SOIL SURVEY

of the

ANDOVER–PLASTER ROCK AREA
NEW BRUNSWICK

J. F. G. MILLETTE and K. K. LANGMAID
Research Station
Fredericton, N. B.

FIFTH REPORT OF THE NEW BRUNSWICK SOIL SURVEY

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INTRODUCTION

This report is an inventory of the soil resources of about 1,290 square miles of the St. John and Tobique river valleys.

The accompanying soil map shows the locations, extents and distributions of the various soils. The soils of the settled sections are mapped in greater detail than those of the forested area. The map may not show, on individual farms, pockets of soil different from the soils mapped.

The report is useful not only to farmers and agricultural workers but also to those interested in land-use planning, forest and wildlife conservation, highway construction, geography and surface geology.

The soils were classified on the basis of the report of the Eastern Section of the National Soil Survey Committee, Ottawa, 1958. Some changes in classification were made at later meetings of the National Soil Survey Committee, but these changes are not given in this report.

GENERAL DESCRIPTION OF THE AREA

Location and Extent

The area surveyed is in the west-central section of New Brunswick (Figure 1). It lies between 46° 30′ and 47° 00′ north latitude and between 67° 00′ west longitude and the Canada-United States border. It comprises part or all of the parishes of Andover, Denmark, Gordon, Grand Falls, Perth, and Drummond in Victoria County; Kent and parts of Aberdeen and Wicklow in Carleton County; and a small, uninhabited section of Douglas in York County.

The total area surveyed is about 1,290 square miles, or 824,000 acres. There are about 14 square miles of lakes and rivers in the area.

Principal Towns

Andover, the shiretown of Victoria County, is on the west bank of the Saint John River in the southwest sector of the County. Across the river lies Perth, a railroad and lumbering center. Plaster Rock, on the Tobique River, and Juniper, on the Southwest Miramichi, are important sawmill towns. Small centers such as Bath, Upper Kent, Aroostook Junction, Salmonhurst, and New Denmark are railway shipping centers for agricultural products.

Population and Racial Origins

The population of the area was 17,200 in 1951 and showed little change in the 1956 census. The farming population is about 7,700. Most of the nonfarming population are employed in the pulpwood and lumber industries. About 90 percent of the population is of English, Scottish, and Irish descent, the remainder being of French, Danish, and Swedish origin.

Transportation and Markets

The western section of the surveyed area has an extensive network of gravel roads but the eastern part has few public roads. Highway No. 2, a hard-surfaced road, crosses the whole area along the Saint John River Valley. There are other hard-surfaced roads between Bristol and Juniper, Perth and Plaster Rock, Grand Falls and Plaster Rock. Two hard-surfaced roads extend from Highway No. 2 to the State of Maine. Two bridges cross the Saint John River

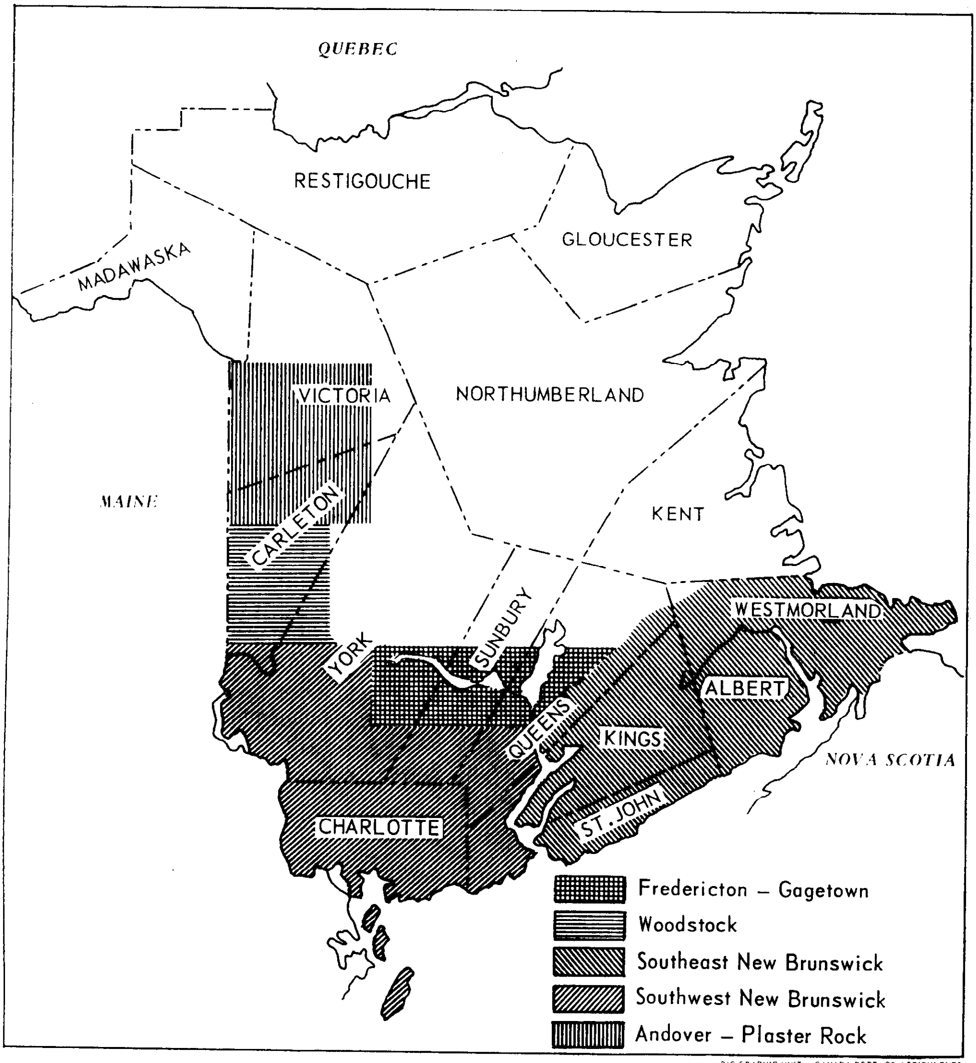


Figure 1.—Areas of New Brunswick in which the soils have been surveyed.

at Perth–Andover and at Limestone, and two more at Grand Falls and Florenceville, near the north and south limits of the surveyed area.

The Moncton–Edmundston line of the Canadian National Railways crosses the eastern section of the area diagonally from the northwest to the southeast. The Edmundston–McAdam line of the Canadian Pacific Railway runs north to south through the Saint John Valley, and has branches from Perth to Plaster Rock and from Aroostook Junction to Fort Fairfield, Maine.

Local markets for farm produce are small. The bulk of the produce is shipped to provincial or outside markets. Registered and certified potato stock is exported mainly to the United States and Central and South America.

Nonagricultural Industries

Lumbering is the main industry of the eastern section of the mapped area. Juniper has a large sawmill, a drying kiln, and a planing mill and Plaster Rock

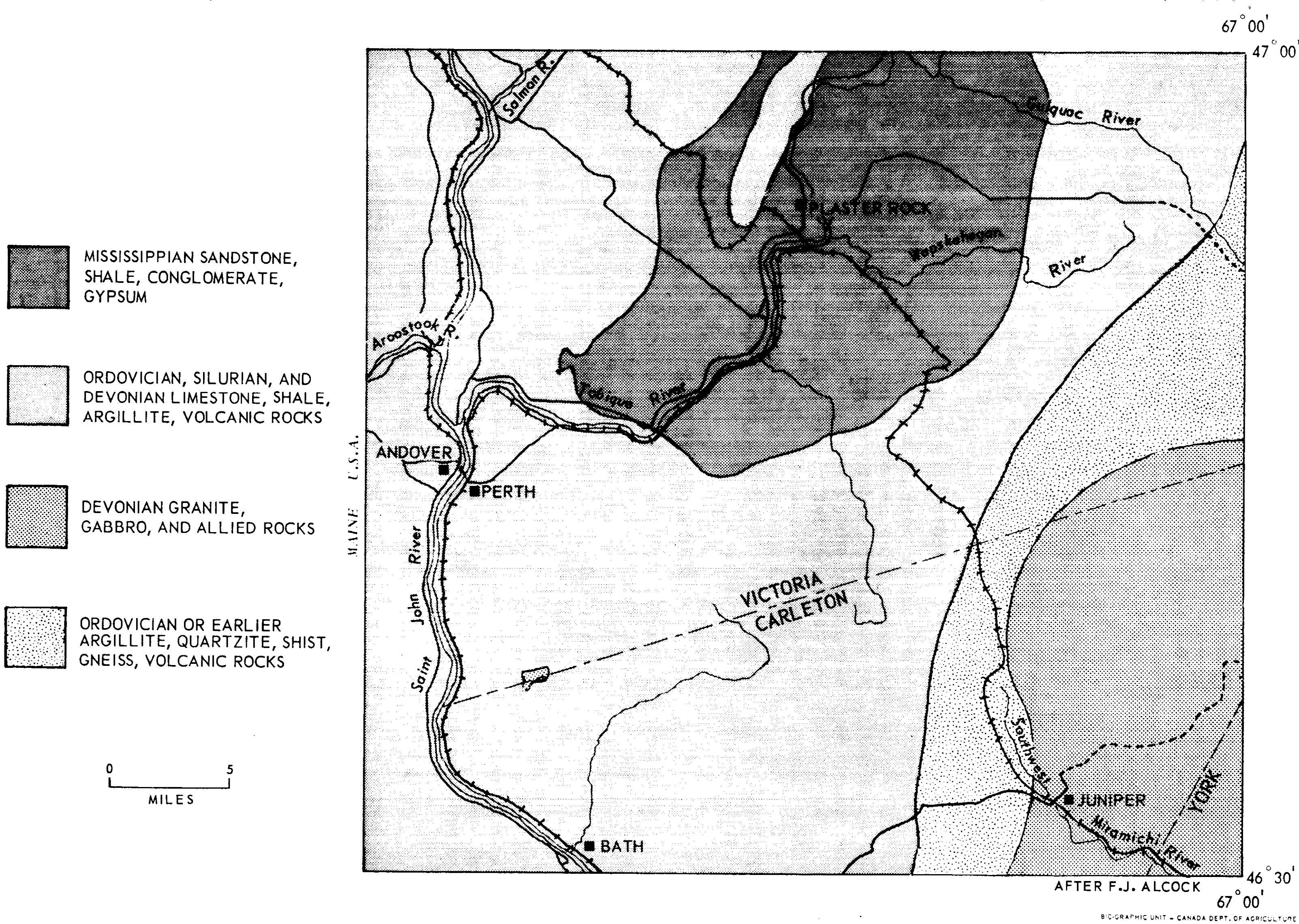


Figure 2.—Geology of surveyed area.

has two large sawmills. A number of small sawmills operate at Bath, River des Chute, Perth, Andover, and Rowena. The sawmills at River des Chute and Andover manufacture box shooks and barrel staves. Small woodworking shops throughout the surveyed area make doors and sashes.

Recent hydro developments at the mouth of the Tobique River and at Beechwood on the Saint John River made cheap power available for industrial expansion.

FACTORS IN SOIL FORMATION

Soil formation is affected by a number of processes, which in turn are influenced by numerous environmental factors, such as geology, climate, relief, vegetation, and time.

Bedrock Geology

The weathering of bedrock produces a primary soil material. In the surveyed area the same types of minerals occur in both the rock fragments and the fine-sand fraction of the till. The underlying bedrock has therefore influenced the mineralogical and perhaps other properties of the till.

Sedimentary and weakly metamorphosed sedimentary rocks of the Ordovician, Silurian, Devonian, and Mississippian periods underlie 60 percent of the area. Igneous and strongly metamorphosed rocks, which weather slowly, occur primarily in the eastern sector. The distributions of these are shown in Figure 2 and their compositions in Table 1.

Weathering of Rock

Rock weathering varies with the weathering agents and with the nature of the rock, such as its mineral composition, texture, structure, and cleavage. The nature of the bedrock affects the characteristics and properties of shallow soils more than deep till soils. The types of rock affect the texture, gravel content and stoniness of the soil.

The red rock of the Mississippian period weathered into red till closely related in texture to that of the underlying bedrock. Clay and clay loam (Kingsclear catena) is found over shale parent material, gravelly sandy loam to loam (Parleeville catena) over conglomerate, and sandy loam (Tobique series) over sandstone.

TABLE 1.—Geological Section of the Surveyed Area[1]

Period	Formation (group)	Lithology	Period	Formation (group)	Lithology
Carboniferous—Mississippian	Windsor	Red shale Red sandstone Red conglomerate with calcareous cement Gypsum	Silurian	—	Limestone Shale Argillite Slate Volcanic rocks
Devonian	—	Granite Gabbro and allied rocks	Ordovician or earlier	—	Argillite Quartzite Schist Gneiss Volcanic rocks

[1] Adapted from the geological map of the Maritime Provinces compiled by F. J. Alcock of the Geological Survey of Canada.

The granite, gabbro, and other volcanic rocks are highly resistant to weathering under the climatic conditions of the area, and tills derived from them have shallow and exceedingly stony soils developed on them (Juniper). The slates, quartzites, schists, and limestone weather more readily. Soils such as the Glassville and Kintore occur in areas with thin till cover; they are stony and have a deeply dissected and rugged topography.

Deep till generally occurs over soft rock, such as shale, argillite, and shaly limestone, and the soils developed on them have relatively few stones. Tills containing fragments of igneous and metamorphic rock have more stones and gravel than tills with fragments of sedimentary rock. The stoniness of the till increases from slight to excessive in the sequence from Caribou, Holmesville, Glassville, and Juniper soils. This is caused by the greater resistance to weathering of the rocks found in these soils. Shallow soils over shale bedrock, such as Undine, are almost stone-free.

Surface Geology

In the glacial period, the unconsolidated parent material of the surveyed area underwent periodic scouring, mixing and redeposition. The products of glacial erosion were probably subjected to periglacial frost heaving, churning, and moving during and after the retreat of the glaciers. Possibly shallow soils (less than 24 inches over bedrock) originated from bare rock that was exposed to postglacial weathering. The coarse fragments of these shallow soils clearly resemble the underlying bedrock lithologically.

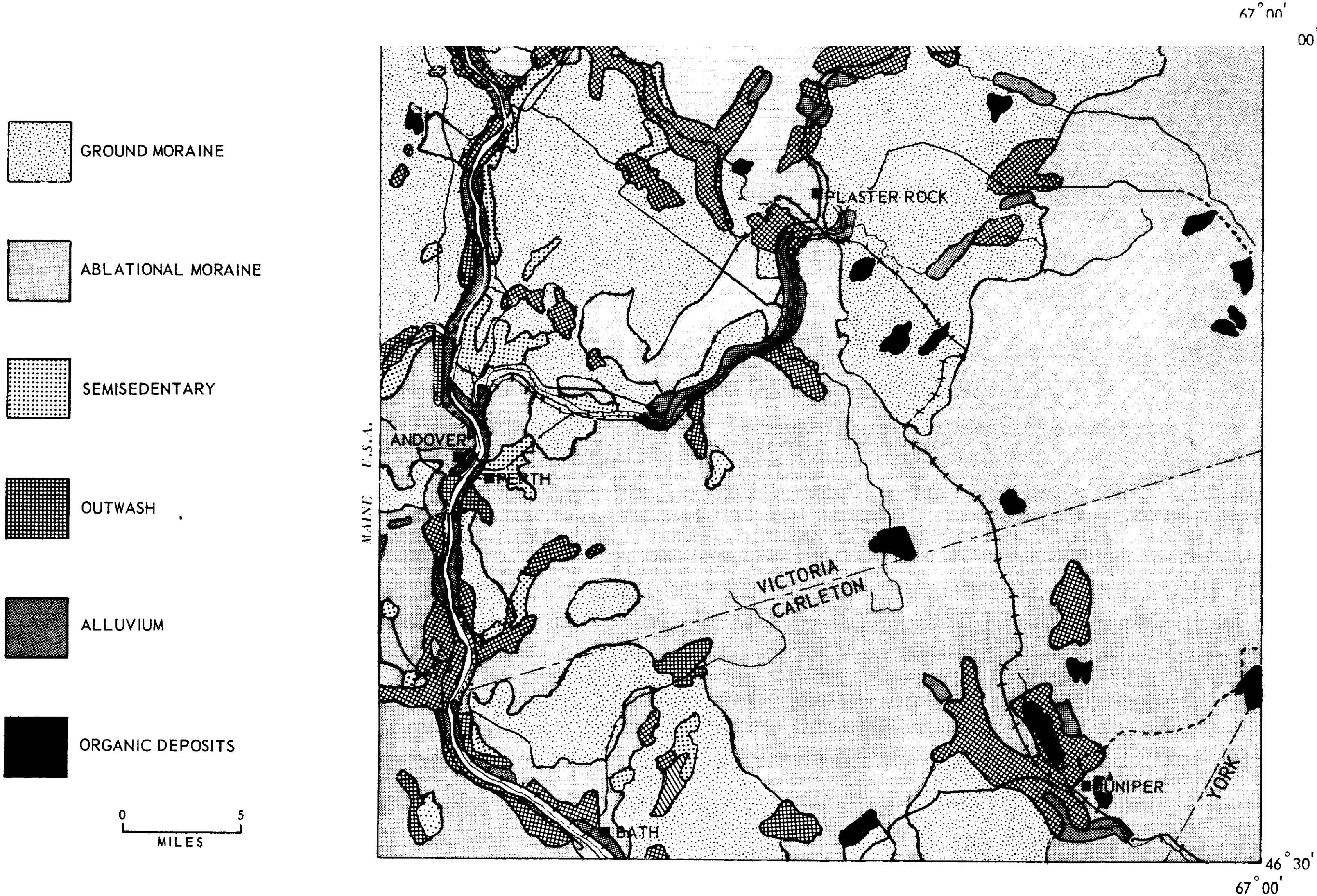
Glaciation greatly modified the landscape of the area by eroding some sections and filling others, creating temporary lakes, and diverting streams and rivers. Thus, glaciation is mainly responsible for the distribution, the form or shape, and the composition of the parent materials from which the soils have developed. The kinds of surface deposits in the area are listed in Table 2, and their distributions and locations shown in Figure 3.

Glacial till covers most (69.2 percent) of the area. It ranges in thickness from 2 feet near the top of ridges to 100 feet in drift-filled preglacial valleys. There are two kinds of glacial till in the area. Ground moraines were deposited under the glacier under exceedingly high pressure. Ablational moraines are loose and porous deposits laid down in the waning stage of glaciation.

The ground moraines are the parent material of 28.4 percent of the soils. The rock fragments are mainly subangular and rounded and their lithology varies widely. In places the ground moraine may be 100 feet thick over bedrock. It is characterized by the compactness of its material (often called hardpan) and a pseudoplaty structure that has probably resulted from the shearing action of moving ice. The fine and coarse particles of this type of deposit are

TABLE 2.—Texture, Topography, and Areas of the Surface Deposits

Deposit	Texture	Topography	Percentage of total area (1,290 sq. mi.)
Ablational moraine	Sandy loam to silty clay loam	Undulating to strongly rolling	40.8
Ground moraine	Sandy loam to clay	Undulating to strongly rolling	28.4
Semisedentary accumulation	Sandy loam to silt	Rolling to hilly	22.1
Glacial outwash	Loamy gravel to fine sand	Level to gently rolling	5.0
Alluvium	Fine sandy loam to silt loam	Level to undulating	1.4
Organic accumulation	Mossy and woody peat	Level to depressional	1.2



BIOGRAPHIC UNIT – CANADA DEPT. OF AGRICULTURE oriented to occupy the smallest space possible. The total pore space in this material may be as low as 25 percent of the total volume. The topography ranges from undulating to strongly rolling and is smoother than that of the underlying rock. Areas with rolling topography and covered with thick till are deeply dissected by postglacial erosion.

Ablational till covers 40.8 percent of the total area. The properties of these deposits, such as moisture retention, erodibility, and agricultural adaptability, depend on the topography, texture, composition, and amount of rock fragments in the till. The thickness of the layer ranges from 2 to 10 feet. The topography varies from undulating to strongly rolling and approximates that of the underlying material. The rock fragments are angular except for a small percentage of rounded and subangular pieces. Ablational deposits that blanket ground moraine material have a great variety of rock fragments; those that lie directly over bedrock are similar lithologically to the underlying geological formation. Colluvium (material moved down a slope by gravity), which covers small areas at the foot of slopes, resembles ablational deposits and has been mapped accordingly.

The red parent material occurs up to six miles east of the geological boundary of the Mississippian formation. It is not uncommon, however, to find fragments of red sandstone in ground moraine material up to 40 miles away from their closest possible geological origin. Semisedentary deposits are shallow (less than 24 inches thick), unconsolidated material developed from the in situ weathering of underlying bedrock. Between 80 and 100 percent of the rock fragments in the loose material originated from underlying bedrock. Glaciation had little influence on the composition and properties of the loose material. Semisedentary soils occupy 22.1 percent of the total area. The topography of these soils depends mostly on that of the underlying bedrock. The character of the rock determines the thickness of the unconsolidated material, its stoniness, gravel content, and texture. Most of these soils are highly erodible when cleared.

Outwash gravel and gravelly sandy loam cover about 5.0 percent of the total area. These outwash materials are in the forms of kames, eskers, apron outwashes, and postglacial terraces. The unweathered portion of the gravel may contain free carbonates at more than four feet below the surface. Coarse sand and gravel terraces occur along the important stream channels. There is a relatively large gravel plain at the fork of the North and South branches of the Main Southwest Miramichi. Soils developed on such deposits are mainly well drained and occasionally droughty.

Alluvial material occupies a small percentage (1.4 percent) of the total area. The alluvium ranges from coarse sandy loam to silt loam. It covers the underlying till, outwash, or bedrock with 2 to 25 feet of laminated and stratified material. These deposits occur on the flood plains or low terraces along the important streams of the area. They make excellent agricultural soils.

Small tracts of organic deposits are scattered throughout the surveyed area. They consist of partly decayed wood, moss, and herbs.

Climate

The climate of the Andover—Plaster Rock area ranges from humid temperate to cool humid. The mean annual temperature is about 39° F. in the Saint John River Valley and 33° F at Plaster Rock in the Tobique River Valley. The total annual precipitation ranges between 34 and 41 inches. The winters are long and windy, the snowfall totals about 100 inches, and the monthly average is nearly constant from December to February. The mean daily temperatures for these months range between 6 and 18° F. Spring is late and cool, and the summer warm and humid. The average precipitation is higher in June and July than in May and greatly contributes to a rapid and lush growth of all the

TABLE 3.—Mean Daily Temperatures Recorded at Selected Stations in or Near Surveyed Area

Month	New Brunswick				Maine, U.S.A.		
	Grand Falls (31 years) Elevation 498	Woodstock (25 years) Elevation 134	Plaster Rock (30 years) Elevation 385	Aroostook (20 years) Elevation 276	Limestone (Loring Base) (10 years) Elevation 700 (approx.)	Presque Isle (25 years) Elevation 606	Caribou (16 years) Elevation 624
December	16	18	12	16	15	17	15
January	9	11	6	11	9	11	9
February	9	12	6	11	10	11	10
Mean	11	14	8	12	11	13	11
March	23	25	20	23	22	24	22
April	36	38	32	39	35	38	35
May	50	51	43	49	49	51	49
Mean	36	38	32	37	35	38	35
June	59	61	53	61	58	60	58
July	65	67	58	66	64	66	64
August	63	64	56	64	62	64	62
Mean	62	64	56	64	61	63	61
September	54	56	48	55	53	55	53
October	44	46	40	44	42	44	42
November	32	32	26	31	29	31	29
Mean	43	45	38	43	41	43	41
Year	38	40	33	39	38	39	37

crops grown. September is warmer than May and generally provides ideal weather for digging potatoes, the most important agricultural crop of the area.

The temperature, frost and precipitation data at selected stations are given in Tables 3-6. The Canadian meteorological stations are in the valleys whereas those in the United States are at higher elevations. Plaster Rock has the lowest mean temperatures of all the stations listed for all the seasons of the year (Table 3). In spite of a lower mean temperature for each season, the average frost-free period at Grand Falls is one day longer than at Woodstock (Table 4). The average growing season ranges from 170 to 190 days and the frost-free period averages 112 days in the St. John River Valley, in comparison with a growing season of 120 to 140 days and a frost-free period of 93 days in the Tobique River Valley. Until September 25, the chances of frost in the fall are greater in the Woodstock than in the Grand Falls area (Table 5).

Table 6 gives the mean monthly and annual precipitation, including snowfall, for stations near the Andover—Plaster Rock area. Except at Aroostook, which has 41.6 inches, the mean annual precipitation is about 35 inches. At the Canadian stations, 42 to 46 percent of the precipitation falls from May to September, in comparison with 48 to 50 percent at the U.S. stations. The figures for Plaster Rock apply only to the valley of the Tobique.

According to M. Sanderson (5), the climate of the Andover—Plaster Rock area is humid with a Thornthwaite moisture index ranging between 64 at Woodstock and 91 at Aroostook. There is no moisture deficiency in the area except on soils of low moisture-holding capacity, and the mean annual water surplus ranges between 14 and 20 inches. During the months of possible water shortage the plants use water stored in the soil. High precipitation in June and July and relatively cool summers prevent excessive use of soil water reserves. Thus drainage is more important than irrigation in the surveyed area.

Soils that are good for agriculture must be well drained and have good moisture-holding capacity. For the important well-drained soils of the surveyed area, the moisture-storage capacity in the top 24 inches is given in Table 7. W. Thorne (7) recently reported that canning peas can utilize water from a depth of 24 inches, and potatoes from 30 to 36 inches. The best agricultural soils of the surveyed area, such as Caribou, Monquart, and Holmesville, retain more than 4 inches of water, which Thornthwaite used as an average for water storage in soil. The good agricultural soils evidently have high moisture-holding capacity and are unlikely to suffer from drought. The soils of the Glassville series, however, may have a moisture deficiency in most of the surveyed area, except near Aroostook. Most gravelly soils similar to the Muniac series are probably droughty part of the year.

Vegetation

A study of the vegetation is important in soil classification for three reasons: (1) to understand how soil forms, (2) to help in recognizing soil boundaries, and (3) to predict from the soil map the characteristics of natural vegetation. Nearly 90 percent of the area remains under forest, and abandoned fields revert rapidly to forest.

The Andover—Plaster Rock area includes three major regions of vegetation according to Halliday (2), namely, Subboreal, Great Lakes, and Acadian (Figure 4). The distribution of the native forest cover reflects the character of the environment as governed by a combination of factors, such as soil, physiography, and climate. The major regions of vegetation are distinguished by the presence of certain tree species that are representative of stable vegetation, and the absence of others. The next subdivision of the units of vegetation corresponds to Halliday's section. This is a geographical subdivision of the region that

TABLE 4.—Summary of Frost Records at Selected Stations in or Near Surveyed Area

Station	Lat. °N.	Long. °W	Feet above mean sea level	No. of years	Average frost-free period Days	Last frost in spring			First frost in fall			Frost-free period					
												Longest			Shortest		
						Average	Earliest	Latest	Average	Earliest	Latest	Last in spring	First in fall	No. of days	Last in spring	First in fall	No. of days
Aroostook	46 48	67 44	276	17	108	May 31	May 10	June 19	Sept. 16	Aug. 30	Oct. 2	May 18	Sept. 26	131	June 4	Aug. 30	87
Grand Falls	47 02	67 44	498	32	115	May 28	May 1	June 22	Sept. 20	Aug. 27	Oct. 2	May 18	Sept. 30	135	June 18	Sept. 12	86
Plaster Rock	46 54	67 22	385	12	93	June 8	May 12	July 3	Sept. 9	July 16	Oct. 1	June 8	Oct. 1	115	May 24	July 16	54
Woodstock	46 09	67 39	134	33	114	May 27	May 5	June 19	Sept. 18	Aug. 26	Oct. 25	June 5	Oct. 25	140	June 19	Sept. 10	83

TABLE 5.—Chances of Frost at Two Stations

Station	Season	Chances of temperature of 32° F or lower on or after indicated date in spring and on or before indicated date in fall						
		9 in 10	3 in 4	2 in 3	1 in 2	1 in 3	1 in 4	1 in 10
Grand Falls	Spring	May 11	May 19	May 23	May 28	June 3	June 6	June 14
	Fall	Oct. 1	Sept. 26	Sept. 24	Sept. 20	Sept. 16	Sept. 14	Sept. 9
Woodstock	Spring	May 8	May 18	May 21	May 27	June 5	June 8	June 13
	Fall	Oct. 2	Sept. 25	Sept. 22	Sept. 18	Sept. 14	Sept. 11	Sept. 3

TABLE 6.—Mean Monthly Precipitation (Inches) Recorded at Selected Stations in or Near Surveyed Area

Month	New Brunswick								Maine, U.S.A.							
	Grand Falls 31 years		Woodstock 25 years		Plaster Rock 30 years		Aroostook 20 years		Limestone 10 years		Presque Isle 26 years		Caribou 16 years		Fort Fairfield 15 years	
December	2.75	(21.3)[1]	2.63	(16.3)	2.85	(20.4)	3.11	(19.5)	2.49		2.30	(19.3)	2.23	(19.6)	2.67	
January	3.43	(26.7)	3.31	(21.6)	3.07	(23.0)	3.67	(19.5)	2.06		2.40	(18.4)	2.24	(20.6)	2.99	
February	2.69	(21.8)	2.49	(19.3)	2.15	(19.2)	2.61	(24.9)	2.07		1.90	(18.4)	1.73	(22.6)	2.20	
Mean	8.87	(69.8)	8.43	(57.2)	8.07	(62.6)	9.39	(63.9)	6.62		6.60	(56.1)	6.20	(62.8)	7.86	
March	2.47	(15.6)	2.76	(15.8)	2.30	(15.9)	2.98	(16.5)	2.45		2.25	(10.5)	2.40	(16.3)	2.31	
April	2.69	(7.7)	2.62	(6.3)	2.19	(8.3)	2.72	(5.1)	2.64		2.51	(6.7)	2.63	(6.5)	2.30	
May	2.55	(0.2)	2.69	(0.4)	2.10	(0.3)	3.04	(0.1)	3.07		2.90	(1.1)	3.14	(0.5)	2.69	
Mean	7.71	(23.5)	8.07	(22.5)	6.59	(24.5)	8.74	(21.7)	8.16		7.66	(18.3)	8.17	(23.3)	7.30	
June	3.56		3.94		2.97	(0.1)	4.30		4.06		3.61		3.95		3.92	
July	3.72		3.40		3.10		4.42		4.06		3.56		4.03		4.43	
August	2.86		2.99		3.14		3.63		3.20		3.04		3.53		3.23	
Mean	10.14		10.33		9.21	(0.1)	12.35		11.32		10.21		11.51		11.58	
September	3.17		3.02		3.14		3.96		3.06		3.37	(0.2)	3.50		3.36	
October	3.59	(2.1)	3.53	(0.8)	3.01	(2.5)	4.10	(2.4)	3.35		3.44	(2.3)	3.47	(1.8)	3.61	
November	3.00	(8.2)	2.80	(5.7)	3.20	(11.5)	3.06	(9.2)	3.35		2.53	(9.1)	3.03	(11.4)	2.56	
Mean	9.76	(10.4)	9.35	(6.5)	9.35	(14.0)	11.12	(11.6)	9.76		9.34	(11.6)	10.00		9.53	
Year	36.48	(103.7)	35.66	(86.2)	34.58	(101.2)	41.60	(97.2)	35.86	(97.4)	33.81	(86.0)	35.88	(99.3)	36.27	
May–September	15.86		16.04		14.45		19.35		17.45		16.48		18.15		17.63	

[1] Inches of snow.

