, seasonal, and annual temperature and precipitation at Portland, Me.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1908).	Total amount for the wettest year (1888).	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	27.1	60	−17	3.77	2.92	4.71	12.0
January	22.0	62	−15	3.76	2.42	6.05	18.8
February	23.8	58	−15	3.45	3.72	5.40	20.3
Winter	24.3	62	−17	10.98	9.06	16.16	51.1
March	32.0	78	− 7	3.89	2.26	3.72	14.4
April	43.0	78	14	3.23	2.14	3.80	4.0
May	53.5	94	30	3.56	4.76	3.36	T.
Spring	42.8	94	− 7	10.68	9.16	10.88	18.4
June	62.6	96	42	3.27	0.53	2.79	0
July	68.0	97	48	3.47	2.58	1.90	T.
August	66.2	95	46	3.55	3.73	4.36	0
Summer	65.6	97	42	10.29	6.84	9.05	T.
September	59.6	94	33	3.31	0.69	8.22	0
October	49.1	84	26	3.70	3.65	7.47	T.
November	37.6	72	− 6	3.67	1.34	7.46	4.8
Fall	48.8	94	− 6	10.68	5.68	23.15	4.8
Year	45.4	97	−17	42.63	30.74	59.24	74.3

The winters are long and rather severe. January and February, with mean temperatures of 22° and 23° F., respectively, are the coldest months. The absolute maximum of the winter season ranges from 58° to 60° F. and the absolute minimum from −15° to −17° F. The average depth of the snowfall for the same period is 51 inches, and for the year, 74.3 inches. The summers are short and cool. July and August are the hottest months, with mean temperatures of 68° and 66° F., respectively, and an absolute maximum of 97° F. and an absolute minimum of 46° F. The range between the mean temperatures of the coldest and warmest months is 46° F., or from

22° F. in January to 68° F. in July. The extreme range between the absolute maximum and absolute minimum of the summer and winter seasons is 114° F. The mean annual precipitation is 42.63 inches. The total amount for the driest year (1908) was 30.74 inches and the total amount for the wettest year (1888) was 59.24 inches.

Although the average for a series of years represents most typically the climate, each month, season or year may depart from the typical to a greater or less degree. The table shows that the mean seasonal precipitation is nearly evenly distributed among the four seasons. Periods of intense heat with high humidity from 2 to 4 days in length may occur any time between the first of June and the middle of September. Wet, cool spells may occur any time during the spring, summer, or fall seasons. The periods of intense cold during the winter season seldom last more than 2 to 4 days. Warm spells or thawing weather may occur during the same season. The average depth of snow at Portland does not represent conditions farther inland, where it is much greater.

The average date of the last killing frost in the spring is May 14 and of the first killing frost in the fall October 18, giving an average growing season of 158 days. The absolute earliest and latest on record are September 11 and May 31, respectively.

As a rule the precipitation is sufficiently evenly distributed to prevent serious damage or the loss of crops by drought or by excessive rainfall. Seasons occur, however, in which either or both conditions happen. They have never resulted in more than a partial failure of crops. Frequently a heavy fall of snow comes before the ground has frozen to any depth and affords a protection during the winter months. At other times the ground freezes to quite a depth before the snow comes and remains frozen the whole winter, thus causing late planting of crops in the spring. The climate is well suited to the production of grass, grain, potatoes, fruit, and short-season vegetables. Early varieties of corn are successful when planted on land least subject to frosts.

AGRICULTURE.

Practically the whole of Cumberland County was originally covered with a heavy forest of white pine and other trees. Its settlement, confined at first to the coastal section, dates from 1632. As the early settlers must produce nearly everything of necessity in the way of food and clothing, their attention was early turned toward agriculture. Small tracts were cleared and corn hoed in without plowing. This cereal, with milk and game in summer and with rye and pork in winter, formed their chief food. Fish and other sea foods were also important articles of diet. As there were no markets nor transportation facilities, the early development of agriculture

was very slow. With the growth of villages and the construction of roads, there came an impetus to the development of the farming industry.

The extension of settlement and the early development of the county are indicated by the incorporation of the greater number of the present towns prior to 1820. In 1800 Portland had a population of 3,704, and the city was incorporated in 1832. Occupations other than agriculture consisted of fishing, trading, lumbering, tanning hides, making charcoal, and various other trades. Saw, grist, carding, stave, and shingle mills were early established. Shipbuilding was an early industry. The early development of all these industries indicates that since the settlement of the county agriculture has not been the sole source of income.

The completion of the Cumberland and Oxford Canal between Sebago Lake and Fore River at Portland in 1830 was an important internal improvement and continued to be of great service to the agricultural development of the western part of the county until the period of railroad building. Railroad construction began with the line from the south into Portland in 1842, which was continued to the northeast in 1848. Practically all the railroads of the county were built prior to 1875. Cities and villages grew rapidly and farming operations spread to all parts of the county.

The agricultural development of the county was steady and gradual until the establishment of manufacturing industries in the cities and villages. At about this time a movement of the rural population toward the cities began and also immigration toward the western States. Since that time there has been a decrease in the number of farms and in the number of acres in cultivation.

There has been comparatively little change in the kinds of crops or in the character of farming since the county assumed agricultural importance. This change consists of a reduction in the acreage devoted to the production of the cereal crops and an increase in that used for hay and forage crops and for truck crops. The last ten years have been marked by increased interest in farming.

Value of farm property.

Year.	Per farm.					Per acre.
	All property.	Land.	Buildings.	Implements.	Domestic animals.	Land value.
	Dollars.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Dollars.*
1880	2,470	.....	88	3	9	.....
1890	2,386	.....	85.16	4.13	10.71	.....
1900	2,454	42.9	40.5	6.2	10.4	13.14
1910	3,415	42.2	41	6.2	10.6	19.06

The above table gives the value of farm property per farm and the land value per acre according to the censuses of 1880 to 1910, inclusive. It shows the existence of rather uniform conditions from 1880 to 1900 and a marked increase in the value of all farm property between 1900 and 1910. As the value of land increased approximately $6 an acre in that period, that fact accounts for a large part of the total increase in value. In addition, the table shows that the relative value of the land and farm buildings is almost equal.

In the following table is given the data relating to farm lands of the county from 1880 to 1910, inclusive:

Land and farm areas.

Year.	Total area of county.	Number of farms.	Proportion of total area in farms.	Average size of farms.	Improved land in farms.	
	Acres.		*Per cent.*	*Acres.*	*Acres.*	*Per cent.*
1880	545,920	5,415	.....	74	45	61
1890	545,920	5,342	73.41	75	41	54.26
1900	545,920	5,101	74.9	80	29	36.3
1910	545,920	5,131	71	75.6	29.5	39.1

The above table gives the total number of farms, the percentage of the total land area in farms, the average number of acres per farm, and the percentage and area of improved land per farm. There was a decrease of nearly 6 per cent in the number of farms between 1880 and 1900 and only a slight increase since that date. The decrease in number since 1880 has not resulted from the abandonment of farms but either from the combination of adjoining farms or their cultivation by farmers in the vicinity, neither of which has improved the character of the methods of farming. The number of acres per farm and the percentage of the county area in farms has remained fairly constant from 1880 to the present time. The data also shows a marked decrease in the percentage of improved land in farms and in the average number of acres of improved land per farm. This has not resulted from a subdivision of farms and hence an increase in the number of farms, for the same table shows a decrease in their number. At the same time a decrease from 61 to 39.1 per cent of improved land per farm or from 45 to 29.5 acres of improved land per farm would mean a decrease in nearly one-third of the acreage in cultivation. There has, of course, been a decrease in the cultivated area, but not so marked as the figures indicate. The larger decrease is due to including as improved land that which is now regarded as unimproved. From 1900 to 1910 there was an increase rather than a decrease in the farmed area.

The following table, compiled from data furnished by the census, gives the acreage and yields of the four principal crops from 1880 to 1910:

Acreage and production of principal crops.

Year.	Hay.		Oats.		Potatoes.		Corn.	
	Acres.	*Tons.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*
1880.....	105,919	83,430	3,019	87,940	4,453	381,410	2,866	93,619
1890.....	106,273	98,514	4,684	125,947	3,111	198,452	748	25,230
1900.....	104,493	82,771	1,533	49,560	2,726	302,980	1,208	47,620
1910.....	100,328	94,805	2,129	64,008	3,426	461,581	1,263	57,882

In general there has been a decrease in the acreage of these crops. From 1880 to 1900 the acreage in hay was fairly constant, with quite a marked reduction in 1910. The fluctuation in production is no greater than might be expected to result from seasonal variations. The acreage in oats shows far greater fluctuations; that of 1880 and 1890 is more than double that of 1900 and 1910. There was a corresponding decrease in the yields during the same period. A larger acreage of potatoes was reported in 1880 than for any of the succeeding periods; the largest yield was given in 1910. The acreage in corn showed a marked decrease from 1880 to 1890, with an increase in 1900 and 1910, respectively. In 1880, 1,459 acres of wheat were reported. This had decreased to 16 acres in 1910. The acreage in rye, barley, and buckwheat ranges from 15 to 75 acres for each crop, and fluctuates from year to year.

On the whole, as far as reported, there was a decrease in acreage of each crop between 1880 and 1910. The reduction in total acreage of hay and forage crops, cereals, and potatoes is slightly less than 10 per cent. The per cent of decrease in cultivated lands for the county as a whole does not equal this figure, as there has been an increase in the acreage in small vegetables, cabbage, and small fruits within the same period, these crops now being grown on land formerly devoted to other crops. The census data also show that the expenditures for fertilizers have increased within the 30 years, and there is some indication that the average yields of the principal crops may also have increased as a result of this and other improvements in the methods of agriculture. The principal sources of the agricultural wealth of the county are shown in the following table, which gives the total acreage, the total value, and the value per cent of the crops by classes, and also the value of live-stock products sold.

Revenue from crop and live-stock sources in 1909.

Crops by classes.	Acreage.	Value.	Per cent.
		Dollars.	
Hay and forage crops	100,329	1,345,629	50.7
Vegetables	6,910	564,825	21.3
Fruits and nuts	6,740	195,429	7.3
Cereals	3,581	78,293	3.0
Other grains and seeds	737	26,828	1.0
All other crops	.....	441,420	16.6
Total	.....	2,652,424	.....
Live stock and products:			
Animals sold or slaughtered	.....	730,745	31.5
Dairy products (excluding home use)	.....	913,177	39.4
Poultry and eggs	.....	669,334	28.9
Wool and mohair	.....	2,825	.1
Total	.....	2,316,081	.....
Grand total	.....	4,968,505	.....

Approximately three-fourths of the improved land of the county is devoted to the production of hay and forage crops. Tame and cultivated grasses are grown on 96,619 acres and wild grasses on 1,406 acres. Coarse forage and grains cut green for hay occupied 2,303 acres. Of the total acreage in these crops, 47,766 are in tame and cultivated grasses other than timothy and clover. This is nearly one-half of the acreage in grass, and includes mowings that have been in sod for a number of years, in which the original stand of timothy and clover has been displaced by other grasses more or less mixed with weeds. Such fields give small yields of hay of poor quality. There were in 1909, 35,902 acres in timothy and clover mixed, 11,325 acres in timothy alone, and 382 acres in clover alone. These figures represent fairly well the state of the hay-growing industry. At least one-half the acreage in grass has reached a stage in which profitable yields are not obtained, and such areas should be plowed and reseeded. The average yield per acre of hay is about five-sixths ton.

The distribution of the hay and forage crops is not confined to any particular section of the county or to any soil type. It is most extensive on the Orono silt loam, Orono fine sandy loam, and Gloucester sandy loam, but hay is produced on all the arable types. A large part of the crop is fed to work, dairy, and other stock on the farms. The surplus finds a ready market in the cities and villages or is shipped to Boston.

Hawkweed, or Indian paintbrush, and wild carrot are chief among the prevalent weeds in the mowings. While a few farmers are fighting them, the majority are making no effort toward their eradication.

Two or three small patches of alfalfa are producing fair yields of hay. These are of recent sowing, and the crop has never been planted to any extent. Only 25 acres were reported in 1910. Two or three cuttings are ordinarily obtained in a season. There seems to be a tendency for other grasses to reappear in the fields and to injure the stand of alfalfa. Well-drained and rather deep areas of the Orono silt loam have, as a rule, been selected. While the soils of the county as a whole, owing to their physical characteristics and drainage conditions, do not seem to be exceptionally well adapted to the production of this crop, with special attention to the eradication of weeds and grasses before planting and to the improvement of the soil by applications of lime and stable manure, it is probable that fair results can be had. Inoculation will also doubtless be necessary. The crop would probably not be successful on soils having a tendency toward excessive drainage. It could be made a valuable minor crop on dairy farms. The hardy variegated varieties, such as Grimm and Baltic, are best suited to the section.

In the class of other grains and seeds, peas and beans are the only crops reported. An area of 715 acres was devoted to beans and 22 acres to peas in 1909. The growing of beans is increasing. The average yield is somewhat over 11 bushels per acre.

Cereal production is confined mainly to the growing of corn and oats. A total of less than 200 acres was used for wheat, barley, rye, and buckwheat in 1909. The same year 1,263 acres in corn produced 57,882 bushels, an average yield of about 45 bushels per acre. These figures are somewhat misleading, as by far the greater part of the corn is the sweet variety and is used for canning purposes. An average yield of the latter under the existing methods of farming is 1,500 pounds per acre. It is grown mainly on the Gloucester sandy loam in the northwestern half of the county in locations which give greatest immunity from late spring and early fall frosts. A good grade of sweet corn is produced and the demand for Maine-grown corn is very good. Crosby is the chief variety planted. The stalks are used either for ensilage or as rough forage for stock. Another part of the corn crop is raised principally for silage. For this purpose an early-maturing variety is chosen and care is taken in the location of the fields. The yields of corn for this purpose are medium. Only a small part of the corn crop is husked for the grain. The greater part of the corn is grown on the Gloucester sandy loam and on favorably situated areas of the Orono silt loam.

From 2,129 acres in 1909, 64,008 bushels of oats were obtained. This acreage and yield represent fairly closely the present status of the crop. There has been a decrease in recent years in the proportion of the crop thrashed, and during the last season the greater part was fed to stock unthrashed. The fields of this crop are small. It

is grown chiefly on the soils of the Orono series and on the Gloucester sandy loam. This crop is confined to no particular portion of the county by climate, market or other conditions. It is grown in reseeding the land to grass.

The total of 3,426 acres, which gave a yield of 461,581 bushels of potatoes in 1909, is about the average of the present planting of the crop. This is not a special crop in any particular section or upon any one soil type in the county. Practically none of the farmers make a specialty of it, but it is probably the most widely grown crop of the county. It is grown in scattered fields of 1 acre to 10 acres in extent on a large number of farms, located on well-drained soil types of the Gloucester, Orono, Merrimac, and Adams series. The average yield for the county in 1909 was about 135 bushels per acre. On the majority of farms the crop is grown only for home use, on others as a money crop. It finds a ready market within the county.

The growing of vegetables is an important source of income with a number of farmers, as an acreage of 3,484 was reported in 1909. They are grown mainly on small farms in the vicinity of towns and especially near the city of Portland. Squashes are probably the most extensively grown of the vegetable crops. Yields of 7 to 8 tons per acre are obtained. Other vegetable crops are carrots, turnips, and lettuce, which are marketed in the cities and towns of the county. No particular soil type is selected for these crops. They are grown on well-drained areas of the Gloucester, Merrimac, Orono, and Adams series. The influx of summer tourists creates a good demand for crops of this character.

Cabbage is another locally important crop in the vicinity of Portland. Small fields are grown on areas of the Gloucester and Orono series. Yields range from 5 to 15 tons per acre. The product is sold locally or shipped to outside markets.

In 1909 there were 269,658 apple trees in the county, yielding 222,893 bushels. By far the greater part of the trees are in small orchards which are given no care and produce low yields of fruit of inferior quality. These have been planted near the farm buildings, with little attention to the selection of the site or soil. A few orchards of commercial size are producing good yields of fruit of fine quality. Only a comparatively small number of the trees are of recent planting. The greatest acreage is located on relatively high lying areas of Gloucester sandy loam. Small home orchards occur on practically all the soil types in settled sections of the county. Baldwin, Ben Davis, Northern Spy, Fameuse, and McIntosh are the chief winter varieties, and there are numerous other early varieties. In the majority of cases fruit is grown for home use alone. The surplus crop is sold in local and near-by markets or is exported to foreign countries.

The quality and yields of apples in certain orchards in this and near-by counties of similar soil conditions show that the crop could be successfully and profitably grown on a much larger commercial scale. An important factor is the selection of a site fairly immune from late spring frosts. In the majority of cases care should be taken to improve the soil conditions before the orchard is set out. Pears, peaches, and cherries are grown on a few farms for home use. Grapes do well, but are not produced on a commercial scale.

In 1909, 125 acres of strawberries, giving a yield of 363,861 quarts, were reported. They are grown in small patches from a fraction of an acre to 3 acres in extent in the vicinity of the cities and larger towns. Senator Dunlap and Warfield are favorite varieties of good quality. Strawberries are grown commercially on soils of the Gloucester, Orono, Merrimac, and Adams series, with little or no preference for any one series or soil type. The yields are good in favorable seasons, and the quality is excellent. The berries command a high price in the local market. Raspberries and blackberries are grown in small quantities for home and local consumption. The production of small fruits is insufficient to supply the local demand, and the extension of small-fruit growing would seem to afford opportunities for the employment of many more farmers than are now engaged in it.

In 1909 there were 13,381 cows on farms reporting dairy products, and the value of the latter was $913,177, excluding home use, or approximately 20 per cent of the total value of all farm products for the county. These figures show that the dairy industry is a relatively important one in the county. It is a source of some income on many farms and the chief source of income on a comparatively few farms in the county, and is an industry which could be profitably extended. At present dairying is practiced most extensively on the Gloucester sandy loam and the Orono silt loam. The herds are mainly grades, with Holstein and Jersey breeds the favorites. Purebred stock of these and other breeds is rather common. Milk and cream are supplied to local markets in the city of Portland and other cities and villages, and a considerable amount is shipped to Boston. Butter making is confined mainly to the farms. There is only one creamery, and this is located in the city of Portland. Practically none of the milk is used in the manufacture of cheese.

Pasture is usually abundant during the summer months. A large acreage in the upland sections of the county, cleared of timber but with too many stones to permit cultivation, is used for pastures. A much greater acreage of similar character, which is best adapted to this purpose, can be made available at a comparatively small cost. The forested areas at present afford very little pasturage. In addi-

tion, pasturing of cattle on improved farming land is practiced to a small extent, grass being made a step in the crop rotations. This practice could profitably be extended as in the case of dairy sections of other States. Hay, forage crops, and silage provide the rough feed for the winter season. The latter two could be produced much more extensively with profit. A large part of the grain for feeding stock is purchased from outside sources. Much of this could easily be grown at home. Perhaps the greatest obstacle to the development of the dairy industry is the long winter season when stock must be fed. This greatly increases the cost of production of dairy products. Dairy farming fits well into the present system of general farming and affords a means of maintaining the productiveness of the soil as well as furnishing a market for the bulky farm crops.

The value of animals sold and slaughtered in 1909 was $730,745, a figure which closely approximates the value of the dairy products. This income is derived from the sale of a few hogs and cattle from the majority of the farms rather than from a specialized development of the feeding of beef cattle. Only a few farmers derive the greater part of their income from this source. In 1909 the number of calves sold or slaughtered was 11,454; other cattle, 9,432; swine, 10,351; and sheep, 3,081. The number of horses sold was 884. With the exception of a decrease in the number of sheep, these figures are doubtless fairly typical of present conditions. The cities and villages of the county with a population greatly exceeding that of the rural sections afford ready markets for such products. This industry could profitably be extended, as there is much available land for permanent pasturage, which is better suited for this purpose than to the production of annual farm crops. Sheep raising is not considered profitable by the farmers in general.

An average grade of work stock is used on the majority of the farms. Horses of medium weight furnish the greater part of the motive power. The use of oxen for draft purposes is still fairly common.

In 1909 poultry and eggs provided an income of $669,334, or approximately 13 per cent of the total farm income of the county. Poultry raising is therefore an important industry. It is an accessory source of income on many of the farms and the chief source of income on a number of small farms, especially in the vicinity of the cities and larger villages. There is a ready market at good prices for poultry and eggs, especially in the summer season. The supply does not equal the demand and there is an opportunity for the extension of this industry.