TABLE 7.—Moisture-holding Capacities of Well-Drained Soils of Surveyed Area

Soil series	Condition	Inches of water[1]
Caribou	Under forest	6.9
Caribou	Under forest	7.6
Caribou	Cultivated	9.7
Monquart	Under forest	6.3
Holmesville	Under forest	5.6
Holmesville	Under forest	8.0
Holmesville	Cultivated	9.2
Juniper	Under forest	4.5
Glassville	Under forest	6.6
Muniac	Under forest	2.0

[1] The sum, for all horizons in the upper 24 inches, of the volume of water held at moisture equivalent minus the volume of hygroscopic moisture.

is characterized by differences in concentration or distribution of the climax dominants and by the consistent occurrence of certain tree associations.

SUBBOREAL

Subboreal vegetation is confined to the northeastern corner of the surveyed area. The stable vegetation on well to imperfectly drained soils consists of white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), white birch (*Betula papyrifera*), red spruce (*Picea rubens*), hemlock (*Tsuga canadensis*) and/or tolerant hardwoods such as sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), and yellow birch (*Betula lutea*). In poorly drained to swampy areas the climax vegetation is black spruce (*Picea mariana*), tamarack (*Larix laricina*), and red maple (*Acer rubrum*).

The S-2 section of the mapped area was included by Halliday in the Acadian region but its vegetation appears more Boreal than Acadian. About 10 percent of the stand volume of the stable vegetation consists of beech, sugar maple, yellow birch, white cedar (*Thuja occidentalis*), and white pine (*Pinus strobus*). The pioneer vegetation consists of species that are transitory to stable vegetation and specific for each type of stable vegetation.

GREAT LAKES

Great Lakes vegetation occurs both east and west of the Tobique River. The species are white spruce, balsam fir, white pine, tolerant hardwoods, and, sometimes red spruce and hemlock.

This vegetation occurs in two sections of the surveyed area. In Great Lakes 1b (Figure 4) the occurrence of white pine is an important characteristic. A narrow transitional area, Great Lakes ld (Figure 4), separates the Subboreal and Acadian regions. This contains important intrusions of red spruce.

ACADIAN

The Acadian region comprises the area along the Tobique River and all the western and southern parts of the surveyed area (Figure 4). The dominant forest species are hemlock, red spruce, and tolerant hardwoods.

In the Acadian 4 section (Figure 4), white pine occurs along the dry banks of streams, and hemlock is absent. The vegetation of ill-drained areas is mainly cedar, red maple, black ash (*Fraxinus nigra*), tamarack, and black spruce. Temporary species include aspen, white birch, gray birch in the east, and white spruce in the north.

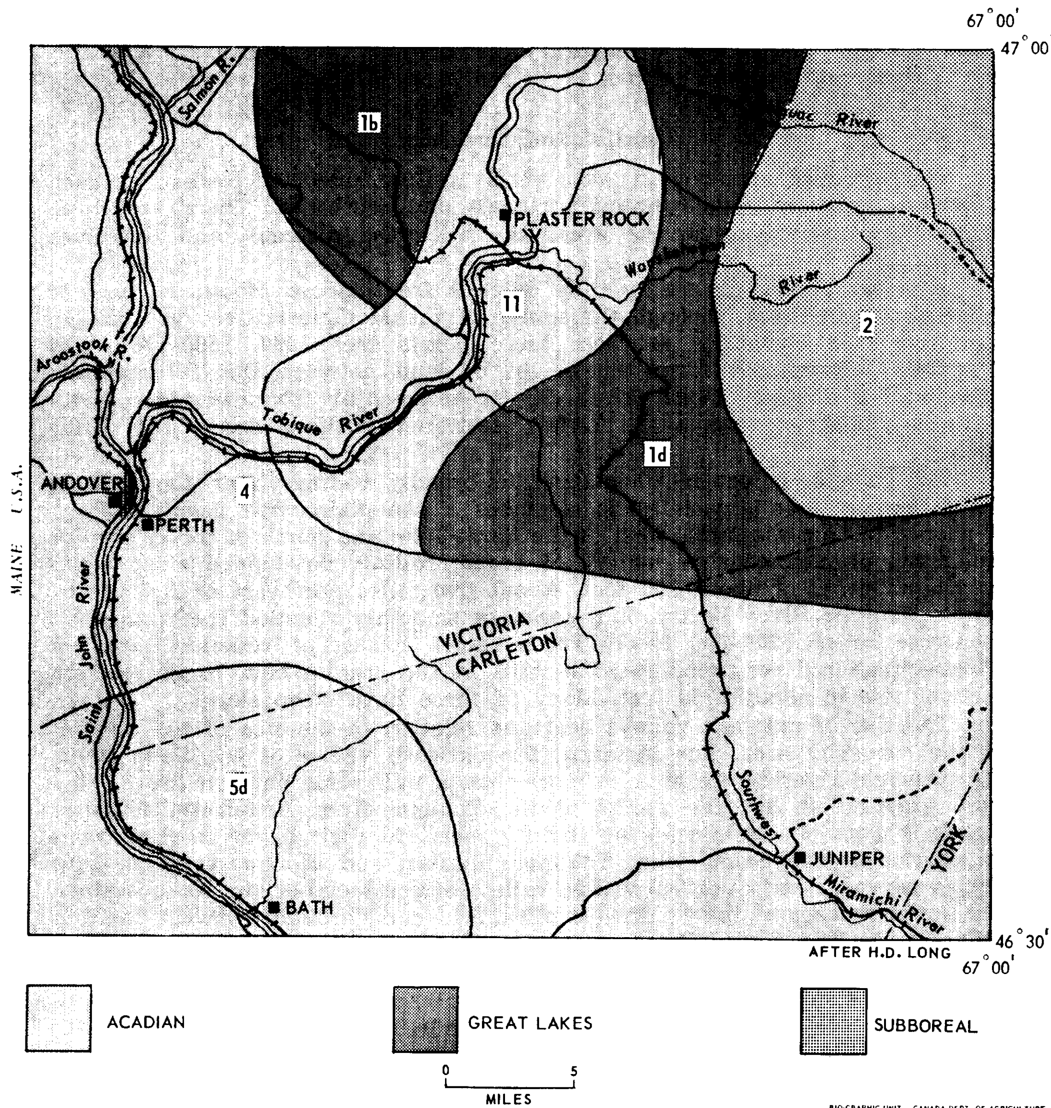


Figure 4.—Vegetation regions of surveyed area.

The Acadian 5d section (Figure 4) has upland associations of hardwoods, namely, sugar maple, beech, red maple, and a few elm (*Ulmus americana*). Hemlock and yellow birch occur on moist lower slopes. Wet areas have cedar, red maple, black ash, some tamarack, black spruce, and balsam poplar (*Populus balsamifera*) as climax vegetation. The chief temporary species are aspen and largetooth aspen (*Populus grandidentata*).

The vegetation of the Acadian 11 section (Figure 4) is mainly coniferous and contrasts strongly with the mixed-wood vegetation of the rest of the Acadian region. The permanent vegetation on well-drained and moist sites is red, white, and black spruce with fir. Some tolerant hardwoods occur on a ridge in the western part. Butternut (*Juglans cinerea*) and red pine (*Pinus resinosa*) occur in the lower Tobique River Valley. A few white pine and hemlock are scattered throughout the area. In wet areas, tamarack predominates as

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permanent vegetation, which includes balsam poplar, red maple, black ash, black spruce, and cedar. Temporary associations are formed by white birch, aspen, and largetooth aspen.

Relief and Drainage

The surveyed area consists of a gently rolling, dissected plateau on each side of a range of hills running northeast and southwest. There are three physiographic divisions in the area: the hills, the plateaus, and the river valleys.

A series of sharply rising hills extends from Moose Mountain, east of the Saint John River, through the source of the Monquart River to Costigan Mountain; the elevations at these three points are: 1490, 1500-1700, and 2195 feet. These hills form the height of land between the Tobique and Southwest Miramichi rivers. They consist of smoothly rounded ridges with an escarpment on one side. A few scattered outliers occur near Blue Bell.

The plateau is gently undulating to broadly rolling. Near the hills in the Glassville area especially, it resembes a peneplain with deeply carved, V-shaped stream channels. West of the Saint John and north of the Aroostook River the plateau consists mainly of broad, rolling, flat-topped ridges with maximum relief of about 300 feet. About five miles northeast of Arthurette, in the Tobique River Valley, is a series of smoothly rounded rocdrumlins of moderate relief (200-300 feet). These ridges consist of resistant areas of Mississippian red conglomerate. The hills in the granite belt, in the eastern section, rise to about 1750 feet. Many of these have steep slopes.

The size of outwash valleys bears no relation to the size of the streams in the surveyed area. For instance, the outwash valley of the Saint John, the principal river of the area, is more than a mile wide only on the Bairdsville gravel flat. But the valley of the Tobique from Arthurette to Riley Brook is usually a mile wide or slightly more. In their lower reaches, some tributaries of the Saint John, Tobique, Muniac, and Monquart rivers have deeply carved, nearly vertical walled valleys of preglacial origin. Near Juniper, the upper reaches of the Southwest Miramichi cuts through a gravel flat four miles wide. The Three Brook stream runs through a gravel valley three miles wide.

Both the main streams and their tributaries have right-angled bends and confluences. The drainage pattern is dendritic. Slightly more than three quarters of the area is in the Saint John River watershed. The southeastern quarter of the area drains into the Gulf of St. Lawrence through the Miramichi River.

DEVELOPMENT, MORPHOLOGY, AND CLASSIFICATION OF SOILS

Profile Development

Soils are affected by parent material, climate, biological activity, drainage, time and man. Environment includes climate, both macro and micro, and relief; and biological activities include all plant and animal activity within or on the soil. These factors influence each other and further complicate their action on the soil.

Time is needed for soil to develop from parent material. A profile evidently develops more rapidly in the early than in the late stages, when it approaches an equilibrium with its environment. In the surveyed area, profile development began when the ice sheet receded, probably 15,000 years ago. Recent measurements of radioactive carbon in a peat deposit near Green

River, New Brunswick, showed the material to be about 10,200 years old. The age of soil ranges from old in undisturbed tills to recent in fresh alluvial and recent earthmounds caused by windthrows or man.

Soil-forming agents, acting for long periods of time, induced a gradual differentiation of horizontal layers, or *horizons,* in the parent material. A *profile* is a vertical section of the soil through all its horizons and extending into the parent material. Though the horizons are seldom exactly similar in two profiles, in areas where soil-forming factors acted similarly the profiles resemble each other closely.

Horizons usually occur in the profile in the following sequence and have these characteristics: The top horizons usually consist of plant and animal residues in various stages of decomposition. Below this horizon is one in which soil-forming processes have removed many of the original constituents except silica. Some of the materials removed from the above horizons are deposited in the succeeding horizon or horizons. The last horizon is the parent material, which is assumed to be similar to the material above it before soil formation began. The horizons above the parent material are called, collectively, the *solum.*

In the surveyed area the climate and vegetation allow partial decomposition of the forest litter. The products of decomposition and the rainwater move through the upper mineral layers, causing the sesquioxides and some clay minerals to move through the upper part of the soil and to be deposited in succeeding layers. The bases are dissolved by the rainwater or organic acids and move out of the soil. However, the extent to which the soils have been leached varies greatly with drainage conditions and the chemical and physical nature of the parent materials. This has required a classification with numerous units and categories of soils.

Kinds of Profiles

According to the kind and arrangement of the horizons in the soil profile, eight great soil groups were recognized in the surveyed area. The soil series with impeded drainage have inclusions of unnamed variants. The normal occurrence is given in Table 8, along with the great soil group or subgroup concerned.

Podzol

Podzols are well to imperfectly drained soils that have developed under forest. They have light-colored surface mineral (eluvial, or Ae[1]) horizons underlain by darker-colored (illuvial, or B) horizons in which mainly sesquioxides and organic matter have accumulated. They have an acid solum.

In the surveyed area there were many variations among the profiles of the Podzol soils. Some profiles that had the general characteristics of a Podzol differed so markedly in their appearance that they were separated into a number of subgroups.

The Orthic Podzol soils have organic surface (L, F, and H) horizons, an Ae horizon more than one inch thick, and a friable Bfh or Bf horizon of high chroma. A Bh subhorizon is lacking or less than two inches thick. Most of the well-drained soils of the area are in this category.

The Minimal Podzol soils have organic surface (L, F, and H). They may have an Ae horizon less than one inch thick and a friable Bfh or Bf horizon. Or the Ae horizon may be more than one inch thick and the B horizons less than two units of chroma or value darker than the Ae horizon.[2]

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[1] The horizon nomenclature adopted at the Fourth Meeting of the National Soil Survey Committee, Guelph, 1960, is used throughout this report. Definitions are in the glossary.

[2] Munsell soil color charts. 1954 ed. Munsell Color Company Inc., Baltimore, Maryland, U.S.A.

TABLE 8.—Classification of Soils of Andover–Plaster Rock Area

Great soil group	Subgroup	Soil series	Type	Acreage	Percentage of total area
Podzol	Minimal	Caribou	Shaly silt loam, shaly loam	22,100	2.6
		Undine	Shaly loam	6,800	0.8
		Maliseet	Sandy loam	8,100	1.0
	Orthic	Gagetown	Gravelly sandy loam	4,200	0.5
		Gulquac	Gravelly sandy loam	5,700	0.7
		Holmesville	Gravelly sandy loam, light loam	107,000	13.0
		Juniper	Sandy loam	134,800	16.4
		Kennebecasis	Fine sandy loam	1,200	0.1
		Monquart	Gravelly loam	34,900	4.2
		Muniac	Gravelly sandy loam	26,300	3.3
		Parleville	Gravelly sandy loam	29,800	3.7
		Tobique	Loamy sand	400	—
	Humic Podzol–Podzol Intergrade	Glassville	Slaty loam	169,300	20.5
	Textural	Kingsclear	Clay loam	40,500	4.9
	Gleyed	Carlingford	Shaly silt loam	3,700	0.4
		Ennishore	Gravelly loam	3,300	0.4
		Johnville	Gravelly loam	16,300	2.0
		McKiel	Gravelly sandy loam	64,400	7.8
		Midland	Gravelly loam	3,200	0.4
		Penobsquis	Gravelly sandy loam	800	0.1
		Plaster Rock	Clay loam	24,500	3.0
		Wapske	Fine sandy loam	500	—
Brown Podzolic	Gleyed	Foreston	Slaty loam	38,300	4.6
Dark Gray Gleisolic	Orthic	Washburn	Silt loam	3,600	0.4
Gleysol	Podzolic	Poitras	Gravelly loam	15,200	1.8
	Rego	Waasis	Silt loam	1,200	0.1
	Eluviated	Nackawick	Clay	29,700	3.7
Regosols	Alluvial	Interval	Silt loam, silt	1,000	0.1
		Bottomland	—	600	0.1
	Lithosols	Kintore	—	8,400	1.1
Organic		Muck		100	—
		Peat		8,400	1.1
Water		Lakes and rivers		8,800	1.1

Textural Podzol soils differ from the Orthic Podzols in having accumulations of clay as well as sesquioxides and organic matter in the Btf horizon. The clay content increases markedly from the Ae to the Btf; it continues to increase in the Bt_2 and Bt_3 and decreases slightly in the parent materials, or C horizon. The solum is acid. This subgroup may be considered as an intergrade between the Podzol and the Gray Wooded group.

The Gleyed Podzol subgroup includes all the soils with a Podzol profile that have mottling (splotches, specks, or streaks of light color or rust) due to periodic wetness in the upper B and sometimes the lower Ae horizons. These soils have an imperfect to somewhat poor drainage. Some properties resemble those of a Eluviated Gleysol; others, those of an Orthic Podzol profile.

The Humic Podzol–Podzol Intergrade is a Podzol that approaches the Humic Podzol in some characteristics.

Humic Podzol

In this great group are Podzolic soils with L, F, and H horizons, an Ae horizon and a Bh or Bhf horizon in which organic matter is the main accumulation product. The Bh or Bhf is at least two inches thick and contains 10 percent or more of organic matter; it generally has a color of 5YR 3/3 or darker.

The Orthic Humic Podzol has a Bh horizon containing free iron as well as 10 percent or more of organic matter and is underlain by a Bhf horizon containing less than 10 percent organic matter. Bh and Bhf horizons may be friable or cemented and may be underlain by a thin, vitreous, dark reddish brown, impervious hardpan.

Brown Podzolic

The Brown Podzolic soils (now called Acid Brown Wooded) have a low base saturation and have no distinct Ah or Ae horizon but usually have L, F, and H horizons. The parent material is usually of low base saturation. There are no distinct illuvial or eluvial horizons.

Gleyed Brown Podzolic are imperfectly drained Brown Podzolic soils with mottling throughout the solum. This is the only Brown Podzolic subgroup in the surveyed area.

Dark Gray Gleysolic

Dark Gray Gleysolic soils are poorly drained and develop under swamp–forest vegetation. They have a dark-colored Ah horizon more than two inches thick abruptly underlain by a gleyed horizon or horizons. They may have L, F, and H horizons totaling not more than 12 inches, in thickness.

The Orthic Dark Gray Gleysolic subgroup has an Ah horizon abruptly underlain by a gleyed horizon or horizons. It may have organic horizons not more than three inches thick.

Peaty Dark Gray Gleysolic soils are similar to other Dark Gray Gleysolic soils except that they have from 3 to 12 inches of peat at the surface.

Gleysol

Soils of the Gleysol Great Group are poorly drained and have no noticeable illuvial or eluvial horizons. They may have organic horizons less than 12 inches thick, or these horizons may be absent. They may have a thin (less than two inches) Ah horizon and have a strong gleyed mineral horizon or horizons. They develop under swamp-forest or heath vegetation.

The Orthic Gleysols are Gleysols in which the organic horizon is less than 6 inches thick.

The Peaty Gleysols are any Gleysols with from 6 to 12 inches of peat.

The Rego-Gleysol soils have less than one inch of peat or muck on the surface, lack an Ah horizon, and have some organic material dispersed through the mineral soil.

Eluviated Gleysol

The Eluviated Gleysol soils have organic horizons less than 12 inches thick or an Ah horizon, or both. They have a mottled eluviated (Aeg) horizon and a strongly mottled illuvial (Bg) horizon. These soils are developed under grasses, sedges, and swamp-forest.

Most of the very poorly drained soils of the surveyed area have a layer of imbricated stones underlying the organic surface. The whitish, eluviated horizon of very poorly drained soils is sometimes partly developed in this layer.

Regosol

These soils have very little or no horizon development. The Mull Regosols of the surveyed area include the recent alluvial materials and have an Ah horizon. The soils of the Orthic Regosol subgroup consist of fragments of disintegrating rock. They occur mainly on bare, steep escarpments. Gleyed Mull Regosol profiles also occur in the surveyed area.

Organic Soils

The organic soils consist of layers of organic accumulation more than one foot thick. The deep organic soils have more than 36 inches of organic material accumulated over the mineral soil. Organic deposits less than 36 inches thick are designated as shallow. Deposits that are slightly decomposed are called peat; others, well decomposed, muck. The organic soils of the surveyed area are heterogeneous and consist of layers of different kinds of material at various stages of decomposition. For instance, organic soils with alder vegetation have a layer of muck of variable thickness underlying the thin layer of peat at the surface. Most of the organic soils of the surveyed area are acid but small tracts of muck north of the Aroostook River and near Lake Edward are neutral and underlain by a layer of marl.

Soil Survey Methods

The soils were examined at two different scales; detailed reconnaissance in the settled sections and broad reconnaissance in the forested area. Each soil was examined in pits that were dug at irregular intervals to determine its characteristics. Soil profiles exposed by road cuts, gravel pits, or any other kind of excavation were also carefully examined. Notes were taken on the characteristics of the soil profiles, external and internal drainage, topography, vegetation, stoniness, land use, and land adaptability.

Areas that were not accessible by car were examined by foot traverses through the area, location being determined by pacing and from geographical details shown on aerial photographs. Soil boundaries were joined between traverses from the lay of the land and interpretation of aerial photographs. Field sheets, used for the survey, were maps two inches to one mile, and aerial photographs, scale 1320, supplied by the Photogrammetry Section of the New Brunswick Department of Lands and Mines. The accuracy of the lines depends on the scale of the map and the type of survey.

The examination of soils in the field was supplemented by physical, chemical, and some mineral analyses of representative profiles. To gain knowledge of the nature of the original soil, only virgin profiles were selected for analysis.

Mapping Units

The basic mapping units in the surveyed area were soil types. The *soil type* is a subdivision of the soil series. It is identified by the series name (always a place name) and the textural class of the upper part of the soil, e.g., Holmesville sandy loam.

In detailed-reconnaissance areas, most mapping units are one soil type. Mapping units in the reconnaissance areas usually consist of, or are designated by, several types in order of dominance. Associations of soil types or series developed on the same parent material but differing in drainage are referred to as *catenas.* A mapping unit in which the associated but undelineated soils have developed on different parent materials are referred to as a *soil complex*. There are some areas in which the land and soil pattern is exceedingly complex, for example, rock outcrops, rough stony land and recently eroded and deposited materials. These are not usually described in terms of individual soil types but are identified by the physiographic features of the land and are referred to as land types, e.g., Kintore. The arrangement of some mapping units and their relationship to topography and geology are shown in Figure 5.

The lines between soil units on the map vary in their significance. Some changes in the field are marked and can be delineated accurately; others are gradual and the boundaries between the soils are only approximate. Areas mapped as single series or types may include up to 20 percent of other types in areas too small to be shown on the map.

The approximate acreages of the different soils, and the percentages of the total area, are given in Table 8.

Key to the Soils

The soils of the Andover—Plaster Rock area are grouped as follows. Soils shallow over bedrock are followed by till and alluvial soils. The other criteria used in the grouping are color and texture of the parent material, lithology of the rock fragments, drainage, and type of profile.

1. Shallow soils developed in situ from underlying bedrock
    - Yellowish-brown parent material derived mainly from soft, weathered shale
        - Loam with fragments of soft shale
            - Well drained .... *Undine shaly loam*
2. Soils developed partly on till, partly in situ
    - Yellowish-brown parent material
        - Slaty loam, with fragments of slate, quartzite, and argillite
            - Well drained .... *Glassville slaty loam*
            - Imperfectly to very poorly drained .... *Foreston slaty loam*
        - Gravelly sandy loam with fragments of granite and basalt
            - Well drained .... *Juniper sandy loam*
            - Imperfectly to very poorly drained .. *McKiel gravelly sandy loam*
    - Red to dark reddish brown parent material
        - Gravelly sandy loam, with fragments of conglomerate with calcareous cement
            - Well drained .... *Parleeville gravelly sandy loam*
            - Imperfectly to very poorly drained .... *Midland gravelly loam*
        - Coarse loamy sand, with fragments of coarse-grained sandstone
            - Well drained .... *Tobique loamy sand*
3. Soils developed on loose ablational moraine
    - Yellowish-brown parent material
        - Gravelly sandy loam to loam, with fragments of soft shale, quartzite, and slate
            - Well drained .... *Monquart gravelly loam*

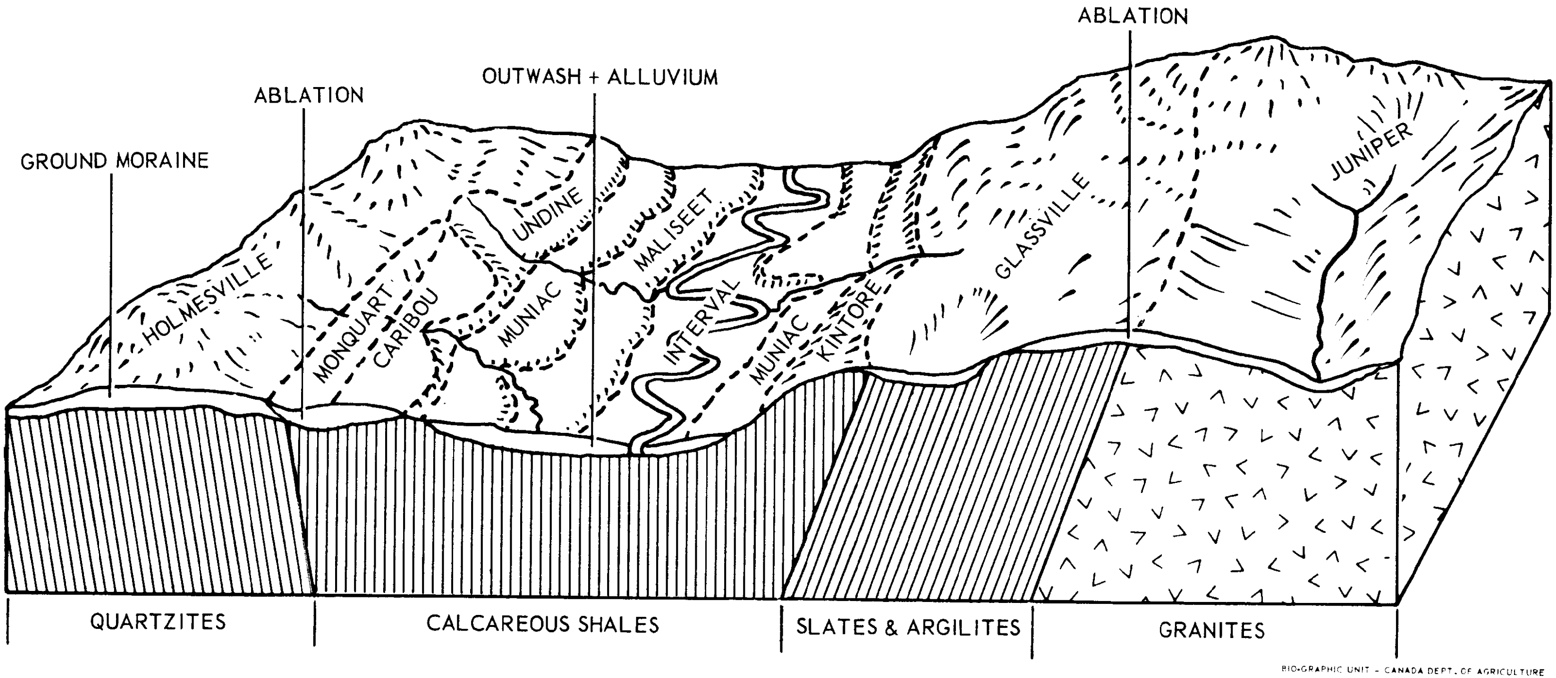

Figure 5.—Relationships of bedrock, surface geology, and soil catenas.

Silt loam or silty clay loam, with fragments mainly of soft shale and some quartzite, argillite, and sandstone
- Well drained .... *Caribou shaly silt loam or shaly loam*
- Imperfectly to poorly drained ...... *Carlingford shaly silt loam*
- Poorly to very poorly drained .... *Washburn silt loam*

4. Soils developed on compact ground moraine
   - Yellowish-brown parent material
     - Gravelly sandy loam, with fragments of quartzite, quartz, sandstone, and some soft shale
       - Well drained .... *Holmesville gravelly sandy loam*
       - Imperfectly to poorly drained .... *Johnville gravelly loam*
       - Poorly to very poorly drained ...... *Poitras stony gravelly loam*
   - Red to dark reddish brown parent material
     - Clay loam, with fragments of shale and sandstone
       - Moderately well drained .... *Kingsclear clay loam*
       - Imperfectly to poorly drained .... *Plaster Rock clay loam*
       - Poorly to very poorly drained .... *Nackawick clay*

5. Soils developed on outwash material
   - Yellowish-brown parent material
     - Gravel, with fragments of quartzite, quartz, and slate with calcareous coating
       - Well drained .... *Muniac gravelly sandy loam*
       - Imperfectly to very poorly drained .... *Ennishore gravelly loam*
     - Fine sandy loam free of gravel
       - Well drained .... *Maliseet sandy loam*
       - Imperfectly to very poorly drained .... *Wapske sandy loam*
   - Brown parent material
     - Gravel, with fragments of granite, sandstone, quartz, and feldspar
       - Well drained .... *Gagetown gravelly sandy loam*
       - Imperfectly to very poorly drained .. *Penobsquis gravelly sandy loam*
   - Red to dark-red parent material
     - Gravel, with fragments of shale, sandstone, conglomerate, and quartz
       - Well drained .... *Gulquac gravelly sandy loam*
   - Reddish-brown parent material
     - Fine sandy loam, free of gravel
       - Well drained .... *Kennebecasis fine sandy loam*

6. Soils developed on recently deposited alluvium
   - Yellowish-brown parent material
     - Silt loam, free of gravel
       - Well to imperfectly drained .... *Interval silt loam*
       - Poorly to very poorly drained .... *Waasis silt loam*

7. Soils developed on organic deposits
   - Brown to dark-brown parent material
     - Slightly decomposed organic matter
       - Poorly to very poorly drained .... *Peat*
   - Black parent material
     - Well-decomposed organic matter
       - Poorly to very poorly drained .... *Muck*

8. Soils developed on a complex of rock outcrops, rough stony land, severely eroded land, or recently deposited or permanently water-logged materials
   - Yellowish-brown to gray parent material
     - Rocky and stony soils
       - Well drained .... *Kintore*

Materials of mixed texture
  Well to poorly drained .... *Bottom land*
Soils with water table permanently at the surface
  Very poorly drained .... *Swamp*

DESCRIPTIONS OF SOILS

The soils are described in the same order as outlined in the key. In each description, the soil color is followed by a set of symbols that designate the color in the Munsell system.[3]

Soils Developed in Situ

Undine Soils

The Undine soils are associated geographically with the Caribou, Monquart, and Holmesville soils. In areas of Caribou and Monquart soils the Undine soils occur as scattered patches of shallow (less than 24 inches deep) shaly silt loam over steeply dipping calcareous soft shale. In areas covered with soils of the Holmesville catena, streams have carved deep channels through glacial deposits and left long tracts of sloping banks with Undine soils.

Undine soils occur in large areas south of the Aroostook River. Those that were mapped occupy about 6,800 acres, but small areas that could not be shown on the map probably cover an equal additional area. The topography ranges between undulating and steeply sloping. The slopes of the undulations vary between 5 and 15 percent and those of the eroded banks between 20 and 40 percent.

Where cultivated, Undine soils have a brown silt loam surface that is porous and have a moderately stable, firm, granular structure. The surface soil stays in good tilth either moist or dry. Under the surface lies a layer, 2-13 inches thick, of yellowish-brown, friable, shaly silt loam. It has a high moisture-holding capacity and provides plants with a mellow, moist, and well-aerated root zone.

At a depth of 8 to 18 inches from the surface lies the parent material, grayish-brown to brown shaly silt loam, which grades into bedrock through a transitional layer of soft, weathered shale. The parent material originated mainly from the weathering of steeply dipping, stratified Silurian calcitic shale, siltstone, and fine-grained sandstone with occasional beds of argillite. The soils are as much as 24 inches deep but areas of bare rock are common.

Stones are few and drainage varies, from good to excessive, with the depth of loose material over bedrock. The surface layer usually has a pH of 5.0.

Because of their close geographical association with the Caribou, Monquart, and Holmesville soils, the small scattered areas of Undine soils are farmed along with the others. Large or long, steeply sloping tracts of Undine soils should be kept either in forest or in permanent pasture because of excessive drainage, shallowness over bedrock, excessive erodibility (Figure 6), or steepness of slope.

Patches of undulating Undine soils that are nearly 24 inches deep warm up rapidly in the spring and retain moisture throughout the growing season. Because of their shallowness and high erodibility, these require careful management. The need of lime varies with the crop. All Undine soils seem to retain their fertility and relatively high organic-matter content.

The forest cover of the Undine soils consists mainly of sugar maple, white ash, beech, and white spruce. Basswood, butternut, and red spruce occur south

[3] Munsell soil color charts. 1954 edition. Munsell Color Company Inc., Baltimore, Maryland, U.S.A.

Figure 6.—An eroded ridge of Undine soil.

of the Aroostook River. The main trees are white birch, trembling aspen, and pine.

The Undine soils have the profile characteristics of a Minimal Podzol. A profile of a moist soil under forest is described as follows:

Horizon	*Depth, inches*	
L	2-1½	Brown mixture of undecomposed leaves, needles, twigs, branches, cones, and club moss.
F	1½-½	Dark-brown layer of semidecomposed, felty and matted organic matter with white and yellow filaments and undecomposed roots and twigs; boundaries abrupt; pH 5.0.
H	½-0	Black or very dark gray (10YR 3/l), decomposed organic matter; weak, medium granular and crumb structure; friable when moist; greasy; sticky but nonplastic when wet; boundaries abrupt.
Ae	0 - 1	Light-gray (10YR 7/2) loam; moderate, medium crumb and platy structure; soft, friable; bleached gravel fraction 70 percent moderately soft, fine-grained sandstone, 20 percent quartzite and 10 percent soft shale; boundaries abrupt; pH 5.1.
Bfh	l - 8	Yellowish-brown (10YR 5/4) shaly loam to silt loam; moderate, medium granular structure; friable; gravel fraction 80 percent soft shale and 20 percent argillite, sandstone, and quartzite; lower boundary gradual; pH 5.4.
Bf	8-12	Brownish-yellow (10YR 6/6) shaly loam to silt loam; friable, smooth, and powdery; gravel as in Bfh horizon; boundaries gradual; pH 5.8.
BC	12-15	Light yellowish brown (10YR 6/4) shaly silt loam; friable, smooth, and powdery; stone fragments 90 percent soft shale; lower boundary diffuse; pH 5.9.
C	15	Broken and porous weathered brown (10YR 5/3) shale fragments with pale-brown shaly silt loam; grading into calcareous shale; pH 5.9.

The Ae horizon is an inch thick on the average but ranges from a trace to, rarely, two inches. Most horizons gradually change color and texture with depth. The apparent shift in composition of the stone fragments through the profile, i.e., the increase in percentage of shale from the surface to the parent material, is due to the intense weathering of the upper horizons.

Soils Developed Partly in Situ, Partly on Till

In some areas, soils have developed on complexes of sedentary material and thin ablational till. The transported material varies from 0 to 6 feet deep over the weathered bedrock. Though the soil is shallow, rock outcrops are uncommon. These soils are stony or very gravelly and droughty, and have a rugged topography that follows that of the underlying bedrock. The bedrock and the rock fragments of the soil are similar in composition, indicating the local origin of the till. These soils are best suited for forest.

Glassville Soils

This is the most widely distributed series of the surveyed area. It occupies 169,300 acres, or about 20.5 percent of the surveyed area. The Glassville soils occur mostly at 800 to 2,000 feet above sea level, either on high and deeply dissected plateaus or on rugged, strongly rolling hills. They are found mainly south of the Tobique River between the Saint John and the North Branch of the Southwest Miramichi rivers, with small outliers between New Denmark and North View. The areas of Glassville soils have fast-flowing streams with deeply carved valleys and few of the soils are poorly drained.

The cultivated layer is a porous, grayish-brown slaty loam. The high gravel content reduces erosion and maintains porosity between rows of intertilled crops. Under the plowed layer is a 12-inch layer of yellowish-brown slaty loam; this makes the root zone very porous and sometimes droughty. The parent material occurs 18 to 20 inches from the surface. It is a pale-yellow to light-gray slaty loam containing mainly angular pieces of the underlying bedrock, namely, gray

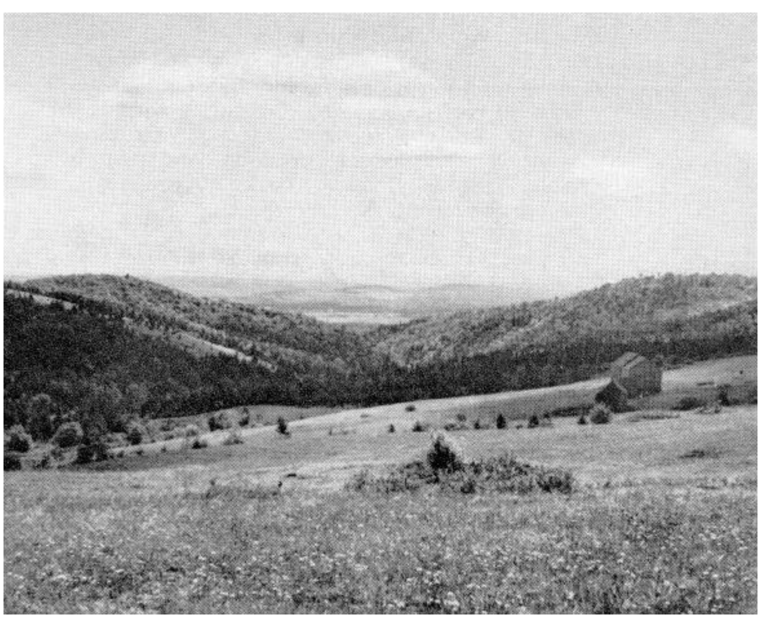

Figure 7.—Land use and topography of Glassville soil.

slate, sandstone, and quartzite. Freshly broken fragments of the unweathered rock may effervesce gently with acid. The rock fragments are flat and less than six inches long. Because it is very slaty (up to 70 percent by volume) the parent material is hard to dig, though loose and porous. The rock fragments are highly resistant to weathering and make the soils fairly stony. These soils are acid throughout.

The Glassville soils have limited agricultural use and are primarily suited to forestry (Figure 7). A few small areas of deep soils occurring near Glassville, Kintore, and Kincardine are used for growing potatoes. A small acreage is used for dairy farming. Most of the soils are either reverting to or have been left under forest. Large sections from Bon Accord to Foreston were once settled and are now abandoned, mainly because of excessive stoniness, a tendency to droughtiness, rugged topography, and in places remoteness from market and lack of adequate roads. Most of these should remain under forest vegetation.

The vegetation consists of upland associations of red and white spruce, sugar maple, and beech. Gray birch occurs in the watershed of the Southwest Miramichi River and white pine is found on the dry banks of streams. Fir is abundant throughout second-growth stands. The main temporary trees are white birch, trembling aspen, and red maple.

Under forest, the Glassville soils have a Humic Podzol—Podzol Intergrade profile. A moist slaty loam under forest is described as follows:

Horizon	*Depth, inches*	
L	3-2½	Brown to dark-brown, undecomposed needles, leaves, branches, twigs, cones, club moss and caribou moss.
F	2½- ½	Dark-brown, semidecomposed, matted, fibrous organic layer with yellow and white filaments, and undecomposed roots, cones and twigs; boundaries abrupt; pH 3.6.
H	½- 0	Very dark gray (10YR 3/1), decomposed organic matter; moderate medium granular and crumb structure; friable when moist; sticky but nonplastic when wet; boundaries abrupt.
Ae	0- 3	White (10YR 8/2) to light-gray (10YR 7/2) slaty silt loam; weak, medium granular structure; friable; stone fragments mainly slate and sandstone with some quartzite, argillite, and schist; boundaries abrupt; pH 3.8.
Bh	3- 5	Dark reddish brown (5YR 2/2) slaty loam to silt loam; moderate, medium granular structure; firm; stone fragments as in Ae horizon; lower boundary clear; pH 4.0.
Bhf	5-13	Yellowish-brown (10YR 5/4) slaty sandy loam and loam; moderate, medium crumb structure; friable; stone fragments as in Ae horizon along with a few of shale; lower boundary gradual; pH 4.6.
Bf	13-18	Brownish-yellow (10YR 6/6) slaty sandy loam and loam; soft, medium crumb structure; friable; boundaries gradual; pH 4.9.
BC	18-22	Light yellowish brown (2.5Y 6/4) slaty sandy loam and loam; very weak, medium crumb structure; very friable; boundaries gradual; pH 4.9.
C	22	Pale-yellow (2.5Y 7/4) slaty sandy loam and loam; very weak, fine crumb structure; very friable; pH 4.9,

The pH of the parent material ranges between 5.0 and 5.6. The Bh horizon is usually continuous but in occasional areas it is intermittent. These areas usually occur at elevations of about 850 feet or on the crests of low ridges. This dark horizon disappears under cultivation and adds an appreciable amount of mineralized organic matter to the cultivated layer. The Ae horizon is tongued and may be five inches thick. Except for an abrupt change between the H, Ae, and Bhf horizons, changes in color and texture are gradual throughout the profile.

Foreston Soils

These soils are the poorly drained members of the Glassville catena. They occur in narrow bands or small depressions within large areas of Glassville soils and occupy 38,300 acres, or 4.6 percent of the total area. The Foreston soils occur between 750 and 1,750 feet in elevation. Boundaries between Glassville and Foreston soils are relatively sharp, changes from good to imperfect and poor drainage being fairly abrupt.

The solum and the upper layer of the parent material have a finer texture than the corresponding layers in the well-drained position. These horizons have a dull-brown to dark-gray color and are strongly mottled with rust. The parent materials of the Foreston and Glassville soils are essentially alike in mode of accumulation, gravel content, and lithology of rock fragments. Materials moved down by gravity may have been added in places to the original material. The soil is acid.

Foreston soils are not under cultivation in the surveyed area. Cleared areas are used as natural pasture. Because of depressional topography, stoniness, and impeded drainage the Foreston is a nonarable soil and should remain in forest.

The permanent vegetation of the Foreston is that of a wet soil, namely, cedar, red maple, black ash, larch, and black spruce in various combinations.

Because of the wide range in drainage conditions it is difficult to describe a single characteristic type of profile of Foreston. The following describes the average profile of the very poorly drained Foreston soil, which belongs to the Orthic Gleysol subgroup. The colors were read on moist soil.

Horizon	*Depth, inches*	
L	3-2½	Brown undecomposed needles and leaves with branches, twigs, and cones.
F	2½- 1	Dark-brown, semidecomposed, matted fibrous organic matter with white filaments and undecomposed roots, cones, seeds; boundaries abrupt; pH 4.8.
H	1- 0	Black (5YR 2/1) decomposed organic matter; sticky but nonplastic when wet; firm, strong granular when moist; boundaries abrupt.
Cg1	0- 8	Dark grayish brown (10YR 4/2) slaty loam and slaty silt loam; slightly sticky and plastic; common, faint, fine mottles; lower boundary gradual; pH 4.6.
Cg2	8-15	Gray (5Y 5/1) slaty silt loam and silty clay loam; sticky and plastic; common, prominent, coarse mottles, rusty; lower boundary gradual; pH 5.0.
C	15+	Dark-gray (5Y 4/1) slaty loam; slightly sticky and plastic; pH 5.0.

The Foreston profile usually does not have a bleached layer. The profiles range between those of a Gleyed Brown Podzolic and Orthic or Peaty Dark Gray Gleysolic, Orthic or Peaty Gleysol, and Rego-Gleysol.

Juniper Soils

These soils lie in the eastern half of the surveyed area. It has a gently rolling landscape with frequent and abrupt changes of slope and a number of mountains. The rolling land occurs at elevations ranging between 750 and 1,000 feet, whereas some mountain peaks reach 2,200 feet above sea level. The total acreage of this soil is 134,800 acres, or 16.4 percent of the surveyed area.

The material on which the Juniper soils have developed is relatively shallow and ranges between one and eight feet in thickness over rock. The till of the parent material is of local origin. The angular rock fragments of the till and the underlying rock have similar lithological constituents, namely, granite, diorite, felsite, gabbro, gneiss, and some quartzite. These acid rock fragments weather very slowly and yield stony, gravelly, and porous sandy loam to silt loam soils that have a tendency to be droughty during summer dry spells.

Because of its droughtiness, excessive rockiness, and stoniness the Juniper soils have never been farmed in the surveyed area. Forest is the only good use for this soil.

In the Southwest Miramichi watershed the vegetation is mainly mixed red and white spruce, maple, and beech with some birch. In the Tobique River watershed, red spruce and gray birch are absent, maple is dominant, while beech, white spruce, fir, cedar, and white pine are sparse.

The average profile of Juniper is that of an Orthic Podzol. A thin Bh horizon may occur in the profile. An undisturbed, moist sandy loam is described as follows:

Horizon	*Depth, inches*	
L	2-1¾	Brown mixture of undecomposed leaves, needles, branches, twigs, and cones.
F	1¾- ¼	Dark-brown to black, semidecomposed, fibrous, matted organic matter, with undecomposed roots, branches, etc.; white and yellow filaments; boundaries abrupt; pH 4.3.
H	¼- 0	Dark reddish gray (10R 3/1), decomposed fibrous mull; strong granular structure; firm when moist; sticky but nonplastic when wet; boundaries abrupt.
Ah	trace	Black, mineralized, granular organic matter mixed with mineral matter.
Ae	0- 2	White (2.5Y 8/1) stony sandy loam and silt loam; weak, fine granular structure; very friable; stones and gravel about 80 percent gray granite, 10 percent sedimentary rock, and 10 percent quartz; boundaries abrupt; pH 4.5.
Bfh	2-12	Reddish-brown (5YR 4/3) stony sandy loam and silt loam; moderate, fine, granular structure; loose and friable; stone fragments 80 percent gray granite; 15 percent sedimentary rock; and 5 percent quartz; lower boundary clear; pH 4.9.
Bf	12-20	Strong-brown (7.5YR 5/6) stony gravelly sandy loam and loam; moderate to weak, fine granular structure; loose and friable; rock fragments 65 percent gray and pink granite, 20 percent sedimentary rock, 10 percent quartz, 5 percent mixture of gneiss, diorite, gabbro, felsite, etc.; lower boundary gradual; pH 5.1.
C	20+	Yellowish-brown (10YR 5/4) stony gravelly sandy loam; weak, fine granular structure; loose, very friable; stones and rock fragments about the same as in the horizon above; pH 5.1.

The stone fragments are mostly angular. There is little textural variation throughout the profile. This may be due to the nature of the rock fragments and soil grains, which are highly resitant to weathering.

McKiel Soils

McKiel soils are the poorly drained members of the Juniper catena and cover 64,400 acres, or 7.8 percent of the surveyed area. The underlying igneous rock resists weathering and is impervious, so that the soils occur widely in areas too small to map. The drainage of the McKiel soils ranges between imperfect and very poor. The topography is undulating to depressional.

The McKiel soils are exceedingly stony and ill-drained. They have never been farmed and are only suitable for trees. The vegetation consists of various combinations of cedar, red maple, larch, and black spruce, with a few black ash.

The usual McKiel profile is a Gleyed Podzol. A moist soil is described as follows:

Horizon	*Depth, inches*	
L	4- 3	Brown undecomposed needles with some leaves, club moss, caribou moss, sphagnum, branches, twigs and cones.
F	3- ½	Dark-brown, semidecomposed, fibrous and matted organic matter with white filaments and undecomposed roots, twigs, branches and cones; boundaries abrupt; pH 4.0.
H	½- 0	Black, decomposed, greasy organic matter; sticky but non-plastic when wet; boundaries abrupt.
Ah	trace	Black silt loam high in organic matter.
Aeg	2- 6	Pale-yellow (2.5Y 7/4) stony gravelly loam; weak, medium granular structure; common, prominent, fine mottles; upper boundary clear, lower one abrupt; pH 4.2.
Bfg	6-18	Light yellowish brown (2.5Y 6/4) stony gravelly loam and sandy loam; weak, medium, granular structure; common, prominent, medium yellowish-brown mottles; lower boundary gradual; pH 4.6.
Btg	18-24	Pale-brown (10YR 6/3) stony gravelly loam; weak, medium, granular structure; common, faint, fine yellowish-brown mottles; boundaries gradual; pH 5.0.
C	24+	Yellowish-brown (10YR 5/4) stony gravelly sandy loam; few, fine, faint mottles; pH 5.2.

Where the Acg horizon is absent, the profile is an Orthic or a Peaty Gleysol if the organic layer is about 12 inches thick.

Parleeville Soils

The Parleeville soils occur almost exclusively in the lower Tobique River Valley from the mouth of the Gulquac River to Caldwell. They are associated with the Kingsclear series and occur in an area that is underlain by red conglomerate of the Mississippian age. A total of 29,800 acres, or 3.7 percent of the surveyed area, is mapped as Parleeville. The topography ranges between undulating and hilly and follows that of the underlying bedrock. Near St. Almo, numbers of rocdrumlins occur.

The cultivated surface of the Parleeville is a dark reddish brown, granular, gravelly sandy loam. It is underlain by a six-inch layer of reddish-yellow gravelly sandy loam followed by a loose and porous red to dark-red gravelly sandy loam. This horizon grades into unweathered red conglomerate with calcareous cement, at an average depth of three feet. The soil is acid throughout, has low moisture-holding capacity and rapid external drainage, and is well to excessively drained. Stones are few; cobbles are plentiful, but do not interfere with cultural practices.

The general shallowness of the Parleeville soils and the lithological similarity of their coarse skeleton to the underlying bedrock indicate a semiresidual origin. The southeast boundary of the Parleeville soil is from one to three miles farther southeast than the geological boundary of the red Mississippian rock. The reddish soils of the surveyed area are encircled by a transitional zone about three miles wide in which the yellowish-brown soils have a pink cast.

Slightly less than 3,000 acres of these soils are cultivated. They are used for growing potatoes, grain, and hay (Figure 8). Most of the potatoes and grain are grown for certified seed. Livestock are few. These soils warm up early in the spring and are easily cultivated. They have a tendency to be droughty in the summer. Due to the cool climate of the Plaster Rock area, the Parleeville is slightly more productive in that area than in other sectors.

Figure 8.—Tobique River Valley near Arthurette.

Erosion may become a problem when intertilled crops are grown on the slopes. The need for lime varies with crop requirements. The low content of exchangeable magnesium indicates that Parleeville soils may suffer the magnesium deficiency, which has been reported by E. M. Taylor (6) in some potato soils of New Brunswick. As a result of their high permeability,. Parleeville soils do not retain their fertility long.

The vegetation of the Parleeville soils is mainly coniferous and comprises red, white, and black spruce, balsam fir, hemlock, and white and red pine. The tolerant hardwoods are practically absent.

The following is a description of a gravelly sandy loam in a moist state:

Horizon	*Depth, inches*	
L	3-2¾	Brown undecomposed needles with caribou moss, branches, twigs, and cones.
F	2¾-¼	Dark-brown, semidecomposed, matted and fibrous organic matter with yellow and white filaments and undercomposed roots, branches, cones, etc.; boundaries abrupt; pH 4.8.

H	¼- 0	Dark-gray to black, well-decomposed organic matter; strong, medium granular structure; firm when dry; friable when moist; greasy and sticky but nonplastic when wet; boundaries abrupt.
Ah	trace	Black granular loam, high in organic matter.
Ae	0- 4	Pinkish-gray (5YR 7/2) gravelly sandy loam; weak, fine platy structure; boundaries abrupt; pH 4.3.
Bfh	4- 8	Dark reddish brown (2.5YR 3/4) gravelly sandy loam; weak, coarse granular, breaking readily to moderately strong fine granular structure; very friable; lower boundary gradual; pH 4.9.
Bf	8-21	Red (10R 4/6) gravelly sandy loam; weak, fine granular structure; very friable; boundaries gradual; pH 5.0.
C	21+	Dark-red (10YR 3/6) loamy gravel; single-grained and firm in place; some pockets of fine material that probably originated from the weathering of shale; pH 5.0.

Most of the rock fragments are smooth and rounded and about 80 percent of them originated through weathering of the bedrock. Tree roots penetrate this soil to bedrock.

MIDLAND SOILS

Midland soils are poorly drained and occur at the bases of slopes and occasionally in depressions. They are associated with Parleeville soils. They occupy about 3,200 acres, or 0.4 percent of the surveyed area.

The plowed surfaces of Midland soils are black to dark brown gravelly loam that may become gray-brown when the drainage is improved. Traces of a former thick, leached layer may be observed in plowed sections of recently broken land. The underlying layer has distinct bright mottles and grades into the dark-red parent material, in which mottling is hardly discernible. The structure of the surface is weak under natural conditions but improved drainage induces granulation. This soil is acid. The Midland has the same type of parent material and lithology as the Parleeville.

A very small acreage of this series is being farmed with Parleeville soils where small tracts of poorly drained and large sections of well drained soils occur together in an intricate land pattern. The imperfectly drained areas of Midland are used for pasture. These soils remain wet and soggy for a long period of the growing season. It is preferable that large areas of Midland remain under forest.

Larch is the predominant tree species and occurs with balsam poplar, red maple, black spruce, cedar, and a few black ash.

The Midland soil belongs to Gleyed Podzol subgroup. A poorly drained profile in a moist to wet condition is described as follows:

Horizon	*Depth, inches*	
L	4-3½	Yellow to brown undecomposed needles with leaves and moss, branches, twigs, cones and seeds.
F	3½- 1	Very dark brown, semidecomposed, fibrous, matted organic matter with undecomposed roots and branches; boundaries abrupt; pH 4.0.
H	1- 0	Black well-decomposed, greasy and sticky organic matter; boundaries abrupt.
Ah	0- 1	Black loam high in organic matter; strong, medium granular structure; firm when moist; plastic when wet; few pebbles; amorphous mineralized organic matter; boundaries abrupt; pH 4.2.

Aeg	1- 5	Light-gray (7.5YR 7/0) gravelly loam; very weak granular structure; friable when moist, plastic when wet; few, prominent, medium, reddish-yellow (7.5YR 7/8) mottles; boundaries abrupt; pH 4.4.
Bfg	5- 8	Gravelly loam; generally wet and massive, plastic and sticky; many prominent, large mottles of yellowish brown (10YR 6/4), brownish yellow (10YR 6/6), and reddish yellow (7.5 YR 7/8 and 6/8); lower boundary gradual; pH 4.6.
Btg	8-16	Reddish-brown (5YR 4/3) gravelly sandy clay loam; generally wet and massive; very plastic and sticky; common, fine, faint yellowish-red (5YR 5/8) mottles; boundaries gradual; pH 5.0.
C	16+	Dark-red (2.5YR 3/6) gravelly loam; wet and massive, plastic and sticky; few, faint mottles; pH 5.2.

The Btg horizon forms an impermeable layer that is common to this type of profile and may have resulted from the mechanical translocation and sedimentation of clay through the Midland gravel.

Tobique Soils

Only three small areas of Tobique soils, totaling 400 acres, occur in the mapped area. Two small areas occur near the Tobique River, south of Plaster Rock, whereas the third area is a few miles north of Anfield. The Tobique soils have rolling to gently rolling topography.

The plowed surfaces of the Tobique soils are a dark gray brown gritty loamy sand underlain by remnants of the former leached layer, which has a pale-brown color. At about 10 inches below the surface the soil changes to dark reddish brown gritty loamy sand or sandy loam. The color gradually changes to dark-red with depth. The parent material grades into Mississippian red grit and coarse sandstone at three feet below the surface. It is shallow and of local origin, the rock fragments being mostly of the same nature as the bedrock. The Tobique soils are excessively drained and almost free of stones. The profile is acid throughout.

Most of the Tobique soils are farmed because they occur with other stone-free soils like Kennebecasis, Maliseet, Gulquac, and Muniac. They are highly permeable soils with low moisture-holding capacity. They warm up rapidly in the spring. Due to the wet and cool climate of the area they are fair agricultural soils. Their response to fertilizer treatments is prompt but of short duration. The Tobique soils are used mainly for mixed farming, a practice that minimizes erosion, which sometimes may be observed on intertilled crops. Need of lime varies with crops.

The forest vegetation on Tobique soils is largely the same as on Parleeville soils.

profile is as follows:

profile is as follows:

Horizon	*Depth, inches*	
L	$3-2\frac{3}{4}$	Brown undecomposed needles with club moss, caribou moss, branches, twigs and cones.
F	$2\frac{3}{4}-\frac{1}{4}$	Very dark brown, matted and fibrous semidecomposed organic matter with undecomposed roots and branches; boundaries abrupt; pH 4.6.
H	$\frac{1}{4}-0$	Black, well-decomposed organic matter; strong, medium, granular structure; firm when slightly moist; greasy, sticky but nonplastic when wet; boundaries abrupt.
Ae	0- 4	Pinkish-white (7.5YR 8/2) loamy sand or sandy loam; single-grained structure; loose; boundaries abrupt; pH 4.6.

Bfh	4- 6	Dark reddish brown (5YR 3/4) loamy sand; weak, fine, granular structure; very friable; lower boundary clear; pH 4.6.
Bf	6- 9	Yellowish-red (5YR 5/6) sandy loam to loamy sand; weak, fine, crumb structure; friable; lower boundary gradual; pH 4.8.
BC	9-15	Yellowish-red (5YR 4/6) loamy sand; single-grained structure; loose; lower boundary diffuse; pH 4.8.
C	15+	Dark-red (2.5YR 3/6) loamy sand; single-grained structure; loose; pH 4.8.

A thick, white leached layer is a characteristic of this profile. It probably resulted from a combination of high permeability, coarse texture, and the quartzitic nature of the sand.

Soils Developed on Till

The soils developed on till are deep over bedrock (not less than two feet) and occur mostly in the Saint John River Valley. They are usually productive soils with good moisture-holding capacity and a deep root zone. The till soils of the mapped area are gravelly but not very stony. Their topography ranges between undulating and strongly rolling.

Monquart Soils

Monquart soils occur in complex association with the soils of the Caribou and Holmesville catenas at elevations ranging between 200 and 600 feet. Their topography ranges between undulating and rolling. The Monquart soils have the lithology of the Caribou and the texture of the Holmesville soils, and they often occur in transitional areas between these two series. The Monquart soils occur mostly south of the Aroostook River and in a few places east of the Saint John River. They cover about 34,800 acres, or 4.2 percent of the surveyed area.

The surface of cultivated Monquart soils is a dark grayish brown, gravelly sandy loam or coarse loam. The cultivated surface retains a good tilth and does not pack under heavy machinery. Underlying the plowed layer a zone of yellowish-brown gravelly sandy loam or coarse loam provides plants with a deep, porous, well-aerated root zone. The parent material occurs at depths ranging between 25 and 45 inches and consists of light olive brown to pale-yellow, loose, porous gravelly sandy loam to coarse loam. The parent material blankets vertically dipping shale and slate of Silurian age or compact ground moraine with three to six feet of loose and permeable material. Rock fragments are angular and subangular; few are rounded. Nearly 50 percent of the rock fragments are soft shale; the remainder are fine- and medium-grained sandstone, quartzite, white quartz, dark-colored agrillite, and schist. The soil is acid throughout.

Erosion may be severe during the spring runoff when the subsoil is frozen, or during the growing season if the soil is mismanaged. Monquart soils are well drained, warm up rapidly in the spring, and can be worked shortly after rain. Large stones are few and easily picked before cultivation.

Most of the Monquart soils in the surveyed area are cleared and farmed. They are probably the best agricultural soils in the area. Good drainage, high moisture-holding capacity, a deep root zone, and low stone content all combine in making these soils ideally suited for truck crop production and dairy farming. At present the soils are used extensively for the commercial production of table stock or seed potatoes (Figure 9). Small acreages were recently diverted to the production of peas and beef cattle.

Erosion should be reduced by use of appropriate conservation methods. The potato soils of the Saint John River on which magnesium deficiency has

Figure 9.—Two-row potato digger in operation on Monquart soil.

been reported (6) undoubtedly included Monquart soils. The use of dolomitic limestone or magnesium added to fertilizers would, therefore, be recommendable on Monquart soils.

The permanent forest cover is composed mainly of deciduous trees such as sugar maple, white ash, beech, basswood, and butternut. The temporary species are chiefly white birch, trembling aspen, red maple, some gray birch, white pine, and balsam fir.

The Monquart soils are Orthic Podzols. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	2-1¾	Brown undecomposed leaves with club moss, some fine needles and branches.
F	1¾- ½	Dark-brown, semidecomposed, compressed, foliated mat of organic matter with undecomposed roots and branches; boundaries abrupt; pH 4.8.
H	½- 0	Black, well-decomposed organic matter; moderately firm; moderate, coarse granular structure; friable when moist; greasy and sticky but nonplastic when wet; boundaries abrupt.
Ae	0- 2	White (2.5Y 8/2) silt loam; moderate, fine to medium granular and platy structure; permeable and friable; predominantly angular fragments of fine-grained sandstone and quartzite with small quantities of quartz, argillite, and weathered shale; boundaries irregular, abrupt; pH 4.4.
Bfh	2- 6	Brown to dark-brown (7.5YR 4/4) gravelly loam; strong, medium, granular structure; permeable and firm; fragments of fine-grained sandstone, quartzite, and soft shale with small amounts of quartz and argillite; lower boundary clear; pH 4.6.

Bf	6-10	Reddish-yellow (7.5YR 6/6) gravelly sandy loam or loam; strong, medium, granular structure; permeable and firm; fragments of fine-grained sandstone and soft shale with some quartzite, quartz, and argillite; lower boundary gradual; pH 4.8.
BC	10-26	Light yellowish brown (10YR 6/4) gravelly sandy loam or loam; moderate, medium, granular structure; permeable and moderately firm; about 50 percent of rock fragments soft shale, the remainder fine-grained sandstone, quartzite, quartz, and argillite; lower boundary diffuse; pH 4.8.
CB	26-42	Olive-yellow (2.5Y 6/6) gravelly sandy loam or loam; weak, fine, granular structure; permeable and friable; stone fragments as above; boundaries diffuse; pH 5.0 to 5.4.
C	42+	Pale-yellow (2.5Y 7/4) gravelly sandy loam or loam; weak, crumb structure; permeable and friable; stone fragments same as above; pH 5.0 to 5.4.

The increase in percentage of shale fragments lower in the profile probably reflects the lessening intensity of weathering processes with depth. Monquart has the deepest of all well-drained sola in the surveyed area.

Caribou Soils

The Caribou soils cover about 22,100 acres, or 2.6 percent of the surveyed area. These soils are mainly south of the Aroostook River between the U.S.-Canada border and the Saint John River. They also occur on highlands immediately north of the confluence of the Saint John River with the Tobique and Salmon rivers.

These soils occur at elevations ranging between 400 and 900 feet and are associated in a complex pattern with the soils of its catenary members, Carlingford and Washburn, and with the Undine, Monquart, and Holmesville soils. The topography ranges between undulating and broadly rolling and consists of long slopes varying between 3 and 15 percent.

The cultivated layer of the Caribou soils is a dark grayish brown silt loam or silty clay loam. Its strong granular structure is almost permanent, and maintains the soil in good tilth. Its structure and fragments of weathered shale make this soil permeable and resilient.