At the present time the forest products are an important asset of the county. While the greater part of the original and valuable timber has been removed a considerable amount of lumber is still

produced as well as great quantities of wood for fuel. In 1900 the value of the forest products was given as $217,679. Since that time there has probably been a decrease in the amount of timber cut, but forest products are increasing in value. The forests may be made an important source of income to the farmers in the future by taking precautions for their preservation and by adopting some practical system of forestry.

Soils and topography have influenced the distribution and extent of the farmed areas more than they have the distribution of the various crops. There is a marked general similarity in the classes and varieties of crops grown on all soil types in cultivated sections of the county. The relative acreage of these different crops does not bear the same ratio in all cases. The stone content and topography have been the determining factors in the distribution of the cultivated sections of the uplands. In general, the areas of most favorable topography and least stone content have been improved, yet there is a very extensive area of unimproved land whose development has not been retarded by these factors. In the case of the Orono series favorable soil and topographic features have resulted in development of the greater part of the series. The tendency toward excessive drainage and in some cases poor drainage has retarded the development of the soils of the terraces.

No part of the county has a sufficient elevation to influence the distribution of crops. There are, however, certain positions on slopes and hills where crops are less likely to suffer damage by frosts. Such areas are commonly chosen for corn and commercial orchards.

Good transportation and markets are to some extent responsible for the general distribution of all crops. The demand for small fruits and truck crops has mainly determined the location of the areas so farmed near the cities, the larger villages, and the centers of the summer population.

The farm income is from a mixed source and consists as a rule of returns from general rather than from special crops. Another source of considerable importance is the keeping of summer boarders. The whole county is well located and easily accessible and the tourist population is rapidly increasing.

The recognition of the adaptability of the soil types to the different crops is recognized in only a minor way. Hay is the principal crop on all soil types throughout the county, though perhaps more extensively grown on soils of loam to silty clay texture. The proportion of other crops varies somewhat with the texture of the soil. Potatoes are grown more largely on well-drained soils of sandy loam texture and corn on well-drained soils of loam to silt loam texture.

Trucking areas are determined by location rather than soil conditions. There is a recognition of the adaptability of certain elevations and slopes to the production of corn and fruit.

Quite an acreage is plowed in the fall in preparation for crops the following spring. Sod land is the most frequently handled in this way. Spring plowing is the prevailing practice. The soil is thoroughly harrowed before planting. From 3 to 5 cultivations are given the tilled crops. Heavy applications of stable manure are usually applied to land before planting to corn and truck crops. Both timothy and clover are sowed with the grain crop in the spring, but when reseeding to grass in the fall only timothy is sowed. Two and three horse teams are used in most of the farm operations.

There is no fixed system of crop rotation. A common rotation consists of potatoes or corn for one or two years, followed by oats, reseeding to grass, followed by several years of hay crops. Modifications of this general scheme vary with the character of the soil and the needs of the individual farmers. One or two crops of potatoes or corn are grown in succession or potatoes take the place of the latter crop for one year of that period. Other crops are sometimes introduced to take the place of one or both of these crops. In some cases the land is plowed and seeded to grain and grass without the use of a cultivated crop, or probably it happens more frequently that sod land is plowed in the fall and seeded immediately to grass without a grain crop. Approximately 25 per cent of the reseeding is of this character. The fields remain in grass five or more years. In many cases there is no system of plowing the fields, and small patches are broken here and there wherever the stand of grass is poorest. On rather stony fields in the uplands, where cultivation is often difficult, there is an excuse for the omission of cultivated crops from the rotation.

Farm machinery of almost all descriptions may be used on practically all the land now in cultivation, and its use may be extended to wide areas now uncleared. The greatest difficulty arises from the presence of bowlders, which may be removed at more or less cost. This has been done over the greater part of the portion now in cultivation. The farm equipment of implements and machinery is generally adequate for tilling the soil and for handling the crops produced. It is, as a rule, carefully housed when not in use.

The farmhouses are, as a rule, commodious and are furnished with modern conveniences. The barns and other buildings are sufficiently large to house all farm crops. The house and barn are usually connected by other smaller buildings and are painted and kept in good repair. The grounds surrounding them are frequently improved and are kept neat.

The expense for fertilizers in 1879 was $45,795. This had increased threefold by 1909. In the latter year 3,211 farms, or 62.6 per cent of the total number of farms, reported an expenditure of $142,470, or an average of $44.37 per farm. Their use is becoming more general every year. Fertilizer is used for potatoes, corn, grass at time of seeding, cabbage, and truck crops. For potatoes and grass at time of seeding the fertilizer contains, as a rule, 4 per cent of phosphoric acid, 6 to 8 per cent of nitrogen, and 7 to 10 per cent of potash. For corn, it contains 2 per cent of phosphoric acid, 8 per cent of nitrogen, and 3 per cent of potash. A high grade of fertilizer is used for cabbage and truck crops. The available supply of stable manure is applied mainly to corn, grass at time of seeding, and truck crops. Seaweed is used by a number of farmers near the coast.

In 1909, 3,267 farms, or 63.7 per cent of the total number, reported an expense of $466,623, or $142.83 per farm, for labor. The farm labor is mainly local and is plentiful. From $25 to $35 per month with board is the average price for farm hands by the year. Two dollars per day and board is paid during the haying season.

The expense for feed in 1909 was $905,108. This was reported by 4,255 farms of a total of 5,131 and gives an average cost of $212.72 per farm. This brings the average total cost of labor, feed, and fertilizers for about 70 per cent of the farms to approximately $400 per farm.

The following table, compiled from the census reports, gives the percentage of farms operated by owners, tenants, and managers. It shows that an unusually high percentage of the farms are operated by the owners and that the number of farms so operated is decreasing very slowly. The average size of farms in 1909 was reported to be 75.6 acres, containing on the average 29.5 acres of improved land. So little land is rented that there seems to be no accepted rental value. For small farms near Portland suitable for market gardening a rental of $16 an acre is charged. Five dollars per acre is probably an average rent of land for general farming purposes.

Tenure of farms.

Year.	Operated by owners.	Operated by tenants.	Operated by managers.
	Per cent.	*Per cent.*	*Per cent.*
1880	95	5	.....
1890	93.32	6.68	.....
1900	92.4	5.7	1.9
1910	92.3	5.6	2.1

There is less range in farm-land values in Cumberland County than in many other sections of as varied soil conditions. There is, however, a range in value due to factors other than the inherent soil characteristics. The demand for land on the islands in Casco Bay, along the ocean front, near lakes, and in other resort sections for summer homes and camps is active and growing. There is also an increasing demand for farms favorably situated with respect to views of the surrounding country, which are also sought by summer residents. These factors have caused both a local and a general increase of farm values and a reduction of sales for farming purposes throughout the county. Owners have been influenced by the sales of land based on factors other than that of agricultural worth and are holding for similar prices. With the above exceptions land values are comparatively low, though higher near the cities and larger villages than at a distance from such centers. The present value of the merchantable timber adds little or nothing to the selling price. The improvements, acreage of cultivated land, and accessibility to market and transportation facilities are the important factors.

Land values range from $5 to $15 an acre for rough and stony timber land to $10 to $50 an acre for farming land. Tracts near the cities and villages sell for a higher figure for trucking purposes. For summer homes and camps, where agriculture is a minor consideration, no range or average can be given.

SOILS.

Cumberland County lies within the Glacial Soil Province as defined by the Bureau of Soils in Bulletin 96.

In order to understand more clearly the action and effects of the different agencies in the formation of the present topography and soils, a brief mention should be made of the extent, location, and character of the underlying rocks. The western and northern parts, more than one-half of the county, are underlain by a hard, coarsely crystalline granite. Gneiss is the predominating rock in the southeastern parts of the towns of Falmouth and Cumberland and of the whole of Yarmouth and Freeport and of the western part of Brunswick. In the remainder of the latter town there is a complex of granite and gneiss alternating with slates and schists. Both the granite and gneiss have been intruded into sedimentary rocks. The same belt covers the greater part of Sagadahoc, Androscoggin, and northern Oxford Counties.

The area underlain by slate and schist includes the greater part of the town of Gorham, the southern part of the town of Windham, the portion of the town of Westbrook south of the Presumpscot River, all of the towns of Scarboro, Cape Elizabeth, and South Port-

land, the city of Portland, most of the islands in Casco Bay, and small areas along the coast and in Harpswell Town. Over all this area a fine-grained grayish to greenish rock of schistose character prevails. Slate is of minor occurrence. Both the slate and schist are in places cut by veins of granite and of trap rock. No outcrops of limestone were observed. These rocks are the metamorphic equivalents of sediments deposited during Ordovician times and have been folded and eroded so that the upturned edges now outcrop. They are less resistant to erosion and occur in the less hilly sections, while the granite and gneiss underlie the higher and rougher regions of the county.[1]

Several geological ages intervened between the formation of these rocks and the invasion of New England by the continental ice sheet. During this interval the region had been land, and its surface had been deeply eroded, so that it conformed in a general way to the outline of the present hills and valleys. A more or less finely weathered mantle, varying in thickness, had accumulated on the surface, which, upon the advance of the ice sheet, was reworked, mixed with the glacially ground material, transported, and deposited as glacial till or drift during the advance and retreat of the ice. During the same period the sandy and gravelly material of the stream terraces and the marine deltas were deposited by streams flowing underneath the ice and from its melting front.

At this time the elevation of the land surface of the region was much lower and the sea covered the present land area up to about the 250-foot contour. Over parts of the area so covered the formation of the deposits known as marine clay took place. Following the elevation of the land to its present level this deposit was eroded, and still later deposits of sandy material were laid down over parts of the surface of the marine clay.

The soils of the county are therefore derived from glacial till and from water-laid deposits. The latter include stream-laid, or terrace, lake-laid or estuarine, and recent-alluvial soils. The agencies of weathering acting on these deposits have formed the present soils, which are broadly separated on the bases of derivation and processes of accumulation into the following groups: (1) Soils derived from glacial till; (2) soils derived from stream-laid, or terrace, deposits; (3) soils derived from lake-laid or estuarine deposits; (4) soils derived from alluvial flood plain deposits; (5) soils derived from an accumulation of organic matter; and (6) miscellaneous soils.

The above six groups are further subdivided into soil series and the series into types. The last is the smallest unit of classification, and is determined by the relative proportion of the different-sized

[1] Monograph XXXIV, U. S. Geological Survey. The Glacial Gravels of Maine and their Associated Deposits. By G. H. Stone.
Water Supply Paper No. 223, Underground Waters of Southern Maine.
Agriculture and Geology of Maine. Sixth Annual Report, 1861, C. H. Hitchcock.

particles of mineral matter making up the soil mass. A mechanical analysis is made of typical samples in the laboratory in order to check the texture as judged in the field examination. The soil types of similar origin, mode of formation, color, structure, and topography form a series, which is either correlated with a series previously mapped or is given a local name and assigned to its proper place in the key of the soils of the province. (Bulletin 96.)

Ten soil series, embracing 21 soil types, with 4 phases, and four kinds of miscellaneous material have been recognized in Cumberland County. The extent and distribution of these are indicated on the accompanying soil map.

Soils derived from glacial till.—The soils of this subdivision occur in the hilly and rocky parts of the county. They are composed of fragments of all sizes from clay and rock flour to the largest bowlders indiscriminately mixed together, and rest for the most part upon glaciated rocks. The depth of this material varies from a few inches to 100 feet or more. It is generally thinner on the hilltops and in the valleys than on the intermediate slopes. Areas of bare rock or rock outcrops are quite common. The upper part of the material is less compact than the lower. Bowlders of all sizes are much more common on the surface than within the material. The character of the till is fairly constant when overlying quite extensive areas of similar rock. It changes rapidly when passing from a region of granitic rock to one of slate and schist. There is then a marked decrease in the number and size, as well as a change in shape and kind of bowlders. There is also a change in texture and general appearance of the soil. These conditions indicate that a large part of the material is derived from local rocks and has been carried only short distances. The till resists erosion better than the stratified deposits, but was doubtless subjected to quite extensive erosion immediately after its deposition. The whole county has been subjected to glaciation, and the deposit not only covers the present hilly sections but underlies the greater part of the sand and clay deposits. Its character and topography indicate that the most of it was deposited as a ground moraine.

Based mainly upon differences in conditions of drainage, the soils of this group are classified as the Gloucester series where well drained, and as the Whitman series where poorly drained.

The soils of the Gloucester series are brown in color and friable in structure. The subsoils are brownish yellow, grading to yellow and then to gray in the lower part of the section. The texture of the subsoil is frequently lighter than that of the soil. It has a friable to open structure. Granitic bowlders of all sizes occur in the surface and in the soil mass in the lighter textured areas, while fragments of

schist and granite bowlders in smaller number occur in the heavier textured areas. The weathering of glacial till derived mainly from crystalline rocks has given rise to the soils of this series. The topography ranges from broadly undulating to gently rolling and hilly. The surface of the hills is smooth and rounded in outline. The drainage is adequate. Four types of the Gloucester series, including a stony sandy loam, sandy loam, very fine sandy loam, and loam, and three phases were recognized in Cumberland County.

The soils of the Whitman series are of gray to dark-gray color. The subsoils are gray to light gray in color and either lighter or heavier in texture than the soils. In places a thin layer of mucky material occurs on the surface. Bowlders of granite are found both on the surface and within the type material. The surface is practically level and the drainage is poor. Ice-laid material similar to that forming the Gloucester series, modified by poor drainage conditions existing for a long period of time, has given rise to this soil series. One type, the sandy loam, represents the series in this county.

Soils derived from stream-laid or terrace deposits.—The soils of this group occur as terraces and outwash plains in former and present stream valleys. The deposits were laid down when the valleys were serving as outlets for glacial waters or for waters of a later period. There are included glacial marine deltas developed near the debouch of glacial streams into the sea, which formerly covered considerable areas, and old beach deposits and eskers and kames laid down beneath the ice. These deposits are known as stratified or modified glacial drift and are locally called plains. They consist mainly of assorted sand and gravel, often stratified in a complex manner and composed of crystalline rock material derived mainly from glacial till of local origin and from that brought in from other sections of the State. The glacial stream terraces and outwash plains are widely distributed in the northwestern half of the county. The greater part are between 250 and 300 feet in elevation. As terraces in well-defined valleys in the glaciated uplands they rise to a height of 400 feet or more. The terrace, delta, and other stratified deposits in association with the marine clays in the remainder of the county are fairly extensive and occur at elevations of 100 to 200 feet above sea level. The thickness of the shallow stratified deposits ranges from a few feet to 100 feet or more. They are underlain most frequently by glacial till. Other basal deposits are marine clays and bedrock. In certain localities a series of terraces is developed, as in the vicinity of Brunswick, along the Androscoggin River. Many of the present areas of these deposits are only remnants of what were formerly much more extensive plains and terraces.

Based upon differences in the character of drainage, in the character of and the depth to the underlying material, and in topography, the soils of this group are separated into the following classes: I. Well-drained material: (1) Deep, over till or bedrock—(*a*) terraced topography, Merrimac series; (*b*) rough or eroded terrace topography, Hinckley series; (2) shallow, over marine clays—Adams series. II. Poorly drained and shallow, over marine clays or glacial till—Scarboro series.

The Merrimac series includes soil types which have brown to light-brown soils and yellow subsoils. In texture and structure the types are characterized by moderately loose sandy soils and sandy and gravelly subsoils and substrata. The gravel content of the surface and of the soils is typically low, but increases rapidly in the lower subsoil and substrata, which frequently consist of beds of rounded gravel and sand. Bowlders are uncommon in the 3-foot section. The types have a terraced topography and lie well above the present stream level. Their drainage ranges from adequate to excessive. They occur as glacial outwash, glacial stream or delta deposits or as river terraces. Modification by weathering since deposition accounts to a large extent for the heavier texture of the soils as compared with that of the subsoils. In places other modification has resulted from the shifting of surface material by wind action. The types have a low organic-matter content and a medium productive capacity. Two members, a sandy loam and its heavy phase and a fine sandy loam, were mapped in the Cumberland County survey.

The Hinckley series is characterized by light-brown to brown surface soils and by subsoils grading with depth from yellowish brown through yellow to gray. The lower subsoils consist of sand and gravel. The series occupies areas of irregular topography on terraces and outwash plains. While the material was originally laid down by running water, it has subsequently been modified by erosion of the original surface. In addition, wind action has resulted in the shifting of a considerable part of the component material in many places. The material is mainly granitic. The series is represented by one type, the sand.

The Adams series comprises soil types having brown surface soils, yellow upper subsoils, and gray lower subsoils. The subsoils are lighter in color and texture than the soils, even in the case of the sands of the series. The bulk of the material of the types consists of different grades of sand which is underlain at a depth of 3 feet or more by the clay formation giving rise to the Orono series. Bowlders and other coarse material are very uncommon. The surface of the loamy members of the series is level to very gently undulating, while that of the light members is undulating. The drainage ranges

from good to excessive. The types of the series consist of sand and finer material derived from crystalline rocks and laid down as comparatively shallow deposits on deltalike areas or shallow outwash plains. The sand and fine sand members have been modified by wind action since their deposition. The types have a medium organic-matter content and fairly high moisture-holding and crop-producing capacity. Three types of the Adams series were recognized in the Cumberland County survey, the fine sand, sandy loam, and fine sandy loam.

The soils of the Scarboro series are gray to light gray in color. The subsoils consist of a brownish to reddish-brown stratum from 8 to 15 inches thick, often partially cemented into a hardpan and underlain by a gray to light-brown material of light texture extending to a depth of 3 feet or more. A thin layer of mucky material occurs in places on the surface. All the lower lying areas are underlain by the bluish-gray marine clays at shallow depths. The higher lying areas have a substratum of glacial till or of bedrock. Gravel and bowlders are uncommon. The soil types of this series consist of poorly drained material of the Adams or Merrimac series, which was deposited as stream terrace, glacial outwash or delta plains over the marine clays or over glacial till. The material is composed of sediments derived from crystalline rocks. It has been subsequently modified by restricted drainage conditions, resulting in the accumulation of organic matter and in little or no weathering or oxidation. The surface is level and the drainage of the types is very poor. Much of it is in a water-logged condition the greater part of the year. The types have a low agricultural value and can not be farmed successfully without artificial drainage. One type, the loamy sand, with loamy coarse sand and loamy fine sand variations, is mapped in Cumberland County.

Soils derived from marine and glacial-lake deposits.—The soils of this group are derived wholly or in part from the rather extensive deposits of marine clays that cover large areas of low elevation comparatively near the coast and extending farthest back along the rivers and larger streams. These deposits consist of exceedingly fine grained material free from sand or other coarse fragments. Its color is typically a bluish to greenish gray. It is composed of fine sediments which were poured into the sea by heavily laden streams from the melting ice. The coarser portions were deposited either in the stream valleys or near the shore, while the finer parts were carried out and deposited farther from the mouths of the streams. Marine erosion of glacial till and of rocks has contributed very little to the formation of these beds. They were laid down during the period when the sea was considerably higher, relative to the land, than it is

at present. The elevation ranges from a few feet above sea level near the coast to 200 feet or more at the inland limit. The relative level of the coast and the inland limits of this formation are probably not the same now as at the time of deposition, as portions near the coast do not appear to have been submerged to the depth necessary to have this material laid down at elevations of 250 feet. The presence of marine fossils in parts of the formation indicate its marine origin. Its thickness now varies widely on account of the extent of erosion since deposition as well as the original depth of the deposit. The material of the lighter textured types does not strictly belong to the marine clays, but has been deposited over them at a later period. The formation rests unconformably upon glacial till.

The types included in the Orono series have light-brown or brown soils, with bluish to greenish-gray subsoils frequently slightly mottled with yellow and rusty brown. The deep subsoils and the substrata are always a stiff, impervious silty clay, which upon drying out loses its greenish cast and becomes a gray to light gray. In the heavier members the change from soil to subsoil takes place abruptly; in the lighter textured members there is usually an intermediate layer or upper subsoil which is lighter in texture than the soil and has a light-yellow color. The soils of all members of the series have a friable structure. The topography ranges from level to undulating or rolling and has resulted from the erosion of the originally rather even surface. The drainage varies from good in the rolling areas to imperfect in the more level sections. The sediments composing the series are derived from a variety of rocks. They consist of the finest of the material from the glacial till and of rock flour. Modification since deposition includes erosion to the present surface features, the incorporation of some organic matter, and the weathering of the material. The soils of the series are productive. Artificial drainage is essential to the full development of some areas of the series. The Orono series is represented in Cumberland County by four soil types, sandy loam, fine sandy loam, loam, and silt loam.

The Suffield series consists of gray to dark-gray soils, underlain by stiff, heavy subsoils of gray color, frequently mottled with yellow and brown. The soils have a fairly high organic-matter content, carry no gravel, bowlders, or other coarse material, and are poorly drained. Types of this series cover level to very gently undulating areas in association with the soils of the Orono series or occupy comparatively broad depressions or rather wide areas having the position of flood plains and in places closely resembling recent lake bottoms. The Suffield series is represented by three types in Cumberland County, coarse sand, silt loam, and silty clay loam.

Soils derived from alluvial flood plain deposits.—The soils of this group are formed from recent-alluvial sediments occupying first-bottom positions along some of the larger streams. The material is derived from the soils of the glaciated uplands and those of the terraces of other valley-filling material. In regions of this character the extent of soils of this kind is very small. They occupy the lowest elevation of the section in which they occur and are found more abundantly in regions of low than of high elevation. Material of this character is classed as the Podunk and Saco series.

The soils of the Podunk series are brown in color and overlie light-brown, grayish-brown or gray subsoils. The subsoil is usually lighter in texture than the soil. The subsoil has a friable to open structure. The types occupy rather high first bottoms and are subject to overflow. The surface is level and the drainage is, as a rule, adequate. The material consists mainly of recent alluvium derived from the soils in the basin of the stream along which it occurs. The parent soils are chiefly those of the Gloucester and Orono series. In places material from rocks of schistose character have contributed directly to the formation. Small areas are in need of artificial drainage. One type, the fine sandy loam, was recognized in the Cumberland County survey.

The Saco series is characterized by light grayish brown or brownish-gray surface soils and greenish-gray, slightly mottled subsoils of similar to somewhat heavier texture. They occupy a first-bottom position and are subject to overflow. The material is largely of crystalline-rock origin. In appearance and physical properties the soils of this series are very similar to those of the Suffield series, but differ in occupying a first-bottom position. One type, the silt loam, was mapped in Cumberland County.

Soils derived from organic accumulations.—The soils of this group consist of accumulations of vegetable matter in various stages of decomposition. They occupy basins or depressions where conditions have been favorable for the growth of and for the preservation of the partially decayed remains of water-loving vegetation. Such accumulations range from the brown fibrous material known as Peat to the nearly black, well-decomposed material known as Muck. Both Peat and Muck are flat and poorly drained. When drained they are productive.

Miscellaneous.—This group includes the areas of Rough stony land, Tidal marsh, and Coastal beach, all of which are mainly non-agricultural in their present condition.

The following table gives the classification and the actual and relative extent of the various soils in Cumberland County.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Gloucester sandy loam	133,184	27.3	Adams fine sandy loam	9,728	1.8
Shallow phase	15,552		Podunk fine sandy loam	8,192	1.5
Orono silt loam	85,056	15.6	Gloucester very fine sandy loam	5,888	1.1
Gloucester stony sandy loam	63,424	15.5	Tidal marsh	4,800	.9
Light phase	21,248		Hinckley sand	4,736	.9
Merrimac sandy loam	62,272	11.5	Orono sandy loam	3,008	.6
Heavy phase	448		Orono loam	2,880	.5
Rough stony land	22,528	4.1	Whitman sandy loam	2,432	.4
Gloucester loam	9,664	3.6	Saco silt loam	2,240	.4
Shallow phase	9,728		Suffield silt loam	1,344	.2
Suffield silty clay loam	18,112	3.3	Merrimac fine sandy loam	1,344	.2
Adams sandy loam	12,544	2.3	Suffield coarse sand	576	.1
Muck and Peat	12,480	2.3	Coastal beach	576	.1
Orono fine sandy loam	11,136	2.0			
Scarboro loamy sand	11,072	2.0	Total	545,920	
Adams fine sand	9,728	1.8			

GLOUCESTER STONY SANDY LOAM.

The Gloucester stony sandy loam consists of 8 to 10 inches of a brown sandy loam underlain by a brownish-yellow to yellow sandy loam which at a depth of 30 inches below the surface grades into a grayish sandy loam. Moderate to large quantities of granitic bowlders, both large and small, rounded and angular, are scattered over the surface. Gravel and bowlders are present in varying quantities in the soil material, which is in places almost rock free and in others is made up almost entirely of rock fragments. Outcrops of granite are more common than in the areas of Gloucester sandy loam.

The soil is friable and the subsoil is loose and open, allowing the free movement of air and water. The content of organic matter is low and the type is only moderately retentive of moisture.

As mapped this type doubtless includes areas of Gloucester sandy loam and Rough stony land, whose separation was unwarranted because of the general nonagricultural character of the greater part of its area.

The boundaries between this type and the Gloucester sandy loam are as a rule arbitrary. In many instances the separation is rather a classification in regard to agricultural value than a type difference. An effort was made to include with this type sections whose rock content was greater and whose topography was less favorable for farming than those of the areas mapped as Gloucester sandy loam. A soil boundary based on these factors must necessarily be a general one.

The texture of the type grades light rather than heavy and in some cases approaches a loamy sand or fine sand. Like the sandy loam

of the series in places the immediate surface is often a grayish sand which passes quickly into heavier material below. Material of this character when cleared and in cultivation has the texture of a mellow sandy loam with a rather high content of silt and fine sand.

This type lies in the uplands of the county, where it is associated with the sandy loam of the series. It has a wide distribution to the north and west of the part of the county occupied mainly by types of the Orono series. The largest areas are found in the hilly regions to the north and northeast of the village of Raymond and in the vicinity of Saddleback Hills in Baldwin and Sebago Towns.

Where the stony sandy loam occurs as isolated areas in association with the Gloucester sandy loam, the former occupies the high hills or steep slopes. The larger areas cover sections of rolling to hilly topography. Here isolated bodies of Gloucester sandy loam occur. On the whole the stony sandy loam has a rougher topography than any type except the Rough stony land. The greater part of it lies at elevations between 400 and 900 feet above sea level. The drainage ranges from good to excessive. The rainfall is readily absorbed by the soil and finds its way to lower levels through the soil material. Except in the main valleys, well-defined drainage ways and streams are uncommon.

This type is derived from glacial till. Usually the depth of the deposit is somewhat less than in case of the deposits from which the Gloucester sandy loam is formed. The greater rock content is due mainly to a variation in the material as originally laid down by the ice rather than to the effects of later agencies. The depth of the ice-laid material ranges from a few feet to 100 feet or more.

The Gloucester stony sandy loam is the third largest type of the series. It is of little present value in the agriculture of the county. It affords some pasturage. A few scattered cultivated fields are located within it, but these are usually on small tracts of less stony land, probably the sandy loam of the series. A growth of pine, oak, maple, and other hardwoods covers practically all the type. Nearly all the salable timber has been removed.

When cleared of timber and rocks this type is adapted to the same crops as are now grown on the Gloucester sandy loam, but owing to the steep topography and stony character clearing is difficult and expensive, and the best use for the greater part of the type is forestry.

There is practically no exchange of this type, whether for farming purposes, for investment, or for its timber. Judged by the standard of other types its value ranges from $5 to $15 an acre.

Gloucester stony sandy loam, light phase.—To an average depth of 8 inches the soil of the Gloucester stony sandy loam, light phase, is a light-brown sandy loam of rather light texture. This grades into a brownish-yellow to yellow sandy loam or loamy sand which gradually

becomes grayer with depth and at 30 inches below the surface is a pronounced gray. The surface is thickly strewn with fragments of granitic rock, varying in shape from angular to rounded, and in size from a few inches to several feet in diameter. Similar, though on the whole smaller, fragments occur in varying quantities throughout the 3-foot section. Outcrops of granitic rock are common. The material comprising the substratum is similar to that of the subsoil.

The variations in this type consist in differences in the stone content and in the depth of the soil material, rather than in its texture or color. As mapped the type probably includes areas of the Gloucester sandy loam and its shallow phase, the separation of which was impracticable on account of the slight differences and the character of the sections in which they occur. The stone content is in places sufficient to prevent boring to any considerable depth with the soil auger.

This type differs from the typical Gloucester stony sandy loam in having a greater content of the medium and coarse grades of sand and a lower content of silt and clay.

The most extensive development of the stony sandy loam, light phase, is east and south of Sebago Lake, where it covers areas of large extent. Other sections in which the type is developed lie near Highland Lake, in Falmouth, Westbrook, and Windham Towns. An area occurs on Knight Hill, in the town of Bridgton. Others are found in Standish town.

The surface features range from gently rolling to hilly. The type on the whole does not have as great a diversity of elevation or as steep slopes as the Gloucester stony loam. The greater part of it lies between elevations of 250 and 600 feet above sea level. The drainage is well established, and on some of the steeper slopes it is excessive. The surface is not gullied as is that of the Orono silt loam. Except in the main valleys the streams traversing the type follow shallow and irregular courses.

The Gloucester stony sandy loam, light phase, although covering approximately 34 square miles, is the least extensive type of the series. Probably 10 per cent of this is cleared and in cultivation; the remainder is forested with pine, oak, maple, and underbrush. Its stony character has been the main factor restricting development, though inaccessibility, and in some cases topography, also have been adverse factors.

The phase is moderately productive. After the removal of the stones it is easily cultivated and may be handled under a wide range in moisture conditions. The organic-matter content and moisture-holding capacity are low. Settlement is sparse, and the phase at present is of relatively little importance in the agriculture of the county.

As on the other soils of the series general farming prevails. Hay leads in acreage as well as in importance as a source of income. Other crops are, in order of importance, grain, potatoes, fruit, and vegetables. These are produced for use on the farm. The yields compare favorably with those of the much more extensively farmed Gloucester sandy loam. Unimproved areas of the type afford considerable pasturage.

The preparation of land of this character for farming operations consists of removing the timber, stumps, and stone. The latter is the most difficult of all. The stones are hauled and piled to form fences along roads and between fields. It is necessary to break many of the larger ones by blasting or otherwise before they can be removed. The general practice is to leave the largest ones and also those which are nearly covered with soil. These, together with the rock outcrop, often make cultivation slow and difficult. The areas so cleared are necessarily small and scattered. They are chosen where conditions are most favorable. The extension of the farmed area of this type is practically at a standstill.

Farms containing several acres of improved land and fair to good farm buildings sell for $15 to $25 an acre. Unimproved land brings from $5 to $15 an acre.

As with the other Gloucester soils, attention should be given to increasing its productive capacity. The normally low organic-matter content should be increased. The use of lime and the planting of cover and leguminous crops would be very beneficial. The phase is adapted to the growing of grain, potatoes, fruit, and vegetables.

GLOUCESTER SANDY LOAM.

To a depth of 8 to 10 inches the soil of the Gloucester sandy loam is a light-brown to brown sandy loam, with a silt content high enough to make it appear like a light loam. The subsoil is a brownish-yellow to yellow sandy loam, which grades at about 24 inches below the surface into a yellowish-gray to gray material of slightly lighter texture. Gravel and large fragments of granitic rocks are usually found in varying quantities throughout the 3-foot section. Bowlders of similar rock, from small to large, are often quite common on the surface of unimproved parts of the type. Cleared fields are fairly free from them. Small, rounded outcrops of the underlying granite and small areas of shallow soil occur here and there. The type is not stony, in the sense of numerous small stones which interfere with cultivation.

As in the case of all soil types formed from unassorted material, this type varies from the above typical description. The soil and subsoil of the type have fairly uniform colors throughout its extent.

There is greater uniformity in the texture of the soil than in that of the subsoil. The chief differences in the type are due to variation in the quantity of rock fragments. As a rule, the rock content is greatest on the immediate surface and decreases with depth, and whenever rock is abundant on the surface it is usually fairly abundant in the type material and vice versa. In places, however, there are few on the surface and many in the soil and subsoil. The rock consists mainly of fragments of granite of all shapes and sizes. The largest are found on the surface, those in the subsoil and substratum being much smaller, as observed in cuts throughout the type.

The texture of this type grades heavy rather than light. Uncleared areas frequently have an inch or two of grayish sand on the surface, below which the soil material has a yellow color instead of the typical brown of the cultivated fields. This subsurface material contains less sand and more silt and clay than material in a similar position in cultivated fields. Hence it often happens that the texture of the soil of uncleared tracts seems to be a light sandy loam, while in cultivated fields it is considerably more loamy. In certain places conditions more favorable to weathering have locally affected the texture. All changes in color and texture within the type are gradual. Pockets of sandy and fine sandy material occur in many places in the subsoil.

The materials giving rise to this soil extend to bedrock or to a depth of 4 to 10 feet, where it may be underlain by a gray to drab loam to clay loam carrying very little gravel or bowlders. This material approaches the character of bowlder clay. Whether this substratum occurs uniformly can not be stated. It was observed only in a few cuts which extend to that depth. It seldom if ever comes within the 3-foot section.

The soil has a friable structure and a moderate organic-matter content and may be handled under a fairly wide range of moisture conditions. The subsoil has a fairly loose structure. When the surface bowlders have been removed there is seldom a sufficient quantity of rock fragments to interfere with cultivation. The moisture-holding capacity varies with the depth of the type material from poor in the shallow areas to good in sections of deep material.

Included with this type are areas of soils of other textures. Such areas are as a rule small and unimportant as far as difference in agricultural value is concerned.

The Gloucester sandy loam differs from the stony sandy loam of the series in having a lower stone content and a less rugged topography. The depth to the grayish material is also less in the former type. It differs from the Gloucester stony sandy loam, light phase, in texture of fine material and in stone content.

The Gloucester sandy loam is the most extensive type of soil in the county. It is the dominant type in the northwestern half of the county, as the Orono silt loam is in the southeastern half. In the latter part of the county the Gloucester loam occupies all or parts of isolated hills surrounded by types of the Adams and Orono series. It covers the greater part of Bridgton, Harrison, Otisfield, Naples, Casco, Sebago, Gray, and New Gloucester Towns, and is found less extensively in all the remaining towns.

The surface is undulating to gently rolling or rolling to hilly. The type occupies hills and ridges, whose slopes toward streams and other drainage courses are usually gradual and whose crests are in most cases broad and undulating to sloping. There is rarely any strictly level land within the type. The valleys are from one-half to 2 miles or more in width and from 100 to 400 feet or more in depth below the crests of the hills. The surface of the hills is smooth. In the part of the county west and north of the region occupied by the Orono series of soils the type lies between elevations of 250 and 900 feet, with the greater part between 300 and 500 feet above sea level. In the remainder of the county its range in elevation is from 100 to 400 feet.

In general the natural drainage of the type is good. There are local areas of shallow soil and steep slopes whose drainage tends to be excessive. Springs and seepage cause local wet areas on certain slopes. In many places there are narrow strips along the drainage ways which are imperfectly drained. The water which falls upon the surface is quickly absorbed and relatively little runs off the surface except in case of exceedingly heavy rains. The majority of the wet places, springs, and small streams are seasonal. There are a number of perennial springs and streams within the type. It also incloses quite a number of lakes and ponds.

A greater acreage of the Gloucester sandy loam than of any other type is in cultivation, but in proportion of total area under cultivation it is exceeded by several other types. Approximately one-third of it is cleared and used for annual farm crops. From the standpoints of acreage farmed and variety, volume, and value of crops grown this is the most important soil type in Cumberland County. The greater part of the original timber has been removed. The forest growth now consists of a rather heavy stand of pine, spruce, oak, maple, birch, and other species. Underbrush is usually abundant. While it is probably true that the better and more easily cleared areas were settled first, there still remain hundreds of acres of land as good and as easily cleared as that now farmed. To a certain extent the nondevelopment of large areas of the type is due to the amount of stone, to topography, and to distance from transportation. These, however, are not the chief or only factors control-

ing development, as is the case in a number of other types. In order fully to understand why it is not more extensively developed the character of farming and the question of settlement must be considered. On each farm a woodlot is an essential feature, and the cleared acreage represents all that the individual farmers or owners care to cultivate. The number of farms is not increasing as it should in a country only one-third developed. It is rather decreasing—a fact which is due mainly to the movement of the younger generations toward the cities. None, either native born or foreign, come to take their place in the sections covered by this type. The type is characterized by farms of medium size and by good farm buildings. The settlement along the public roads is fairly thick, but there are in many places extensive areas of unsettled country between the roads.

There would be little waste land within the areas now cleared and farmed if they were properly farmed. This is a fairly safe soil in seasons of high, normal, and low rainfall. Crops suffer more quickly, however, from drought than from excessive rainfall. Quite extensive areas of this type are rather remote from markets and shipping points.

All varieties of crops grown in this section of the country are produced on this type under a system of general farming. The acreage devoted to the production of hay exceeds that of all other crops combined, at least 60 per cent of the part in cultivation being used for that purpose. Farm stock consumes a large part of the hay crop, and the remainder is marketed at the nearest railroad points. Potatoes are an important crop with some of the farmers. They are grown rather universally for home use. Oats is the only small-grain crop, and it is rarely thrashed. The acreage in corn is greater than that on all the other soil types in the county. A large part of it is sweet corn for canning. On the majority of the farms small orchards produce fruit for home use; on some there are larger commercial orchards. Cabbage, garden vegetables, and berries are other minor crops. Extensive areas are used for pastures.

Hay yields from one-half ton to 2 tons, potatoes from 100 to 300 bushels, sweet corn an average of 1,500 pounds, and cabbage about 8 to 9 tons per acre.[1] No estimates of yields were obtained for the minor crops.

Dairying and stock and hog raising are not important industries for this type as a whole. A few farmers make a specialty of them. On many of the farms a few cows are kept to provide milk and butter for home use and to afford a little income from the sale of surplus products during the summer months. The products of the

[1] The crop yields given in this report are based on information obtained from the county demonstration agent and from the farmers.

more important dairy farms either are sold in local villages and cities or shipped to more distant markets. Dairying should be much more extensively practiced than it is at present. Many of the farmers sell one or two beef animals a year, but few make a business of beef production. Raising hogs also is mainly to provide meat for home use, though some surplus reaches the local markets. Poultry raising, though not a specialized industry on many farms, is profitable and of increasing importance.

A rotation with hay as the important crop is generally followed. It usually consists of one or two years of tilled crops, one year of oats and seeding to grass, followed by several years in grass. Sod land is plowed in the fall when possible, stable manure is applied, and the land planted to corn or potatoes the following spring. Light applications of commercial fertilizers are frequently used on these crops. The grass seeding consists of both timothy and clover. The latter grows surprisingly well, considering the time that the fields have been in cultivation and the lack of attention to the building up of the soil. Moderate to good crops of hay are obtained for two or three years, when the yield begins to decrease as the fields become weedy. In some seasons a second cutting of hay is made. The mowing lands in many cases are pastured after the hay is cut.

The orchards of commercial size receive very little extra care in the way of cultivation or fertilization. Many of them are not well pruned. The largest orchards are in the vicinity of Harrison Village, in the northern part of the county. Baldwin, Ben Davis, Northern Spy, Fameuse, and McIntosh Red are the leading varieties. Practically all the orchards are in grass. The small orchards receive little care. Hogs or cattle are pastured in them, or the grass is cut for hay. Cultivation of the orchards is uncommon.

In favorable years the short-season varieties of corn mature, but the frost-free period is short, and field corn for grain is a somewhat uncertain crop. A relatively large part of the corn acreage is devoted to sweet corn, which is grown for local canning factories. The stalks are used for ensilage or grown for local fodder. In the selection of the location of corn fields care is taken to avoid as far as possible the liability of damage by late spring or early fall frosts. Corn canned in this county commands a high market price. Other varieties are grown both for grain and for ensilage.

At present the clearing of land of this type is practically at a standstill and has apparently been so for a number of years. The cost of clearing depends upon the quantity of rocks on the surface. No estimates of cost are available. The stones are piled in rows to form fences along the roads and between fields. These fences are frequently from 4 to 10 feet in width and from 3 to 5 feet high. It is frequently necessary to break the larger bowlders by blasting.

When most of the rocks have been removed the fields are plowed and planted. Additional stones are removed at subsequent cultivations.