Under the plow layer lies 13 to 18 inches of a yellowish-brown, mellow, strong granular loam. This fluffy layer contains a lot of soft shale fragments, has a high moisture-holding capacity, and provides plants with a deep, moist, well-drained, and aerated rooting zone.

The parent material usually occurs at a depth of 24 inches from the surface. It is a mellow, light olive brown shaly loam to clay loam with moderate to strong granular structure. The thickness ranges between 20 and 30 inches. The parent material contains fragments that are predominantly of soft, weathered, grayish-brown shale. There is a low percentage (usually less than 30 percent by volume) of gray limestone, gray quartzite, fine-grained sandstone, dark-colored argillite, quartz, schist, and slate fragments near the Glassville soils.

Most of the shale apparently originated from the almost vertically dipping Silurian, calcitic shale that commonly outcrops in the region. The weathered shale fragments are completely leached of carbonates, but veins of calcite and carbonates occur in unweathered rock. The depth of the loose material over bedrock ranges between two and ten feet and averages four feet.

This soil is well drained, has a high moisture-holding capacity, but is the most erodible soil of the surveyed area. A few stones occur at the surface and must be removed before cultivating the land. The whole profile is acid.

A fairly large acreage of the Caribou series is cleared and farmed in the surveyed area. Due to good drainage, high moisture-holding capacity, strong and stable granular structure, medium texture, a well-aerated and deep root zone, gently sloping topography, and low content of stones at the surface, the Caribou soils are ideally suited for truck crop production and dairy farming. They are intensively used at present for commercial potato (Figure 10) and seed grain production.

Small acreages were diverted recently to producing peas for freezing. Only small tracts of this land are used for dairy farming. A recent trend among potato growers is to raise and feed beef cattle off the clover grown in the rotation of potatoes, oats, and clover (Figure 11).

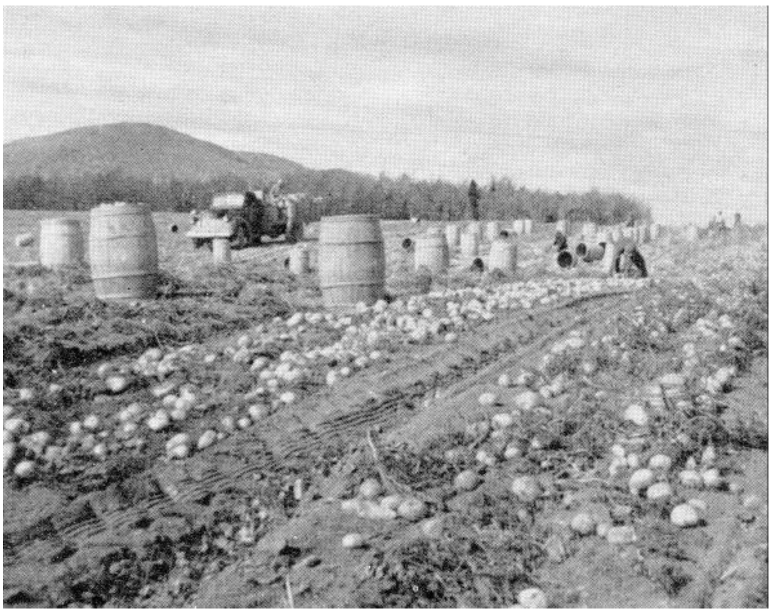

Figure 10.—Harvest time on Caribou soil.

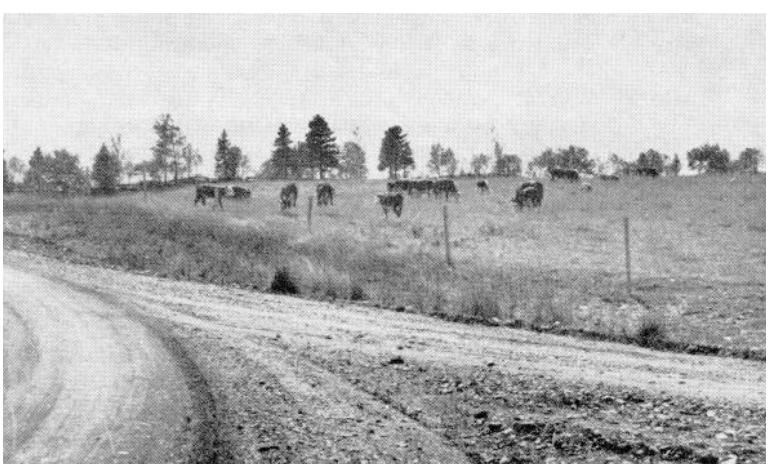

Figure 11.—Hereford cattle grazing on Caribou soil.

The high erodibility and magnesium deficiency (6) of the Caribou soils are the major problems in its management. Depending on the crop, the surface soil may or may not require lime but needs magnesium. A liberal application of fertilizer containing magnesium is necessary to obtain high yields. Diversion terraces, contour plowing and contour strip cropping may be used advantageously to control erosion of the Caribou soil.

The forest cover of the Caribou consists of sugar maple, white ash, elm, beech, yellow birch, basswood, and butternut, along with some red spruce. The temporary species are chiefly white birch, trembling aspen, red maple, some gray birch, and white pine. White spruce and balsam fir become comparatively abundant in second-growth stands.

The Caribou soils are Minimal Podzols. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	1- $\frac{3}{4}$	Brown, undecomposed leaves with needles, club moss and moss, branches, twigs, and cones.
F	$\frac{3}{4}$- 0	Black or very dark brown, semidecomposed, compressed foliated organic matter with undecomposed roots and branches; boundaries abrupt; pH 4.6.
Ah	0- 2	Black (10YR 2/1) loam or silt loam high in organic matter; moderate, medium crumb and strong, medium granular structure; permeable; friable to firm; a few fragments of shale, argillite, fine-grained sandstone, and quartzite (the last increasing in quantity in the fine gravel fraction); boundaries abrupt; pH 4.4.
Ae	trace or 2- 3	White (10YR 8/2) loam or silt loam; moderate, medium crumb and granular structure with a tendency to weak platiness; permeable; firm; stone fragments of white-leached sandstone, shale, gray argillite, quartzite, and quartz; lower boundary clear; pH 4.3.
AB	trace or 3- 4	Very pale brown (10YR 7/3) loam or silt loam; moderate, medium crumb and granular structure; permeable; firm; rock fragments of gray sandstone, argillite, shale, quartzite, and quartz; lower boundary abrupt; pH 4.4.
Bfh	2-10	Strong-brown (7.5YR 5/6) loam or silt loam; strong, medium, granular structure; permeable; firm; 50 percent of the rock fragments of brown soft shale, the remainder being gray sandstone, quartzite, and argillite; lower boundary gradual; pH 4.7.
Bf	10-14	Brownish-yellow (10YR 6/6) gravelly loam; moderate to strong, medium granular structure; permeable; friable; 70 percent of the rock fragments of brown and gray shale, the remainder being sandstone, quartzite, and quartz; lower boundary diffuse; pH 5.1.
C	24+	Pale-yellow (2.5Y 8/4), gravelly, coarse clay loam; moderate, medium, granular structure; permeable; friable; many clay skins; pH 5.4.

Except for a comparatively sharp line of demarkation between the Ae and Bfh horizons, changes of color, texture, and structure are gradual throughout the profile. The Ae horizon is pocketed and ranges in thickness between 0 and 2 inches. Where Caribou soils are shallow (about 24 inches) over bedrock or ground moraine, the C horizon is almost absent. Clay skins are found in the lower part of the profile and are most abundant between 24 and 30 inches; very few occur below 60 inches.

Carlingford Soils

The Carlingford soils are the imperfectly to somewhat poorly drained members of the Caribou catena, and is commonly associated with the Caribou, Undine, and Monquart soils. The Carlingford soils generally occupy the lower-third portion of slopes or shallow depressions where water movement is retarded. These soils cover about 3,700 acres, or 0.4 percent of the surveyed area. The topography ranges between undulating and rolling with a range in slope from 1 to 15 percent.

Under cultivation, the surface layer is a black to very dark gray silt loam high in organic matter and of good, granular structure. Siltation from surrounding areas is partly responsible for the silty texture of this horizon. Under the plowed layer lies 10 to 12 inches of light olive brown, granular, shaly silt loam or loam followed by the parent material, which consists of an olive-brown shaly loam. In areas where the Undine series predominates, the parent material of the Carlingford consists almost exclusively of soft, weathered shale. In other areas of Carlingford, the soil material is a mixture of ablational till and material slowly carried downward by solifluction from surrounding hills and ridges.

The reaction of the surface soil varies. It appears to be partly determined by the proximity of the water table, the original vegetation, and the occurrence of calcite near the surface of surrounding ridges. In cultivated fields the surface soil is generally slightly acid but the subsoil may range from slightly acid to neutral.

Carlingford and Caribou soils are closely associated in the field, and receive similar management. Impeded drainage, greater stoniness than for Caribou, erosion, and siltation may cause problems of management. These soils are wet and cool in the spring. Artificial drainage to remove excess water, and diversion terraces to reduce erosion and siltation, should be part of the normal management of these soils. The pH of Carlingford soils ranges from acid to neutral, so that some areas may be suited to potatoes, and others to hay and clover.

The vegetative cover of the Carlingford consists of balsam fir, red, black, and white spruce with some tamarack and cedar, and a few red maple and black ash. White birch, trembling and large-toothed aspen, and balsam poplar make up the temporary forest vegetation.

The Carlingford soils are generally Gleyed Podzols. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	2-1½	Light-brown to brown, undecomposed needles with moss and caribou moss, branches, twigs, and cones.
F	1½- 0	Reddish-black, semidecomposed, matted and fibrous organic matter with undecomposed roots, branches, and cones; boundaries abrupt; pH 4.2-6.4.
Ah	0- 2	Dark grayish brown (10YR 4/2) (dry), and very dark brown (10YR 2/2) (moist), silt loam; high in organic matter; strong, medium granular structure; permeable; firm; stone fragments of brown soft shale and fine-grained sandstone with some quartzite; boundaries abrupt; pH 4.4-6.5.
Aeg	2- 5	Light-gray (5Y 7/2) silt loam; moderately firm; weak, fine, granular structure; a few faint, fine mottles; rock fragments mainly argillite with fine-grained sandstone and shale; irregular horizon; lower boundary clear; pH 4.4-6.6.

Bfhg	5-11	Yellowish-brown (10YR 5/4) loam; weak to moderate, medium, crumb structure; permeable; friable; clay skins and clay flows common; common, faint, fine mottles; stone fragments of brown soft shale, argillite, and micaceous fine-grained sandstone; lower boundary clear; pH 4.8-6.6.
Bg	11-15	Light olive brown (2.5Y 5/5) loam; moderate, medium, crumb structure; friable; less permeable than other horizons; clay skins and clay flows common; common, distinct, medium mottles of brownish yellow (10YR 6/6); rock fragments mostly of soft shale with some fine-grained sandstone and quartzite; lower boundary gradual; pH 4.8-6.5.
Cg	15-30	Light olive brown (2.5Y 5/4) loam; weak, fine crumb structure; common, distinct, medium mottles of brownish yellow (10YR 6/6) and pale yellow (2.5Y 7/4); clay skins common; rock fragments mainly of soft shale with some sandstone and quartzite; lower boundary diffuse; pH 5.0-6.5.
C	30+	Pale-olive (5Y 6/3) gravelly clay loam; very weak, coarse granular structure; clay skins common; rock fragments same as in Cg horizon; some rock fragments and fines adhering to stones effervesce with acid; pH 5.1-6.6.

A Gleyed Acid Brown Wooded variant of this occurs. It occurs in small, unpredictable areas along with the Gleyed Podzol on acid or nearly neutral parent material. In the Gleyed Acid Brown Wooded profile the Ae horizon is missing and the Bfhg layer is less apparent.

Field observations revealed that in the Bg horizon clay skins and clay flows were abundant, texture was the finest, and permeability was at a minimum. This was supported in the laboratory, the low values obtained in the Bg horizon for the volume of gravel, total volume of pores (Table 14), sand percentage (Table 13) and maximum water-holding capacity (Table 15) indicating that an impermeable pan layer is developing in this soil.

Washburn Soils

The Washburn soils are the poorly to very poorly drained members of the Caribou catena and are associated with Caribou, Undine, and Monquart soils. It occupies depressions or areas where the permanent water table is close to the surface. These soils cover about 3,600 acres, or 0.4 percent of the surveyed area. Topography ranges between level and depressional.

In the cultivated state the surface layer is a black silt loam to silty clay loam, high in organic matter. In spots where the black surface layer is less than four inches thick the plow turns up some of the underlying light-gray material. The cultivated layer may contain as much as 30 percent organic matter but averages 12 percent. The surface layer has a high moisture-holding capacity, which keeps the soil wet and cold even during prolonged dry weather. Some rock fragments may contain free carbonates.

Under the plowed layer there is a light-gray mottled layer followed by thick layers (20 inches) of strongly mottled olive-gray to light olive brown silt loam to silty clay loam. The smooth silty material of the subsoil is nearly impermeable and holds the water table close to the surface.

The parent material of Washburn soils resembles that of the Carlingford and Caribou in origin and composition. Its pH ranges between 6.0 and 7.4, the soil and rock fragments occasionally effervescing with dilute acids. Thickness of the loose material over bedrock ranges between two and ten feet, the average being five feet.

As a result of depressional or flat topography, erosion is practically absent on Washburn soils but accumulation of material washed off the slopes of adjacent areas is common.

Washburn soils are wet and soggy. Small sections of them are used either as dumping grounds for stones and cull potatoes or are farmed the same as Carlingford and Caribou soils. Stones are few at the surface but generally numerous at a depth of one foot. The soils have limited agricultural uses but may provide lush grass sward in droughty periods. The large areas are kept under forest.

The permanent forest cover consists of black spruce, tamarack, cedar, black ash, red maple, and balsam poplar. Temporary trees are trembling aspen, white birch, and witch hazel (*Hamamelis virginiana*).

The Washburn soils are Dark Gray Gleysolics. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	4-3½	Brown, undecomposed leaf litter, twigs, needles; pH 6.2.
F	3½- 2	Very dark brown (10YR 2/2), semidecomposed litter, felted; pH 6.2.
H	2- 0	Black (10YR 2/1), well-decomposed organic material; strong, coarse crumb structure; somewhat greasy when wet; pH 6.6.
Ah	0- 4	Very dark brown (10YR 2/2) silt loam; weak crumb structure; loose, fluffy; pH 6.6.
Cg1	4-17	Olive-gray (5Y 2/2) silty clay loam; massive; sticky, plastic; many prominent, coarse, olive-yellow (2.5Y 6/6) mottles; upper horizon boundary abrupt, lower diffuse; pH 6.6.
Cg2	17-23	Olive-gray (5Y 5/2) silty clay loam; massive; sticky, plastic; many prominent, medium mottles of light olive brown (2.5Y 5/4); lower boundary abrupt; pH 6.8.
Cg3	23+	Dark-gray (5Y 4/1) silty clay loam; massive; sticky, plastic; common, prominent, medium mottles; calcite fragments common; pH 7.2.

Gleyed Podzol, Orthic and Peaty Gleysol, and Low Humic and Eluviated Gleysol variants occur mixed with the Dark Gray Gleysolic. These occur usually as small areas and were not considered of sufficient importance to map separately.

The percentage of clay is highest in the Cg_1 and Cg_2 horizons and appears to characterize these layers as horizons of clay accumulation (Table 12). Several analyses of the Cg_1 horizon represent maxima or minima in the profile. They are: absence of gravel (Tables 12, 13), a large percentage of the fractions of fine sand of low specific gravity and a small percentage of medium (Table 14), and a large percentage of quartz and epidote minerals and a small percentage of hornblende and opaque minerals (Table 15). These results indicate that the Cg_1 layer contains material that is strongly weathered.

Holmesville Soils

Holmesville soils occupy 107,000 acres (13 percent of the total area), the largest acreage of good agricultural soil of the surveyed area. These well-drained soils occur in large, undulating to rolling, till-covered ridges (Figure 12) that are dissected with deeply entrenched, narrow streams.

The elevation of these soils ranges between 400 and 900 feet above sea level. A large area of this soil surrounds Holmesville in Carleton County, but most of the areas are in Victoria County on both sides of the Saint John River. Small sections are scattered through areas of Caribou and Monquart soils. The Undine soils are commonly associated with the Holmesville as they occur on the upper sections of the eroded slopes of the entrenched streams.

Figure 12.—Broadly rolling topography of Holmesville soil.

The surface of a cultivated Holmesville soil is dark yellowish brown. It is acid and has a gravelly sandy loam or gravelly loam texture with a weak, medium to fine granular structure. Gravel is beneficial in this soil as it increases the infiltration of water and reduces runoff and surface erosion (2). The soil surface becomes almost a gravel pavement if the fines are washed away. Hard, nonporous gravel retains moisture at the interface between soil and rock fragments, while porous gravel retains additional moisture within its pores. Stones occur at the surface soon after clearing; they are comparatively small and are picked up easily.

The subplow layer is brown and extends to a depth of about 18 inches. It has a strong granular structure and is the most friable layer of this soil. The texture is gravelly sandy loam or gravelly loam and the reaction is acid. This horizon is very permeable but retains sufficient moisture to maintain continuous plant growth throughout the summer.

The parent material normally occurs at 18 inches below the surface. It is a compact, gravelly sandy loam to gravelly loam with a light olive gray to light olive brown color. Although compact, the upper six to ten inches of the parent material (CB horizon) appears to be somewhat loosened up, possibly by frost action. Below this loosened layer the very compact and hard parent material retards vertical water movement through the soil. Speckles of rust usually occur between 28 and 36 inches below the surface. The total volume of pores in this layer does not exceed 30 percent. Tree roots do not penetrate into the parent material. Farmers designate this horizon as a hardpan. The till ranges between four and 50 feet thick over bedrock. Rock fragments are rounded or subrounded and firmly embedded in a sandy loam to loam matrix. Fragments of quartz, quartzite, and quartzitic fine-grained sandstone predominate but fragments of argillite, slate and schist are fairly common. Variations in the lithology of the Holmesville soils occur at the contacts with Glassville, Kingsclear, and Parleeville soils, where fragments of gray slate, red shale, and red sandstone are common. The transitions from well to poorly drained areas are gradual.

Less than 50 percent of the Holmesville soils (Figure 13) are used for growing potatoes, raising beef, or dairying; the remainder is under forest. The soils are suited for intertilled crops. In general, they are less erodible and more productive than the Undine, Caribou, and Monquart soils. Stoniness is their only serious mechanical impediment to agriculture, and cobble stones may become a problem where potato digging machinery is used for the first time. The acid surface requires lime in varying quantities, depending on the crop being grown. The Holmesville soils, like the Monquart and Caribou (other important potato soils), have a very low content of exchangeable magnesium. Small quantities of dolomitic limestone or magnesium-added fertilizers should be used on this soil to obtain high crop yields.

In Carleton County the Holmesville soils bear a deciduous vegetation composed mostly of sugar maple, beech, and red maple but with practically no basswood or elm. In Victoria County the permanent vegetation of the Holmesville soils is made up of mixed wood, red and white spruce, balsam fir, maple, yellow birch, and basswood. White pine occurs locally on dry banks of streams. The temporary trees are mainly white birch, trembling aspen, and red maple.

The Holmesville gravelly sandy loam is an Orthic Podzol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	2-1¾	Brown, undecomposed, mixed litter of leaves and needles with branches, twigs, cones, and some club moss.
F	1¾ -½	Dark-brown to black, semidecomposed matted and fibrous organic matter with yellow and white filaments and undecomposed roots and branches; boundaries abrupt; pH 4.2.
H	½-0	Black, well-decomposed organic matter; moderate, medium crumb structure; greasy, sticky, but nonplastic when wet; friable when moist; firm when dry; boundaries abrupt.

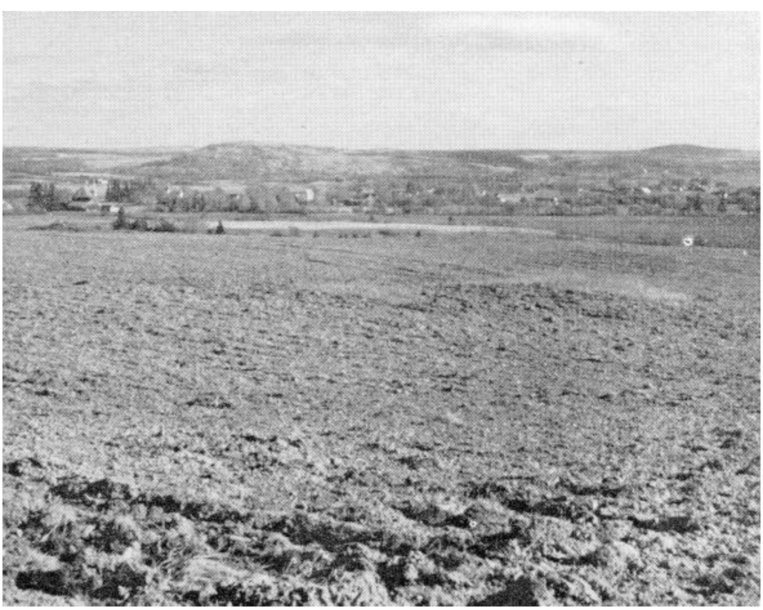

Figure 13.—Farmed Homesville soil.

Ae	0- 2	Light-gray (10YR 7/2) loam or silt loam; moderate, medium granular to weak, medium platy structure; friable; permeable; subrounded and rounded fragments of quartz, quartzite, and sandstone with some argillite and slate; boundaries abrupt; pH 4.4.
Bh	trace	Dusky-red (2.5YR 3/2) loam; strong, fine granular structure; firm; few clay skins; boundaries abrupt.
Bfh	2- 5	Dark-brown to brown (7.5YR 4/4), gravelly sandy loam or gravelly loam; strong, medium granular structure; firm; permeable; few clay and silt skins; subrounded and rounded fragments of quartz, quartzite, fine-grained sandstone, argillite, and slate, some schist and soft shale; lower boundary clear; pH 4.5.
Bf	5- 7	Yellowish-red (5YR 4/6), gravelly sandy loam or gravelly loam; strong, fine to coarse granular structure; friable; permeable; few clay and silt skins; rock fragments, same as above; boundaries clear; pH 4.8.
BC	7-17	Light yellowish brown (10YR 6/4), gravelly sandy loam or gravelly loam; moderate, fine, granular structure; friable; permeable; very few clay and silt flows, occurring only in soil cracks; stone fragments same as above; lower boundary gradual; pH 4.8.
CB	17-24	Light olive brown (2.5Y 5/4), gravelly, very gritty sandy loam or gravelly loam; strong, coarse, fragmental and conchoidal structure breaking to moderate, fine granular; friable; slightly compact; clay and silt skins common; stone fragments same as above; lower boundary clear; pH 5.2.
C	24+	Light olive gray (5Y 6/2), gravelly, very gritty sandy loam or gravelly loam; moderate, coarse, pseudoplaty structure breaking to weak, fine granular; firm; impermeable; very compact; a few distinct, fine mottles at 40 inches; clay and silt skins and flows common, decreasing to few at 72 inches; pH 5.4.

The AB and Bh horizons occur in few places, the latter especially at elevations higher than 850 feet above sea level and at about a third below the top of the slope. In such places the Bh horizon is only half an inch thick and broken. There seems to be no relationship between the occurrence of clay skins and compaction.

Johnville Soils

The Johnville soils are the imperfectly to poorly drained members of the Holmesville catena. These soils occur in depressional areas with slow water movement or on hillsides at and below the zone of seepage.

There are 16,300 acres of these soils, or 2.0 percent of the surveyed area. The topography ranges between depressional and rolling with a range in slope of 5 to 25 percent. Elevation is the same as for the Holmesville series.

The cultivated layer consists of six inches of black to very dark gray gravelly loam. Areas with only impeded drainage have a dark-brown to dark yellowish brown gravelly loam surface. In general, the texture of the surface soil tends to be progressively siltier downslope.

The plowed layer, grades into a gravelly loam that ranges from strong brown under imperfect drainage to mottled pale yellow under poor drainage. This middle layer has a moderately firm, granular structure. at depths ranging between 15 and 18 inches the subsurface layer changes rather abruptly to the parent material, a compact olive-gray to olive-brown gravelly loam that reaches maximum compaction at about six to ten inches below the horizon boundary. The subsoil is mottled throughout. Both the surface layer and the subsoil are acid.

The parent material of the Johnville soils is like that of the Holmesville in composition and properties, including variations. The till ranges between three and 25 feet thick over steeply dipping beds of hard shale, argillite, and quartzite.

Areas of the imperfectly drained soil are farmed with those of the Holmesville soils, whereas the poorly drained areas are used as permanent pasture or remain under forest vegetation with the very poorly drained Poitras soils. The agricultural limitations are similar to those of the Carlingford soils except that the Johnville usually does not have a neutral reaction. The Johnville soils are acid, cool, and moist and require liming and drainage improvements as well as fertilization for fair productivity. The agricultural usage depends on the moisture status. The imperfectly drained areas are used to grow potatoes, grain and hay. Stones must be removed from the surface after the first breaking and occasionally thereafter.

In undisturbed areas, the Johnville soils support a luxuriant vegetation of red maple, black ash, tamarack, and black spruce in varying combinations. Yellow birch and hemlock occur on the moist lower slopes in Carleton County. The pioneer vegetation is composed of trembling aspen and white and gray birch with black spruce.

The Johnville gravelly loam is a Gleyed Podzol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	3-2½	Dark yellowish brown to brown, undecomposed leaves and needles, club moss, caribou moss, and sphagnum moss with branches, twigs, and cones.
F	2½- ½	Dark-brown to black semidecomposed, fibrous and matted organic matter with white filaments and undecomposed roots, branches, and cones; boundaries abrupt; pH 4.0.
H	trace	Black organic matter; strong, medium, granular structure; greasy, sticky, but nonplastic when wet; friable when moist; pH 4.0.
Aeh	trace	Very dark gray (10YR 3/1) gravelly loam that changes to gray (10YR 5/1) when rubbed; moderate, medium, granular structure; loose and friable; stone fragments of quartz, quartzite, and sandstone; pH 4.2.
Ae	0- 2	Light-gray (2.5Y 7/2) gravelly sandy loam or gravelly loam; moderate, medium granular and weak, thin, platy structure; loose and friable; clay skins few; stone fragments of quartz, quartzite, sandstone, and some argillite; boundaries abrupt; pH 4.2.
Bfhg	2- 4	Strong-brown (7.5YR 5/6) gravelly loam; moderate, medium granular structure; friable; permeable; few, fine, faint mottles; clay skins few; rock content same as in Ae horizon; lower boundary clear; pH 4.5.
Bfg	4- 9	Brownish-yellow (10YR 6/6) gravelly loam; weak, coarse granular breaking readily to weak, medium granular structure; more compact than leached layer; common, coarse, prominent mottles of yellow (10YR 7/6) and white (2.5Y 8/2); clay skins and flows common; rock fragments of sandstone, quartzite, argillite, with some shale and quartz; lower boundary gradual; pH 4.5.
Cg1	9-17	Yellowish-brown (10YR 5/6) gravelly sandy loam or gravelly loam; weak, medium granular structure; common, prominent, medium mottles of yellow (10YR 7/6) and reddish yellow (7.5YR 7/8); fairly compact; clay skins and flows common; sometimes more gravelly than other horizons; rock fragments same as in horizon above; lower boundary clear; pH 4.5.

Cg2	17-29	Light yellowish brown (2.5Y 6/4) gravelly loam or gravelly sandy loam; strong, thin, pseudoplaty structure; firm and very compact; clay and silt skins and flows common; common, fine mottles of yellow (2.5Y 7/8) and brownish yellow (10YR 6/6); rock fragments same as in horizon above; lower boundary gradual; pH 5.4.
Cg3	29-60	Olive-gray (5Y 5/2) gravelly loam or gravelly sandy loam; lower part of horizon sometimes of a heavier texture than upper part; strong, coarse, fragmental and irregular structure; clay skins and flows few; compact; a few, fine, distinct mottles of yellowish brown (10YR 5/4); rock fragments same as in horizon above; lower boundary Same as Cg3 but without mottling.
C	60+	Same as Cg3 but without mottling.

The thickness of the L-H horizon remains about the same under different drainage conditions, but a thin Ah may occur under very moist conditions. An intermittent and thin (maximum thickness of one inch) Bh horizon may occur under the leached layer in the imperfectly drained areas, about a third of the way up the slope. Under poorly drained conditions the Ae horizon is mottled and underlain by a Bfhg horizon.

POITRAS SOILS

The Poitras soils occupy depressions in areas of the Holmesville series and are water-saturated most of the time. Poitras soils cover 15,200 acres, or 1.8 percent of the surveyed area. Because of the close association of Johnville with Poitras soils in the field, the total acreage of this series may be underestimated. The topography is flat to depressional and the elevations are the same as for the Holmesville series.

The cultivated layer is black and may be four to 12 inches thick with a range in texture from stony gravelly loam to clay. The surface layer is usually so thick that the underlying gray layer is seldom plowed up. Between the organic layer and the mineral subsoil lies a four- to 12-inch layer of rubble, cobble, and gravel. Through this stony layer the black surface grades to a dark olive gray color, which in turn passes gradually to pale olive at about 18 to 20 inches from the surface. As a result of very poor drainage, mottles are few in the pale-olive to olive-gray compact loam of the subsoil. The parent material is the same as in the Johnville and Holmesville soils and its thickness ranges between five and 20 feet over bedrock.

Most of the Poitras soils are under forest. Small areas are cleared and plowed occasionally; they are used as permanent pasture. The agricultural uses are greatly limited by excessive stoniness and wet conditions. For all practical purposes these soils should never be cleared.

The vegetative cover is essentially that of a wet soil, namely, black spruce and red maple with some cedar, black ash, and tamarack. Temporary species are trembling aspen, witch hazel, and some white birch.

The Poitras gravelly loam to clay is a Podzolic Gleysol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	4-3½	Brown undecomposed needles, caribou moss, and sphagnum with branches, twigs, and cones.
F	3½- 1	Very dark brown to black, semidecomposed, fibrous and matted organic matter with white filaments and undecomposed roots, branches, and cones; boundaries abrupt; pH 3.8-5.2.