The amount of cleared land and the character of the farm improvements have a marked influence upon the sale value of farms on this type. Proximity to market and the percentage of the farm susceptible of cultivation are also important factors. The prices range from $25 to $50 an acre. In places near lakes and in other desirable situations there is an active demand for sites for summer homes and camps. This, together with a less active call for farms for summer homes by wealthy nonresidents, has resulted in the holding of farms on this type at a higher price than they would bring for farming.

As the acreage plowed each year ordinarily is comparatively small, several years are required to cover the arable part of a farm. In the mean time many of the mowings fall into poor condition. Unless the cultivated area can be made greater and all the land pass through the rotation in a shorter period, attention should be given to improving the sods, and as a result the yield of hay, by applying commercial fertilizers, stable manure or lime.

Most of the land now in cultivation has been farmed for many years, with little or no attention at least on the greater number of the farms to the maintenance of the productiveness of the soil. Stable manure is used, but the supply is inadequate. More attention should be given to the growing of live stock and to dairying, in which more of the bulky crops are consumed on the farm and the supply of stable manure increased. The organic-matter content of the soil is low, and good results would follow its increase through the growing of cover crops and green-manure crops. Much of the type would be greatly benefited by applications of lime at least once during each rotation. A rotation which calls for more cultivated crops in order to assist in the eradication of weeds should be adopted. Many farmers are fighting these weeds by cultivation and by cutting them before seeding time, but there must be cooperation in order to eradicate them or to decrease their effects on the yields and the quality of crops. The extensive areas of unimproved land should be made to produce profitable timber crops.

This is one of the best soils in the county for orchard fruits. Not all portions of the type are equally adapted, however, and great care should be taken in the selection of the orchard site. Farmers recognize that there are certain locations in every neighborhood, and on nearly every farm where the chances of damage by frosts are much less than in others. These, provided the slope and character of the land is favorable, should be chosen. The growing of fruit, especially of apples, on a commercial scale, should be a profitable industry.

Gloucester sandy loam, shallow phase.—The soil of the Gloucester sandy loam, shallow phase, is a light-brown sandy loam with a depth of 6 to 10 inches. The subsoil is a yellowish-brown sandy loam grading at about 24 to 30 inches into a gray loamy sand which continues to a depth of 3 feet or more. Numerous rock fragments, mainly granite and gneiss, both angular and rounded and varying from gravel to large bowlders, occur on the surface and through the soil. Rounded outcrops of granite and gneiss are abundant. The phase shows greater effect of the weathering of the underlying rocks than other types of the series.

The above description applies to the soil as it exists in the pockets between the outcrops, but the depth of the fine-earth mantle ranges from zero to several feet, and many rock outcrops occur. These may follow fairly well defined courses along the slopes and on the crests of hills, or they may occur promiscuously over the individual areas. The tracts of fairly deep soil between the more rocky areas vary in size from a few acres to 10 acres or more. In more accessible sections these variations could in many cases be mapped as Gloucester sandy loam and Rough stony land. Under present conditions and prospects of development it seemed best to map areas of such a character together and to class them as a shallow phase of the Gloucester sandy loam.

Land of this character is locally known as "ledge land." It is intermediate between the Gloucester sandy loam and Rough stony land. The material is on the whole too shallow and outcrops of rocks are too numerous and too large to warrant mapping with the typical soil. On the other hand, there is too much agricultural land within its limits, and the topography is not sufficiently rough for it to be classed as Rough stony land. It differs from the Gloucester stony sandy loam in having less fragmental rock on the surface and mixed with the soil and subsoil as well as in having much more extensive rock outcrop and a shallower soil.

The phase is confined to parts of the county comparatively near the coast and underlain by granite or gneiss. It is most extensively developed in the towns of Falmouth, Cumberland, Freeport, and Brunswick.

The surface varies from undulating to gently rolling. The drainage is good to excessive. The greater part of the phase lies at elevations between 100 and 400 feet. Few well-defined drainage courses traverse it.

This phase represents a shallow deposit of glacial till composed of material derived mainly from granite and gneiss.

The shallow phase of the Gloucester sandy loam covers several fairly large areas and many smaller ones. At present little of it is farmed. Its present use is as forest land. Some parts afford a little

pasturage. When land in general shall have become more valuable, however, a considerable acreage of the type will be used as farm land. The tracts that can be farmed vary from small to fairly large. When improved they should be adapted to the same crops as the other members of the series. At present it would seem that the phase can be used to best advantage in the growing of forest crops.

The sale value of this phase is at present low, as the merchantable timber has been removed. Practically none of it is changing ownership. From $5 to $10 an acre is probably a fair value. As parts of farms composed mainly of other types it has a somewhat higher value.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Gloucester sandy loam:

Mechanical analyses of Gloucester sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100325	Soil	9.3	12.4	5.1	17.0	17.0	30.3	8.8
100326	Subsoil	10.1	12.5	5.3	17.5	18.8	28.2	7.9

GLOUCESTER VERY FINE SANDY LOAM.

The Gloucester very fine sandy loam is a light-brown very fine sandy loam, 8 to 10 inches deep, underlain by a brownish-yellow very fine sandy loam extending to a depth of 3 feet or more. A substratum of similar material continues to bedrock. The included stone consists mainly of small to moderately large angular fragments of schistose rock, with only here and there small rounded granitic bowlders. Both on the surface and within the type material there are varying quantities of small, flattened schistose fragments, from one-third to 1 inch or more in diameter. Shattered outcrops of similar rock occur here and there. The depth to bedrock ranges from a few inches to 50 feet or more.

In places the texture grades toward a fine sandy loam and in others toward a loam. In the latter case the boundaries between the two types are somewhat arbitrarily placed. In shallow areas the soil assumes a reddish cast, probably as the result of more complete weathering. Variations from type description are in rock content and depth of material. In certain areas stones are abundant; in others the soil is almost stone free. Areas of shallow soil are usually small but of much more frequent occurrence than in the coarser textured members of the series.

The soil is friable and easy to cultivate. It contains a moderate quantity of organic matter and is fairly retentive of moisture.

Areas of this type of soil are confined mainly to the towns of Gorham and Windham and the southeastern part of Standish. It is not extensive, covering but 9.2 square miles.

The surface is broadly rolling to rolling, and for the most part smooth. The drainage is usually good, and in areas of shallow soil it may be excessive. The elevation is between 200 and 450 feet above sea level.

The parent material of this type consists of glacial till derived mainly from rocks other than granite and gneiss. It apparently contains a little more material of granitic origin than the loam of the series.

Approximately 35 per cent of the Gloucester very fine sandy loam is in cultivation. While important to the agriculture of the section in which it chiefly occurs, its influence in the county as a whole is small. No one factor is the cause of the low percentage in cultivation. The proportion compares favorably with that of other upland types of similar topography and is about the average for the county. There is comparatively little of it which is really nonagricultural.

At least three-fourths of the cleared area of this type is in grass. The remainder produces crops for farm use alone, such as potatoes, grain, fruit, and vegetables. The yields and methods of farming are the same as for the loam of the series.

The sale value of this type is from $15 to $30 an acre. Little of the land has recently changed ownership.

The Gloucester very fine sandy loam is a fairly productive soil and a desirable one for general farming purposes. None of it lies at a greater distance than 6 miles from a railroad station, with which it is connected by fairly good roads. It covers one of the most thickly settled sections of the county. The type is adapted to a variety of crops, among which are hay, grain, potatoes, and fruit. This should be one of the best soils for fruit in the county. The soil is deficient in organic matter, which may be supplied through the use of green-manure crops and stable manure. Lime also would be beneficial.

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

Mechanical analyses of Gloucester very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100347	Soil	3.3	6.9	3.5	18.4	32.6	28.1	7.4
100348	Subsoil	3.5	7.5	3.6	17.0	34.1	28.3	6.4

GLOUCESTER LOAM.

To an average depth of 12 inches the surface soil of the Gloucester loam is a brown to light-brown loam or fine silty loam. The subsoil is a yellow light silty loam to very fine sandy loam extending to a depth of 3 feet or more, except in a few places in which a lighter or grayish-yellow material is encountered in the lower part of the 3-foot section. A characteristic feature of this type is the presence on the surface and in the soil and subsoil of varying quantities of small, flat fragments of schistose rock. Larger angular, slablike fragments of the same kind of rock occur. These seem to be for the most part on the surface. Some granite bowlders, usually rounded, are mingled with the soil material. Low shattered outcrops of rocks other than granite and gneiss are common. There is a wide range in the depth to bedrock. When greater than 3 feet the substratum is similar to the subsoil.

The soil is friable, has a medium organic-matter content, and is easily cultivated under a fairly wide range of moisture conditions. The subsoil is moderately friable and open. Water passes downward readily, and yet the type is fairly retentive of moisture.

As in case of other soils of similar origin the chief variations in this soil consist of differences in the proportion of rock fragments. The texture does vary somewhat, however, grading on the one hand into a stony or gravelly loam and on the other into a silt loam, the latter condition being the more common.

There are several features which distinguish this type from the sandy loam of the series. The material of the former appears to be derived from rocks other than granite and gneiss, while the latter is derived mainly from granitic rocks. In color of soil there is a field difference which is hard to describe. The soil of the loam is a lighter brown, with, in places, a yellowish cast and where the rock is close to the surface a slightly reddish cast. Comparing color of subsoil the loam is more uniformly yellow, the color continuing to greater depths than the yellow of the sandy loam, which usually becomes gray below 20 to 24 inches. The loam is on the whole shallower than the Gloucester sandy loam.

The Gloucester loam is confined to the parts of the county underlain by schistose and slaty rocks. It is most extensive and together with its shallow phase forms practically all the ice-laid material on the islands in Casco Bay, on the long peninsulas or necks extending into the bay, and in the part of the county south of a line drawn from Portland to White Rock, which is located a short distance northwest of South Windham. The large areas, including the greater part of the type, occur in Gorham Town. In all other sections of the county where the type is found, the shallow phase is

much more extensive and the typical soil occupies small areas comparatively free from outcrop. Soils of the Orono series in places form the lower elevations in association with this type.

The type covers rather smooth rolling hills, many of them isolated, extending from sea level to 200 feet in elevation. Extending northward from a point a short distance northwest of Gorham village there is a series of hills, known as Cressey, Fort, and Smalls Hills, whose elevations slightly exceed 300 feet. A continuation of this same ridge is seen north of the Presumpscot River. On this the very fine sandy loam of the series is mapped. The drainage usually is good and in a few places excessive.

Since its deposition the material forming this type has been considerably modified by the weathering both of the glacial till itself and, to a less extent, of the associated and underlying rocks. The more shallow the material the greater the effect of these influences are believed to have been. It is probable, also, that at least parts of the type have been modified somewhat by the action of water during the period of deposition of the marine clays.

A considerable part of this type is in small scattered areas, and it has little influence on the agriculture of the county. The areas in the central part of Gorham town are important locally, but they contain the greater part of the uncleared land of the type. Of the total area, 30.3 square miles, about 90 per cent is cleared, and the greater part of this land is in cultivation. The remainder is covered with a forest of pine and hardwoods. The proportion of this type in cultivation exceeds greatly the percentage of cultivated land for the county as a whole.

General farming, with hay as the main crop, is the type of agriculture. Much of the land is farmed in connection with other soils. Approximately 75 per cent of the farmed area is in grass. The remainder is planted to grain, potatoes, fruit, and vegetables, of which the acreages are about equal. Cabbage and navy beans are important crops in some sections. A considerable acreage is used for pastures. The average yields are slightly greater than for the sandy loam of the series.

Dairying and the production of beef cattle and hogs receive attention in a minor way and contribute to the farm income. Poultry raising is another minor source of income.

The farm practices are the same as on the more extensive Gloucester sandy loam. A long rotation, consisting of a year of intertilled crops, a year of oats, and seeding to grass with a long period of hay production, is the usual practice. Grass lands generally become infested with weeds and in poor condition for several years before they are plowed up. The few small orchards receive little attention.

Values based on actual transfers of this type by itself were unobtainable. Included with other types it sells for $15 to $40 an acre. In a few places near the coast its value in small tracts for summer homes and camp sites is very much greater.

This type is adapted to a variety of crops. Much of it has been farmed for many years, with little or no attempt to maintain or increase its productiveness. The yields are surprisingly good when the treatment of the soil is considered. Very little stock is kept and little stable manure is produced. Attention should be given at once to building up the soil by the use of green-manure crops, some legume being preferred. The type responds readily to good treatment.

The Gloucester loam is naturally a productive soil. It is well situated with respect to markets and shipping facilities, and is fairly well settled. Medium-sized farms with good farm buildings are found on it. The water supply for home use is good and plentiful, springs being numerous.

Gloucester loam, shallow phase.—Areas of soil belonging to the Gloucester loam which are shallow and have frequent rock outcrop, and yet are of too much agricultural importance and not rough enough to be classed as Rough stony land, have been mapped as the shallow phase of the Gloucester loam. The soil in such areas is a brown, fine-textured loam 8 to 10 inches deep. This is underlain by a subsoil consisting of brownish-yellow to yellow loam extending to a depth of 3 feet or more or to bedrock. Small rock fragments are common on the surface and in both the soil and subsoil. They are most abundant near outcrops and in the shallower areas. These small fragments consist mainly of flat, angular pieces of schistose rock. Rock fragments of larger size, which also occur, are composed of granitic and schistose rocks. Those of granite are rounded, of medium size, and comparatively few, while the latter are angular, slablike, and numerous. The large fragments are more abundant on the surface than in the soil mass. Low, somewhat rounded, though shattered outcrops of the underlying rocks occur in many places. In some places the content of mica is conspicuous. Where weathering has been most active the soil frequently has a reddish color.

The depth of the soil blanket varies widely within short distances. In places it is as deep as that of the typical soil; in others only a few feet or even a few inches deep. The rock outcrops, though small, occur promiscuously, and it is usually impossible to find a continuous cultivable area of any considerable size. As mapped, this phase doubtless includes some small bodies of stony loam, rock outcrop or Rough stony land, and, less frequently, areas of the very fine sandy loam and silt loam of the series.

The soil is friable and is easily cultivated. It is not especially deficient in organic matter. The subsoil where developed is fairly loose.

The occurrence of this phase is confined, as a rule, to areas of rather low elevation near the coast and to the islands in Casco Bay. Its most extensive development is found in Harpswell, Cape Elizabeth, and South Portland Towns, where it is associated with the typical Gloucester loam and the soils of the Orono series. Scattering areas also occur in Scarboro town.

The surface of the phase is undulating to rolling, with comparatively little difference in elevation. Nearly all of it lies below the 150-foot contour. The drainage is good to excessive, though springs cause local wet places on a number of slopes.

The presence of foreign rocks, even though in small numbers, shows that at least a part of the material forming the phase is of ice-laid origin. More of it is apparently derived from schistose than from granitic rocks. It doubtless contains a relatively high proportion of preglacially weathered material. This phase has been influenced more by the weathering of the glacial till and of the underlying rocks than any other type in the county. Although the associated soils of the Orono series lie at well-defined levels below areas of this phase, parts of it were doubtless either deeply covered by the sea or at least washed by the waves and tides while the marine clays were being deposited.

The shallow phase of the Gloucester loam covers an area of 15.2 square miles. Its value for farming is not as high as that of the typical soil, nor is the phase as important agriculturally. A much smaller proportion of the phase is cleared and farmed, approximately 20 per cent being used for crops as compared with 90 per cent of the typical soil. A considerable acreage is used as pasture land. The uncleared areas support a small growth of pine, fir, and some cedar. White birch is common in areas of scattered timber growth.

This phase occurs in some of the most thickly settled sections of the county. Cultivation is confined to small, irregular fields confined between the rock outcrops. A greater proportion of it is farmed in Cape Elizabeth Town than elsewhere. Here a considerable acreage is in cabbage, berries, squash, and other truck crops. The farms are small and the cultivation intensive. Other crops are hay, grain, and potatoes. Dairying and raising live stock are not practiced. Some orchard fruit, chiefly apples, is grown for home use.

The yields and methods of farming are much the same as on the typical Gloucester loam.

Many of the areas in cultivation are kept in tilled crops for long periods, the same crop frequently being grown for two or more sea-

sons in succession. Heavy applications of stable manure, rockweed (seaweed) or commercial fertilizers are used.

Land of this phase commands the highest price of any soil in the county, but this price is not based on its demand for farming, but on its location on or near the ocean or bay front, where it is sold in small tracts for cottage or camp sites or for more pretentious summer homes. A considerable part of this type is already taken by private estates, summer homes, and resorts or is held at too high a price to allow its profitable use for farming. Back from the coast a few miles it is valued at from $5 to $20 an acre, which probably represents its agricultural value.

The future agricultural development of the shallow phase, Gloucester loam, will be confined to the growing of crops by intensive methods. Even the rather shallow areas seem to hold moisture well. The soil is productive and is located near good markets. The products find a ready sale at good prices to summer visitors along the coast.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Gloucester loam:

Mechanical analyses of Gloucester loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100368	Soil	1.8	3.6	1.5	7.3	36.1	39.7	10.1
100369	Subsoil	1.0	3.1	1.5	7.7	46.5	34.9	5.6

WHITMAN SANDY LOAM.

The Whitman sandy loam consists of 6 to 8 inches of gray to dark-gray sandy loam, underlain by a gray to yellowish-gray loamy sand, extending to a depth of 3 feet or more. In places the subsoil material shows faint mottling of yellow. From 1 inch to 3 inches of mucky material often covers the surface. Rounded granitic bowlders of varying size occur on the surface and in the soil mass.

There is a fairly wide textural range in the type as mapped, as much of it represents a similarity in condition rather than in texture. The extent of areas of the different textures was not sufficient to warrant separate mapping. These textures range from light very fine sandy loam to loam.

The Whitman sandy loam occurs in association with the soils of the Gloucester series. While the extent is not great, the distribution is fairly wide. The areas are for the most part small or long

and narrow. Many areas, too small to map, are included with the Gloucester soils.

The Whitman sandy loam occupies relatively low or flat positions near the heads of streams, on the tops of broad divides, or along streams traversing comparatively broad valleys whose lower slopes are very gentle and formed of ice-laid material. In places the surface appears to be depressed below the adjoining soil types. Streams head in or traverse practically every area of the type. These flow in shallow channels. Both surface drainage and subdrainage are slow. The type receives seepage from higher surrounding land and remains in a wet or soggy condition during much of the year.

This type has little influence in the agriculture of the county. The original timber has been removed, but nearly all the area now supports a second growth of pine, spruce, and hardwoods. A few areas, most of them too small to show on the map, are farmed in conjunction with the surrounding soils of the Gloucester series. Hay is the chief crop. The areas farmed are so inextensive that accurate yields can not be given. No attention is given to the rotation of crops or other improved farm practices.

The type is valued rather low. As a part of farms consisting mainly of better drained upland soils it sells for the prevailing price of from $25 to $35 an acre.

In its present state the type is of low productiveness, and when artificially drained considerable attention will be required to bring it to a high state of cultivation. Drainage is the first requisite for its improvement. The areas are for the most part small and have sufficient slope to be drained at a comparatively low cost. The availability of other types more favorable for agriculture has retarded and will continue to retard the development of this type.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Whitman sandy loam:

Mechanical analyses of Whitman sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100323	Soil	11.5	10.0	4.0	23.6	20.4	24.1	6.1
100324	Subsoil	15.0	15.8	7.5	23.4	14.4	17.7	6.3

MERRIMAC SANDY LOAM.

The surface soil of the Merrimac sandy loam is a brown light sandy loam to sandy loam of fairly loose structure, 8 to 10 inches deep. The subsoil is a yellowish-brown loamy sand to light sandy

loam, underlain at an average depth of 24 inches by a light grayish yellow loose sand, carrying a large quantity of rounded gravel. The substratum is similar to the lower subsoil. Gravel, though occurring in small quantities in places, is not common on the surface or in the soil and upper subsoil. The occurrence of bowlders on the surface or through the 3-foot section is very scattering.

The different grades of sand composed of quartz and feldspar fragments form the bulk of the material. The quartz grains are sharp and the feldspar rather rounded. The gravel in the lower subsoil ranges from medium to coarse. The gravel, cobbles, and bowlders are mainly granitic. Where areas of this type occur in association with the very fine sandy loam and loam of the Gloucester series the soil is often slightly heavier and small angular to flattened fragments of schistose rocks are present throughout the 3-foot section. Cuts show the more or less assorted character of the material, which extends to a depth of from 10 to 100 feet or more and is underlain either by glacial till or by bedrock. In a few localities there are small outcrops of the latter.