H	1- 0	Dark-brown (7.5YR 3/2) to black, well-decomposed organic matter; strong, medium granular structure; greasy and sticky when wet; permeable layer with high moisture-holding capacity; stone fragments of sandstone, quartzite, quartz, argillite, and slate; lower boundary gradual; pH 3.8-5.4.
Aeh	absent to 0- 7	Dark grayish brown (2.5Y 4/2) stony, gravelly clay loam, lighter in color when rubbed; strong, medium granular structure; firm when dry; massive, sticky, and plastic when wet; very stony; rock fragments of sandstone, quartzite, slate, quartz, argillite, and some felsite and pink granite; lower boundary gradual; pH 3.8-5.4.
Aeg	0-10	Pale-yellow (5Y 7/4) stony gravelly loam to gravelly clay loam; sticky and massive; distinct, common, fine mottles of olive yellow (2.5Y 6/6); clay skins and flows few; boundaries gradual; pH 4.2-5.6.
Bfg	10-22	Light olive brown (2.5Y 5/4) gravelly sandy loam or gravelly loam; sticky and plastic; common, prominent, coarse mottles of brownish yellow (10YR 6/6); clay skins and flows few; boundaries gradual; pH 4.5-5.6.
Btg	22-32	Light yellowish brown (2.5Y 6/4) gravelly loam to gravelly clay loam; sticky and plastic; compact, massive, and impermeable; common, faint, fine mottles of brownish yellow (10YR 6/6); clay skins and flows common; lower boundary clear; pH 4.5-5.6.
Cg	32-42	Light yellowish brown (2.5Y 6/4) gravelly loam; strong, thin, pseudoplaty structure; compact and massive; common, faint, fine mottles of gray (2.5Y 6/0) and brownish yellow (10YR 6/6); clay skins and flows few; lower boundary gradual; pH 4.9-5.6.
C	42+	Light olive gray (5Y 6/2) gravelly loam or gravelly sandy loam; moderate, thin, pseudoplaty to weak, coarse, fragmental structure; a few, faint, fine mottles; very compact; clay skins few; pH 5.2-5.6.

Peaty Gleyed Podzol, Orthic, Peaty, or Rego-Gleysol variants of this soil occur but were not separated in mapping. They are not as common as the Podzolic Gleysol. The Ah horizon is usually absent.

Plant roots penetrate to about 20 inches but not into the Btg horizon. The occurrence of a stony layer under the organic surface layer is due probably to erosion after glaciation but before development of a profile. The weakly developed morphological characteristics of the profiles suggest that development has been retarded by impeded drainage.

Kingsclear Soils

The well-drained, imperfectly drained (Plaster Rock) and very poorly drained (Nackawick) soils of the Kingsclear catena form a complex land pattern. Hence, these soils cannot be mapped accurately on the scale of mapping used. The Kingsclear clay loam occurs in the Tobique Valley where there is red shale of Mississippian age. It is associated with the Parleeville and Tobique soils, which are found in areas underlain by red conglomerate and red sandstone respectively. The Kingsclear soils are usually undulating but may be strongly rolling near the Tobique River. The range in elevation is between 450 and 650 feet above sea level. The soils occupy 40,500 acres or 4.9 percent of the total area.

The cultivated layer is a dark-red clay loam, plastic and sticky when wet, hard and cloddy when dry. The subsoil is a yellowish-red to dark-red clay loam to silty clay with strong granular structure. It is not readily permeable, though not compact, and grades into the red gritty clay of the parent material, which is very compact and has the typical, hard, pseudoplaty structure of a ground moraine. Stones are few at the surface. Because of the fine texture of this soil, drainage depends mostly on surface runoff. External drainage is rapid, internal drainage is slow, and the effective rate moderately good. Mottling usually occurs at a depth of 18 to 24 inches. The profile is generally acid throughout but may be alkaline in the parent material.

Due to the fine texture and numerous wet spots, very little Kingsclear soil is under cultivation. The cleared soil is generally too wet and cold for growing potatoes and is used mostly for hay and grain. This soil would be somewhat improved by drainage. Erosion and stoniness are not a problem. Exchangeable magnesium (Table 15) in subsoil layers is higher than in the Caribou and Homesville soils. When well managed, the Kingsclear series is suited for dairy farming. For high yields, lime and fertilizer are essential. The organic matter content should be kept at a high level to maintain the surface soil in good tilth.

Under natural conditions the Kingsclear soil supports a coniferous vegetation of balsam fir, red and white spruce, some cedar and white pine.

The Kingsclear clay loam is a Textural Podzol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	2-1½	Brown undecomposed needles, cones, twigs, branches, and caribou moss.
F	1½- 0	Black, semidecomposed, fibrous and matted organic matter with white and yellow filaments, undecomposed roots and branches; boundaries abrupt.
H	trace	Black decomposed organic matter; strong granular structure; greasy and sticky when wet; firm; boundaries abrupt; pH 3.9.
Ae	0- 2	Pinkish-gray (5YR 7/2) loam to clay loam; moderate, medium platy structure; firm and permeable; clay skins few; boundaries abrupt; pH 3.6-4.0.
Bfht	2- 5	Yellowish-red (5YR 4/6) clay loam or silty clay; moderate, fine granular structure; firm and permeable; clay skins few; lower boundary gradual; pH 4.1-4.4.
Bft	5- 9	Dark-red (2.5YR 3/6) clay loam or silty clay; moderate, medium granular structure; firm and permeable; clay skins common; lower boundary clear; pH 4.1-4.6.
Bt	9-24	Dusky-red (10R 3/4) clay to silty clay; sticky and plastic when wet; firm when moist; very compact and impermeable; strong, thick, pseudoplaty, breaking to coarse, blocky structure; a few, faint, fine mottles; many clay skins; containing black specks of carbonaceous material; lower boundary gradual; pH 5.0-6.6.
C	24+	Dusky-red (10R 3/4) silty clay loam; strong, thick, pseudoplaty structure; sticky and plastic when wet; firm; very compact and impermeable; a few, faint, fine mottles; clay skins common; containing black specks of carbonaceous material; may effervesce with acid at 48 inches; pH 5.5-7.0.

Bisequa Podzol and Orthic Gray Wooded variants of this soil occur but are not common. Free carbonates may occur at a depth of 18 inches.

Plaster Rock Series

Plaster Rock soils are imperfectly to poorly drained. They occupy 24,500 acres, or 3.0 percent of the mapped area. The topography is gently sloping and rarely exceeds 10 percent. These soils occur at about the same elevation as the

Kingsclear soils, the well-drained member of the catena. The only difference between the soils is drainage; they are alike in composition.

The cultivated layer of the Plaster Rock series is a slightly gritty, dusky-red clay loam that is massive and sticky when wet and well granulated when dry. Below plow depth the soil changes abruptly to a mottled, massive and sticky red clay loam to clay. At 12 to 15 inches deep there is a hard, compact clay layer that breaks to large angular clods. This layer is impermeable and is speckled with rust. The red clay loam parent material usually occurs at three to four feet. Even when the solum is wet, this layer is always comparatively dry. The upper part of the solum is acid but effervescence is not uncommon at 24 inches.

A very small acreage of these soils is farmed. They generally receive the same treatment as the Kingsclear soils. Without improved drainage, productivity is low; with improved drainage and liming, it is fair for dairy farming. For all practical purposes, under present conditions, these soils are best suited to forestry.

Tamarack, black spruce, and cedar make up most of the forest vegetation on these soils, but there are some balsam poplar, red maple, and a few elm.

The Plaster Rock clay loam is a Gleyed Textural Podzol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	3-2½	Brown undecomposed needles, twigs, branches, cones, caribou moss, and sphagnum.
F	2½- 1	Black, semidecomposed, fibrous and matted organic matter with white filaments and undecomposed roots and branches; boundaries abrupt.
H	1- 0	Black, well-decomposed organic matter; weak granular structure when moist; greasy and sticky when wet; boundaries abrupt; pH 4.0.
Ah	0- 1	Dusky-red (2.5YR 3/2) loam with specks of weak red (2.5YR 5/2); high in organic matter; strong, medium granular structure; very firm when dry; lower boundary clear; pH 4.2.
Aeg	1- 4	Pinkish-white (5YR 8/2) loam; moderate, coarse, platy, breaking to moderate, fine granular structure; firm, slowly permeable; common, prominent, medium mottles of reddish yellow (5YR 6/8); clay skins common; lower boundary abrupt; pH 4.2.
ABtg	4- 6	Reddish-yellow (5YR 7/6) clay loam; moderate, medium granular structure; firm and slowly permeable; common, faint, fine mottles of yellowish red (5YR 5/6); clay skins common; lower boundary clear; pH 4.2.
Bftg	6- 8	Reddish-brown (5YR 5/4) clay loam; strong, medium granular structure; firm and impermeable; common, faint, fine mottles of reddish yellow (5YR 6/6); clay skins common; boundaries clear; pH 4.6.
Btg1	8-11	Reddish-brown (2.5YR 4/4) gritty clay; strong, coarse, fragmental structure when dry; massive and sticky when wet; common, faint, fine mottles; clay skins common; boundaries clear; pH 5.0.
Btg2	11-36	Weak-red (10R 4/3) gritty clay; strong, thick, pseudoplaty, breaking to strong, coarse, fragmental structure; massive and sticky when wet; a few, faint, fine mottles; clay skins common; lower boundary gradual; pH 5.0-6.0.
C	36+	Dusky-red (10R 3/4) clay loam; strong, thick, pseudoplaty structure; compact and impermeable; clay skins common; containing black specks of carbonaceous material; usually effervescing with acid at 30 or 36 inches; pH 6.5-7.5.

Aside from the light color of the bleached horizon, this profile is nearly uniform in color. In fact, textural changes are more noticeable than color variations. The textural gradation from coarse to fine with depth follows that in the Kingsclear and in some Textural Podzol soils of southern New Brunswick, for example, the Queens loam. The quantities of clay skins and clay flows start decreasing at a depth of 48 to 54 inches.

NACKAWICK SOILS

Nackawick soils are very poorly drained and have developed on the same kind of red parent material as the Kingsclear soils. They occur in depressional areas and are associated with Parleeville soils and other series of the same catena, Kingsclear, and Plaster Rock. Pockets of Nackawick soils are so common throughout the section of red till in the Tobique River valley that most of them are mapped in complexes with other soils. There are about 29,700 acres of these soils (3.7 percent of the surveyed area).

Nackawick soils generally have a comparatively thick organic surface, underlain by a strongly mottled, pinkish-gray gravelly clay loam layer that in turn grades rapidly into the red-colored clay of the parent material. In places where the pinkish-gray layer is absent the organic surface layer grades directly into the red clay till.

There is no Nackawick soil under cultivation, and only a few small tracts are used for natural pasture. The agricultural uses are limited by the fine texture and wet conditions. These soils should never be cleared.

Tamarack, black spruce, and cedar make up the natural vegetation. Alder grows in swampy areas.

The Nackawick clay is a Low Humic Eluviated Gleysol. A description of a wet, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	4-3½	Brown undecomposed needles, sphagnum, branches, twigs, and cones.
F	3½- 0	Black, semidecomposed, fibrous and matted organic matter with white filaments and undecomposed roots, branches, and cones; boundaries abrupt; pH 4.0.
H	trace	Black, well-decomposed organic matter; moderate, medium granular structure when moist; greasy and sticky but non-plastic when wet; friable.
Ah	0- 1	Very dark gray (5YR 3/1) silt loam, high in organic matter; weak crumb structure; pH 4.4.
Aeh	1- 8	Dark-gray (10YR 4/1) clay loam, lighter in color when rubbed; weak granular structure; massive and sticky when wet; boundaries gradual; pH 4.6.
Aeg	8-10	Pinkish-gray (7.5YR 6/2) clay loam; massive and sticky; common, prominent, coarse mottles of reddish yellow (7.5YR 6/6); clay skins few; lower boundary gradual; pH 5.0.
Btg	10-13	Reddish-brown (5YR 4/4) clay; massive and sticky; common, faint, fine mottles; lower boundary clear; pH 5.2.
Cg1	13-23	Weak-red (10R 4/4) gravelly clay loam; moderate, thick, pseudoplaty, breaking to moderate, fragmental structure; very compact and impermeable; clay skins common; a few, faint, fine mottles; lower boundary gradual; pH 5.5-6.5.
Cg2	23-34	Same as Cg_1 horizon but effervescing with dilute acid; pH 7.1.
C	34+	Dusky-red (10R 3/4) clay loam; strong, thick, pseudoplaty structure; firm; compact and impermeable; clay skins common; black specks of carbonaceous material; effervescing with acid; pH 7.2.

Small areas of Peaty Gleysols were included in the mapping units of the Nackawick soils.

Soils Developed on Outwash Material

Outwash materials are generally stratified, i.e., deposited in layers of varying thickness and texture. Their particles and rock fragments are smooth and rounded. The moisture regime of each soil is governed by the depth of the layer with the finest texture. Outwash materials in the surveyed area have smoother topography and are less erodible than till soils. The outwash materials are separated, on the basis of their texture, into gravel and sand.

Outwash gravel in the surveyed area occurs in the form of terraces, small plains, or “horseback ridges”. The terraces and the plains are smooth whereas the “horseback ridges” resemble the bed of an abandoned railway. Soils on outwash gravel have high permeability and generally lack moisture during the growing season unless they receive seepage water from neighboring hills.

Outwash sands in the surveyed area consist of stone-free, stratified deposits of medium and coarse sand of varying thickness that may contain some lenses of fine gravel. Their topography varies from level to undulating and drainage and erosion may become serious problems.

The soils on these deposits are generally productive and respond readily to liming and fertilization. In general, they retain moisture and fertility longer than soils on outwash gravel.

MUNIAC SERIES

The Muniac series occurs along the banks of present-day and old stream valleys at elevations ranging between 225 and 400 feet along the Saint John River valley and up to 800 feet in the Juniper area. The largest areas are near Bairdsville, Blue Bell, and Juniper. These soils occupy 26,300 acres, or 3.3 percent of the surveyed area. Most of the gravel deposits, on which the Muniac soils have developed, have nearly level topography and originated as glacial outwash. The few eskers mapped as Muniac have a long, sinuous crest with steep sides and are combined in places with knob and kettle features (Figure 14).

Figure 14.—Esker topography of Muniac soil.

Cultivated Muniac soils have a grayish-brown gravelly sandy loam surface underlain by a strong-brown gravelly sandy loam subplow layer. The parent material is light olive brown gravel to gravelly sandy loam. The gravel consists of flat, rounded fragments of slate and some shale with rounded and subrounded pieces of quartz, quartzite, quartzitic sandstone, calcite, and calcareous sandstone. Calcium carbonate coats and cements the rock fragments at depths greater than four feet. The reaction is acid throughout the profile but effervescence with acid occurs at depths ranging between 4 and 10 feet. Some kame terraces of the Muniac series that rest against mountain sides may be as much as 100 feet deep, but about 20 feet is the average depth.

The soil contains cobbles, but no large stones. The drainage is good to excessive, so that the soil is deficient in moisture during part of the growing season.

Muniac soils are droughty and warm up early in the spring. They are fair forest and agricultural soils. Where cleared, they are used for potatoes, grain, hay, early fruits, and vegetables. These soils are also used in dairy farming since they provide early pasture and can yield good crops of alfalfa. Because of their acidity and rapid permeability, the soils require frequent and large applications of lime and fertilizer, according to crop requirements, to ensure high yields. The content of exchangeable magnesium is higher than in the Holmesville series and similar potato soils and has not yet been shown to be deficient. The most important limiting factor is the uncertain distribution of rainfall during the growing season.

Because of their good drainage and nearly level topography, most of the Muniac soils have been cleared. The permanent forest species are maple, yellow birch, spruce, fir, and white pine. Temporary species are aspen and white birch.

Muniac gravel appears to be the best material in the surveyed area for gravelling secondary roads. When it is crushed the fines derived from the small percentage of shale and the carbonates that coat the rock fragments bind the gravel into a hard, pavement-like surface.

The Muniac has an Orthic Podzol profile. A description of a moist profile is as follows:

Horizon	*Depth, inches*	
L	2-1¾	Brown undecomposed leaves, needles, club moss, caribou moss, branches, and cones.
F	1¾- ½	Dark reddish-brown, semidecomposed, matted and foliated organic matter with white and yellow filaments, undecomposed roots, branches and cones; boundaries abrupt; pH 4.7.
H	½- 0	Black, well-decomposed organic matter; firm, strong, granular structure when dry, friable when moist; boundaries abrupt.
Ae	0- 3	Pale-brown (10YR 6/3) gravelly loam; moderate, medium platy structure; friable and permeable; boundaries abrupt; pH 4.2.
Bfh	3- 7	Dark-brown (7.5YR 4/4) gravelly sandy loam; moderate, fine, granular structure; friable and permeable; lower boundary clear; pH 4.6.
Bf	7-13	Strong-brown (7.5YR 5/8) gravelly sandy loam; weak, fine, granular structure; very friable and permeable; lower boundary gradual; pH 4.9.
BC	13-20	Brownish-yellow (10YR 6/6), very gravelly sandy loam; weak, fine, crumb structure; very permeable; lower boundary diffuse; pH 5.0.
C1	20-48	Light olive brown (2.5Y 5/4) loamy gravel or gravelly sandy loam; single-grained structure; very permeable; lower boundary clear; pH 5.3.

C2	48+	Light olive brown (2.5Y 5/4) loamy gravel; free carbonates effervescing with acid; single-grained structure; very permeable; pH 7.7.

The sola are developed to irregular depths (between 20 and 40 inches). Under the deep (40-inch) solum it is possible to detect faint remnants of a B horizon of clay accumulation. This almost imperceptible layer consists of lumps of material of finer texture and slightly darker color than the horizons above and below it. Effervescence always occurs immediately below this layer. This indicates that the Bisequa Podzol that probably once existed in the Muniac series has been destroyed by further podzolization.

Ennishore Soils

The Ennishore soils occur in depressional areas associated with the Muniac series. They occupy 3,300 acres, or 4.0 percent of the surveyed area, and occur as long, narrow tracts of land by permanent or temporary water channels.

Since the soil texture is coarse, impeded drainage is due to topography or slowly permeable layers, or both. Drainage ranges from imperfect to very poor. The Gleyed Podzol is the main type of profile. The very poorly drained Muniac soils are Peaty Degraded Dark Gray Gleysolic variants. There are considerable areas of these included with the Ennishore as it is mapped, but they have been named the Cyr series in areas surveyed later. The pH may be higher than 5.0 near the surface and free carbonates may occur at less than three feet.

The cultivated layers of the Ennishore soils are dark-gray gravelly loams to silt loams underlain by a light-gray, strongly mottled subsoil. The parent material is a light olive brown loamy gravel with specks of rust.

Under forest, the organic surface layer consists mostly of three to six inches of semidecomposed organic matter underlain by an Aeh horizon. As much as six inches of the Aeh layer occurs in places. The Aeh gradually changes to an Aeg horizon that is a few inches thick. The change from the Aeg to the underlying Bg or Btfg is fairly abrupt but changes are gradual into the parent material.

Because of their topographical position, the Ennishore soils are difficult to drain. They are not cultivated but small areas are used as natural pasture. They are poor agricultural soils that should remain under forest. The forest vegetation is cedar, tamarack, black spruce, and some gray birch.

Gagetown Soils

The largest area of the Gagetown soils occurs east of Juniper along the Southwest Miramichi River. This outwash plain has an elevation of 800 feet above sea level and has nearly level topography. It occupies 4,200 acres, or 0.5 percent of the surveyed area.

The Gagetown soils have developed on coarse gravel outwash deposits that contain mainly rounded and subrounded fragments of quartz, pink and gray granite, felsite, and gabbro with some shale and slate. The cultivated surface is a light-brown gravelly sandy loam or loam. It is underlain by strong-brown to yellowish-red gravelly sandy loam and parent material of brown gravel. The parent material consists of layers of coarse gravel and coarse sand. Stones are few and drainage ranges between good and excessive. The soil is acid throughout.

Gagetown soils are droughty and are not farmed at all in the Juniper area. The few natural hay fields found at abandoned lumber camps turn brown early in the summer. Some Gagetown soils are used for apple orchards in the southern part of New Brunswick. They are, however, low in productivity and should remain under forest in the surveyed area.

The Gagetown gravelly sandy loam is an Orthic Podzol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	2½- 2	Brown undecomposed needles, twigs, branches, and cones.
F	2- 0	Black (2.5YR 2/0), partly decomposed, fibrous, matted organic matter, undecomposed roots and branches; boundaries abrupt; pH 4.4.
H	trace	Black, decomposed organic matter; strong, medium granular structure; greasy and sticky when wet.
Ae	0- 5	Pinkish-white (5YR 8/2) gravelly sandy loam; weak, fine crumb structure; loose; very permeable; boundaries abrupt; pH 4.2.
Bfh	5-12	Strong-brown (7.5YR 5/8) gravelly sandy loam; weak, fine crumb structure; loose; very permeable; lower boundary clear; pH 4.6.
Bf	12-20	Yellowish-red (5YR 5/8) gravel; single grains; very permeable; lower boundary gradual; pH 4.6.
C	20+	Brown (7.5YR 5/4) gravel; loose; very permeable; pH 4.6.

The Ae and Bfh horizons are irregular, especially under dead tree trunks and stumps, where they are thick.

Gagetown soils support a natural vegetation of white and red pine, white spruce, and some hardwoods such as maple and birch.

Penobsquis Soils

The Penobsquis soils cover only 700 acres, or 0.1 percent of the mapped area. They are the poorly drained soils of the Gagetown catena and occur on flat to depressional topography. The lithology and the physical composition of the parent material are the same in the two series, but the profile characteristics of Penobsquis soils reflect differences in drainage. The Penobsquis soils range in drainage from imperfect to very poor. The main type is the Gleyed Podzol, which consists of a thin, black organic layer underlain by a comparatively thick (five inches or more), strongly mottled, gray sandy loam. Below this is a thick horizon of rusty-brown gravelly sandy loam that grades into the stratified brown sand and gravel of the parent material.

The Penobsquis soils are not used for farming. Under forest they maintain a cover of tamarack, black spruce, alder, some gray birch, poplar, and shrubby plants.

Gulquac Soils

In sections that are covered with red till or underlain by red bedrock, most of the outwash gravel is red. This red gravel is the Gulquac series and occurs in the Tobique River valley in association with the soils of the Parleeville, Tobique, and Kingsclear catenas. These soils are found on nearly level outwash plains and terraces along the Tobique and the Wapskehegan rivers at elevations ranging between 300 and 450 feet above sea level. They cover 5,700 acres, or 0.7 percent of the surveyed area.

The cultivated layer is a dark reddish brown gravelly sandy loam that grades to red gravelly loamy sand in the subplow layer and to a dark-red gravel in the parent material. The parent material consists of layers of coarse red sand and gravel and contains rounded and subrounded fragments of red sandstone, conglomerate, shale, and pink and white quartz. In some areas the particles are coated with calcium carbonate. The material ranges from five to 15 feet thick.

These soils are well to excessively drained. The profile is acid throughout but free carbonates may occur at four or five feet below the surface.

About 500 acres of Gulquac soils are farmed near the Tobique River. They are used for growing potatoes, grain, and hay. The soils are droughty but warm up rapidly in the spring and provide early pasture. The problems and the limiting factors in managing these soils are the same as those for the Muniac series. Most of the soils are under forest, which consists of red pine, white pine, white spruce, and fir.

The Gulquac gravelly sandy loam is an Orthic Podzol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	2½- 2	Fresh needles, twigs, branches, cones, and moss.
F	2- 0	Black (7.5YR 2/0), matted and fibrous, semidecomposed organic matter with white and yellow filaments and undecomposed branches and cones; boundaries abrupt; pH 4.2.
H	trace	Black decomposed organic matter; strong, medium granular structure; greasy and sticky when wet; firm.
Ae	0- 5	Pinkish-gray (7.5YR 7/2), gravelly, coarse sandy loam; weak crumb structure; boundaries abrupt; pH 4.4.
B	5-12	Red (2.5YR 4/6) gravelly loamy sand; single grains; loose; very permeable; lower boundary gradual; pH 4.8.
C	12+	Dark-red (2.5YR 3/6) stratified sand and gravel; loose; very permeable; pH 5.0.

As in other soils developed on gravel (Gagetown and Muniac), the texture becomes coarser with depth. Except for the Ae horizon, the mineral horizons are weakly developed.

Maliseet Soils

These soils occur on terraces along the Saint John River and its tributaries and the south branch of the Main Southwest Miramichi. They cover 8,100 acres, or 1.0 percent of the surveyed area. Their topography is level to slightly undulating. Drainage ranges from good to excellent, rarely excessive.

The cultivated layer is dark-brown sandy loam that grades into a yellowish-brown subplow layer and olive-brown parent material. The parent material consists of thinly stratified, fine and medium sand that is somewhat firm in place. The entire profile is acid.

Nearly all of the Maliseet soils are cleared and farmed. This series provides the most versatile and some of the most productive soils of the surveyed area. The soils grow any kind of crop suitable to the climate of the area. They respond to fertilization and liming, suffer no erosion, retain moisture, but drain and warm up rapidly in the spring. However, symptoms of magnesium deficiency have been observed on potatoes, oats, clover, and peas growing on this soil. The most apparent magnesium deficiency showed in oats after potatoes. It was then possible to discern the rows where potatoes had grown the preceding year. The exchangeable magnesium in the subsoil is almost as low as that of the Holmesville and Caribou soils. Dolomitic limestone and fertilizers that have magnesium added are recommended for these soils.

None of the original forest vegetation remains on the Maliseet soils. The forest species present are mostly white birch, fir, white spruce and white pine, and some elm and ash.

Maliseet sandy loam is a Minimal Podzol. A description of a moist, undisturbed profile is as follows:

Horizon	*Depth, inches*	
L	2½- 2	Undecomposed needles, leaves, branches, twigs and club moss.

F	2- 0	Black, semidecomposed, matted and foliated organic matter with yellow and white filaments, undecomposed roots and branches; boundaries abrupt; pH 4.5.
H	trace	Black decomposed organic matter; firm, strong, medium, granular structure when dry; greasy and sticky when wet.
Ae	0- 1	Light-gray (10YR 7/1), very fine sandy loam; moderate, medium platy structure; friable and permeable; boundaries abrupt; pH 4.0.
Bfh	1- 5	Strong-brown (7.5YR 5/8) loamy sand; moderate, medium crumb structure; friable and very permeable; lower boundary gradual; pH 4.6.
Bf	5- 9	Yellowish-brown (10YR 5/6) loamy sand; weak, medium crumb structure; slightly firm and permeable; lower boundary gradual; pH 4.7.
BC	9-15	Light olive brown (2.5Y 5/4) loamy sand; single grain; very permeable; lower boundary diffuse; pH 4.9.
C	15+	Olive-brown (2.5Y 4/4) fine sand; bedded and stratified with coarse sand; single grain; slightly firm; very permeable; pH 5.1.

The profile varies in thickness (one half to three inches) and texture (loamy sand to sandy loam) of the Ae horizon. An Ah horizon appears under the H layer where earthworms have been active.

Wapske Soils

There are only 500 acres of the Wapske soils in the mapped area. They occur in low-lying areas at the contact between the terraced Maliseet soils and the till ridges bordering the valleys. Wapske is the poorly drained member of the Maliseet catena and has a slightly depressional topography.

The black organic surface layer consists of partly decomposed leaves, twigs and roots of mixed forest vegetation. It is underlain by an intensely mottled, gray, fine sandy loam followed by a strongly mottled yellowish-brown layer. The parent material is speckled with rust in the upper part but at greater depth it is the same as that of the Maliseet. The Wapske sandy loam is a Gleyed Podzol.

Almost no Wapske soil is under cultivation. Impeded drainage is the only limiting factor but this is difficult to improve. The forest vegetation is tamarack, alder, red maple, and black spruce.

Kennebecasis Soils

The Kennebecasis soils have developed on reddish-brown outwash sand. They are found in the Tobique River watershed where red till and red Mississippian bedrock occur. They occupy 1,200 acres, or 0.1 percent of the mapped area. The series has nearly the same topography and other characteristics as the Maliseet series, the main difference being in the color of certain layers. The leached layer is a pinkish-gray and other horizons grade from strong brown to reddish brown in the subsoil and from red to dark red in the parent material. The cultivated surface is dark-brown, very fine sandy loam. These soils are acid, well drained, permeable, and friable.

Except for a few patches along the Wapskehegan River, most of the Kennebecasis soils are farmed. The crops grown and their management are very similar to those of the Maliseet series. All comments made on the land use of the Maliseet apply to the Kennebecasis.

The forest vegetation consists of red pine, white spruce, and fir.

Soils Developed on Recently Deposited Alluvium

Recent alluvial materials are stone-free and are deposited in flats by rivers when water levels rise above normal and flood the lowland. These deposits are flooded frequently and do not drain as readily as the sand or gravel outwash deposits. Recent alluvium consists of thinly stratified layers of silt and fine sand with organic matter. Due to periodic rejuvenation they show little or no horizon development.

Interval Soils

There are 1,000 acres of Interval soils, or 0.1 percent of the surveyed area. They are on the flood plains of the various streams and river valleys. The topography is nearly level, with a few undulations due to low terraces and abandoned oxbows of the streams. Drainage ranges between moderately good and imperfect. Faint, fine mottling occurs through all the material.

The Interval soils consist of layers of light-brown sand and silt. Due to the youth of the parent material, the soils have not had sufficient time to develop a solum. This lack of definite horizons is a characteristic feature of immature or azonal soils. In sections where the Interval has not been flooded for many years, the surface layer is a dark-gray silt loam as a result of accumulation of organic matter. Analyses of exchangeable calcium, percentage base saturation (Table 16), and total carbon and nitrogen (Table 17) indicate weak development of horizons in the profile sampled. The pH ranges between 5 and 6.

Most of the Interval soils are farmed. They are used for growing potatoes, oats, hay, and pasture. They are highly fertile soils, productivity being limited by impeded drainage and flood hazard. Nevertheless, they respond to fertilization, especially on higher fields that are seldom flooded. Near Plaster Rock, tile-drained Interval soils are the most productive of the mapped area. The noncultivated Interval soils generally support a vegetation of shrubs, alder, ash, and some red maple.

Waasis Soils

These soils occupy 1,200 acres, or 0.1 percent of the surveyed area. They occur in depressional areas and are the poorly drained soils associated with the Interval series. The surface layer may consist of gray, mottled silt loam, with small, distinct pieces of semidecomposed organic matter (Rego Gleysol profile) or of dark-gray silt loam with decomposed and dispersed organic matter that has faint mottling (Gleyed Mull Regosol profile). The Gleyed Mull Regosol was not mapped separately from the Rego Gleysol and was considered a variant of the Waasis series. The parent material occurs at one to six inches below the surface and consists of laminated or thinly stratified, slightly acid, gray, mottled silt loam and fine sand. These soils usually support an alder vegetation or hydrophylic grasses if cleared. They are nonagricultural soils.

Organic Soils

Organic soils in the mapped area occur in depressions and have more than 12 inches of organic material at the surface. The depth of the organic layer varies considerably and in places reaches 10 feet. The drainage is always very poor.

According to the state of decomposition of the organic layer, the organic soils are classified as peat (almost undecomposed) or muck (well decomposed). The average peat deposits in the surveyed area are twice as deep as the average muck deposits.

PEAT

Peat soils consist of brown, partly decomposed organic matter. They owe their origin to the accumulation of vegetal remains in a water-saturated medium. The vegetation consists of combinations of cedar, stunted black spruce, sphagnum moss, labrador tea, and lambkill. Most of the peat occurs as small tracts of land in the eastern half of the mapped area. These deposits occupy 8,400 acres, or 1.1 percent of the area. The pH ranges between 4 and 6.5. These soils are not used for agriculture and their potential productivity remains unknown.

MUCK

Muck, as a rule, is shallow (one to three feet) and consists of well-decomposed, black organic matter in which plant remains are not identifiable. Some of the muck areas are shallow over peat, which occurs at 18 to 24 inches below the surface. Muck is very poorly drained and is usually underlain by gray mineral material but may also be underlain by marl. A few samples of marl from New Brunswick were analyzed and showed a content of 95 percent calcium carbonate and 2 percent magnesium carbonate. Muck is found in low-lying, wet areas and occasionally on hillsides that receive considerable seepage. These soils occur in small areas and probably occupy more than the 100 acres shown on the soil map. The pH ranges between 5 and 7. The vegetation is made up of cedar and alder with some red maple.