Variations other than in gravel content, already mentioned, consist in a gradation toward a loamy sand in certain areas and toward a loam in others. In the former the differences in texture and agricultural value are minor and insufficient to warrant the mapping of a loamy sand type or of a light phase of the sandy loam. The latter have been mapped as a heavy phase. Where the type occupies extensive terraces in stream valleys a light texture of the soil and a grayish color in the lower subsoil are more pronounced than in the high-lying areas where oxidation and weathering have been more complete. A few areas of the Merrimac coarse sandy loam were included with the type on account of their small extent. In these areas the soil consists of a brown coarse sandy loam, 8 to 10 inches deep, underlain by a yellow, light, coarse sandy loam to loamy coarse sand, which between 20 and 24 inches below the surface gradually passes into a grayish-yellow coarse sand carrying large quantities of rounded gravel and extending to a depth of 3 feet or more. A substratum of material similar to that of the lower subsoil continues to a depth of many feet and rests either upon glacial till or upon the bedrock.

The Merrimac sandy loam is found in all the towns of the county, but is most extensive in the towns of Gray, New Gloucester, Windham, Standish, and Baldwin. The largest area of the included coarse sandy loam lies about 1½ miles northwest of Cumberland Center. Two others occur about 6 miles northwest of Freeport, one 2 miles west of Yarmouthville, and the only other occurs 3½ miles west of South Windham.

The Merrimac sandy loam has three distinct positions with respect to topography and to associated soil types: (1) As high-lying isolated areas from a few acres to several hundred acres in extent, often capping the highest hills of the section, surrounded by soils of the Orono series. In a few instances narrow areas of Gloucester sandy loam and loam or of Rough stony land lie between this type and those derived from the marine clays. In general, areas of such a character are confined to the eastern and southern parts of the county or to those parts where the soils of the Orono series occur. Sandy, Oak, Scottow, Blue Point, and Pleasant Hills are among the most conspicuous examples of this location. (2) As relatively narrow, terrace areas between lower lying soils of the Orono series and hilly sections of glaciated country. These in places at least appear to occupy the positions of old beach lines. They are well developed along Walnut and Blackstrap Hills. (3) As well-developed terraces in present and old stream valleys and as rather extensive outwash plains. The former are flanked by hilly areas of Gloucester soils and good examples occur along the Saco River and Crooked River, and from the village of Gray northward to the Royal River. Examples of more extensive areas are near Watchic Lake, between Raymond village and North Windham, near West Cumberland, and south to the county line from the southern end of Sebago Lake.

The surface of all the areas is that of a level to very gently undulating terrace. Kettle holes are prominent topographic features in certain sections. The range in elevation is from 75 to 400 feet, the higher elevations being found in the valleys in the northern part of the county. All rainfall is immediately absorbed by the surface, and sinks quickly to lower depths, finding its way to streams through springs and seepage. Though the type material retains considerable moisture, there is a tendency toward excessive drainage.

The type consists of assorted stream-laid material derived from crystalline rocks. The weathering of the upper soil and the incorporation of organic matter account in part for the heavier texture of the soil as compared with that of the deep subsoil. Many of the smaller and somewhat isolated areas were originally connected and have been eroded to their present size. On the islands in Casco Bay the material of this type seems to be obscurely stratified.

The Merrimac sandy loam is a fairly extensive as well as widely distributed soil type. It is the most extensive of the series or in fact of any of the terrace soils. Approximately 25 per cent of it is in annual crops. The remainder has a forest of pine, oak, maple, and other hardwoods. White birch and shrub growths are abundant in places. Blueberry and huckleberry bushes are common where the timber growth is scattering. A greater amount of development has taken place on the isolated areas than on the extensive tracts on out-

wash plains and terraces. The light or sandy texture and the tendency to drought have been the chief factors in the slow development of this type. The greater part of it has a topography favorable for farming operations and is easily accessible.

The type is moderately productive, the yields being markedly less in seasons of less than normal rainfall. It is somewhat deficient in organic matter. The soil is easily cultivated under varying moisture conditions. Practically all of it is susceptible of development. The clearings on individual farms range from a few to 100 acres or more in extent. Settlement on this type is in places fairly dense and in others rather scattering. In many places farms include other soils besides the Merrimac, and in such cases the farm buildings stand upon the latter. The location of the roads on the level terraces is the reason for this.

The same class of farming and kind of crops prevail on this type as on the uplands. A few farmers have adopted crops and methods suited to the type. General rather than intensive farming methods are the rule. A greater acreage is given to the production of hay than to all other crops combined. Potatoes and grain are grown on about an equal acreage. Small orchards have been planted near the farm buildings. Cabbage is grown in South Portland and Cape Elizabeth Towns. Beans and other vegetables are minor crops. Little or no corn is produced. Dairying and other live-stock industries are practiced to a less extent than on the types of the Orono and Gloucester series.

The income of farms on this type is derived from a mixed source. Hay, either directly as a cash crop or indirectly as forage for farm stock, contributes a larger part of it than any other crop. The sale of dairy products and of live stock is a minor source. Certain farms have a considerable income from the sale of poultry and eggs. Approximately three-fourths of the villages of the county are located on this type. Adjoining these are usually a number of small farms whose owners cultivate a few acres to produce crops for home use and derive the greater part of their income from work in the towns.

Hay yields from one-fourth to 1½ tons and potatoes from 100 to 300 bushels per acre. Grain is rarely thrashed, and estimates of yields are not available. Cabbage gives yields of 7 to 8 tons per acre.

The character and period of rotation is much the same as on other types in the county. There is a tendency to increase the time in cultivated crops and to decrease that in grass. Grass follows grain. The yields for the first year or two after seeding are fairly good, but they decrease quite rapidly. The stand is often thin and the quality poor. Little of the type is used for pastures.

The sale value of this type ranges from $10 an acre, in remote uncleared sections, to $50 an acre for improved land in the vicinity of towns.

The Merrimac sandy loam responds readily to good treatment and is adapted to a variety of crops. It is not commonly regarded as a good grass soil, but the production of hay is nevertheless an important part of the farming system. Crops which allow tillage to aid in conserving moisture give the best returns. The growing of potatoes, garden vegetables, and berries should be profitable on areas well located with respect to markets. Intensively farmed crops will bring greater returns than those produced by general-farming methods.

Normally the organic-matter content is low. This should be increased by the use of green-manure crops. Cover crops would prevent leaching during the winter and early spring. The use of lime and leguminous crops should prove beneficial.

Merrimac sandy loam, heavy phase.—The heavy phase of the Merrimac sandy loam consists of 6 inches of brown heavy sandy loam to loam, underlain by yellowish-brown sandy loam, which at 20 inches below the surface rests upon a mass of cobbles, gravel, and sand extending to a depth of 3 feet or more. Cobbles and gravel are more abundant on the surface and throughout the 3-foot section than in the case of areas of the typical soil.

As a rule the phase occupies a part of the same terraces as the typical soil. The largest area lies about 1 mile east of Gray village. Another is situated near the north end of Walnut Hill. One or two others are found in other parts of the county. The areas are level and well drained.

Practically all this soil is in cultivation to the usual crops of the section. The yields compare favorably with those of the typical soil.

Below are given the average results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the typical Merrimac sand loam:

Mechanical analyses of Merrimac sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100329, 100363.	Soil.....	8.2	30.5	12.3	12.5	8.3	15.9	12.2
100330, 100364.	Subsoil.....	12.9	40.2	17.3	13.6	5.2	8.0	2.9
100331, 100365.	Lower subsoil...	10.1	41.6	13.8	15.1	5.7	10.2	3.6

MERRIMAC FINE SANDY LOAM.

The soil of the Merrimac fine sandy loam, to an average depth of 12 inches, is a light-brown fine sandy loam. The subsoil is a light yel-

lowish brown loamy fine sand to loamy sand extending 3 feet or more below the surface. The substratum generally consists of coarse, sandy, and gravelly material. Gravel and bowlders are seldom found on the surface or in the upper part of the soil section. In places a few rock outcrops occur.

The type grades light rather than heavy in texture. When associated with the fine-textured soils of the Gloucester series it contains a few fragments of schistose rocks.

About 10 areas, ranging in size from 50 to 500 acres, are mapped in Cumberland County. They are associated with the sandy loam of the series and the lower lying soils of the same section are most frequently those of the Orono series. The most important areas are found about a mile east of North Scarboro, 1½ miles west of West Bridgton, 1 mile southeast of Cornish Station, and 1½ miles north of White Rock.

The surface of this type is level to undulating and gently rolling. Areas of level to undulating topography occur on distinct terraces in river valleys, and those of rolling topography exist as remnants of former more extensive outwash plains. The elevation ranges from 100 to 400 feet above sea level. The drainage is naturally good. In periods of less than normal rainfall the soil tends toward droughtiness. Few streams or draws traverse the type.

The Merrimac fine sandy loam is a minor type of the series. Practically all of it is cleared and farmed, but it is of relatively little importance in the agriculture of the county. A greater moisture-holding power accounts for the more extensive development of this than of the other types of the series.

The crops, their yields, the methods of farming, and the means of improvement are practically the same as those discussed in connection with the Merrimac sandy loam. The type is held at $25 to $40 an acre.

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

Mechanical analyses of Merrimac fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100341	Soil	4.0	15.2	9.4	31.4	19.7	15.4	5.4
100342	Subsoil	6.4	21.6	12.8	32.8	16.2	7.6	2.7

HINCKLEY SAND.

The Hinckley sand consists of a light-brown to brown sand, underlain at a depth of 8 to 10 inches by a 10-inch stratum of yellowish-brown to yellow sand, which in turn rests upon a bed of yellow-

ish-gray to gray sand and gravel extending to a depth of 3 feet or more. The coarse material is mainly granitic. Bowlders occur infrequently.

As mapped in Cumberland County the type includes some departures from the typical description. Wind action is to a large extent responsible for these variations. Small knolls of glacial till, irregular areas of soils of the Merrimac series, and strips of Muck along streams are included types, whose separation was not warranted. The greatest variation occurs where the material forming the type has blown over sections of glacial till. Here the sandy mantle varies from a few feet to several feet in depth and the subsoil is either unassorted ice-laid material or consists of sand differing from the soil only in color. No rounded gravel is present in such sections. In other places the sandy mantle has been blown over deeply eroded terraces. Such areas have either a few inches or several feet of sandy material underlain by a mass of gravel and sand. The sand is unevenly distributed and gravel is frequently found in the soil.

Only two areas of this type were mapped. The largest lies to the north of Watchic Lake and south of the Richville-Steep Falls road. It has an area of several square miles. The other is an irregular area in the Saco River Valley, extending from near Cornish Station northward to the county line.

The topography of the area in the Saco River Valley above Cornish Station is that of a high-lying eroded terrace with a gullied surface sloping steeply toward the present river. The surface features of the larger area are those of an eroded or dissected outwash plain or extensive terrace, modified to a considerable degree by wind action. The sections of greatest irregularity are those in which knolls of glacial till occur at frequent intervals. In elevation the type ranges from 250 to 350 feet above sea level.

The drainage is for the most part excessive. A few small areas on account of their depressed position are poorly drained.

The Hinckley sand represents material of an originally level, high-lying terrace or outwash plain, subsequently deeply eroded and later modified by the shifting of parts of this material by the wind. The type material is derived mainly from crystalline rocks.

The type has little or no agricultural importance in Cumberland County. Its development as farm land had been prevented by the rough surface, light texture, and excessive drainage. The probability of future development is remote. The original forests have been removed either by logging or by forest fires. It now supports a growth of small pines, a few hardwood trees, and underbrush. Blueberries and huckleberries are abundant in places. The sections from which forest fires have removed the timber now support only small brush.

None of the type is in cultivation. Its sale value, which depends mainly on prospective timber value, ranges from $5 to $10 an acre.

This type would best be used for the production of timber, under the methods of practical forestry.

ADAMS FINE SAND.

The Adams fine sand consists of about 10 inches of a brown, fine to medium sand, underlain by a light yellowish brown, fine to medium sand to 20 to 24 inches. At this depth a yellowish-gray to gray fine to medium sand is encountered, the material extending without change to a depth of 3 feet or more. The soil material is incoherent and of uniform texture throughout the 3-foot section. Material coarser than medium sand is not common in the type. Soil and upper and lower subsoils are differentiated mainly on the basis of color. At depths ranging from 6 to more than 20 feet typical areas have a substratum of clay many feet in thickness. The higher organic-matter content accounts for the darker color of the soil, as compared with that of the subsoil. The organic-matter content is moderately low.

The type as mapped includes a few small, irregular areas not protected by vegetation. The surface of these is being constantly shifted by the wind. These really should be classed as Dunesand, but on account of their small extent and low agricultural value they were not separated. The soil in the barren areas is a light-brown to grayish-brown, loose fine sand. The subsoil is similar in texture and color to the soil. These areas lie southwest of Brunswick and west of Freeport.

In places there is a gradation of the fine sand toward a very fine sand, and a few areas of that texture are doubtless included in the type. The extent of this difference was not deemed sufficient to warrant the mapping of another type. In several areas the fine loam grades toward the sand of the series. Southwest of Brunswick small areas of the type overlie glacial till. These areas are rather uneven, and wherever the soil is shallow bowlders and rock outcrops occur.

In places where the texture is medium and a slight loaminess is developed the color of the soil is darker than typical. In the areas near Steep Falls and in certain of those southwest of Portland the type as mapped appears to be underlain by gravel and coarse sand rather than by the usual heavy substratum. The color of such areas is a light brown. The soil drifts where unprotected.

The characteristic topography of this type is that of a hummocky to undulating plain. The surface is for the most part confined between elevations of 50 and 150 feet above sea level. Parts of the

type covering glacial till have a rolling surface. The drainage is good to excessive.

The Adams fine sand is not extensive, some of the more important areas occurring near Brunswick and just east of Steep Falls in Standish Town.

The material forming this soil is derived mainly from crystalline rocks. It was deposited as a comparatively shallow mantle over the marine clays as outwash or delta plains. Its present character and topography are largely the result of the action of the wind on the original deposits.

The agricultural importance of this type is relatively small. Only a small part of it has been cleared for farming. The present timber growth consists of small pine, fir, birch, and brush. The areas on which the timber is small and scattering support a sparse growth of grass.

The light texture and consequent low moisture-holding capacity of this soil have retarded its development for farming. Its extensive use in the near future is improbable. Very little of the land is now in cultivation. Hay, practically the only crop, gives light yields. The type affords considerable pasturage during the early summer. Undeveloped land of this type has a value of $5 to $10 an acre.

The Adams fine sand is considered too light and sandy for growing general farm crops. It is better adapted to the production of certain vegetable and berry crops after careful preparation of the soil. Increasing the organic-matter content through the use of green manures would result in the needed improvement of the moisture-holding capacity of the type.

ADAMS SANDY LOAM.

The Adams sandy loam consists of 8 to 10 inches of brown, friable light sandy loam with a moderate content of organic matter. The subsoil is a yellowish loamy sand, grading at 16 to 20 inches below the surface into a gray or yellowish-gray sand. It is typically porous in structure. Stratified marine clay underlies the type at a depth ranging from 4 to 15 feet. Material coarser than a coarse sand is rarely included. Uncultivated areas have a somewhat darker color than the cultivated areas.

The texture of the soil is fairly uniform throughout its extent. It grades, however, toward a loamy sand rather than toward a heavy sandy loam. These areas of lighter texture have about the same agricultural value as the typical soil and have not been separated as a phase on the map. The subsoil of such areas is typical. The Adams coarse sandy loam also is developed, but not in areas sufficient to justify a type separation. These areas of coarser texture are characterized by a brown, light coarse sandy loam 8 to 10 inches deep

resting upon a yellowish loamy coarse sand, which grades at a depth of about 20 inches into a gray coarse sand. As with the typical Adams sand marine clays usually are encountered at depths of 4 to 10 feet.

This type and its variations differ from the corresponding types of the Merrimac series in showing less effects of the weathering of the component material and in the less complete oxidation of the subsoil, as indicated by the gray color in the lower portion. The Adams sandy loam represents a fairly shallow deposit of sandy material over the marine clay deposits, while the Merrimac sandy loam is a comparatively deep deposit of assorted material, including gravel, cobbles, and bowlders, and rarely overlies the deposits of clay.

The Adams sandy loam is a fairly extensive type in the section southwest of Portland and in the town of Brunswick. It occurs in association with soils of the Orono series and with other types of the Adams series.

The individual areas range from a few acres to several hundred acres. The areas distinctly coarse in texture, which have a total extent of about 1 square mile, occur in the northern part of Scarboro Town, bordering the Nonesuch River.

The type occupies terraces and delta plains now lying well above the present levels of the streams. It has a smooth, level surface with steep front slopes toward adjoining lower terraces or stream bottoms. The terrace topography is especially well defined in the vicinity of Brunswick, where there are four distinct terrace levels with drops of 10 to 25 feet between them. Besides the main streams, only a few short streams traverse areas of the type. The drainage ranges from imperfect to excessive, according to the character of the season. Water falling upon the surface is quickly absorbed by the soil, but the underground drainage is rather slow, on account of the level character of the type and the closeness of the underlying stratum of clay. In seasons of more than normal rainfall there is a tendency for the subsoil to become saturated with water, while in seasons of light rainfall or of drought the porous character of the subsoil and other sandy material above the clay substratum permits excessive drainage. Although the drainage conditions vary thus with the season, the greater part of the type may be considered as sufficiently drained for cultivation under normal conditions. Some areas warm up rather slowly in the spring, when the subsoil is filled with water from the melting snows.

The shallow deposit of sandy material over the marine clays shows little effects of weathering since its deposition, except in the surface soil. This accounts in part for the loamy texture of the soil as compared with the subsoil. The quartz grains, which predominate,

are fairly sharp, while those of feldspar are rounded. There has been little or no modification of the soil by drifting. Small quantities of organic matter have accumulated from the decay of vegetation.

The Adams sandy loam is an important soil type in the sections of the county where it is extensively developed. Its distribution, however, is restricted and its agricultural importance is small in comparison with more extensive and more widely farmed soils. There are 19.6 square miles of the type, of which about one-half is under cultivation. Small and large fields, and in some cases whole farms, of the type are in cultivation. The farms are usually small, and the size of the farmed areas varies from a few acres to 25 acres. In places this type seems to have been one of the first soils cleared and farmed; in others it was apparently among the last. The settlement ranges from moderately dense to very scattering. About one-half of the type is in forest, comprising pine, with some oak, birch, and underbrush. Blueberry and huckleberry bushes are abundant.

This type, together with other flat sandy soils, is locally known as "plains land." It is recognized as a moderately productive soil. The surface soil is easily tilled under a fairly large range in moisture conditions. It does not bake or clod.

General farming, on a small scale, is the usual type of agriculture. There are no specialized crops or live-stock industries. The more important crops are hay, grain, potatoes, squash, beans, fruit, and vegetables. A far greater acreage is in grass than in all other crops combined. Hay yields from one-fourth to 1 ton, and potatoes from 100 to 200 bushels per acre. The grain is not usually thrashed.

A large part of the hay and all the grain are fed to stock on the farm. Fruit and vegetables are grown for home use. Dairying and cattle raising are not important industries, although they are the source of a part of the farm income. The sale of hay, potatoes, squash, and beans furnishes a large part of the income. A considerable acreage is used for pasturage.

This soil is considered well adapted to the production of potatoes and vegetables. Corn is not a successful crop on account of the low position of the type and the resulting damage by late and early frosts. Small fruit is apparently successful but is not planted in commercial quantities. Strawberries, grown in small quantities for the local markets, bring good returns. There is good demand for the wild blueberries which grow abundantly in undeveloped areas where the timber stand is thin.

Commercial fertilizers are not extensively used. They are generally applied with oats at the time of reseeding of fields to grass. The use of lime is not general. Stable manure is applied either

before or after plowing. Very little is used on grass land. The growing of leguminous and green-manure crops is not practiced.

There appears to be no systematic rotation of crops on the majority of the farms on this type. Fields are left in grass for several seasons and become infested with weeds. Small tracts here and there are plowed and planted to tilled crops each year. The following year these tracts are either used again for intertilled crops or are sown to oats and seeded to grass. In most cases there seems to be no regular order in which these small tracts are plowed. They are often scattered in various places about the farm. The greater part of the plowing on this type is done in the spring.

The selling price of farms on this type ranges from $20 to $35 an acre. The farms usually include some unimproved land, as well as small areas of other soil types. Tracts of unimproved land sell for $10 to $15 an acre.

The Adams sandy loam seems better adapted to intensive farming than to general farming. The present farming methods are practically the same as on the heavier soils of the Orono and Gloucester series. These should be modified to meet the demands of the soil and the crops to which the soil is best suited. The use of leguminous crops and green-manure crops with lime is recommended.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Adams sandy loam:

Mechanical analyses of Adams sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100332	Soil	4.0	28.9	21.4	24.7	4.8	9.4	7.2
100333	Subsoil	6.4	31.0	18.0	26.8	6.4	7.4	4.2
100334	Lower subsoil	2.4	26.8	20.8	38.2	7.0	3.2	1.8

ADAMS FINE SANDY LOAM.

The soil of the Adams fine sandy loam is a brown fine sandy loam of friable structure to a depth of 8 to 10 inches. The subsoil is a light yellowish brown loamy fine sand, underlain at 20 to 24 inches by a yellowish-gray to gray fine sand, which extends to a depth of 3 feet or more. The change from soil to subsoil is rather abrupt, but that between the upper and lower subsoils is gradual, taking place within a stratum some 3 to 5 inches thick. The substratum, consisting of several feet of horizontally stratified clays, is from 4 to 12 feet below the surface. Coarse sand, gravel, and bowlders are not present. The immediate surface in forested areas is a grayish fine sand. Quartz is the predominating mineral. The soil has

a medium organic-matter content and the subsoil a moderately compact structure.

With the exception of a few places where the soil grades toward a loamy fine sand and is a lighter or a grayish brown, the texture and color of the soil are uniform. Occasionally the subsoil is a yellowish-gray fine sand, underlain by a very compact, gray, fine to very fine sand. The sandy material above the clay substratum is deeper on the stream side than on the side toward the higher lying soil types.

The Adams fine sandy loam differs from the Orono fine sandy loam mainly in the depth to the clay substratum. In the former it does not come within the 3-foot section, while in the latter it is found as a rule below a depth of 24 inches. The Merrimac fine sandy loam does not have the clay substratum typical of this type and carries coarse material in the lower subsoil and substratum. These structural differences in addition to those of color and position of the types are sufficient to warrant their separation.

The type is found mainly in the towns of Gorham, Freeport, and Brunswick. Together with the fine sand of the series it occupies fairly well defined levels or sections apart from the coarser members of the Adams series. Another type with which it is commonly associated is the Orono silt loam. This occurs on the higher elevations on the side of the valley next the uplands or is exposed along draws and slopes on the stream side.

The surface of the type is that of a plain or terrace, traversed by stream courses along which in many instances the underlying clays are exposed. The main valleys are narrow and deep, while the draws are narrow, deep, and V-shaped. The type lies at elevations of 100 to 200 feet above sea level. The surface of the different areas is in general level, but local irregularities give a slightly undulating topography to certain small sections. The drainage is on the whole adequate. The areas of deeper soil are in certain seasons excessively drained, while the areas of shallower soil are insufficiently drained in wet seasons. The surface drainage is good, but the underground drainage is retarded by the impervious substratum.

Water-laid sediments derived from crystalline rocks and deposited over the marine clays form this type. Slight weathering and the incorporation of organic matter have effected the only changes in the original material.

Like the sandy loam of the series, this type is important in the sections where it occurs. It, however, does not have a wide distribution over the county, and, by comparison with more extensive types, its importance is not great. Soil conditions and the location of the areas have favored its development, and practically all of it is cleared of timber. Approximately 90 per cent of it is now in cultivation,

and the greater part has been in cultivation for many years. The part in forest supports a growth of pine, hemlock, birch, and underbrush.

This is regarded as a desirable soil type. It is the most productive of the series, is easily tilled under quite a wide range in moisture conditions, and does not clod or bake. It has a fairly good moisture-holding capacity, warms up rather early in the spring, and has a medium organic-matter content.

There are no specialized crops or live-stock industries in connection with this type. The farming may be classed as general farming on a small scale. The most important crops are hay, grain, potatoes, fruit, and vegetables. It is estimated that at least three-fourths of the type is in grass. The acreages in grain and potatoes are approximately equal. The area devoted to these crops is comparatively small and constitutes the part of the type actually in cultivation. A large part of the hay and all of the grain are fed to stock on the farm. Fruit and vegetables are produced for home use. Dairying on a small scale provides a means of using the field crops and furnishes a part of the farm income. Cattle raising is not an important industry. The sale of the excess hay and potatoes contributes largely to the farm income. A considerable acreage is used for pastures. The ordinary yields for the type under prevailing methods of farming are one-half to 1½ tons of hay and 100 to 250 bushels of potatoes per acre. The oats are not thrashed. The type gives higher yields of hay than the sandy loam of the series, and is considered a better grass soil. It is not so good as the heavier types of the Orono series. The yields of other crops compare favorably. Corn is seldom grown on this type.

The general practice seems to be to keep the greater part of the farm in grass for hay. This is mainly timothy, although some clover is sown at the time of seeding. As only a few acres are plowed each year a number of years is required to reseed the farm to grass. In the meantime the hay land becomes badly infested with weeds, and other grasses of less value than timothy and clover become abundant. Thus the yield as well as the value of the hay crop is greatly diminished. The plowed areas are usually planted to cultivated crops the first year and followed by sowed crops, chiefly oats, and reseeded to grass. Practically all the hay crop is placed in the barns. A small supply of stable manure is available and is applied either before or after plowing. Commercial fertilizers are not extensively used. The use of lime and the growing of leguminous crops are not practiced.

The sale value of this type ranges from $15 to $35 an acre, with little land changing hands.

The Adams fine sandy loam is adapted to the production of potatoes, vegetables, small fruit, and berries. It is fairly well suited to the

growing of hay and grain. The farming methods should be modified to meet the needs of the soil and its adaptation to crops. There should be a shorter rotation of crops, thus allowing a more frequent seeding of the mowing lands. The use of lime would be found advantageous in most cases.

Results of mechanical analyses of samples of the soil, subsoil, and lower subsoil follow:

Mechanical analyses of Adams fine sandy loam.

Number	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100354	Soil	3.8	13.2	9.0	38.9	14.0	13.5	7.5
100355	Subsoil	3.0	11.0	9.2	46.6	13.0	10.5	7.1
100356	Lower subsoil	1.8	5.6	4.2	61.8	16.0	5.9	4.8

SCARBORO LOAMY SAND.

The soil of the Scarboro loamy sand is a light-gray to gray loamy sand to sand, with a depth of 8 to 10 inches. While a layer of mucky material, 1 to 5 inches in thickness, has accumulated on the surface in many places, the soil as a whole contains little organic matter. The subsoil consists of 8 to 15 inches of a brown or reddish-brown loamy sand to loamy coarse sand, underlain by a gray to light-brown sand to coarse sand extending to a depth of 3 feet or more. The upper subsoil is frequently partially cemented and is difficult to penetrate with the soil auger. The cemented material may or may not include the whole of the brown stratum. As a rule, however, it is from 3 to 5 inches thick and comprises the lower part of this stratum. The sand grains are sharp and consist of quartz fragments.

Where associated with the soils of the Adams and Orono series the heavy clays of the latter form the substratum at a depth of 4 to 6 feet below the surface. Where they occupy the higher lying terraces with the types of the Merrimac series glacial till or bedrock forms the substratum.

There is a marked uniformity in the size of the sand grains comprising the type. Material coarser than coarse sand seldom occurs. Rounded gravel and bowlders are never present. The soil grades on the one hand into the loamy coarse sand of the series, into the Adams sandy loam, or into the Merrimac sandy loam, but on the other into shallow deposits of muck underlain by sandy material. In places the boundary is well defined, in others the change takes place within a belt ranging from 200 to 500 feet in width.

While the presence of the hardpanlike stratum in the subsoil is considered typical, there were many instances in which it was not encountered. In places the material is firmly cemented, in others

cementation is imperfect. It was impossible to note the effect of this layer upon the passage of water through the type on account of the extremely wet season in which the survey was made. Material both above and below this layer was saturated with water practically all the time. It is believed that its presence greatly interferes with the internal drainage of the type. It lies too deep to interfere with the development of shallow-rooted crops. The fact that this hardpan disappears gradually as the better drained types are approached seems to indicate that it may be expected to disintegrate where artificial drainage is supplied.

There have been included with this type a few small areas of loamy fine sand, which it was not considered essential to map as a separate type. Some rather important areas of loamy coarse sand were also encountered. The description of the material of these areas conforms to that of the type except in the matter of texture, being finer in one case and distinctly coarser in the other. Such areas occur on the sandy plain southwest of Brunswick and on that part of a plain lying immediately west of the southern extremity of Sebago Lake. As mapped the type doubtless includes small depressed areas where the accumulation of mucky material is deep enough to be classed as Muck. In addition there are probably a few small areas in which the character of the material approaches that of the Adams sandy loam.

The coarse-textured areas are confined to the part of the low-lying region in the vicinity of Buggy Meetinghouse, about 5 miles southwest of Portland, where it covers two fairly extensive areas on each side of the Nonesuch River. It is associated with the soils of the Adams and Orono series.

The type has the same general distribution over the county as the soils of the Adams and Merrimac series, being confined to terraces or outwash plains. The individual areas range in size from a few acres to more than 1 square mile. It is most extensively developed south and southwest of Portland, mainly in Scarboro Town.

This type has the most uniformly flat surface of any soil in the county. Some areas occupy fairly well defined depressions within other soil types. This is especially true where the type is associated with the Merrimac sandy loam. There are practically no streams traversing the areas of the type, but a number of small draws or tributaries head within its limits. Its elevation is from 50 to 350 feet above sea level. It lies well above the present stream bottoms and is not subject to overflow. Water frequently stands on the surface for some time after heavy rains and a large proportion of it is in a water-logged condition during the greater part of the year. The drainage is retarded by its level surface, its depressed position with respect to surrounding types, and by its impervious substratum.

The position and character of the type indicate that its material was originally the same as that from which the Merrimac and Adams sandy loams have been formed. The present differences from these types are the result of poor drainage and lack of aeration.

As only a few small areas are farmed in conjunction with associated soils, this type has little or no agricultural importance at the present time. The chief cause of its lack of development is poor drainage. The reclamation of many of the smaller areas is possible at comparatively little cost. Reclamation of many of the larger ones presents greater difficulties.

There is opportunity for artificial drainage through streams traversing adjoining types. The possibility of any immediate concerted action in this direction is quite remote on account of the abundance of better agricultural land as favorably situated.

In its present condition the type has a low agricultural value, and the possibility of growing crops successfully on the greater part of it is remote. In seasons of less than the average rainfall parts of it could be used for late crops, among them hay. The type has been in a poorly drained condition for so long a time and is so sandy that even after artificial drainage has been established much labor and expense will be required to bring it to a good state of productiveness.

The present forest growth comprises pine, birch, and underbrush. There is little or no merchantable timber on the type at the present time. Its chief use is as a source of fuel. It also affords some pasturage.

No actual transfers of areas wholly of this type have taken place recently. Its value for forest use under existing conditions is low. The greater part of the type is held for $5 to $15 an acre. In conjunction with other soil types it frequently commands a higher figure. Certain areas near the city of Portland are valued at $30 an acre.

An effort should be made by the owners to adopt some system of practical forestry whereby the type would in the course of a few years produce a timber crop of considerable value. This could be done at a low cost and with little labor, and would bring some returns pending the establishing of drainage system.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Scarboro loamy sand:

Mechanical analyses of Scarboro loamy sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*
100317	Soil	11.6	24.6	10.2	30.6	8.6	11.4	3.0
100318	Subsoil	14.2	34.4	14.0	20.2	6.8	3.5	7.2
100319	Lower subsoil	3.6	10.6	7.4	62.9	10.9	1.6	3.1

ORONO SANDY LOAM.

The soil of the Orono sandy loam is a grayish-brown to brown sandy loam, 10 to 15 inches deep. It has a friable structure and a medium organic-matter content. The subsoil is a bluish-gray to greenish-gray, stiff, silty clay to a depth of 3 feet or more. Rounded or angular fragments of rocks coarser than coarse sand are seldom present within the soil, subsoil or substratum.

Some variations in color and texture were noted. Flat areas of fairly light texture have a gray sand to a depth of a few inches, underlain by a brown light sandy loam and this in turn by silty clay. The flat areas of a texture somewhat heavier than typical are dark gray in color. There is also a range in the depth to the clay subsoil, and the deeper parts have an intermediate stratum or upper subsoil of yellow loamy sand to sandy loam, which often shows faint mottlings of gray in the few inches immediately above the silty clay stratum. The presence of this layer is not so common as in the fine sandy loam and loam of the series. The soil is, as a rule, deepest on the highest part of the individual areas and thins out toward the lower lying areas of silt loam or silty clay loam.

This type occurs in sections of the county where the deposits of marine clays have a thin sandy mantle. Such conditions exist in parts of Scarboro, Gorham, and Westbrook Towns. The type is most extensively developed in the vicinity of Dunstan in Scarboro Town. Other types of the Orono series, especially the silt loam, are most commonly associated with it.

The surface of the type is level to very gently undulating. As a rule it lies higher than the adjoining soils of the same series and lower than those of other series in the same section. Its elevation is from 100 to 200 feet above sea level. The areas are poorly or adequately drained according to their position. The low-lying areas are usually flat. They receive seepage from higher types and are usually poorly drained. Some small areas lying above surrounding types, though comparatively flat, are well drained. No streams of importance cross the type.

The Orono sandy loam frequently occupies an intermediate position between the heavier members of the series and the Adams sandy loam. It represents in such cases a thinning out of the sandy material of the latter type, so that the silty clay substratum of the Adams series becomes the subsoil of the Orono. The heavier texture of this type as compared with that of the Adams sandy loam is due in part, at least, to the incorporation of a small proportion of the fine material of the subsoil with the sandy surface material.

This type has relatively little influence on the agriculture of the county. This results from its comparatively small extent, its local distribution, and the manner and extent of its cultivation. Insufficient drainage is the chief factor regarding its development. The original forest has been removed from approximately 75 per cent of the type, and the greater part of this acreage is now in cultivation. The remainder supports a forest growth of mixed character. The individual areas are, as a rule, of comparatively small extent and are farmed with the surrounding soils.

General farming without any special crops or live-stock industries is the prevailing type of farming. As on the other types in cultivation, hay is the chief crop. Other crops are grain, potatoes, corn, and garden vegetables. All these products, except a part of the potatoes and the hay, are consumed on the farms. Dairying is not important on the type.

Hay yields from one-half to one ton per acre and potatoes from 100 to 250 bushels per acre. The yields of other crops are seldom estimated or recorded. In favorable positions corn is a successful crop. The type, when well drained, is considered well suited to the production of potatoes and other vegetables. While not regarded as a first-class grass soil by the farmers, the general character of the farming throughout the county causes the greater part of the cultivated area to be used for hay production for a number of years in succession.

Well-drained, typical areas of this type have a fairly high crop-producing power. These areas have a fairly good moisture-holding capacity. The lighter, flat, poorly drained areas are commonly considered as of low productiveness. When drained the soil is easily tilled under quite a range in moisture content.

The price of land of this type ranges from $15 to $30 an acre. The farm practices are the same as on the fine sandy loam of the series. Up to the present time no attention has been given to the artificial drainage of this type. Its inherent fertility warrants the outlay of a moderate amount of money and labor for improvement. The construction of an adequate drainage system for the greater part of the type is a comparatively inexpensive and easy matter. The areas are small and have sufficient slope to afford adequate fall for the ditches. If general farming is to be practiced the adoption of a shorter rotation in which grass is not grown for so many years in succession is essential. The type seems to be better adapted to the production of crops under intensive than under extensive methods. The use of lime would be beneficial on the greater part of the type.

Mechanical analyses of samples of the soil and subsoil gave the following results:

Mechanical analyses of Orono sandy loam.

Number.	Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100307	Soil	9.8	22.6	11.2	22.2	7.4	17.8	9.2
100308	Subsoil	.2	.6	.6	1.8	4.0	17.2	35.6

ORONO FINE SANDY LOAM.

The Orono fine sandy loam consists of 10 to 12 inches of a brown fine sandy loam, underlain by a 10-inch to 12-inch stratum of grayish-yellow to yellow fine sand, which rests upon the typical subsoil of the series, a slightly greenish gray stiff silty clay, extending to a depth of 3 feet or more. A continuation of this material to a depth of many feet forms the substratum of the type. Rock fragments coarser than medium sand do not occur. The soil, though compact in its natural state, is friable when cultivated. The upper subsoil is loose and incoherent, but the lower subsoil and substratum are stiff and impervious.

In places the texture grades toward a very fine sandy loam, but textures coarser than a fine sandy loam do not occur, except in a few instances where it approximates a loamy fine sand. The light stratum intervening between the soil and lower subsoil is typical, but there is some variation in its thickness. This is the factor which determines the depth to the heavy subsoil. When this stratum is from 6 to 8 inches in thickness the lower subsoil is encountered at about 18 inches below the surface; when it is 15 to 20 inches thick the lower subsoil is found from 28 to 30 inches below the surface. In the latter case the light-textured material is gray in its lower part. A freshly plowed surface presents a rather variegated appearance, with gray, brown, and other colors.

This type differs from the Adams fine sandy loam in structure and in texture of lower subsoil. The lower subsoil of the Orono represents the stiff silty clay substratum of the Adams. The texture of the soil is slightly heavier and finer than that of the Adams fine sandy loam.

The Orono fine sandy loam has a fairly extensive distribution in parts of the county lying below the 250-foot contour. It is confined to sections underlain by marine clays and is an especially important type in the towns of Yarmouth, North Yarmouth, Cumberland, Westbrook, Windham, and Gorham. Areas of Orono silt loam are always associated with it.

The surface of the type is level to undulating. Small hummocks of deeper fine sandy material are common. It occupies either flat

terracelike areas or relatively broad divides, with the Orono silt loam on the slopes toward the drainage ways. Few drainage courses, other than shallow draws, traverse the areas. The numerous draws of the lower Orono silt loam usually head near the boundary between the types. The position and size of the individual areas determine to a large extent the character of the drainage. Except in seasons of excessive rainfall the soil readily absorbs all water and there is little surface run-off. The internal drainage is greatly restricted by the impervious character of the subsoil and substratum. In the case of the rather level areas the upper subsoil holds large quantities of water for long periods after rains. The areas on the well-defined divides are better drained, but even these drain rather slowly. The greater part of the type would be benefited by artificial drainage.

The lower subsoil of this type is the typical one of the series. The lighter material forming the upper subsoil and the soil represents a thin stratum deposited in fairly quiet waters in bays or other favorable locations. It rests conformably upon the underlying marine clays. The relative position and topography of this and adjoining areas of the Orono silt loam indicate that this fine sandy stratum was once much more extensive and covered at least a part of what is now the silt loam type. The weathering of the material and the incorporation of organic matter have resulted in the differentiation of this stratum into soil and upper subsoil.

The Orono fine sandy loam is second in size among the several types of the Orono series, which is the second largest series in the county. Approximately 90 per cent of the type is in cultivation, and its relation to the agriculture of the county is important. Soil conditions and the situation of the areas have been generally favorable for the development of the type, as well as for that of the surrounding types so that practically the whole region in which the type occurs consists of improved land. The settlement in these sections is comparatively dense. Unimproved land of this type has a timber growth of pine, fir, spruce, and some hardwoods.

This is a moderately productive, easily tilled soil. It does not bake or clod and has a medium organic-matter content. The moisture-holding capacity is fairly good. Much of the land, however, is quickly affected by an increase in the rainfall, and artificial drainage is essential to the production of a sufficiently varied group of crops and to good farming methods generally.

General farming with the production of hay of chief importance best describes the type of farming. No great variety of crops is grown on this type. At least 75 per cent of the acreage in cultivation is devoted to the production of hay. Small grain, mainly oats, and potatoes, fruit, and garden vegetables are minor crops, grown largely for home use. A large part of the hay is fed to stock on the

farm. Dairying is practiced on a small scale. The dairy herds are mostly small and of medium grade. The sale of hay, of a small quantity of dairy products, of a few beef cattle and hogs, and of eggs and poultry provide the greater part of the income on the farms of this type.