Muck soils are generally low in fertility but can be most productive when properly managed. They are high in carbon and nitrogen but deficient in phosphorus and potash. Furthermore, muck soils have a high exchange capacity and a large buffering effect and their acidity cannot easily be altered. They have very high moisture-holding capacity. The limiting factors to high productivity are drainage, fertility, and hazard of early frost.

Land Types

Land types, in this report, refer to areas of land that have little or no natural soil, or are so wet and so variable that it was not feasible to classify the individual soils. The land types include rock land, eroded land, rough broken land, colluvial land, swamp, and alluvial land.

KINTORE

The Kintore land type consists mainly of eroded rock escarpments and the heterogeneous masses of colluvial material accumulated below them. In fact, the Kintore is a rocky, steeply sloping and eroded phase of the Holmesville, Glassville, Caribou, and Monquart series. Most of the 8,400 acres of Kintore are along the east bank of the Saint John River and north of the mouth of the Tobique River. Kintore soils are wasteland.

BOTTOM LAND

About 600 acres were mapped as Bottom land. It is a complex of alluvial and colluvial materials and hence varies greatly in texture, drainage, stoniness, and pH. These soils are used chiefly for permanent pasture.

SWAMP

Swamp has no agricultural value as it is covered with water for a large part of the growing season. There are 900 acres mapped as swamp. Organic matter is generally incorporated within the mineral soil and the thickness of peat at the surface rarely exceeds a few inches. The soil profile is that of a Rego-Gleysol. There is a scanty vegetation of shrubs and dwarfed black spruce. Swamp often grades to peat.

AGRICULTURE

History and Development

The Saint John River was the only natural transportation route in the northwestern part of the province and the first settlements were made on its banks. There were French settlements north of the surveyed area before 1800. Probably the first settlement in the area was an Indian reserve established in 1801 at the mouth of the Tobique River. Undoubtedly, a few scattered families were then living along the valley and were lumbering in a small way. Pine for masts and spars was the important product.

After 1800, settlers from the Loyalist settlements in the southern part of the province began to settle in the area. Between 1817 and 1820, large numbers of soldiers from disbanded regiments settled along the Saint John River valley. The West Indian Rangers settled on the east bank of the Saint John, upstream from the Tobique, and the Kent Regiment settled between River des Chutes and the Aroostook River. The back settlements, on the west bank of the Saint John especially, were settled between 1820 and 1870 by New Brunswick natives and by Irish farmers who emigrated from Europe during the great famine and founded Gillespie Settlement.

After a change in the land-granting policy of the provincial government in 1850, and an expanded program of immigration, Danish and Scottish immigrants settled in the Denmark and Perth parishes respectively. Meanwhile, native settlers opened the Holmesville–Johnville area to farming.

From time to time there has been considerable immigration from the United States.

Agricultural Statistics

Since the surveyed area does not correspond with parish and county boundaries, some of the following statistical data were compiled from available census figures, partly by estimation.

Population

Though the total population of Carleton and Victoria counties has increased slightly since 1941, the farm population has been decreasing from 47 and 44 percent of the totals respectively in 1941 to 43 and 39 percent by 1951, and to 40 and 36 percent by 1956.

Changes are taking place in the economy of the area. Large firms have been established for packing and shipping of agricultural products. Some of the farm population is being attracted away from farms, especially the small ones, and is becoming reestablished in other phases of the agricultural industry of the area.

Number and Size of Farm Holdings

The total number of farm holdings in the surveyed area was highest between 1890 and 1910. It has been decreasing steadily ever since. Most of the farms abandoned are in the Kincardine, Bon Accord, and Juniper areas, on poor soils of the Glassville series. The number of holdings of less than 10 acres was highest in 1890, but is almost zero today. Farm holdings of 10-50 acres were highest in 1910, when the total number of farm holdings was highest, but are now decreasing rapidly. Holdings of 50-100 acres have always been the most common. Most of the old grants were for 100 acres. In 1940, however, their number had fallen to that of 1870. Holdings of 100-200 acres increased until 1910 and decreased after 1920. Only holdings of more than 200 acres have been increasing, because of amalgamation of small units into larger ones. In 1955, seven farms had more than 1,000 acres each.

Acreage and Condition of Land Occupied

The total acreage of occupied land in the surveyed area reached a high figure in 1880, decreased in 1890, but was highest after the first World War in 1920. At that time there was a noticeable decrease in the total number of farms and the increase in total acreage of occupied land was due to enlargement of the existing farms. Ever since 1920, however, the acreage of occupied land has decreased, like the total number of farms. In 1920, the total acreage of improved land reached a peak which was maintained until 1930, despite a decrease in the total acreage of occupied land. Thus it is likely that subsistence farming nearly disappeared from the area about 1920. The economic depression in the 'thirties and the increase in cost of production since 1940 possibly were instrumental in decreasing the acreage of improved land for the last 30 years. Since 1930 the use of large acreages of stony and sloping land changed, these being unsuitable for mechanized farming. This change is associated with an upward trend in pasture land from 1950 until 1955 and an increase in beef cattle production. The peak of 1920 in total acreage of pasture land corresponded with a peak in total occupied land together with a large population of horses and dairy and beef cattle. The total acreage in crops was highest in 1930, when the acreages of most crops reached similar peaks.

Acreages under Various Crops

The acreages of several crops, such as hay, oats, and buckwheat, were highest in 1930 and have since decreased. This parallels a similar trend in the total animal population of the area. Similarly, there were parallel decreases in barley acreage (peak of 2,000 acres) and hog production from 1950 to 1955. Wheat acreage was highest (2,200 acres) in 1880 and, except for a slight resurgence to 1,400 acres between 1900 and 1920, dropped almost to zero by 1955. Hay in 1955 still occupied the largest acreage, followed by oats and potatoes. The ratio of potato acreage to total acreage in crops was then rapidly narrowing. The decrease, following peak acreages (in 1920), stems from a combination of factors such as disease, mineral deficiency of the soil, and marketing problems. Since 1940, however, new increases in potato acreage have followed intense mechanization, heavy fertilization, cure of the magnesium deficiency, introduction of new varieties of disease-resistant potatoes, improved pest and disease control, and more favorable marketing conditions.

Trends in Yields

Since 1890, the yields of oats, barley, and potatoes have increased (Table 9). The upward trend, particularly in the last ten years, stems from better crop management, pest and weed control, heavy fertilization, and the development of productive and disease-resistant varieties. The comparatively low yields

TABLE 9. Crop Yields from Census Figures for Carleton and Victoria Counties and an Illustration Station in the Area
Bushels per Acre

Crop	1870	1880	1890	1900	1910	1920	1930	1940	1950	Illustration station at Salmonhurst
Potatoes	110	98	100	70	192	145	207	177	212	465
Oats	—	—	19	22	30	30	30	30	40	65
Barley	—	—	13	11	25	24	25	22	35	42

of 1940 were due to adverse weather. Hay yields have been about one ton to the acre since 1870. Potato growers limit the use of limestone and so tend to reduce yields of clover. Yields of wheat increased from 12 to 27 bushels and of buckwheat from 16 to 25 bushels per acre from 1900 to 1950.

Average county yields are compared with averages that were obtained at an illustration station at Salmonhurst, on Holmesville soil. The 212-bushel average potato yield for Victoria County is less than half the average yield obtained at the illustration station. Likewise, the average yields of oats and barley were substantially below those at the illustration station. The one-ton average yield of hay per acre in Victoria County was 0.5 tons lower than the 11-year average yield at the illustration station. Such increases from improved technology would require superior management and evaluation of the added costs in relation to the returns.

Numbers of Animals and Tractors

Until 1931, Victoria County also included what is now Madawaska County. In Victoria County the hog population varied inversely to that of other animals. The number of horses and dairy and beef cattle was highest in 1900, while hog population was the smallest. Dairy and beef cattle reached a secondary peak in numbers in 1940, during the Second World War. The increase in numbers of beef cattle and the decrease in dairy cattle between 1950 and 1955 reflect the present tendency of potato growers to use the clover and grain grown in their three-year rotation (potatoes, oats, clover) in beef rather than dairy production. Since 1940 the number of horses has decreased rapidly, offset by a sharp increase in the number of tractors. The sharp decline in hogs and dairy cattle, from 1950 until 1955, parallels a decrease in acreages of oats, barley, and hay in the surveyed area.

Present Agriculture

The surveyed area is the center of an intensive potato and seed-oats growing area. About three million bushels of potatoes, both seed and table stock, are produced every year. Large quantities of Certified and Foundation seed potatoes are normally exported to the United States and Central and South American countries. Large quantities of potatoes are processed in local factories into potato chips, frozen french fries, and potato starch.

The land-use pattern of the area in 1955 was as follows:

	Percentage of total area
Occupied land	19.3
Improved land	7.4
Forest land	92.6

The improved land was used as follows:

	Percentage of improved land
Pasture	31.3
Wheat and Barley	0.8
Oats	21.0
Potatoes	12.4
Hay	29.5
Miscellaneous	5.0

The animal population in 1955 was as follows:

Horses	830
Milk Cows	3460
Other horned animals	4840
Total	9130

There is one animal for every two acres of pasture and two acres of hay. The surveyed area could support twice the present animal population. More beef cattle are being raised, so that in time the tonnage of hay that is sold every year as a low-income cash crop may be reduced.

Considerable interest has been shown recently in the production of timothy and clover seed. Also, freezing plants have been established near the surveyed area, and a few thousand acres of land have been diverted since 1956 from oats and clover to the production of green peas and beans for freezing. The acreage is increasing each year as this enterprise ties in well with potato production. The freezing of broccoli, brussels sprouts, fiddleheads and rhubarb is also increasing.

In this area of intensive farming there was one tractor for every 60 acres of land under crops in 1955. This ratio has probably decreased because farms are growing in size and are becoming more highly mechanized. Hay balers and combine harvesters (many self-propelled) are a common sight. Sprayers are used extensively for disease and weed control.

The combination of intertilled crops and mechanized tillage creates a serious erosion problem on some farms where rows are up and down the slopes. Many farmers use diversion terraces and contour strip farming to slow the eroding, downhill flow of water. Erosion is most serious on the Caribou and Undine soils but is limited on gravelly soils like Holmesville. On Caribou soil, erosion can occur in pastures as well as in cultivated fields.

Practices in potato growing range between continuous potatoes and a three-year rotation of potatoes–oats–clover. There is little difference in yields between potatoes grown continuously and in rotation. Tests of the physical properties of the Holmesville and Caribou series (major potato soils in New Brunswick) indicate that continuous cultivation for many years had no great detrimental effect on the structure of these soils. Generally one ton per acre of 6-12-12-1 fertilizer (with magnesium added) is applied for the potato crop and no treatment given for oats. The practice of applying 500 pounds of dolomitic limestone before seeding oats and clover is increasing. Great care is given to keeping the soil acidic and preventing potato scab. Good farmers on the Caribou, Holmesville, Monquart, or Maliseet soils average between 400 and 450 bushels of potatoes to the acre. A few farmers reported fields yielding as high as 600 bushels to the acre. Oat yields ranged between 50 and 100 bushels to the acre.

Grouping of the Soils According to Their Suitabilities for Crops

The soils of the Andover—Plaster Rock area are grouped in Table 10 in five different classes. The grouping is based mainly on suitabilities for various crops and potential productivities of the soils. The soils that are suited to a large number of crops and give high yields are ranked highest. The natural fertility of the soil is of small importance, because of heavy fertilization on potatoes. This classification depends on the ability of a soil to hold fertility, to retain moisture, to drain, and to maintain good physical condition. The ratings are based on field observations and information from practical experience with the land as well as on studies of physical properties of these soils in the field and in our laboratory. The rating of each series for each crop was based on the yields expected under good management.

Group I

The soils of this group give the highest yields and are suited to any of the types of farming practiced in the surveyed area. These soils are well aerated and well drained, yet retain enough moisture to avoid drought under average conditions. They have a texture and/or structure that permits easy cultivation soon after heavy rain, the Interval series being excepted. All the

TABLE 10.—Ratings[1] of the Soils for Production of Various Crops

Acreage	Percentage of total	Soils	Potatoes	Oats	Hay	Pasture	Green peas	Other hoed crops	Special problems[2]
				I. Very Good					
174,300	21.2	Caribou	A	A	A	A	A	B	Erosion (c)
		Holmesville g. s.l. to g.l.	A	A	A	A	A	A	Erosion (a), stoniness (a)
		Monquart g. s.l. to g.l.	A	A	A	A	A	A	Erosion (b)
		Maliseet s.l.	A	A	A	A	A	A	
		Kennebecasis s.l.	A	A	A	A	A	A	
		Interval si.l.	A	A	A	A	A	A	Flooding (b)
				II. Good					
97,500	11.9	Undine sh.l.	A	A	B	B	B	D	Shallowness (c), erosion (c), topography (b)
		Carlingford sh.si.l.	B	B	A	A	C	C	Drainage (b)
		Johnville g. l.	B	B	A	A	C	C	Drainage (b), stoniness (b)
		Kingsclear c.l.	C	B	A	A	B	C	Physical properties (c), drainage (a)
		Parleeville g. s.l.	A	B	C	C	C	B	Gravel content (b), droughtiness (a), shallowness (b)
		Tobique l.s.	A	B	C	C	B	B	Droughtiness (a), shallowness (a)
				III. Fair					
206,000	25.3	Glassville sl.l.	C	B	B	B	C	D	Stoniness (c), topography (b), shallowness (b)
		Muniac g. s.l.	B	B	C	C	B	B	Droughtiness (b)
		Gagetown g. s.l.	C	C	C	C	C	B	Droughtiness (b)
		Gulquac g. l.s.	B	B	C	C	B	C	Droughtiness (b)
		Bottom land	C	B	B	B	B	C	Drainage (b)

TABLE 10.—Ratings[1] of the Soils for Production of Various Crops—Concluded

Acreage	Percentage of total	Soils	Potatoes	Oats	Hay	Pasture	Green peas	Other hoed crops	Special problems[2]
				IV. Poor					
255,100	31.6	Washburn si.l.	D	C	B	B	D	D	Drainage (c), alkalinity (b)
		Poitras g.l.	D	C	B	B	D	D	Drainage (c), stoniness (c)
		Plaster Rock c.l.	D	C	B	B	D	C	Physical properties (c), drainage (b)
		Nackawick c.	D	D	C	C	D	D	Physical properties (c), drainage (b
		Midland g. l.	D	C	B	B	D	D	Gravel content (b), pan layer (b), drainage (c)
		Ennishore g. s.l.	D	D	B	B	D	D	Drainage (c)
		Penobsquis g. s.l.	D	D	C	C	D	D	Drainage (c)
		Juniper g. s.l. to g.si.l.	D	D	C	C	D	D	Stoniness (c)
		Wapske s.l.	C	C	B	B	D	D	Drainage (c)
		Waasis si.l.	D	D	B	C	D	D	Flooding (c), drainage (c)
		Foreston sl.l.	D	D	B	B	D	D	Drainage (c), stoniness (b)
		Muck	D	D	C	C	D	D	Drainage (c)
				V. Very Poor					
82,100	10.2	McKiel g. s.l.	D	D	D	D	D	D	Stoniness (c), drainage (c)
		Kintore	D	D	D	D	D	D	Shallowness (c), topography (c)
		Peat	D	D	D	D	D	D	Drainage (c)
		Swamp	D	D	D	D	D	D	Drainage (c)

[1] A, very good; B, good; C, fair; D, unsuitable.
[2] a, slight; b, moderate; c, acute.

soils respond readily to fertilization. They are acid soils and their management varies with the crop and any associated soil problem. Erosion is a serious handicap in the Caribou and Monquart soils. Stoniness may be a limiting factor in the Holmesville and flooding in the Interval soils.

Group II

The soils of the second group have at least one fairly serious limiting factor or a combination of less serious problems. The Undine soils are not fit for Group I because of shallowness, excessive erodibility, and broken topography. The Kingsclear soils have impeded aeration and moderately slow drainage; they are well adapted to dairy farming. Drainage limits the suitability of the Carlingford and Johnville soils and must be improved for their best use. All the soils of this group that have impeded drainage have a higher natural fertility than the soils of Group I, with the exception of Interval soils. A pH near neutrality may eliminate some areas of Carlingford from potato production. The Parleeville and Tobique soils are highly permeable but are rarely dry in this region. Response to fertilization and improved management practices ranges from rapid in the Parleeville, Tobique, and Undine soils to moderately slow in Carlingford and Johnville and very slow in Kingsclear.

Group III

Excepting the Glassville soils and Bottom land, all the soils of Group III have a coarse texture. Muniac, Gagetown, and Gulquac are very permeable and well to excessively drained soils. They warm up rapidly in the spring and depend on favorable weather during the summer for good yields. Drainage is a limiting factor only in Bottom land. Shallowness, excessive stoniness, and rugged topography make the Glassville soils hard to cultivate and unsuited to many crops. All soils of this group have low natural fertility and respond readily to fertilization. They have an acid surface layer in general, but free carbonates, or alkaline reaction, are common at four to five feet below the surface of Muniac soil; alfalfa thrives well on this soil.

Group IV

Except for the Juniper soils, all the soils of this group are poorly to very poorly drained. They have moderate natural fertility but low productivity. The poorly drained soils differ greatly from their well drained equivalents in that they are not as acid, stones are more abundant (a stone pavement is common under the organic surface), and the surface layer is finer in texture and contains more organic matter. The poorly drained soils are cold and water-saturated most of the year. They occur in low topographical positions (usually frosty hollows) and are difficult to drain. Some of these poorly drained soils have a fine, impervious, compact layer at depths of 20 to 24 inches, so that internal water movement is restricted. The soil under this pan layer is only moist all year around. These soils may be used as natural pasture, during summer dry spells. Juniper is a stony, shallow soil that is unsuited to any kind of agricultural crops except wild hay and natural pasture.

Group V

The soils of this group are unsuited to any kind of agricultural crops. Areas of swamp and peat in their natural state are even unsuited to forest vegetation. Hardly any vegetation thrives on the Kintore land type, which consists of bare steep slopes and material accumulated at the base of the escarpment.

Comparison between Actual and Potential Land Use

In 1955 there were 61,700 acres of improved land in the surveyed area, 42,400 acres of which were under crops. Part of the improved land contains

TABLE 11.—Ratings of the Soils for Forest Productivity

Soil type	Class of site[1]			
	White spruce	Black spruce	Balsam fir	Sugar maple
Carlingford sh.si.l.	I	I	I	I and II
Johnville l.	I and II	I	I and II	II
Caribou sh.l. to sh.si.l.	II	I	II	II
Plaster Rock c. l.	I	I	II	II
Foreston slaty l.	I and II	I	I and II	—
Monquart g. s.l. to g.l.	II	I	I and II	II
Kingsclear c.l.	I and II	I	II	II
McKiel g. s.l.	I and II	I and II	II	—
Washburn si.l.	I and II	I and II	II and III	—
Ennishore g.s.l.	I and II	I and II	II and III	—
Holmesville g.s.l. to g.l.	II	I and II	II	II
Poitras g. l.	II	I and II	II	—
Midland g. l.	II	I and II	II	—
Nackawick c.	I and II	II	II and III	—
Penobsquis g. s.l.	II and III	I and II	II and III	—
Glassville sl.l.	II	II	II	II and III
Juniper s.l.	II and III	II	II and III	III
Parleeville g. s.l.	II and III	II	II	III
Muniac g. s.l.	III	II	III	—
Kennebecasis s.l.	III	II	III	—
Tobique l.s.	III	II	III	III
Gagetown g. s.l.	III	II	III	—
Maliseet s.l.	III	II and III	III	—
Kintore	III	II and III	III	—
Wapske s.l.	III	II and III	III	—
Peat	III	II and III	III	—
Undine sh.l.	II	—	II and III	III

[1] Based on the number of cords of wood produced on a pure stand of one acre in 50 years: I, 35 to 50 cords; II, 20 to 35; III, under 20.

soils of Groups II and III, whereas soils of Group I have been abandoned in places. A small percentage of the land in Group I has a topography more rugged than desirable, thus slightly reducing the acreage of good land available for farming. However, the acreage of Group I soil being farmed in the surveyed area might be tripled.

Though some farms on Group I soils have been abandoned, most of those abandoned were on soils of Group III (Glassville and Gagetown). An area of Holmesville soil (Group I) remains undeveloped in the highlands west of Plaster Rock because communication is poor. On the other hand, soils of Group III (Glassville) are still being farmed near the east bank of the Saint John River mainly because of good road and railway communications and partly as a matter of tradition.

Farmers own most of the good land near the Saint John River. No large acreage of Group I soils held by the Crown is available for settling. However, relocation or enlargement of farms on privately owned land, of Group I soils, could greatly increase the acreage of improved good soil whenever the need arises.

Grouping of the Soils According to Their Forest Productivity[4]

About 92 percent of the surveyed area is covered with trees and, in spite of the intensive farming, forestry remains as important an industry as agriculture. A classification of the soils, based on their suitabilities for pulpwood species and maple, is given in Table 11.

[4] Information supplied by members of the Forestry Branch, Maritime District, Canada Department of Forestry, Fredericton, N.B.

Details on wood volume production and height growth are almost entirely lacking for the area. However, studies conducted by the Forestry Branch, Canada Department of Forestry, on the same or similar soils in other areas gave the estimates of productivity by species shown in Table 11. Each class of site represents a relatively wide range of production, but local variations in depth of profile development, texture, structure, porosity, shallowness over rock, and especially moisture regime combine to create great variation in site quality in some soils.

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APPENDIX

Analytical Methods

Because the methods of analysis changed during the study, more than one procedure is mentioned for these determinations.

Reaction (pH)—Beckman glass electrode. Thick paste method. W. T. McGeorge, Soil Sci. 59: 231-237, 1945.

Mechanical analysis—Hydrometer method. G. G. Bouyoucos, Soil Sci. 42: 225-230, 1936.

Hygroscopic moisture—By heating at 105° C. until the weight remained constant.

Moisture equivalent—L. J. Briggs and J. W. MacLane, U.S. Dept. Agr., Bur. Soils Bull. 45, 1907.

Maximum water-holding capacity *Moisture at pF 1.8* *Absolute specific gravity of total soil* *Total volume of pores* *Bulk density*	Samples taken with a Uhland core sampler and pF measured by the method of R. W. Leamer and B. Shaw, Am Soc. Agron. 33: 1003, 1941.

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Specific gravity fractions of sand—Separated by the method of N. J. Volk, Am. J. Sci. 226: 114-129, 1933.

Upper plastic limit—A. Atterberg, Int. Mitt. Bodenk. 1: 10-43, 1911.

Total carbon—C. J. Schollenberger, Soil Sci. 29: 53-56, 1945. A Walkley and J. A. Black, Soil Sci. 27: 29, 1934.

Total nitrogen—Association of Official Agricultural Chemists, 8th ed., 1955, p. 12. Metallic mercury alone as catalyst. Ammonia collected in boric acid.

Total phosphorus—Digestion with perchloric acid, colorimetric determination of S. H. Yuen and A. G. Pollard, Soc. Chem. Ind. 6: 225, 1955.

Total potassium—Association of Official Agricultural Chemists, 8th ed., p. 35, 1955.

Total silica and sesquioxides—Association of Official Agricultural Chemists, 8th ed., p. 31, 1955.

Total aluminum—Colorimetric determination, G. Robertson, J. Sci. Food & Agr. 1; 59-63, 1950.

Total iron—Colorimetric determination, J. E. Houlihan and P. E. L. Farina, Analyst 78: 559, 1953.

Total calcium and magnesium—Chemical methods of soil analysis, Div. Chem., Science Service, Can. Dept. Agr., pp. 72-73, 1949.

Exchange capacity—A 2-g. sample was placed in a 15-ml. centrifuge tube with 4 ml. of normal ammonium acetate solution, pH 7. Adsorbed ammonia was displaced with NaCl solution and the extract steam-distilled with 1N NaOH in micro-Kjeldahl distilling apparatus. Ammonia was collected in boric acid and titrated with standard acid.

Exchangeable calcium, magnesium and potassium—Chemical methods of soil analysis, Div. Chem., Science Service, Canada Dept. Agr., pp. 53-59, 1949.

Readily available phosphorus—E. Truog, J. Am. Soc. Agron. 22: 874-882, 1930.

Free iron and aluminum—Extraction, R. C. MacKenzie, J. Soil Sci. 5: 167, 1954. Three consecutive extractions were done on each sample.

HF-extractable carbon—By method of M. Schnitzer and J. R. Wright, Can. J. Soil Sci. 37: 89-95, 1957.

Mineral identification—Sand grains were mounted in gelatin on slides by the method of C. E. Marshall and C. D. Jeffries, Soil Sci. Soc. Am. Proc. 10: 397-405, 1945. The fraction with specific gravity higher than 2.95 was identified by the petrographic methods of W. H. Fry, U.S. Dept. Agr., Tech. Bull. 344, 1933, and of H. B. Milner, Sedimentary Petrology, 3rd ed., Thomas Murby & Co., London, England, 1952. The minerals of the light specific gravity fraction (less than 2.70) were identified by the staining technique of S. W. Reeder and A. L. McAllister, Can. J. Soil Sci. 37: 57-59, 1957, which was modified as follows: the minerals were treated with a 3:1 mixture of 48 percent hydrofluoric acid and distilled water in a lead crucible for 30 seconds. The minerals of the medium specific gravity fraction were treated with 3:1 hydrofluoric acid solution like the light fraction and the grains stained with murexide powder in ammoniacal ethanol. Differences in color of the grains were due to differences in the composition of the minerals.

Discussion of Analytical Data

Mechanical Composition

Results of mechanical analysis are listed in Table 12. In profiles of Orthic Podzols such as Juniper, Parleeville, Monquart, Holmesville, Muniac, Gagetown, and Maliseet, Minimal Podzols such as Caribou, and Humic Podzols such as Glassville, the content of silt and/or clay in the leached layer is about the same as or larger than that of the Bfh horizon. Silt content is always highest in the Ae and decreases with depth in association with a decrease in intensity of weathering. Chemical weathering, which favors the formation of clay, is most active in the leached layer. There seems to be only a slight movement of clay in these profiles (Figure 15).

Figure 15.—Schematic profile of an Orthic Podzol soil.

Clay accumulates at a depth of eight to 26 inches in one of the profiles of Kingsclear clay loam. The clay layer overlies a layer with free carbonates, which strongly suggests that this particular profile is that of a Podzolized Gray Wooded soil as described by Mathews *et al.* (2). However, most of the Kingsclear soil belongs to the Textural Podzol subgroup. This is characterized by a sharp increase in clay percentage between the leached and the upper B horizons, and a steady rise in clay content to the fine-textured deep layer, without free carbonates in an underlying layer.

In the imperfectly and poorly drained soils, a high silt and/or clay content of the surface layer may reflect the combined effects of siltation and accelerated weathering. The sola of soils with impeded drainage usually contain more silt and/or clay than do their well-drained catenary equivalents. An increase in the clay content of one of the B horizons is common in soils with impeded drainage and possibly shows that a pan layer is developing.

Physical Composition of Undisturbed Soil

In Table 13 the physical characteristics of undisturbed soils, sampled in cores, are compared on a volume basis. Some trends that were noticed in mechanical composition (Table 12) are emphasized; others are changed. For instance, in Orthic Podzol profiles like Juniper, Monquart, and Holmesville and in the Humic Podzol profile of Glassville, the high content of silt and clay in the leached layer is greater when expressed on a volume basis. The volume of gravel and total pore space is usually smaller in the Ae than in the upper B horizon. The trend in the increase of sand is reversed in most profiles, the minimum volume percentage showing somewhere in the B horizon. The accumulation of fines observed at the surface of or within the profiles of soils with impeded drainage (Table 12) is emphasized by volume measurements.

The total volume of pores in the mineral horizons of well-drained soils is highest in the upper B horizon and lowest in the parent material. With the exception of Kingsclear, the soils on ground moraine like Holmesville, Johnville, and Poitras have less than 30 percent total volume of pores in the C horizon despite a relatively coarse texture.

Physical Analyses

Trends in physical properties, such as maximum water-holding capacity, moisture equivalent, and upper plastic limit, are similar throughout most profiles (Table 14). They follow the general distribution of total carbon and nitrogen, loss on ignition (Table 17), and total pore volume (Table 13). Maximum water-holding capacity, moisture equivalent, and upper plastic limit are lower in the Ae than in the upper B horizons of most well-drained soils, despite the high clay content of the Ae horizon, thus suggesting that organic matter is the important factor in regulating moisture retention in the solum. The large clay content of the B horizon in the Kingsclear profile has little effect on the moisture retentivity of the soil.

Table 14 shows that the percentage of the fine sand fraction with specific gravity less than 2.70 decreases with depth, and the percentage with higher specific gravity increases correspondingly. This may reflect the effects of weathering on the minerals of the fine sand. The light specific gravity fraction (2.70), which consists mainly of quartz, is highest in the Ae horizon, the most weathered horizon of the Podzol profile. The medium fraction (2.70 to 2.95), which contains more easily weatherable materials, such as anorthite, labradorite, andesine, and chlorite in addition to resistant materials like the micas and impure quartz, is highest in relatively unweathered parent material. Variations in percentage of specific gravity fractions in the C horizon may indicate layering in the original till deposit. A comparison of figures (medium fraction) in

Table 14 for comparable upper horizons of the soils in the Caribou–Washburn and Holmesville–Poitras catenas indicates that surface material is weathered less as drainage becomes more impeded. Therefore, increases in fines of upper horizons in soil with impeded drainage may be due to downslope accumulation of fines rather than to accelerated weathering.

Mineralogical Composition

The mineralogical composition of the fine sand fraction of the Caribou catena is given in Table 15. The low plagioclase and high quartz contents of the Ae horizon in the Caribou probably result from strong weathering. The content of quartz is lower and that of plagioclase higher in the solum of Carlingford than in that of Caribou.

Brydon (1) reported recently that the silt of the parent material of Caribou contains large quantities of quartz and low amounts of feldspar (albite), chlorite, and mica. Brydon, in the same article, stated that the clay fraction of Caribou parent material consists mostly of illite with significant quantities of chlorite and kaolinite.

Chemical Composition

Data on total elements in the soil are given in Table 17, and extractable elements are listed in Table 16.

The distribution of total nitrogen, total carbon, and loss on ignition through profiles seems related to the distribution of cation exchange capacity (Table 16) and physical properties. The upper B horizons of most profiles of the Orthic Podzol subgroup contain more total iron, total aluminum, and/or sesquioxides than the parent material. However, the highest content of total sesquioxides occurs in the parent material of the Kingsclear, a Textural Podzol. Total silica content is always highest in Ae horizons.

Contents of total calcium and magnesium are relatively low and show no increase in the mineral horizons overlying the parent material. Total calcium content is higher than that of total magnesium in the L-H layers whereas the percentage of total magnesium is larger than that of total calcium in most of the mineral layers excepting in the parent material of the Juniper, Johnville, Poitras, Muniac and Washburn series and in the leached layer of some others. The total Ca:Mg ratio is usually close to unity in the Ae horizon but total magnesium content is higher than that of total calcium. Total calcium content increases in the L-H layers as drainage becomes impeded, such as the increase from Caribou to Washburn and from Holmesville to Poitras.