Hay yields from one-half to over 1 ton per acre. Oats are seldom thrashed, being fed in the straw. The crop makes a good growth and fills well in most seasons. The yields should be good. The other crops are seldom grown in commercial quantities and average yields are not available. The type produces abundant pasturage when well seeded.

The common practice is to plow a few acres of sod land each year for cultivated crops. The following season this is sown to oats and seeded to grass. Both timothy and clover are sown at the time of seeding, but the clover seldom lasts more than one or two seasons except in a few better drained fields. The acreage plowed each year is so small that it requires a number of years to pass all sod land through the rotation. In the meantime the grass land becomes infested with weeds and grasses other than timothy or clover. Thus not only the yields but also the value of the hay crop is greatly diminished. Barn space is available for all the hay crop.

The farm supply of stable manure is applied to fields plowed for cultivated crops, either before or after plowing. Commercial fertilizers are used sparingly at the time of seeding the grass. The plowing of sod is done in the fall when possible. The use of lime and green-manure crops is not practiced. A second cutting of hay is obtained from some of the newly seeded fields in certain seasons.

From the few recent sales reported the price of this land may be placed at $15 to $35 an acre. In sections near cities and towns it has a somewhat higher value. A shorter rotation of crops should be adopted on this soil, in order to keep the meadows in better condition and to keep the soil generally in a more productive state. Applications of lime would be beneficial. The type is capable of giving a much greater income than is possible under the present methods of farming.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Orono fine sandy loam:

Mechanical analyses of Orono fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100357	Soil	0.4	1.6	1.4	57.4	22.0	8.9	8.2
100358	Subsoil	.6	2.4	1.8	77.8	9.6	3.6	4.4
100359	Lower subsoil	.0	.1	.1	6.3	9.8	45.2	38.6

ORONO LOAM.

The Orono loam consists of 10 to 12 inches of brown loam underlain by grayish-yellow to gray loamy fine sand to loamy sand which rests, at a depth of 20 to 26 inches, upon a slightly greenish gray silty clay. The substratum is similar to the lower subsoil. Gravel and bowlders, either rounded or angular, are practically absent. The structure of the soil is friable, of the upper subsoil comparatively loose, and of the lower subsoil stiff and impervious.

The light intermediate stratum or upper subsoil is typical and the soil seldom if ever rests directly upon the silty clay. There is a range in the character of this layer from loamy sand to very fine sandy loam in texture and from yellow to gray in color. These variations are of local occurrence and minor extent. The change from upper to lower subsoil is abrupt, and there is practically no change or variation in the texture and color of the latter material.

In a few areas the Orono loam was mapped where soils of silt loam and of fine sandy loam textures were so mixed that their separation was impossible. In places the loam soil appears to have been modified by material washed from the higher lying types, especially the Merrimac sandy loam; here the texture is somewhat coarser than typical.

The Orono loam occupies areas a few acres to several hundred acres in extent in the towns of Gorham, Windham, Westbrook, Scarboro, Portland, and Falmouth. It is most commonly associated with the Orono silt loam, which, as a rule, occupies lower elevations.

The surface of this type is undulating to gently rolling, being intermediate between that of the rolling silt loam and the rather level fine sandy loam of the same series. In Gorham and Windham Towns it has a higher position than any other type of the series. In a few places, especially within the city limits of Portland, it has a relatively low position. All the type occurs below elevations of 250 feet above sea level. In Windham Town it has an intermediate position between the higher soils of the Gloucester or Merrimac series and the Orono silt loam.

The drainage ranges from imperfect to good. The small, high areas are well drained, while others which occupy a low position or such as to permit them to receive seepage water from higher types are rather poorly drained. The surface is as a rule well drained, but the heavy lower subsoil retards drainage so that the upper subsoil holds considerable water after heavy rains.

The lower subsoil of this type consists of the stratified marine clays common to the series. The soil and upper subsoil material appears in many cases to have originally been similar to that now forming the soil and upper subsoil of the fine sandy loam of the

series. That the texture is slightly heavier than in the latter type is due to weathering and to reworking of the deposits.

The Orono loam is one of the less extensive types of the series. It has a total area of less than 5 square miles. As practically all of it is under cultivation, it has some importance in the agriculture of the county. Like other members of the series the sections in which this type occurs are thickly settled and well developed.

This is a desirable soil for general farming. Where well drained and near markets, special crops would be profitable. The soil has a moderate content of organic matter. It is easily cultivated under a fairly wide range in moisture conditions, yet holds moisture well where properly tilled.

The class of farming and kinds of crops are the same as for the better drained parts of the fine sandy loam and for the silt loam of the series. Hay is the chief crop. Potatoes, grain, fruit, and vegetables are grown, largely for home use. Dairying is a minor industry.

The yields of crops, the farm methods, and the value of the type are practically the same as for the Orono silt loam.

The Orono loam is adapted to the production of a variety of crops, including hay, grain, potatoes, and fruit. When well drained it should be one of the best soils in the county for potatoes. Berries should also do well. Attention should be given to improvement in the drainage of certain areas and to the adoption of a definite short rotation of crops suited to the needs of the soil. The use of green-manure crops, together with applications of lime in some form, should be adopted.

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

Mechanical analyses of Orono loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100351	Soil	5.0	15.1	7.2	15.6	16.0	32.7	8.2
100352	Subsoil	7.2	24.6	9.6	20.6	13.5	17.8	6.7
100353	Lower subsoil	1.6	6.8	3.8	9.4	8.2	41.2	29.2

ORONO SILT LOAM.

The soil of the Orono silt loam is a light-brown silt loam of friable structure, having an average depth of 10 inches. The subsoil is a stiff grayish silty clay extending to a depth of 3 feet or more. In many places the subsoil is faintly mottled with yellow and rusty brown. The substratum is similar to the subsoil and extends to a

depth of many feet. Sand, gravel, and other coarse material occur only in contact with higher lying and lighter types. The presence of bowlders is rare. They occur only on the surface. The change from soil to subsoil is as a rule abrupt.

There is some range in color and texture of the type as mapped. On the shorter and steeper slopes to drainage ways the soil is shallower, grayer, and heavier than typical. On knolls a fine sandy material often occurs, which, if of sufficient size, would be mapped as the fine sandy loam of the series. Between this and the typical silt loam there is frequently a narrow belt which has the texture of a loam. In places the texture is a heavy silt loam approaching a silty clay loam, in others it is a silty loam. The silt loam texture, however, predominates in all areas mapped as the Orono silt loam. The other textures occur in small areas and are not of sufficient agricultural importance to warrant separation.

In places an intermediate layer of a yellowish silt loam lies between the surface soil and the typical heavy subsoil. This is usually thin and covers areas of small extent. The subsoil is usually massive, but in deeper cuts there is a more or less well defined system of horizontal bedding planes. The material cracks and checks into cubes upon drying. The depth of the deposits from which the type is formed varies widely in different parts of the same valleys. In general the thickness is greatest on the lowlands and least on the adjacent slopes. Although the boundaries between this type and the adjacent upland types are well defined, the material lies unconformably upon the ice-laid deposits beneath, and knobs of this material frequently project above the surface of the type. These have either been exposed by erosion or have never been covered by the stratified deposits. Such conditions are most common in the Pleasant River Valley and on the islands in Casco Bay.

This type is extensively developed in over one-half of the towns of the county. It is confined mainly to sections having an elevation less than 250 feet above sea level and the southeastern half of the county. Here it is the prevailing type in the valleys of all the principal streams and many of the minor streams. Other types of the series and soils of the Adams series are associated with it. It occupies an almost continuous body of irregular outline, inclosing many areas both large and small of other soil types.

The type has a distinctive topography, by which it is easily recognized. Considered as a whole, the topography is gently sloping and very gently rolling to rolling. In detail the soil has typically an eroded surface with rounded outline. The divides are narrow to broad but seldom sharp. The soil has a greater diversity of topography and elevation than the other types of the series.

Surface drainage is well established; underdrainage is retarded by the impervious subsoil and substratum. Water seldom stands on the surface after rains, and a much greater proportion of the rainfall runs off during and immediately after rains than in the case of other types of the series. In places artificial drainage is necessary to the fullest development of the type.

The materials giving rise to this soil were deposited in quiet marine waters during late glacial times. The present surface features are the results of erosion. The lighter texture of the soil as compared with that of the subsoil is due in part to the washing out of fine particles of clay in the upper part of the 3-foot section during the development of the drainage and in part to originally differing materials.

The Orono silt loam is the most extensive type of the series. It is also one of the most extensive types in the county and a greater proportion of it is in cultivation than of any of the other extensive types. A favorable topography and location, freedom from bowlders and rocks, and the capacity to hold moisture well have been the chief factors in its development. It is characterized by fairly thick settlement, moderate-sized farms, and good farm buildings.

This is a productive and desirable soil for both general and intensive farming. It has a moderate content of organic matter. Cultivation is fairly easy. If handled under proper moisture conditions, a good tilth results, but if worked when too wet it clods and bakes badly. It has a favorable location with respect to markets and shipping points. The proportion of waste land on farms is relatively small. On the whole this is one of the safest soils in the county in a season of unusually high or low rainfall as well as in normal seasons.

General farming with a tendency toward specialization in the production of hay is the prevailing type of farming. Dairy farming, while not a dominant industry, is practiced more largely than on other soil types of the county. Hay is the chief crop, approximately 75 per cent of the cultivated area being given to its production. A large part of the hay is used to feed work, dairy, and other stock on the farm. The remainder finds a ready market in the near-by towns. While the majority of the farmers plant potatoes for home use alone and not on a commercial scale, this is an important minor crop and on certain farms provides a large part of the farm income. Oats are practically the only variety of grain grown and are usually fed in the straw. A small acreage of Hungarian grass is sown for forage. Corn is grown to a limited extent in favorable locations. It is used for ensilage rather than for the grain. There are no commercial orchards on this type, fruit being grown only for home use. In a few localities a small acreage is devoted to cabbage.

Vegetables are a garden crop. A few small tracts with a favorable location near Portland and certain of the larger towns are intensively farmed to truck crops and strawberries. A considerable acreage is used for pastures.

Dairy products are produced on many of the farms on this type but only on a few is dairying the dominant industry. On the majority of the farms only enough cows are kept to provide milk and butter for home use; a small surplus is sold during the summer months. The growing and feeding of beef stock is not a special industry, and yet the aggregate income from the sale of such stock, consisting of one or two animals and in some cases more per farm, annually amounts to a considerable sum. On nearly every farm hogs are raised to provide pork for home use and there is usually a surplus of pigs and meat products to be sold in the local markets. Poultry products also bring in considerable income. Poultry raising is receiving more attention as a specialty each year. On at least 90 per cent of the farms on this type the farm income is derived from a mixed source.

Of the extensive soil types this is among the best in the county for the production of hay and grain. It is also an important general-purpose soil. All crops seem to do well with proper attention. There is less seasonal variation in the fields than on certain other soils, which may produce greater yields of some crops in favorable seasons. Hay yields from one-half to 3 tons per acre, with an average yield of 1 ton per acre. In favorable locations which afford protection from early fall frosts short-season varieties of corn do well. The yield of potatoes ranges from 100 to 300 bushels per acre. Yields of from 40 to 70 bushels of oats per acre are reported. Cabbage yields on the average about 10 tons per acre. The soil makes good pastures.

A rotation of crops is practiced in a general way. It consists of one or two years in tilled crops, one year in oats with a seeding to grass, and then several years in sod. The farm supply of stable manure is usually applied to land used for cultivated crops either before or after plowing, which is done, whenever possible, in the fall. Some commercial fertilizers are used on these crops. Both timothy and clover are sown with the grain crop. Good stands are usually obtained, but as the land has been farmed for a long time and has become rather foul, weeds and wild grasses quickly become abundant and the yields of hay decrease. The clover except on the best drained areas does not last for more than one or two seasons. Frost is largely responsible for its disappearance. Little or no lime and no green-manure crops are used. In some cases seeding to grass immediately follows fall plowing without the use of a cultivated or grain crop in the rotation.

The greater part of this type is easily accessible to transportation and marketing facilities. Its value therefore depends largely upon its fertility and desirability, as well as upon the farm improvements. The selling price of farm lands averages rather low throughout the county, and the demand is not strong. This type sells for $25 to $50 an acre. The soil material is from sources other than limestone and is doubtless somewhat acid in the surface soil. The subsoil seems to be slightly calcareous. An increase in the organic-matter content would improve the productiveness. This may be accomplished by feeding the greater part of the crops and returning the manure to the soil, and by plowing under green-manure crops. Cover crops to aid in preventing leaching and the greater use of leguminous crops are recommended. As hay is the main crop under the present system of farming, more attention should be given to improving the sod land. Weeds should be cut before their seeding time and a shorter rotation should be adopted. There are a few of the farmers who are attempting to adopt some of the better methods of farming, and their example will be followed as their success is noticed.

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

Mechanical analyses of Orono silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100305, 100349.	Soil.....	2.8	4.6	1.9	7.5	15.0	52.3	15.9
100306, 100350.	Subsoil.....	.2	1.2	.8	4.8	6.6	44.7	41.6

SUFFIELD COARSE SAND.

The Suffield coarse sand consists of 10 to 20 inches of a light-gray, medium to coarse sand, underlain by a stiff, grayish clay, similar to that forming the subsoil of the Orono type, extending to a depth of many feet. The immediate surface is in places somewhat mucky and dark colored, and an accumulation of muck appears to have covered at one time a somewhat greater part of the surface and to have been burned off.

The type occupies a flat area about 6 miles southwest of Portland. Upon the generally level surface there are numerous small mounds or hummocks of deeper sandy material. The elevation of the type is about 50 feet above sea level. The area is poorly drained and frequently remains saturated with water during the greater part of the year. The run-off is slow and the subdrainage is much restricted.

The Suffield coarse sand represents a thinning out to the south of the sandy mantle which forms the Adams sandy loam and the Scar-

boro loamy sand. Apparently the only modification since deposition has been an accumulation of small quantities of organic matter. The soil consists of material derived from crystalline rocks and deposited by moving water. The subsoil and substratum consist of material from a similar source but deposited in very quiet water, probably in an arm of the sea.

There is less than a square mile of this type and none of it is in cultivation. It supports at present only a small growth of pine, birch, and underbrush. Its development for farming has been retarded by poor drainage and low productiveness. There is no immediate prospect of its reclamation.

SUFFIELD SILT LOAM.

The Suffield silt loam consists of a dark-gray silt loam 6 to 8 inches deep, resting upon a silty clay, gray mottled with yellow and brown, which extends to a depth of 3 feet or more. Bowlders, cobbles or gravel do not occur within the type, though it is usually underlain at depths of 4 to 10 feet by glacial till. Timbered areas have a dark-gray to nearly black color in the immediate surface.

Included with this type are a few small areas of fine sandy loam and silty clay loam. These were not of sufficient importance to warrant the establishing of a new and separate type for each. They closely resemble the silt loam in all respects except texture.

This type covers areas ranging in size from 50 to 250 acres lying within the glaciated uplands of the county. They occur at elevations in excess of that of the Orono series. The largest areas are found 3 miles east of Bridgton, 1 mile southwest of North Pownal, 1 mile southeast of Cooks Mills, south of South Portland, near North Deering, several in the eastern part of the town of Windham, and two in the southern part of the town of Baldwin.

In most cases the type appears to occupy basinlike areas either traversed by streams or lying at the heads of streams. The surface is flat and both surface and subsurface drainage are slow. Water often stands on the surface for some time after rains. The soil lies at elevations between 200 to 350 feet above sea level.

The topography, position, and character of the type indicate that its origin is mainly lacustrine, with some modification by the addition of more recent alluvial material. The sediments forming the type have been derived mainly from the surrounding Gloucester soils.

The Suffield silt loam is a minor soil type in the county. Approximately 50 per cent of it is in cultivation. The remainder supports a growth of pine, oak, maple, and other hardwoods. Nearly all the cleared area is used for hay, which gives good yields in favorable seasons.

The type has a topography favorable for farming operations. It contains much organic matter, but is difficult to cultivate on account of its tendency to clod and bake unless tilled in the proper condition with respect to moisture content. It is adapted to general farming and especially to hay and grain production. Artificial drainage is essential and may be accomplished at a reasonable cost.

The value of this type by itself could not be ascertained as tracts located wholly on it are seldom sold. Together with surrounding types it sells for $20 to $40 an acre.

SUFFIELD SILTY CLAY LOAM.

The soil of the Suffield silty clay loam is a gray silty clay loam from 4 to 6 inches deep. It is compact and hard when dry and slightly plastic when wet. The organic-matter content ranges from low to high, and the color of the soil varies accordingly. The soil material changes abruptly to the stiff, gray silty clay forming the subsoil, which extends to a depth of 3 feet or more. This usually shows faint mottlings of yellow and rusty brown. The substratum is similar to the subsoil and continues to a depth of many feet without marked change. The type is practically free from coarse sandy material, gravel, and bowlders.

In places, especially where the soil is deepest, the surface has a dark-gray color; where the depth is least the color is light gray. Areas of very shallow soil are common, and in places the subsoil is practically at the surface. The subsoil usually has a slightly greenish cast.

The type has the same distribution as the Orono silt loam series but occupies lower situations, mainly below the 150-foot contour. It is confined to the southeastern half of the county and is found mainly in the towns of Westbrook, Portland, Gorham, Scarboro, Cumberland, North Yarmouth, Brunswick, and Harpswell. The Orono silt loam is most closely associated with it in occurrence.

The surface is level or very gently sloping to undulating. In places the areas are basinlike. Both surface and subsurface drainage are slow, and water frequently stands on the surface of many areas for long periods after rains. The areas are in a wet condition during a considerable part of the year. Small, shallow stream courses, which cross nearly every area, afford the only means of drainage.

This type more nearly represents the character of the marine clays as originally laid down than the lighter and better drained soils included in the Orono series. There has been practically no modification by weathering, oxidation or erosion since its deposition. The only modification has resulted from poor drainage conditions and a slight accumulation of organic matter. In a few in-

stances erosion of the surface silt loam material has resulted in the formation of this type.

Practically all the Suffield silty clay loam is cleared and in cultivation. It is a soil of some importance in the agriculture of the county. It consists of more or less isolated bodies from a few acres to several hundred acres in extent so situated that farms are seldom wholly on it, the farm buildings usually being placed on the surrounding higher and better drained soils. It is not as good a soil as the Orono silt loam, having a more restricted crop adaptation and being less productive on account of poor drainage.

The Suffield silty clay loam is naturally a strong soil, and the smoother surface and proximity to markets also make it a desirable type for farming. The poor drainage conditions tend to overcome these favorable features. Cultivation is considered difficult, and the soil must be worked at the proper stage of moisture content or it clods and bakes to such an extent that the yields are diminished. The topography permits the use of all kinds of farm machinery, though the wet condition of the soil sometimes prevents their use at the desired time. The soil warms up slowly in the spring. It retains a fair supply of moisture during droughts.

General farming with hay as the chief crop is the usual kind of farming on this type. At least 90 per cent of the tilled area is in grass. The remainder is used for the production of grain and pasturage crops. Cultivated crops, such as potatoes and other vegetables, are seldom grown. No orchards are located on it. The disposal of the crops grown is the same as on the Orono silt loam.

Hay yields from one-half to 3 tons per acre. The grain crop is rarely thrashed.

Little or no attention is paid to the rotation of crops on this type. The soil is not well adapted to the production of intertilled crops and therefore small grains are about the only crops available for rotation with hay. The fields are kept in grass as long as they produce profitable yields; they are then plowed in the fall and immediately reseeded to grass or are sowed the following spring to oats and grass. Timothy is the chief hay grass, as clover does not catch well or last long on such wet land. A majority of the hay fields are extremely weedy. Good yields of hay of fine quality are usually produced for one or two years after seeding. Occasionally two crops are cut the same season. The fields are pastured after the hay is removed.

Land of this type is valued at $20 to $50 an acre. It is seldom sold by itself but as a part of farms made up largely of other types.

The greatest need of the Suffield silty clay loam is drainage, which can be accomplished at a comparatively small cost, though in some instances cooperation among the owners will be necessary for satis-

factory results. Open and tile drains with a wider and deeper main ditch would provide sufficient drainage. When drained the cultivation of the type would be much easier and could be done at the proper season, so that there would be no delay in the seeding and handling of the crops. It would be adapted to a greater variety of crops and larger yields would be obtained. The recommendations given in the discussion of the Orono silt loam also apply to this.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Suffield silty clay loam:

Mechanical analyses of Suffield silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100313	Soil	0.3	0.6	0.4	1.2	6.6	57.0	33.9
100314	Subsoil	.0	.4	.4	2.8	10.2	48.5	37.7

PODUNK FINE SANDY LOAM.

The surface soil of the Podunk fine sandy loam is a light-brown to brown fine sandy loam, with an average depth of 12 inches. The subsoil is a lighter brown to grayish-brown fine sandy loam to fine sand, extending to a depth of 3 feet or more. The substratum is similar to the subsoil.

There are a number of variations from the typical description which are worthy of mention, though not of enough importance to warrant separate mapping. Along some of the smaller streams poor drainage conditions have resulted in the development of a soil of dark-gray color, with a mottled gray and brown subsoil. Generally in such areas the soil material is quite variable in texture ranging from coarse sandy to silty. Along streams heading in the soils of the Orono series the texture grades toward a very fine sandy loam of typical color. Along the large rivers like the Saco and Androscoggin the soil is a brown fine sandy loam, underlain by yellowish-brown fine sand subsoil. The texture and color are lighter near the banks of the streams along which it occurs. Areas of the Podunk fine sandy loam too narrow to map are included with adjoining soil types.

The most extensive development of this type is found along the Presumpscot, Royal, Pleasant, and Piscataqua Rivers. These areas vary from 400 feet to a quarter of a mile or more in width. They are not continuous along the entire courses of the rivers, but are found usually first on one side then on the other, though they may lie in places on both sides of the rivers. Some areas occur along

the Androscoggin River and several are mapped along certain of the smaller streams.

The surface of this type is typical of first-bottom soils. It is slightly higher near the banks of the streams than near the adjacent uplands. There is also a slight slope in the direction of the flow of the streams. The surface lies from 4 to 10 feet or more above the normal level of the present stream channels and is overflowed only during periods of excessively high water. The periods of overflow are comparatively short and infrequent. At all other times the greater part of the type is fairly well drained. Small areas have a restricted drainage.

Practically all the type is cleared and farmed to hay and grain. The narrow bottoms are cultivated in conjunction with adjoining soils. Considering its small extent this is a relatively important agricultural soil type. Its low position practically precludes its use for crops whose growing season renders them subject to damage by frost.

Both topography and character of soil are as a rule favorable for agriculture and the type is a desirable one for general and certain special farm crops. The overflow periods are not sufficiently long or frequent to cause serious loss or damage of crops. Cultivation is comparatively easy and the moisture-holding capacity of the type is good. The type is relatively productive. It has good market and transportation facilities. The type is sold in conjunction with adjoining soil types for $15 to $50 an acre.

When first seeded good yields of hay of fine quality are produced, but both yield and quality decrease rapidly as the fields are mowed year after year. If impracticable to shorten the time the sod is allowed to stand, attention should at least be given to improving it by the use of stable manure or fertilizers.

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

Mechanical analyses of Podunk fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100360	Soil	0.0	2.0	4.6	50.2	22.4	15.0	5.8
100361	Subsoil	.3	3.5	2.9	44.8	27.4	15.7	5.2

SACO SILT LOAM.

The soil of the Saco silt loam is a light grayish brown silt loam, with an average depth of 10 inches. It is underlain to a depth of 3 feet or more by a gray silty clay loam to silty clay, which in places

shows faint mottlings of brown and yellow. A substratum similar to the subsoil underlies the type. Material coarser than fine sand does not occur in the soil or subsoil.

In places small areas of fine sandy texture are found near the stream courses, while in others, especially in slight depressions, material slightly heavier than silt loam and of darker color occurs. This latter variation is found in parts of the areas along the Royal River, and here in places a thin deposit of mucky material covers the surface.

The Saco silt loam is found along the course of the Nonesuch River from the county line to the upper limit of the Tidal marsh, a distance of nearly 9 miles. This area is from 500 feet to one-fourth mile in width. Another area one-half mile wide and approximately 4 miles in length lies in the Royal River Valley east of the village of New Gloucester.

The area along the Nonesuch River occupies a level valley floor along the greater part of the valley. Steep and, in places, almost precipitous slopes rise immediately from the margin of the type. The Nonesuch River has a rather sluggish current and winding course in a shallow channel through this area. The elevation of the area increases gradually from 20 to 100 feet above sea level. A few old channels and cut-offs cross it.

The flat occupied by the area of Saco silt loam east of New Gloucester represents a widening of the floor of the Royal River Valley. Both above and below this area there is only a narrow strip of Podunk fine sandy loam. The surface is practically level and the type is subject to overflow. Water stands on the surface for comparatively long periods after overflow, and much of this area is in a water-logged condition during the greater part of the year. The Royal River, with a sluggish current, flows across it in a meandering channel. The area lies at an approximate elevation of 100 feet above sea level, and there is less than 20 feet difference in elevation in the lower and upper limits.

The material forming this type consists of sediments derived from the Gloucester and Orono soils which have been deposited during periods of overflow. In places there has been some modification resulting from poor drainage and accumulation of organic matter.

The type closely conforms in color and texture of subsoil to the soils of the Orono series, but its position and origin preclude its correlation with that series.

The type does not represent a deposition of material under strictly alluvial conditions. The process of formation has been influenced to a large extent by lacustrine deposition.

All the type is cleared and practically all of it is farmed to hay. During the time of the survey none of the area along the

Nonesuch River was in use for any other crop. The fields have been in sod for a number of years. The stand of grass is good, but consists of mixed varieties, and does not produce a first quality of hay. The farming of the area near New Gloucester is slightly more varied. A few small fields in the less poorly drained parts are plowed and sowed to oats, but by far the greater part of this area is in permanent mowings, and has been used for that purpose for a number of seasons. The most poorly drained areas produce only crops of wild hay of rather poor quality.

Haying is handicapped and often delayed by the wet condition of the land. In the unusually wet summer of 1915 haying began early in August and continued well along into September.

Buildings on the farms including this type are located on areas of higher lying soil types. Whole farms are seldom composed of this type alone. The fields are fairly large. Cultivated crops are rarely grown and reseeding to grass usually follows a fall plowing. Manure and commercial fertilizers are seldom used.

Land of this character is valued at $10 to $20 an acre. Few sales of this type by itself or together with the adjoining soils have been made in recent years.

Improvement of the drainage conditions is the first and most essential step in the development of this type. Cooperation among the land owners is necessary for satisfactory results in most cases. Drainage is practicable from the standpoints of topography and cost. It is believed the use of lime would greatly benefit the greater part of the type.

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

Mechanical analyses of Saco silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
100315	Soil	0.0	0.4	0.4	3.0	14.9	56.8	24.6
100316	Subsoil	.0	.1	.1	2.0	17.6	56.3	23.9

MUCK AND PEAT.

The growth and decay of water-loving vegetation flourishing in certain poorly drained areas gradually forms accumulations of more or less decomposed organic matter, which when quite thoroughly decomposed and mixed with a small proportion of mineral matter is classed as Muck, but when only partially decomposed and practically free from mineral matter is known as Peat. On account of intricate

association of the two and their small total extent in the county, they are mapped together.

Muck consists of a dark-brown to black, smooth, finely divided and thoroughly decomposed mass of organic matter with an admixture of mineral matter consisting of silt, clay, and fine sand. The fine sand occurs mainly in marginal and other shallow areas. The depth of the organic deposits ranges from 18 inches to 3 feet or more. To a depth of 18 to 24 inches the material is fairly uniform in texture, color, and structure. Mucky material of greater depth has a slightly more fibrous texture and a dark-brown color. The typical Muck is usually sticky to somewhat plastic when wet.

The separation of Muck from Tidal marsh in the section south and southeast of Portland is based mainly upon the presence of a growth of small trees on the former. One type grades into the other so gradually that no definite boundary can be based upon texture and structure of material. These areas which lie just beyond the Tidal marsh have doubtless been influenced to some extent by salt water and salt-water vegetation.

The underlying material varies with the position in which the type has been developed. On sandy terraces and along streams it is either a gray sand or sandy loam. Within areas of glacial till it consists of compact deposits of ice-laid material of clay or of bedrock. As a rule, the more shallow areas are found on the terraces. Depths of 25 feet are reported for some of the bogs. The depth of the organic accumulations around Great Pond in Cape Elizabeth Town varies from 3 to 13 feet.[1] The depth in an area one-half mile east of Highland Lake (Duck Pond) is said to be from 17 to 18 feet. The deposit in Rigby Bog south of Portland varies in depth from 1 to 2 feet.

Peat is a brown, fibrous mass of partially decayed vegetation, with admixture of very little mineral matter. In depth it varies from 1 or 2 feet to more than 15 feet. The sandy material of the terraces or the glacial till of the uplands underlies the organic accumulation.

One area along Merrymeeting Bay, about 5 miles northeast of Brunswick, might be classed as a salt-water variation of Peat. It conforms to the general description of the type, but occurs on a tidal flat, and is at times covered by rather brackish water. It lies practically at the mouth of the Androscoggin River.

Muck and Peat have a fairly wide distribution over the county. Areas from 10 to 250 acres or more in extent are found within the limits of all the soil series in the county except the Orono and Podunk. They lie along streams, around ponds, and in broad depressions, where the wet conditions have been favorable for the growth and decay of vegetation and the accumulation of the resulting prod-

[1] "The Peat Deposits of Maine," U. S. Geol. Sur., Bul. 376.

ucts. Among the largest of the areas of Muck are the Rigby Bog southeast of Portland, the area around Great Pond, in Cape Elizabeth Town; areas along Dunstan River, in Scarboro Town; along North West River, in Sebago Town; and others near Richville, in Standish Town, west of Bridgton village, and a few miles south of Harrison village. Numerous areas too small to show on the soil map are included with the surrounding types.

Several areas of a distinctly peaty character ranging from a few acres to 200 acres or more in extent occur in different sections of the county. Of these the principal areas are found one-half mile east of Highland Lake (Duck Pond), north of the city of Westbrook, 2 miles southeast of Bridgton village, at the south end of Rigby Bog, southeast of Portland, and the one already mentioned northeast of Brunswick.

The surface of the areas of Muck and Peat is practically flat. Along streams it has a slight slope in the direction of stream flow. In elevation the areas range from 15 to 500 feet or more above sea level. The streams crossing areas of these two soils have a very sluggish current and a meandering course. Ponds and sloughs occur in places. Water frequently stands on the surface for long periods, and the material is in a saturated condition during the greater part of the year.

Only a few acres of Muck, located along the Dunstan River in Scarboro Town, are in cultivation. This tract is used in certain seasons for oats. In other seasons crops of hay are cut. The yields are fairly good in favorable seasons.

Peat and Muck are rarely sold alone, and the sale value is difficult to fix. It could doubtless be purchased for $5 an acre.

The drainage of much of the Muck is possible and practicable. When well drained it is adapted to the production of onions, celery, lettuce, cabbage, and other truck crops. With proper management and good marketing and shipping facilities, these crops can be made to give big returns on the investment for the land and its preparation for farming. Cranberries should prove a profitable crop where the bogs may be flooded easily.

None of the Peat is under cultivation. When cleared and drained it could be used for hay. The returns from this source would probably not justify the expense of preparation. It is not well adapted to cultivated crops, even when drained. Cranberries would be successful on those bogs which can be easily flooded.

Investigations have been made by private parties and by the United States Geological Survey[1] to determine the character, extent, and value of these deposits for fuel. Peat may be used as a

[1] "The Peat Deposits of Maine." Bull. 376, U. S. Geol. Sur.

source of organic matter for those soils which are low in that constituent. It may also be used as an absorbent in stables.

ROUGH STONY LAND.

Rough stony land comprises the areas of such a rough and stony character that their development for farming is practically impossible. In Cumberland County two variations of this material are found; one comprises areas underlain by the crystalline rock, granite or gneiss, the other those underlain by mica, schist, and associated rocks. These variations are not shown separately on the soil map, as none of the type is agricultural.

TIDAL MARSH.

Near the coast and bordering the tidal streams for short distances inland, the low, flat, treeless areas supporting a salt-loving vegetation are mapped as Tidal marsh. Such areas are known locally as "tide flats."

The typical dark-gray to black, mucky surface material extends from a depth of 12 inches to 3 feet or more below the surface. The relative percentage of sand, silt, and clay in the soil varies widely, the sand being most abundant near areas of Coastal beach and in areas of shallow soil, while the silt and clay are most common near the main and tributary stream channels. The subsoil where developed ranges from a gray or drab sand to silty clay loam. The mucky material contains in places some coarse fibrous matter. Over the greater part of the type the mucky surface material probably extends to depths greater than 3 feet.

The boundary between this type and areas of Muck farther up the stream courses is rather indefinite, and the basis of separation in a number of cases was the change from a growth of grasses to one of forest trees.

The largest area of Tidal marsh occurs in the southeastern part of Scarboro Town, where Mill Brook and Dunstan, Nonesuch, and Libby Rivers join just before emptying into the ocean between Prouts Neck and Pine Point. Quite an area lies along Spurwink River south of Portland. Small areas are found on the ocean side of Falmouth, Cumberland, Yarmouth, Freeport, Brunswick, and Harpswell towns.

Tidal marsh is subject to overflow, though parts of it are covered only at times of highest tide. One main channel, wide near the coast and narrowing inland, together with many winding tributaries, traverses the various areas of the type.

Tidal marsh has been formed through the deposit of sediments washed mainly by tidal water from the drainage basins of the streams

along which it occurs, mixed with accumulations of the remains of salt-loving vegetation.

Coarse grasses and rushes comprise the native vegetation on Tidal marsh areas. These are cut for hay, which is used for forage and bedding. It is cut during low tide and placed for curing on platforms raised from 2 to 3 feet above the level of the ground. It is hauled after the ground has frozen. The feeding value is rather low.

COASTAL BEACH.

Areas of loose sandy material along the ocean front are classed as Coastal beach. This includes the wave-swept and tide-swept areas as well as the high-lying or dunelike areas immediately back of the beach proper. The former consist of different grades of sand with small quantities of gravel in places, and slope gently to the sea. They support no vegetation. The dune areas consist of a loose grayish sand without gravel and owe their position and billowy surface to wind action. In places they support only a sparse growth of sand grasses, in others a scattering stand of scrub pines and grasses.

Coastal beach is found as comparatively narrow areas in coves and other places where conditions are favorable for the deposition of sandy material by shore currents. These areas are for the most part small and isolated and have no agricultural value.

SUMMARY.

Cumberland County lies in the southern part of the State of Maine and comprises 853 square miles, or 545,920 acres.

The county comprises two rather distinct physiographic divisions, one including the northwestern half of the county, a region of high, broadly rolling hills of rounded outline and an unsystematic arrangement of valleys, the other a flat to rolling plain studded with isolated rounded hills. The former has an average elevation of 600 to 700 feet, the latter 150 feet. The highest elevation in the county is on Pleasant Mountain, 1,920 feet. The Saddleback Hills, 1,407 feet, are conspicuous topographic features.

The Presumpscot River drains over one-half of the county. The Saco and Androscoggin Rivers, forming the southern and northern boundaries for short distances, drain small areas. The Royal River drains a part of the eastern section. The Stroudwater and Nonesuch Rivers and other small coastal streams drain the remainder. Only small local areas are poorly drained.

The greater part of the population is native born. In 1910 the population was 112,014, of which 22.8 per cent was rural, giving an average density of 30 persons per square mile. Portland, the county seat and largest city, had a population of 58,571 in 1910. Westbrook,

South Portland, and Brunswick are other important cities and towns.

The steam and electric railroad facilities are excellent. A section north and northeast of Sebago Lake is farthest from railroad communication. The county has an extensive system of good public roads.

The market facilities are good, as the urban greatly exceeds the rural population. The greater part of the crops are sold locally and the remainder is shipped to Boston and other points.

The climate is characterized by long, rather cold winters with a fairly heavy snowfall, and by short, pleasant summers. The mean annual precipitation of 42.63 inches is usually fairly well distributed throughout the year. There is a range in temperature from an absolute maximum of 97° F. to —17° F., with a mean annual temperature of 45.4° F. The average length of the growing season is 158 days. Climatic conditions are favorable to the production of a variety of annual farm crops.

Agriculture was the leading industry from the early settlement of the county until the development of manufacturing, which resulted in a rapid growth of cities and villages.

The acreage and production of crops declined after 1880, reaching a minimum between 1900 and 1910. Since that time the production has shown a gradual increase and an improvement in the general farming methods has taken place.

The prevailing type of agriculture is general farming, with hay as the principal product. Approximately three-fourths of the cleared acreage is devoted to the production of hay and forage crops. Vegetables, including potatoes, come next. The acreage in orchard fruits is next in order, and then come the cereals, with oats and corn as the leading crops of the class.

Dairying is an important industry as it furnishes about 20 per cent of the total agricultural income. Cattle and hogs sold and slaughtered afford approximately 14 per cent and poultry and eggs about 13 per cent of this total income. Thus the returns from livestock and animal products nearly equal the income from farm crops.

Timothy, clover, and other tame grasses are cut for hay, and corn is grown for silage. Sweet corn for canning purposes is an important product. Oats is practically the only grain and much of the crop is fed in the straw. Potatoes and cabbage are a source of considerable income. Garden vegetables are important crops with a few farmers, mainly those in the vicinity of the cities and large villages. Only a few commercial orchards are found. The farms average about 75 acres in size. The average area of improved land per farm is 29.5 acres. The farm buildings are as a rule commodious and well built. All crops and machinery are housed.

The general plan of rotation is intertilled crops for one or two years, oats, seeded with grass, one year, and hay several years. There is only a general recognition of the adaptability of soils to farm crops.

The use of fertilizers has increased rapidly in the last few years. Local labor is usually adequate for all farm operations. Land values have quite a range due to other than agricultural conditions.

The soils of the county are classed in six groups on a basis of origin: Soils derived from glacial till, from terrace deposits, from estuarine and glacial-lake deposits, from alluvial flood-plain deposits, from accumulations of organic matter, and miscellaneous nonagricultural. In all, 10 series with 21 soil types, 4 phases, and 4 miscellaneous types have been mapped.

The glacial-till soil covering the greater part of the uplands is the most extensive group. The six types and two phases of this group belong to the Gloucester and Whitman series. The terrace soils are next in extent and belong to the Merrimac, Adams, Hinckley, and Scarboro series. The soils derived from the estuarine and glacial lake deposits, another extensive group, belong in the Orono and Suffield series. The soils derived from recent flood-plain and organic-matter deposits are of comparatively small extent.

The Gloucester series is the most extensive series. The soils of this series are well adapted to general farming and to fruit when not too stony and too rough. The sandy loam of the series is the most extensive and about one-third of it is in cultivation.

The Whitman series, with only one type, is unimportant and inextensive. Poor drainage conditions render its agricultural value low.

The Merrimac series, comprising two types and one phase, is well drained and adapted to a variety of crops.

One type of the Hinckley series is mapped. This is a terrace soil of rough and eroded surface and nonagricultural character.

The Adams series, of which three types are mapped, has a varied agricultural value. The lighter types are unimproved, while the others are in part farmed to hay, grain, potatoes, and other crops.

The Scarboro series includes poorly drained types of terrace or delta-plain material. It comprises one type, which is mainly undeveloped.

The Orono series is represented by four types. A greater proportion of the land of this series is improved land than of any other series. The soils are adapted to a variety of crops, but especially hay and grain.

Three types of the Suffield series are shown. The silt loam and silty clay loam types are adapted to hay and grain, and are used largely for the production of those crops. The coarse sand is largely undeveloped.

The Podunk series comprises soil types which have brown soils and light to grayish-brown subsoils. The fine sandy loam, the only type of the series mapped, is not extensive. It is used principally in the production of hay.

The Saco silt loam is the only representative of this series. It is devoted mainly to the production of hay.

Muck and Peat need drainage and for the most part are not agriculturally developed. The former is a nearly black, finely divided mass of more or less thoroughly decomposed vegetable matter with a small percentage of mineral matter.

Rough stony land, Tidal marsh, and Coastal beach are mainly nonagricultural.

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[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.]

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