Total phosphorus is low in all the soils except Interval. The highest concentrations of total phosphorus occur in the L-H and the upper B horizons, but due to the low bulk density of the L-H horizons the quantities of total phosphorus are lower in the surface layers than in other horizons.

The well-drained soils have a strongly acid solum, except that Kingsclear has a neutral Bt horizon (Table 16). The reactions of the sola of some soils may reflect the influence of rock fragments. For instance, the soils of the Holmesville–Johnville–Poitras catena contain mostly quartzite rock fragments and their sola become more acid near the surface as drainage becomes more impeded, whereas the soils of the Caribou–Carlingford–Washburn catena become less acid as drainage becomes more impeded. The rock fragments in Caribou parent material are shale, which may contain veins of calcite.

The exchangeable calcium, magnesium, and potassium of the mineral layers seem to vary directly with the reactions of the various horizons of the profile (Table 16); the higher the pH, the larger the quantity of exchangeable ions. The content of exchangeable magnesium is very low in most of the soils and is generally lower than that of exchangeable calcium.

In well-drained soils, free iron is highest in the upper B horizon, whereas free aluminum is highest in the lower B horizon. The percentage of these ions is often lower in the leached layer than in the parent material, a sign of depletion. In soils developed on yellowish-brown parent material, the decrease in the amount of free iron with depth in the B horizons closely follows the decrease in the red hue of these horizons. Total carbon appears to have little or no effect on the color of the solum, but the amount of HF-extractable carbon, in Holmesville and Caribou profiles, seems to bear some relationship to the value and chroma of their B horizons. Holmesville, for instance, at 7.5YR 4/4 has 2.14 percent HF-extractable carbon, whereas Caribou at 7.5YR 5/6 has 0.18 percent.

GLOSSARY

Alluvium—Fine material, such as sand, silt, or clay, deposited by streams.

Alluvial fan—A sloping, fan-shaped mass of loose rock material deposited by a stream at the place where it emerges from an upland into a broad valley or plain.

Boulder—A fragment over two feet in diameter.

Bulk density—The weight of oven-dry soil (105° C.) divided by its volume at field moisture condition, expressed in grams per cubic centimeter.

Catena—A group of soils developed on the same parent material but under different moisture conditions and therefore having very different sola.

Cation exchange capacity—A measure of the absorptive capacity of a soil for cations: the amount of cations that can be absorbed, in milliequivalents per 100 grams of soil.

Clay skins—Thin layers of clay deposited on the surfaces of voids or of peds in the soil.

Cobble—A rock fragment three to ten inches in diameter.

Consistence (soil)—The mutual attraction of the particles in a soil mass, or their resistance to separation or deformation. It is described in terms such as loose, soft, friable, firm, hard, sticky, plastic, or cemented.

Depth—Distance below the surface, e.g., depth at which a horizon occurs.

Dissected plateau—A plateau dissected by streams and erosion.

Eluvial horizon—A horizon from which material has been removed in solution or water suspension.

Fines—Material less than 2 mm. in diameter.

Gley—A gley horizon is one in which the mineral material has been modified by a strong reduction process brought about by saturation, with water, in the presence of organic matter.

Gravel—Rock fragments from two millimeters to three inches in diameter.

Horizon—A layer in the soil profile approximately parallel to the land surface with more or less well defined characteristics that have been produced through the operation of soil-forming processes. The major organic horizons are defined as follows:

L—An organic layer characterized by the accumulation of organic matter in which the original structures are definable.

F—An organic layer characterized by the accumulation of partly decomposed organic matter in which the original structures are discernible with difficulty.

H—An organic layer characterized by an accumulation of decomposed organic matter in which the original structures are undefinable.

The major mineral horizons are defined as follows:

A—A mineral horizon or horizons formed at or near the surface, in the zone of maximum removal of materials in solution and suspension and/

or maximum in situ accumulation of organic matter. It includes (1) horizons in which organic matter has accumulated as a result of biological activity (Ah); (2) horizons that have been eluviated of clay, iron, aluminum, and/or organic matter (Ae); (3) horizons dominated by 1 and 2 above but transitional to the underlying B or C (AB or A and B); (4) horizons markedly disturbed by cultivation or pasturing (Aa).

B—A mineral horizon or horizons characterized by one or more of the following: (1) an illuvial enrichment (exclusive of dolomite or salts more soluble in water) of silicate clay, iron, aluminum, or organic matter (Bt, Bf, Bh, Bfh); (2) a concentration of weathering products believed to have been formed in situ (Bt); (3) the removal of dolomite and salts more soluble in water (Bm); (4) an oxidation of sesquioxides that gives a conspicuously darker, stronger, or redder color than overlying and/or underlying horizons in the same sequum (Bmf); (5) a prismatic or columnar structure.

C—A mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (1) the process of gleying and (2) the accumulation of carbonate and salts more soluble in water.

The mineral horizons described in this report are denoted by the following lower-case suffixes:

e—A horizon characterized by the removal of clay, iron, aluminum, or humus. Usually lighter-colored than the layer below.

f—A horizon enriched with hydrated iron.

g—A horizon characterized by reduction and gray colors, often mottled.

h—A horizon enriched with organic matter. It must show at least one Munsell unit of value darker than the horizon immediately below.

j—A horizon whose characteristics are weakly expressed.

k—A horizon enriched with carbonate.

m—A horizon characterized by the loss of water-soluble materials only.

t—A horizon enriched with silicate clay.

Litholic changes are indicated by Roman numeral suffixes. If more than one lower-case suffix is required and if *one* only is a weak expression, then the *j* is linked to that suffix with a bar, i.e., $Bm\bar{f}j$.

Horizon boundaries—Boundaries between horizons vary in distinctness and in surface topography. The distinctness depends partly on the contrast between the horizons and partly on the width of the boundary itself. The widths are defined as follows:

abrupt—less than 1 inch
clear—1 to 2 inches
gradual—2½ to 5 inches
diffuse—more than 5 inches

The topography of the boundaries is described as follows:

smooth—nearly a plane
wavy—pockets wider than deep
irregular—parts of the horizon unconnected with other parts

Illuvial horizon—A horizon that has received material in solution or suspension from some other part of the soil.

Hygroscopic moisture—The water lost from air-dry soil heated at 105° C. until constant weight is obtained. *See* "Methods".

Liquid limit—The water content at which soil flows. *See* "Methods".

Marl—An earthy, crumbling deposit consisting chiefly of calcium carbonate mixed with clay or other impurities in varying proportions.

Manadnok—A residual rock, hill, or mountain standing above a peneplain.

Maximum water-holding capacity—The water held by a soil when it is saturated. *See* "Methods".

Moisture equivalent—Water held in a soil when subjected to a force of 1000 times the force of gravity. Approximate field capacity. *See* "Methods".

Moraine—An accumulation of earth, stones, etc., carried and finally deposited by a glacier.

Mottles—Irregularly marked spots or streaks, usually of rust color. They are described in terms of abundance, contrast, and size.

Outwash—All detrital material swept out of a melting glacier by meltwater streams.

Parent material—The unaltered or essentially unaltered mineral material from which the soil profile develops.

Ped—An individual natural soil aggregate.

Periglacial—Having a position marginal to but beyond the glacier.

Period, geological—A unit of geological time smaller than an era and larger than an epoch.

Permeability—Readiness with which air or water can pass through soil.

pF 1.6—This is the moisture held by a soil when a suction of 40 cm. of water is exerted on it. Approximate noncapillary pores. *See* "Methods".

pH—The intensity of acidity or alkalinity expressed as the logarithm of the reciprocal of the H ion concentration. With this notation, pH 7 is neutral; lower values indicate acidity, higher values alkalinity.

Porosity—The fraction of the total soil volume not occupied by solid particles.

Preglacial—Of geologic time before the glacial epoch.

Profile—A vertical section of a soil through all its horizons and extending into the parent material.

Regosol—Soils in which profile development has been restricted mainly due to age and the nature of the parent material.

Relief—The elevation or inequalities of the land surface when considered collectively. Minor surface configurations are referred to as microrelief.

Rocdrumlin—Drumlin-like ridges made up of resistant cores of bedrock.

Sedentary—Formed in place, without transportation, by disintegration of the underlying rock or by accumulation of organic material.

Soil reaction—The acidity or alkalinity of the soil. Acid reactions are characterized as follows:

Slightly acid	pH 6.1 – 6.5
Medium acid	pH 5.6 – 6.0
Strongly acid	pH 5.1 – 5.5
Very strongly acid	pH 4.5 – 5.0
Extremely acid	pH below 4.5

Solifluction—The slow flowing downslope of masses of rock debris that are saturated with water and not confined to definite channels.

Solum—The part of the soil profile that is above the parent material and in which the processes of soil formation are active. It comprises the A and B horizons.

Structure—Arrangement of primary soil particles into aggregates, which are separated from adjoining aggregates by surfaces of weakness.

Structure class—Size of aggregates.

Structure grade—Degree of distinctness of aggregates.

Structure type—Shape and arrangement of aggregates. The following types are mentioned in this report:

Blocky—Blocklike aggregates with sharp, angular corners.

Crumb—Porous, spheroidal aggregates.

Fragmental—Large, irregular polyhedral aggregates with sharp, angular corners and without orientation of faces, which can be plane or curved.

Granular—Spheroidal aggregates, relatively nonporous.

Platy—Platelike aggregates.

Pseudo-platy—Thick and irregular, platelike aggregates.

Single grained—Each grain by itself as in sand.

Texture—The percentages of sand, silt, and clay in a soil determine its texture. Particles from 2 to 0.05 mm. in diameter are called sand, those from 0.05 to 0.002 mm. are called silt, and those less than 0.002 mm. in diameter are called clay. *See* Figure 16.

Thickness—Distance between opposite surfaces, e.g., thickness of a horizon.

Till—Glacial drift deposited by and underneath the ice with little or no transportation by water.

Topography—General configuration of the land surface.

The following classes are used in this report:

Depressional—Forming a basin that is practically undrained.

Dissected—Original surface broken and lowered in places by natural denudation.

Flat—Level or nearly level.

Hilly—Very steep, simple or complex slopes.

Rolling—Irregular, moderate slopes.

Undulating—Irregular, gentle slopes.

Variant—A soil that differs in one or more respects from a named soil series with which it occurs. It is not of sufficient known extent to warrant separation.

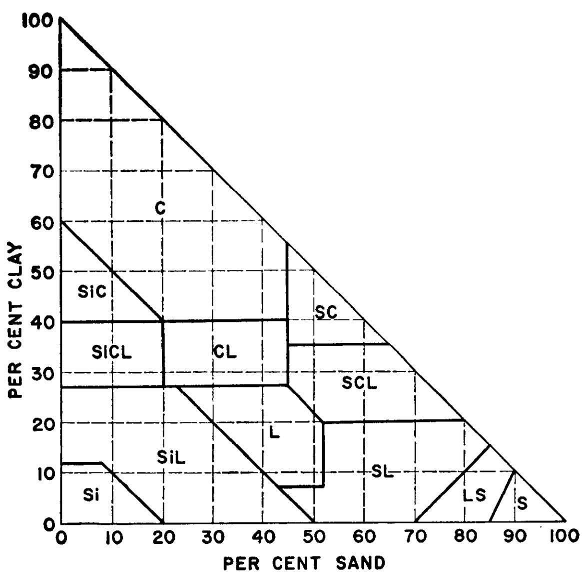

Figure 16.—Percentages of clay and sand in the main textural classes of soils; the remainder of each class is silt. See Toogood, J. A., Can. J. Soil Sci. 38:54-55, 1958. The limits between classes are as in *Soil Survey Manual*, U.S.D.A. Handbook 18, 1951.

TABLE 12.—Mechanical Analyses of Representative Soil Profiles

Percentages of Oven-dry Weights

Horizon	Depth Inches	Gravel More than 2 mm.	Sand: Very coarse 2–1 mm.	Sand: Coarse 1.0–0.5 mm.	Sand: Medium 0.5–0.25 mm.	Sand: Fine 0.25–0.1 mm.	Sand: Very fine 0.1–0.05 mm.	Sand: Total 2–0.05 mm.	Silt 0.05–0.002 mm.	Clay Less than 0.002 mm.	Texture
Caribou shaly silt loam[1]											
Bfh	2–10	16.5	2.4	3.6	3.5	5.0	8.1	22.6	53.1	24.3	sh.si.l.
Bf	10–14	25.6	4.0	4.7	6.1	7.0	8.0	29.8	51.1	19.1	sh.si.l.
BC	14–24	33.1	3.2	3.7	5.2	6.0	7.0	25.1	51.6	23.3	sh.si.l.
C1	24–30	29.0	3.1	4.1	4.9	5.9	6.9	24.9	41.1	34.0	sh.c.l.
C2	30–40	36.1	3.0	4.1	4.4	4.9	6.1	22.5	53.9	23.6	sh.si.l.
Cr	40–49	65.4	2.6	4.3	8.3	10.1	11.9	37.2	41.9	21.9	l.g.
Caribou shaly loam											
Ah	0–2	6.6	1.7	4.0	5.6	8.1	13.3	32.7	49.2	18.1	l.
Ae (pocket)	2–4	12.1	5.5	2.6	4.4	7.3	7.8	27.6	49.3	23.1	l.
Bfh	4–7	16.6	11.2	3.8	4.4	6.2	7.0	32.6	46.0	21.4	sh.l.
Bf	7–12	—	0.0	4.1	6.1	9.9	11.8	31.9	42.4	25.7	l.
BC	12–16	16.5	6.1	5.5	6.3	9.2	8.6	35.7	35.7	28.6	sh.c.l.
C	16–36	21.5	5.7	5.8	6.0	8.8	9.6	35.9	34.5	29.6	sh.c.l.
Carlingford shaly silt loam											
Ah	0–2	4.9	3.3	1.5	3.8	6.3	8.0	22.9	57.8	19.3	si.l.
Aeg	2–5	16.8	12.9	1.9	2.3	3.6	7.9	28.6	50.2	21.2	si.l.
Bfhg	5–11	10.6	8.0	0.8	2.3	4.8	10.6	26.5	48.9	24.6	l.
Bg	11–15	5.5	5.4	1.1	2.7	6.5	9.6	25.3	49.6	25.1	l.
Cg	15–30	10.5	17.7	1.4	4.8	6.6	10.8	41.3	35.4	23.3	l.
Gagetown gravelly sandy loam											
Ae	0–5	50.0	—	—	—	—	—	70.0	22.0	8.0	g.s.l.
Bfh	5–12	51.0	—	—	—	—	—	77.0	17.0	6.0	g.s.l.
Bf	12–20	76.0	—	—	—	—	—	86.0	9.0	5.0	g.
C	20 +	61.0	—	—	—	—	—	85.0	11.0	4.0	g.

TABLE 12.—Mechanical Analyses of Representative Soil Profiles —Continued

Percentages of Oven-dry Weights

Horizon	Depth Inches	Gravel More than 2 mm.	Sand: Very coarse 2–1 mm.	Sand: Coarse 1.0–0.5 mm.	Sand: Medium 0.5–0.25 mm.	Sand: Fine 0.25–0.1 mm.	Sand: Very fine 0.1–0.05 mm.	Sand: Total 2–0.05 mm.	Silt 0.05–0.002 mm.	Clay Less than 0.002 mm.	Texture
Glassville slaty loam											
Ae	0–3	42.6	2.4	4.2	3.9	6.1	5.6	22.2	56.0	21.8	g.si.l.
Bhf[2]	3–5	54.0	16.8	13.1	4.4	5.4	4.9	44.6	37.9	17.5	g.l.
Bfh[2]	5–13	77.9	20.5	16.0	5.3	6.1	6.8	54.7	31.3	14.0	l.g.
Bf	13–22	34.2	25.6	21.1	8.8	7.7	6.1	69.3	22.1	8.6	g.s.l.
C	22–48	49.3	15.6	19.0	10.7	9.9	8.5	63.7	25.4	10.9	g.s.l.
Glassville slaty loam											
Ae	0–2	32.8	—	—	—	—	—	31.0	48.0	21.0	g.l.
Bfh	2–9	41.3	—	—	—	—	—	40.0	50.0	10.0	g.l.
Bf	9–17	39.9	—	—	—	—	—	48.0	40.0	12.0	g.l.
C	17–36	69.9	—	—	—	—	—	60.0	29.0	11.0	g.s.l.
Holmesville gravelly loam											
Ae	0–2	12.6	0.9	2.8	4.8	10.6	11.8	30.9	49.8	19.3	l.
Bfh	2–5	16.0	5.2	8.8	9.1	13.1	11.1	47.3	36.5	16.2	g.l.
Bf	5–7	17.6	8.7	11.6	9.9	14.6	13.7	59.5	25.1	16.4	g.s.l.
BC	7–17	23.4	6.5	9.7	10.0	13.1	9.6	48.9	33.1	18.0	g.l.
C1	17–48	23.7	6.3	9.5	10.1	12.9	10.6	49.4	30.2	20.4	g.l.
C2	48–54	25.0	10.7	2.4	11.2	14.6	12.1	51.0	23.6	25.4	g.s.l.
Holmesville sandy loam											
Ae	0–2	9.4	3.5	3.6	4.8	0	18.7	30.6	47.6	21.8	l.
Bfh	2–5	9.7	8.4	13.1	8.7	0	22.0	52.2	36.0	11.8	s.l.
Bf	5–9	18.2	4.0	6.5	7.5	0	20.5	38.5	43.3	18.2	g.l.
BC	9–13	9.3	5.8	7.2	7.0	0	15.5	35.5	43.6	20.9	l.
C	13–40	13.6	5.0	9.7	7.9	0	20.5	43.1	37.5	19.4	l.

TABLE 12.—Mechanical Analyses of Representative Soil Profiles—Continued

Percentages of Oven-dry Weights

Horizon	Depth Inches	Gravel More than 2 mm.	Sand						Silt 0.05–0.002 mm.	Clay Less than 0.002 mm.	Texture
			Very coarse 2–1 mm.	Coarse 1.0–0.5 mm.	Medium 0.5–0.25 mm.	Fine 0.25–0.1 mm.	Very fine 0.1–0.05 mm.	Total 2–0.05 mm.			
					Interval loam						
Ahj	0–9	—	—	—	—	—	—	40.0	47.0	13.0	l.
C1	9–18	—	—	—	—	—	—	33.0	51.0	16.0	si.l.
C2	18–27	—	—	—	—	—	—	34.0	50.0	16.0	si.l.
C3	27–38	—	—	—	—	—	—	35.0	51.0	14.0	si.l.
					Johnville gravelly loam[1]						
Ae	0–2	24.7	0.4	1.6	5.1	12.4	17.1	36.6	49.3	14.1	g.l.
Bfh	2–4	55.1	4.8	5.8	7.2	9.0	10.0	36.8	46.1	17.1	g.l.
Bfhg	4–9	53.5	8.2	9.1	7.8	8.6	9.8	43.5	41.9	14.6	g.l.
Cgl	9–17	47.4	8.4	11.2	10.8	11.6	12.8	54.8	34.9	11.3	g.s.l.
Cg2	17–29	37.5	5.4	8.6	9.3	11.1	11.8	46.2	37.5	16.3	g.l.
Cg3	29–37	39.8	9.7	13.4	16.6	18.0	12.0	69.7	21.0	9.3	g.s.l.
Cg4	37–60	28.1	3.4	4.7	6.6	9.8	11.7	36.2	37.6	26.2	g.l.
C	60 +	41.1	6.7	9.0	10.7	12.0	12.3	55.9	25.9	18.2	g.s.l.
					Johnville gravelly loam						
Aeh	0–1	44.7	15.1	11.8	7.2	7.6	6.4	48.1	39.3	12.6	g.l.
Aeg	1–13	33.6	11.0	9.0	10.7	13.0	9.7	53.4	32.2	14.4	g.s.l.
Bfhg	13–24	32.7	7.7	8.0	8.3	12.5	10.5	47.0	32.7	20.3	g.l.
Cg	24–36	31.4	5.4	8.3	8.7	12.7	10.7	45.8	34.3	19.9	g.l.
					Juniper sandy loam						
Ae	0–2	6.6	—	—	—	—	—	58.0	34.0	8.0	s.l.
Bfh	2–12	13.4	—	—	—	—	—	59.0	32.0	9.0	s.l.
Bf	12–20	19.1	—	—	—	—	—	66.0	26.0	8.0	g.s.l.
C	20 +	9.0	—	—	—	—	—	63.0	30.0	7.0	s.l.

TABLE 12.—Mechanical Analyses of Representative Soil Profiles—Continued

Percentages of Oven-dry Weights

Horizon	Depth Inches	Gravel More than 2 mm.	Sand: Very coarse 2–1 mm.	Sand: Coarse 1.0–0.5 mm.	Sand: Medium 0.5–0.25 mm.	Sand: Fine 0.25–0.1 mm.	Sand: Very fine 0.1–0.05 mm.	Sand: Total 2–0.05 mm.	Silt 0.05–0.002 mm.	Clay Less than 0.002 mm.	Texture
Juniper silt loam											
Ae	0–2	18.4	1.4	3.2	4.2	5.8	14.6	29.2	55.9	14.9	g.si.l.
Bfh	2–5	5.8	0.5	1.8	2.4	4.6	14.2	23.5	61.5	15.0	si.l.
Bf	5–18	37.1	5.1	9.9	10.2	14.2	11.2	50.6	36.4	13.0	g.l.
C	18–40	25.5	4.9	11.8	11.8	13.4	20.7	62.6	29.0	8.4	g.s.l.
Kingsclear clay loam											
Ae	0–2	4.5	—	—	—	—	—	33.0	44.0	23.0	l.
Bfht	2–5	4.1	—	—	—	—	—	30.0	38.0	32.0	c.l.
Bft	5–9	4.4	—	—	—	—	—	31.0	35.0	34.0	c.l.
Bt	9–24	9.6	—	—	—	—	—	23.0	33.0	44.0	c.
Kingsclear clay loam[1]											
Ae	0–1	12.2	0.3	1.1	1.5	4.5	14.8	22.2	45.6	32.2	c.l.
Bft	1–8	8.3	0.3	0.9	1.1	3.7	11.6	17.6	40.0	42.4	c.
Bt1	8–15	1.0	0.1	0.2	0.2	1.0	3.8	5.3	48.1	46.6	si.c.
Bt2	15–26	3.6	0.1	0.2	0.4	1.0	2.2	13.9	45.2	40.9	si.c.
C1	26–38	12.1	0.3	0.8	1.0	3.7	8.9	14.7	50.8	34.5	si.c.l.
C2	38–52	4.9	0.1	0.3	1.3	7.2	16.4	25.3	46.4	28.3	s.l.
C3	52–64	14.8	0.8	1.5	2.5	7.5	12.5	24.8	48.9	26.3	l.
Maliseet sandy loam											
Ae	0–3	0	—	—	—	—	—	60.0	28.0	12.0	s.l.
Bfh	3–7	0	—	—	—	—	—	76.0	20.0	4.0	s.l.
Bf	7–11	0	—	—	—	—	—	79.0	18.0	3.0	s.l.
BC	11–17	0	—	—	—	—	—	84.0	13.0	3.0	l.s.
C	17–40	0	—	—	—	—	—	88.0	10.0	2.0	s.

TABLE 12.—Mechanical Analyses of Representative Soil Profiles—Continued

Percentages of Oven-dry Weights

Horizon	Depth Inches	Gravel More than 2 mm.	Sand: Very coarse 2–1 mm.	Sand: Coarse 1.0–0.5 mm.	Sand: Medium 0.5–0.25 mm.	Sand: Fine 0.25–0.1 mm.	Sand: Very fine 0.1–0.05 mm.	Sand: Total 2–0.05 mm.	Silt 0.05–0.002 mm.	Clay Less than 0.002 mm.	Texture
					Monquart gravelly loam[1]						
Ae	0–2	23.2	1.8	2.8	4.3	7.2	7.8	23.9	57.3	18.8	g.si.l.
Bfh	2–6	24.0	1.8	3.9	5.1	7.3	8.1	26.2	52.6	21.2	g.si.l.
Bf	6–10	26.9	5.3	7.3	7.3	9.6	11.2	40.7	47.7	11.6	g.l.
BC1	10–12	50.1	6.1	9.4	10.3	11.4	10.0	47.2	37.7	15.1	g.l.
BC2	13–26	39.5	6.7	7.7	10.0	12.2	11.8	48.4	37.0	14.6	g.l.
CB	26–42	44.3	6.7	8.6	12.4	15.6	13.2	56.5	34.9	8.6	g.s.l.
C1	42–60	43.9	7.8	9.6	10.9	13.6	11.3	52.2	32.3	15.5	g.s.l.
IIC[3]	60–66	31.0	3.5	5.6	6.3	8.2	9.3	32.9	39.4	27.7	g.c.l.
					Muniac gravelly sandy loam						
Ae	0–3	15.0	—	—	—	—	—	33.0	47.0	20.0	g.l.
Bfh	3–7	32.0	—	—	—	—	—	54.0	36.0	10.0	g.s.l.
Bf	7–13	43.0	—	—	—	—	—	61.0	28.0	11.0	g.s.l.
C1	13–48	51.0	—	—	—	—	—	68.0	20.0	12.0	g.s.l.
C2	48–96	55.0	—	—	—	—	—	69.0	16.0	15.0	g.s.l.
					Nackawick clay[1]						
Btg	10–13	0.4	0.5	0.7	0.9	4.8	6.9	13.8	30.6	55.6	c.
Cgl	13–23	28.1	1.4	1.3	2.6	6.3	13.1	24.7	45.2	30.1	g.c.l.
Cg2	23–34	16.2	1.3	1.6	2.4	8.9	17.8	32.0	45.2	22.8	g.l.
C1	34–45	17.6	2.3	3.1	4.9	9.3	15.0	34.6	37.1	28.3	g.c.l.
C2	45–66	17.0	2.9	3.7	5.2	8.4	13.0	33.2	38.9	27.9	g.c.l.
					Parleeville gravelly sandy loam						
Ae	0–4	33.2	—	—	—	—	—	41.8	38.0	20.2	g.l.
Bfh	4–8	69.0	—	—	—	—	—	75.4	15.2	9.4	g.s.l.
Bf	8–13	63.0	—	—	—	—	—	75.0	15.8	9.2	g.s.l.
BC	13–21	66.1	—	—	—	—	—	72.4	17.0	10.6	g.s.l.
C	21+	77.2	—	—	—	—	—	62.4	23.4	14.2	l.g.

TABLE 12.—Mechanical Analyses of Representative Soil Profiles—Concluded

Percentages of Oven-dry Weights

Horizon	Depth Inches	Gravel More than 2 mm.	Sand: Very coarse 2–1 mm.	Sand: Coarse 1.0–0.5 mm.	Sand: Medium 0.5–0.25 mm.	Sand: Fine 0.25–0.1 mm.	Sand: Very fine 0.1–0.05 mm.	Sand: Total 2–0.05 mm.	Silt 0.05–0.002 mm.	Clay Less than 0.002 mm.	Texture
					Poitras stony gravelly loam[1]						
Aeg	0–10	57.8	5.9	7.2	6.8	8.5	8.5	36.0	44.3	18.8	g.l.
Bfg	10–22	20.0	4.6	6.1	11.4	14.8	14.1	51.0	35.7	13.3	g.s.l.
Btg	22–32	28.1	3.8	5.0	9.0	12.6	11.0	41.4	37.6	21.0	g.l.
Cg1	32–42	32.9	3.1	4.2	7.8	11.4	12.3	38.8	43.3	17.0	g.l.
Cg2	42–54	33.4	2.8	4.4	7.4	10.3	11.9	36.8	46.0	17.2	g.l.
C	54+	40.2	5.1	10.6	13.5	15.6	11.0	55.8	30.1	14.1	g.s.l.
					Poitras stony clay						
Aeh	2–9	—	3.3	2.5	5.0	11.7	16.2	38.7	19.9	41.4	c.
Aeg	9–13	6.4	1.7	3.2	6.9	14.2	12.4	38.4	35.5	26.1	c.l.
Cg	13–24	17.5	2.7	5.1	8.5	17.9	11.0	45.2	32.9	21.9	g.l.
					Washburn silt loam						
Ah	0–4	1.5	0.3	0.2	0.8	3.4	10.4	15.1	66.5	18.4	si.l.
Cg1	4–17	0.0	0.0	0.4	1.1	3.7	11.4	16.6	54.2	29.2	si.c.l.
Cg2	17–23	19.4	8.4	0.2	0.6	2.5	7.6	19.3	51.6	29.1	g.si.c.l.
Cg3	24–38	23.2	0.7	0.4	1.4	5.7	11.8	20.0	52.4	27.6	g.si.c.l.

[1] Averages obtained from individual analyses of three or more cores sampled from the same horizon; others, one core only.
[2] Organic matter destroyed.
[3] Unlike the material from which the solum has developed.

TABLE 13.—Physical Analyses of Representative Soil Profiles
Percentages[1] of Total Volumes

Horizon	Depth Inches	Large pores drained pF 1.6	Small pores filled pF 1.6	Total pores	Gravel	Total sand	Silt-clay, and/or organic matter	Total solids
			Caribou shaly silt loam					
L–H	1–0	50.1	23.9	74.0	0.2	—	25.8	26.0
Ah	0–2	35.8	26.3	62.1	1.3	—	—	37.9
Bfh	2–10	29.1	41.9	71.0	5.8	7.0	16.2	29.0
Bf	10–14	30.2	33.1	63.3	7.9	10.0	18.8	36.7
BC	14–24	22.9	26.2	49.1	21.9	8.1	20.9	50.9
C1	24–30	11.8	27.8	39.6	18.9	11.6	29.9	60.4
C2	30–40	11.5	39.1	40.6	24.7	6.0	18.4	59.4
Cr	40–49	18.8	27.4	46.2	42.5	4.7	6.6	53.8
			Carlingford shaly silt loam					
L–H	2–0	28.0	49.0	77.0	0.0	0.0	23.0	23.0
Ah	0–2	17.9	49.3	67.2	1.8	6.5	24.5	32.8
Ae	2–5	17.4	42.5	59.9	7.5	8.1	24.5	40.1
Bfhg	5–11	15.5	41.6	57.1	5.3	13.6	24.0	42.9
Bg	11–15	7.4	39.8	47.2	3.3	15.5	34.0	52.8
Cg	15–30	8.4	44.0	52.4	13.8	16.7	17.1	47.6
			Glassville slaty loam					
L–H	3–0	47.9	31.1	79.0	0.0	0.0	21.0	21.0
Ae	0–3	—	—	54.0	10.5	12.9	22.6	46.0
Bh	3–5	49.2	14.1	63.3	15.6	7.0	13.1	36.7
Bhf	5–13	29.5	44.3	48.7	33.8	8.4	9.1	51.3
Bf	13–22	19.8	19.1	38.9	34.1	15.6	11.4	61.1
C	22–48	21.7	8.5	30.2	32.8	16.2	20.8	69.8
			Holmesville gravelly loam					
L–H	2–0	53.5	24.8	78.3	0.0	0.0	21.7	21.7
Ae	0–2	26.5	26.2	52.7	5.2	7.3	34.8	47.3
Bfh	2–5	17.5	42.3	39.8	5.2	11.9	23.1	40.2
Bf	5–7	8.3	50.3	58.6	7.2	18.8	15.4	41.4
BC	7–17	9.6	37.6	47.2	12.0	18.5	32.3	52.8
C1	17–48	5.1	26.3	31.4	16.2	19.2	23.2	58.6
C2	48–54	3.4	24.7	28.1	26.5	25.3	20.1	71.9
			Johnville gravelly loam					
L–H	3–0	40.3	47.6	87.9	0.0	0.0	12.1	12.1
Ae	0–2	27.2	35.8	63.0	10.9	11.5	14.6	37.0
Bfh	2–4	23.1	35.9	59.0	28.6	4.8	7.6	41.0
Bfhg	4–9	8.1	35.2	43.3	34.4	11.8	10.5	56.7
Cg1	9–17	3.9	27.3	31.2	34.7	20.2	13.9	68.8
Cg2	17–29	6.5	20.7	27.2	27.5	25.0	20.3	72.8
Cg3	29–37	6.1	23.9	30.0	30.3	30.3	9.4	70.0
Cg4	37–60	4.4	25.9	30.3	22.1	17.3	30.3	69.7
C	60+	5.5	19.5	25.0	32.9	25.9	16.2	75.0
			Juniper gravelly silt loam					
L–H	2–0	52.4	31.4	83.8	0.0	0.0	16.2	16.2
Ae	0–2	27.9	24.4	52.3	9.2	9.5	29.0	47.7
Bfh	2–5	12.9	55.6	68.5	2.0	4.3	25.2	31.5
Bf	5–18	38.0	10.3	48.3	21.5	22.3	7.9	51.7
C	18–40	51.4	5.7	57.1	11.3	20.2	11.4	42.9

TABLE 13.—Physical Analyses of Representative Soil Profiles—Concluded

Percentages[1] of Total Volumes

Horizon	Depth Inches	Large pores drained pF 1.6	Small pores filled pF 1.6	Total pores	Gravel	Total sand	Silt-clay, and/or organic matter	Total solids
			Kingsclear clay loam[1]					
L-H	1-0	45.4	47.7	93.1	0.3	0.0	6.6	6.9
Ae	0-1	28.2	27.1	55.3	6.1	7.8	30.8	44.7
Bft	1-8	17.9	33.4	51.3	3.7	6.8	38.2	48.7
Bt1	8-15	10.5	34.5	45.0	0.6	4.5	49.9	55.0
Bt2	15-26	8.5	33.2	41.7	2.5	6.9	48.9	58.3
C1	26-38	8.9	33.2	42.1	8.0	7.6	42.3	57.9
C2	38-52	11.7	21.1	32.8	3.7	18.4	45.1	67.2
C3	52-64	9.4	24.0	33.4	19.8	12.6	34.2	66.6
			Monquart gravelly loam[1]					
L-H	2-0	31.0	33.5	64.5	6.4	0.0	29.1	35.5
Ae	0-2	30.4	31.5	61.9	10.4	5.4	22.3	38.1
Bfh	2-6	45.8	37.8	83.6	6.0	2.1	8.3	16.4
Bf	6-10	26.3	40.4	66.7	9.6	5.4	18.3	33.3
BC1	10-13	11.4	31.3	42.7	32.4	13.3	11.6	57.3
BC2	13-26	13.6	29.2	42.8	24.6	15.8	16.8	57.2
CB	26-42	12.4	24.9	37.3	32.9	18.2	11.6	62.7
C1	42-60	9.8	24.6	34.4	31.3	19.7	14.6	65.6
IIC[2]	60-66	7.6	31.6	38.2	23.0	14.3	24.5	61.8
			Nackawick clay[1]					
L-H	3-0	52.8	38.8	91.6	0.0	0.0	—	8.4
Ah	0-1	23.6	71.0	94.6	0.0	0.0	—	5.4
Aeh	1-8	30.1	57.8	87.9	0.0	0.0	—	12.1
Btg	10-13	5.4	43.5	48.9	0.2	5.1	45.8	51.1
Cg1	13-23	9.4	24.0	33.4	19.8	11.6	35.2	66.6
Cg2	23-34	4.2	27.9	32.1	12.0	19.0	36.9	67.9
C1	34-45	5.0	26.1	31.1	13.0	16.3	39.6	68.9
C2	45-66	3.6	27.5	31.1	12.6	18.0	38.3	68.9
			Poitras stony gravelly loam[1]					
L-H	4-0	51.2	23.1	77.3	0.0	0.0	22.7	22.7
Aeg	0-10	9.6	26.5	36.1	48.4	10.1	12.4	65.9
Bfg	10-22	3.7	29.0	32.7	14.6	30.3	22.4	67.3
Btg	22-32	6.8	25.0	31.8	22.2	21.3	24.7	68.2
Cg1	32-42	6.0	24.7	30.7	26.9	15.6	26.8	69.3
Cg2	42-54	6.7	26.5	33.2	26.9	16.6	23.3	66.8
C	54	5.9	21.1	27.0	33.2	25.2	14.6	73.0
			Washburn silt loam					
L-F	4-2	42.6	36.7	79.3	0.0	0.0	20.7	20.7
H	2-0	12.1	73.7	85.8	1.3	0.0	—	14.2
Ah	0-4	12.3	68.2	80.5	0.9	2.5	16.1	19.5
Cg1	4-17	6.1	58.9	65.0	0.0	8.2	26.8	35.0
Cg2	12-23	6.7	52.1	58.8	5.6	8.8	26.8	41.2
Cg3	23-38	7.9	48.6	56.5	11.4	5.7	26.4	43.5

[1] Averages of tests made on three or more cores.

[2] Unlike the material from which the solum has developed.

TABLE 14.—Physical Measurements of Representative Soil Profiles

Horizon	Depth Inches	Bulk density	Maximum water-holding capacity	Moisture equivalent	Hygroscopic moisture	Liquid limit	Percentage of fine sand fraction with specific gravity of	
							Less than 2.70	2.70–2.95
			Caribou shaly silt loam					
L-H	1–0	0.26	349	92	7.0			
Ah	0–2	0.60	118	43	1.1			
Bfh	2–10	0.74	81	39	4.3			
Bf	10–14	0.93	62	31	2.1			
BC	14–24	1.46	41	25	1.2			
C1	24–30	1.64	42	25	1.0			
C2	30–40	1.65	45	26	1.1			
Cr	40–49	1.60	48	25	0.9			
			Caribou shaly loam					
Ah	0–2	0.54	159	47	4.0	62	95.8	2.5
Ae	2–4	0.81	91	32	1.7	42	97.2	1.4
Bfh	4–7	0.87	74	44	9.3	64	86.6	11.9
Bf	8–12	1.03	58	42	5.1	57	90.2	8.2
BC	12–16	—	—	33	4.3	45	79.4	19.2
C	16–36	1.43	32	24	1.8	30	78.4	20.0
			Carlingford shaly silt loam					
L-H	2–0	0.47	165	75	7.5			
Ah	0–2	0.64	104	52	6.4	79	92.5	6.6
Aeg	2–5	0.91	66	29	1.7	38	95.2	4.2
Bfhg	5–11	1.11	51	26	1.3	35	91.2	8.3
Bg	11–15	1.37	31	25	0.9	29	80.1	19.1
Cg	15–30	1.23	43	25	1.2	34	57.6	41.2
			Glassville slaty loam					
L-H	3–0	0.20	459	164	10.0	—	—	—
Ae	0–3	0.96	—	39	1.9	42	95.8	1.7
Bh	3–5	0.78	81	41	7.1	—	83.3	13.9
Bhf	5–13	1.10	67	33	8.4	69	78.0	22.0
Bf	13–22	1.44	23	21	4.4	49	81.6	18.1
C	22–48	1.82	17	11	1.1	21	70.1	28.8

TABLE 14.—Physical Measurements of Representative Soil Profiles—Continued

Horizon	Depth Inches	Bulk density	Maximum water-holding capacity	Moisture equivalent	Hygroscopic moisture	Liquid limit	Percentage of fine sand fraction with specific gravity of Less than 2.70	Percentage of fine sand fraction with specific gravity of 2.70–2.95
			Holmesville gravelly loam					
L-H	2–0	0.26	315	104	6.2	—	—	—
Ae	0–2	0.69	76	30	1.5	22	94.9	1.5
Bfh	2–5	0.71	85	35	5.7	56	88.7	10.4
Bf	5–7	0.97	61	31	4.7	53	89.9	7.0
BC	7–17	1.21	39	23	4.4	37	79.8	18.7
C1	17–48	1.67	19	17	0.8	23	78.0	19.8
C2	48–54	1.83	24	18	0.6	—	86.0	12.2
			Holmesville sandy loam					
L-H	1–0	0.29	445	103	8.2	—	—	—
Ae	0–2	1.12	57	30	1.5	37	98.0	0.7
Bfh	2–5	0.82	122	43	6.0	52	94.4	4.3
Bf	5–9	0.83	93	42	5.2	54	96.8	2.3
BC	9–13	1.28	45	26	1.6	32	89.8	8.8
C	13–40	1.72	36	22	0.6	23	85.7	12.9
			Holmesville gravelly loam					
L-H	2–0	0.13	293	69	7.5			
Ae	0–3	0.76	78	27	1.5			
Bhf	3–4	0.66	27	20	5.8			
Bfh	4–7	0.67	54	23	5.0			
Bf	7–10	1.03	55	24	2.7			
BC	10–17	1.33	44	19	1.2			
CB	17–27	1.62	29	18	0.8			
C1	27–48	1.98	20	14	0.3			
C2	48–66	1.98	32	19	0.7			

TABLE 14.—Physical Measurements of Representative Soil Profiles—Continued

Horizon	Depth Inches	Bulk density	Maximum water-holding capacity	Moisture equivalent	Hygroscopic moisture	Liquid limit	Percentage of fine sand fraction with specific gravity of	
							Less than 2.70	2.70–2.95
			Johnville gravelly loam					
L–H	3–0	0.16	352	87				
Ae	0–2	1.09	63	28				
Bfh	2–4	1.27	79	30				
Bfhg	4–9	1.55	37	24				
Cg1	9–17	1.83	28	16				
Cg2	17–29	1.97	25	15				
Cg3	29–37	1.92	24	10				
Cg4	37–60	1.92	35	20				
C	60+	2.03	28	15				
			Johnville gravelly loam					
H	3–0	0.20	518	114	7.3	—	—	—
Aeh	0–1	0.95	82	28	2.0	65	88.1	9.1
Aeg	1–13	1.83	36	17	3.2	24	77.2	22.0
Bfhg	13–24	1.88	34	18	0.5	22	74.9	23.2
Cg	24–36	2.00	35	17	0.5	23	75.4	22.3
			Juniper gravelly silt loam					
L–H	2–0	0.16	528	123	8.6	—	—	—
Ae	0–2	1.22	45	24	0.8	31	93.7	2.0
Bfh	2–5	0.81	84	22	2.6	60	90.3	7.9
Bf	5–18	1.33	37	16	1.3	31	88.2	9.8
C	18–40	1.58	37	9	0.7	26	87.8	10.0
			Kingsclear clay loam					
L–H	1–0	0.40	241	65	10.7			
Ae	0–1	1.26	43	27	1.7			
Bft	1–8	1.31	48	30	2.3			
Bt1	8–15	1.54	48	26	2.6			
Bt2	15–26	1.67	43	26	3.5			
C1	26–38	1.61	44	24	2.5			
C2	38–52	1.91	29	17	2.0			
C3	52–64	1.91	29	18	1.9			

TABLE 14.—Physical Measurements of Representative Soil Profiles—Continued

Horizon	Depth Inches	Bulk density	Maximum water-holding capacity	Moisture equivalent	Hygroscopic moisture	Liquid limit	Percentage of fine sand fraction with specific gravity of: Less than 2.70	2.70–2.95
			Monquart gravelly loam					
L-H	2–0	0.89	94	43	3.0			
Ae	0–2	0.96	60	32	1.2			
Bfh	2–6	0.64	105	42	3.9			
Bf	6–10	0.85	79	35	3.3			
BC1	10–13	1.58	38	19	1.5			
BC2	13–26	1.52	30	17	1.2			
CB	26–42	1.73	24	12	0.5			
C1	42–60	1.73	24	14	0.6			
IIC[1]	60–66	1.77	38	21	0.8			
			Nackawick clay					
L-H	4–0	0.14	463	118	—			
Ah	0–1	0.26	309	94	14.3			
Aeh	1–8	0.50	136	62	8.2			
Btg	8–13	1.47	55	32	2.9			
Cg1	13–23	1.88	39	20	1.7			
Cg2	23–34	1.93	31	16	2.4			
C1	34–45	1.95	40	20	1.5			
C2	45–66	1.98	40	20	1.6			
			Poitras stony gravelly loam					
L-H	3–0	0.12	576	137	14.6			
Aeg	0–10	1.81	38	23	1.6			
Bfg	10–22	1.82	26	17	1.1			
Btg	22–32	1.94	29	19	0.6			
Cg1	32–42	1.96	33	20	0.7			
Cg2	42–54	1.91	32	21	1.0			
C	54+	2.01	25	14	0.4			

TABLE 14.—Physical Measurements of Representative Soil Profiles—Concluded

Horizon	Depth Inches	Bulk density	Maximum water-holding capacity	Moisture equivalent	Hygroscopic moisture	Liquid limit	Percentage of fine sand fraction with specific gravity of	
							Less than 2.70	2.70–2.95
			Poitras stony clay					
Ah	0–2	0.11	889	—	—	—	—	—
Aeh	2–9	—	89	39	3.82	95	86.1	12.5
Aeg	9–13	1.43	32	29	1.22	39	84.1	14.5
Cg	13–24	2.02	12	16	0.41	21	76.4	21.1
			Washburn silt loam					
L–F	4–2	0.17	454	212	18.6	—	—	—
H	2–0	0.33	266	164	20.1	—	—	—
Ah	0–4	0.40	199	80	7.3	118	89.7	10.0
Cg1	4–17	1.00	67	38	1.5	45	94.6	5.3
Cg2	17–23	1.17	51	35	2.1	31	90.4	9.4
Cg3	24–38	1.20	49	39	2.4	54	82.4	16.3

[1] Unlike the material from which the solum has developed.

TABLE 15.—Composition of Fine Sand (0.25–0.1 mm.) in Representative Soil Profiles

Percentages of Total Number of Mineral Grains in Each of Three Specific Gravity Classes

Horizon	Depth Inches	Specific gravity less than 2.70				Specific gravity 2.70–2.95						Specific gravity more than 2.95						
		Percentage of total fine sand	Quartz	Plagioclase	Orthoclase	Percentage of total fine sand	Impure quartz	Plagioclase	Muscovite	Biotite	Chlorite	Percentage of total fine sand	Zircon	Tourmaline	Epidote	Spinel	Hornblende	Opaque
Caribou shaly loam																		
Ah	0–2	95.8	100	trace	0	2.5	32	65	2	0	1	1.7	12	3	43	2	7	33
Ae	2–4	97.2	100	0	trace	1.4	75	19	4	trace	2	1.4	10	2	41	2	5	40
Bfh	4–7	86.6	76	24	0	11.9	10	87	3	trace	1	1.5	9	5	49	2	10	25
Bf	7–12	90.2	74	26	trace	8.2	6	91	3	trace	1	1.6	9	4	51	2	9	25
BC	12–16	79.4	59	41	trace	19.2	11	86	2	0	1	1.4	7	4	51	2	9	27
C	16–36	78.4	67	33	trace	20.0	20	78	2	trace	trace	1.6	8	3	40	2	9	38
Carlingford shaly silt loam																		
Ah	0–2	92.5	80	20	trace	6.6	7	91	2	0	trace	0.9	7	3	47	8	6	29
Aeg	2–5	95.2	87	13	trace	4.2	9	88	2	0	1	0.6	9	4	48	7	8	24
Bfhg	5–11	91.2	86	14	trace	8.3	7	90	3	trace	trace	0.5	6	3	55	7	10	19
Bg	11–15	80.1	76	24	trace	19.1	5	94	1	trace	trace	0.8	9	4	48	6	8	25
Cg	15–30	57.6	75	25	0	41.2	2	98	trace	trace	0	1.2	7	3	50	8	8	24
Washburn silt loam																		
Ah	0–4	89.7	95	5	0	10.0	4	88	8	0	trace	0.3	6	2	63	7	6	16
Cg1	4–17	94.6	100	trace	0	5.3	2	93	5	0	trace	0.1	4	1	80	5	3	8
Cg2	17–24	90.4	95	5	0	9.4	15	81	4	0	trace	0.7	5	2	60	8	4	21
Cg3	24–38	82.4	77	23	trace	11.3	82	14	4	trace	0	1.3	9	6	57	10	11	9

TABLE 16.—pH and Exchangeable and Extractable Ions of Representative Soil Profiles

Based on Oven-dry Weight

Horizon	Depth Inches	pH	Cation exchange capacity m.e./100 g.	Exchangeable cations, m.e./100 g.			Base saturation %	Free iron %	Free aluminum %	HF-soluble carbon %	Soluble phosphorus p.p.m.
				Ca	Mg	K					
				Caribou shaly loam							
Ah	0–2	4.4	32 57	3.78	1.66	1.34	20.8	—	—	0.47	
Ae (pocket)	2–4	4.3	16.24	1.80	0.59	0.71	19.2	0.28	0.10	0.14	
Bfh	4–7	4.7	41.59	1.73	0.81	0.92	8.3	2.85	0.33	0.18	
Bf	7–12	5.1	35.60	0.16	0.02	1.11	3.6	2.58	0.53	1.40	
BC	12–16	5.1	20.48	0.18	0.03	0.38	2.9	1.52	0.44	0.40	
C	16–36	5.4	10.47	0.18	0.02	0.87	10.2	0.94	0.19	0.25	
				Carlingford shaly silt loam							
L–H	2–0	6.4	51.12	32.00	1.80	1.88	69.8	0.82	0.15	—	
Ah	0–2	6.5	31.14	20.40	1.20	1.13	88.5	1.13	0.25	0.14	
Aeg	2–5	6.6	16.67	5.80	0.42	1.01	43.4	1.05	0.19	0.22	
Bfhg	5–11	6.6	11.25	3.80	0.26	0.56	41.1	1.26	0.16	0.42	
Bg	11–15	6.5	14.17	3.14	0.23	0.79	29.6	1.02	0.11	0.02	
Cg	15–30	6.5	13.00	4.30	0.30	0.50	39.2	2.05	0.31	0.23	
				Glassville slaty loam							
L–H	3–0	3.8	111.64	11.58	3.00	1.13	14.1	—	—	—	
Ae	0–3	3.7	14.15	1.14	0.42	1.10	18.8	0.84	0.08	0.24	
Bh	3–5	4.0	36.27	1.53	0.61	2.20	11.9	4.43	0.33	3.49	
Bhf	5–13	4.5	30.22	1.05	0.27	1.15	8.2	4.50	1.02	6.96	
Bf	13–22	4.6	10.77	0.36	0.03	0.44	7.7	2.00	1.05	2.06	
C	22–48	4.9	6.21	0.27	0.02	0.79	17.4	0.60	0.29	0.23	
				Glassville slaty loam							
L–H	2–0	3.6	104.67	14.69	3.46	1.60	18.9				29.8
Ae	0–2	3.8	8.23	1.07	0.76	0.35	37.7				1.0
Bfh	2–9	4.6	31.17	0.60	0.59	0.37	5.0				0.5
Bf	9–17	4.9	13.84	0.24	0.51	0.31	7.7				0.9
C	17–36	4.9	5.28	0.11	0.38	0.14	11.9				1.0

TABLE 16. pH and Exchangeable and Extractable Ions of Representative Soil Profiles—Continued
Based on Oven-dry Weight

Horizon	Depth Inches	pH	Cation exchange capacity m.e./100 g.	Exchangeable cations, m.e./100 g. Ca	Mg	K	Base saturation %	Free iron %	Free aluminum %	HF-soluble carbon %	Soluble phosphorus p.p.m.
				Holmesville gravelly loam							
L-H	2–0	4.2	49.47	18.60	4.05	3.79	53.8	—	—	—	
Ae	0–2	4.4	13.15	1.87	0.38	0.72	22.7	0.23	0.30	0.01	
Bfh	2–5	4.5	32.77	0.73	0.12	0.65	4.6	2.84	0.71	2.14	
Bf	5–7	4.8	28.48	0.36	0.03	0.72	3.9	2.40	0.68	1.23	
BC	7-17	4.5	15.07	0.49	0.0	0.24	4.9	0.98	0.46	1.03	
C1	17–48	4.5	11.41	0.30	0.03	0.99	11.5	0.61	0.13	0.0	
C2	48–54	5.4	15.70	7.95	0.15	2.44	67.0	0.89	0.14	0.07	
				Holmesville sandy loam							
L-H	1–0	4.5	127.90	12.10	1.48	3.60	13.5	—	—	5.70	
Ae	0–2	4.5	13.62	2.78	0.41	0.62	28.0	0.11	0.10	0.05	
Bfh	2–5	4.9	53.90	1.18	0.34	1.56	5.6	3.35	0.23	2.22	
Bf	5–9	5.2	40.30	0.39	0.03	1.47	4.7	1.72	0.25	0.88	
BC	9–13	5.3	18.08	0.43	0.08	0.96	8.1	0.77	0.22	0.37	
C	13–40	5.5	12.39	0.19	0.0	0.65	6.8	0.45	0.15	0.39	
				Interval loam							
Ahj	0–9	5.9	10.20	8.29	0.62	0.07	87.7				34.8
C1	9–18	5.9	11.70	7.98	0.46	0.10	72.9				23.6
C2	18–27	5.9	7.80	4.98	0.23	0.05	67.5				23.2
C3	27–38	5.8	7.80	6.15	0.29	0.13	84.2				21.0
				Johnville gravelly loam							
L-F	6–3	4.0	—	—	—	—	—	—	—	—	
H	3–0	4.0	110.44	11.19	2.25	20.00	30.3	—	—	—	
Aeh	0–1	4.2	17.75	1.29	0.40	0.73	13.6	0.25	0.15	0.63	
Bfhg	13–24	4.5	9.02	0.45	0.07	0.65	12.9	0.58	0.13	0.47	
Cg	24–36	4.5	9.50	1.48	0.44	0.68	27.2	1.22	0.13	0.55	

TABLE 16.—pH and Exchangeable and Extractable Ions of Representative Soil Profiles—Continued

Based on Oven-dry Weight

Horizon	Depth Inches	pH	Cation exchange capacity m.e./100 g.	Exchangeable cations, m.e./100 g. Ca	Mg	K	Base saturation %	Free iron %	Free aluminum %	HF-soluble carbon %	Soluble phosphorus p.p.m.
				Juniper sandy loam							
L–H	2–0	4.3	105.83	36.68	7.69	6.12	47.7	—	—	—	39.0
Ae	0–2	4.5	4.76	1.82	0.61	0.13	53.8	0.23	0.14	—	1.1
Bfh	2–12	4.9	13.60	1.11	0.29	0.17	11.5	2.52	0.60	—	1.8
Bf	12–20	5.1	7.70	0.69	0.40	0.24	17.3	1.11	0.43	—	1.8
C	20+	5.1	4.65	0.43	0.47	0.16	22.8	1.27	0.95	—	2.6
				Kingsclear clay loam							
L–H	2–0	3.9	77.06	10.80	3.04	1.56	20.0				13.5
Ae	0–2	3.6	8.53	0.45	0.52	0.24	14.2				0.9
Bfht	2–5	4.1	19.98	0.17	0.25	0.60	5.1				0.7
Bft	5–9	4.1	11.19	0.71	0.50	0.42	14.6				1.1
Bt	9–24	6.6	16.60	18.93	1.32	0.30	saturated				9.7
				Maliseet sandy loam							
L–H	2–0	4.5	32.19	9.82	1.36	0.89	37.5				11.4
Ae	0–3	4.0	10.10	0.06	0.32	0.12	5.0				6.2
Bfh	3–7	4.6	16.84	0.07	0.13	0.11	1.8				32.1
Bf	7–11	4.7	9.00	0.14	0.13	0.11	4.2				16.7
BC	11–17	4.9	9.07	0.10	0.13	0.12	3.4				21.1
C	17–40	5.1	6.93	0.01	0.06	0.19	3.7				15.8
				Muniac gravelly sandy loam							
L–H	2–0	4.7	81.76	30.39	6.13	5.15	31.6				17.7
Ae	0–3	4.2	17.80	5.34	1.23	0.38	39.0				2.7
Bfh	3–7	4.6	21.50	0.56	0.56	0.32	6.7				2.2
Bf	7–13	4.9	8.62	0.20	0.43	0.33	11.1				3.4
C1	13–48	5.3	3.66	0.15	0.47	0.17	21.6				4.9
C2	48–96	7.7	4.28	17.38	0.69	0.14	saturated				1.1

TABLE 16.—pH and Exchangeable and Extractable Ions of Representative Soil Profiles—Concluded

Based on Oven-dry Weight

Horizon	Depth Inches	pH	Cation exchange capacity m.e./100 g.	Exchangeable cations, m.e./100 g. Ca	Mg	K	Base saturation %	Free iron %	Free aluminum %	HF-soluble carbon %	Soluble phosphorus p.p.m.
				Parleeville gravelly sandy loam							
L-H	2–0	4.8	72.53	35.15	4.81	1.24	58.2				31.2
Ae	0–4	4.3	9.59	0.80	0.06	0.22	11.3				4.4
Bfh	4–8	4.9	12.24	0.30	trace	0.58	7.2				6.6
Bf	8–13	5.0	7.64	0.30	trace	0.80	14.4				6.6
BC	13–21	5.0	6.61	0.80	0.20	1.17	32.5				9.2
C	21+	5.0	7.84	2.30	0.62	0.90	48.7				17.0
				Poitras stony clay							
Ah	0–2	3.8	78.00	—	—	—	—	—	—	—	
Aeh	2–9	3.8	52.48	2.64	0.90	3.12	12.7	0.27	0.23	0.0	
Aeg	9–13	4.2	21.83	0.45	0.07	0.63	5.3	0.10	0.12	0.0	
Cg	13–24	4.9	7.24	2.04	0.55	0.55	43.5	0.07	0.02	0.04	
				Washburn silt loam							
L-F	4–2	5.8	187.16	109.00	3.95	3.90	61.7	—	—	—	
H	2–0	6.6	233.14	73.60	4.20	3.08	34.6	0.50	0.01	5.05	
Ah	0–4	6.8	31.31	47.50	2.52	3.35	saturated	1.26	0.56		
Cg1	4–17	7.1	8.64	39.40	2.40	2.88	saturated	2.36	0.30	0.20	
Cg2	17–23	7.6	8.14	33.40	1.23	1.96	saturated	0.38	0.14	0.21	
Cg3	24–38	6.7	18.32	15.00	3.36	2.70	saturated	0.52	0.18	—	

TABLE 17.—Total Chemical Analyses of Representative Soil Profiles

Percentages of Oven-dry Weights

Horizon	Depth Inches	Loss on ignition	C	N	Si	Fe	Al	Ca	Mg	K	P	SiO_2 / R_2O_3	Total ses-quioxides
					Caribou shaly loam								
Ah	0–2	15.7	8.69[1]	0.46	31.20	1.26	4.98	0.65	0.19	—	0.075	11.4	
Ae (pocket)	2–4	3.9	1.75	0.13	37.90	1.19	4.25	0.39	0.16	—	0.031	12.8	
Bfh	4–7	11.3	4.95	0.27	27.40	5.82	8.03	0.39	0.45	—	0.061	4.8	
Bf	7–12	9.8	3.54	0.22	28.50	5.58	8.45	0.41	0.87	—	0.018	4.9	
BC	12–16	5.6	1.73	0.13	28.80	5.13	9.44	0.73	0.70	—	0.018	4.6	
C	16–36	2.5	0.65	0.08	34.60	2.00	8.37	0.27	0.79	—	0.022	6.4	
					Caribou shaly silt loam								
Ah	0–1	16.9	5.60[2]	0.41	33.30	1.57	5.37	0.26	0.34	0.42	0.013	10.3	
Ae	1–2	4.2	0.78	0.09	39.80	1.17	4.67	0.11	0.22	0.77	0.009	14.5	
Bfh	2–6	13.4	2.60	0.21	31.40	2.10	8.33	0.14	0.68	0.81	0.018	6.4	
Bf	6–15	9.7	1.74	0.14	29.70	1.90	9.30	0.14	0.91	0.98	0.009	5.6	
C	15–36	6.3	1.05	0.12	33.00	1.36	10.20	0.11	1.32	1.19	0.009	5.9	
					Carlingford shaly silt loam								
L–H	2–0	28.8	15.25[1]	0.79	22.20	2.23	7.41	1.72	0.19	—	0.065	5.0	
Ah	0–2	15.7	7.70	0.51	28.30	1.52	7.44	0.10	0.70	—	0.075	6.6	
Aeg	2–5	3.1	0.85	0.11	31.30	3.49	10.20	0.79	0.77	—	0.013	5.1	
Bfhg	5–11	2.7	0.97	0.08	34.00	2.47	7.70	0.17	0.61	—	0.009	7.3	
Bg	11–15	1.7	0.39	0.07	34.70	3.22	7.85	0.20	0.62	—	0.009	7.1	
Cg	15–30	2.4	0.35	0.10	28.60	2.87	13.15	0.68	0.70	—	0.018	3.8	
					Gagetown gravelly sandy loam								
L–H	1–0	30.5	—	0.57	21.00	—	—	0.60	0.30	0.69	0.088	—	70.80
Ae	0–5	4.6	—	0.07	39.80	—	—	0.24	0.22	0.77	0.031	—	9.70
Bfh	5–12	13.2	—	0.18	29.84	—	—	0.25	0.43	0.70	0.101	—	19.90
Bf	12–20	5.2	—	0.05	33.50	—	—	0.12	0.70	1.02	0.035	—	17.30
C	20+	3.0	—	0.06	35.60	—	—	0.28	0.76	0.95	0.031	—	18.60

TABLE 17.—Total Chemical Analyses of Representative Soil Profiles—Continued

Percentages of Oven-dry Weights

Horizon	Depth Inches	Loss on ignition	C	N	Si	Fe	Al	Ca	Mg	K	P	$\frac{SiO_2}{R_2O_3}$	Total ses-quioxides
						Glassville slaty loam							
L-H	3–0	88.0	56.10[1]	1.00	0.61	0.06	0.03	1.29	0.39	—	0.026	20.4	
Ae	0–3	3.7	1.47	0.14	37.20	0.87	6.26	0.21	0.21	—	0.013	10.7	
Bh	3–5	18.0	12.22	0.34	26.90	4.43	7.97	0.69	1.20	—	0.035	5.1	
Bhf	5–13	17.3	11.30	0.16	22.70	4.65	11.90	0.53	0.50	—	0.013	3.2	
Bf	13–22	11.1	4.64	0.24	26.20	3.46	8.31	1.46	1.91	—	0.013	5.1	
Cg	22–48	2.2	0.89	0.07	31.30	1.92	10.83	0.31	0.31	—	0.018	5.3	
						Glassville slaty loam							
L-H	2–0	89.3	23.91[2]	2.02	2.65	—	—	0.58	0.05	0.50	0.096	—	2.44
Ae	0–2	2.1	0.58	0.12	40.60	—	—	—	0.22	1.04	0.013	—	8.58
Bfh	2–9	18.1	5.24	0.33	26.30	—	—	0.11	0.60	0.84	0.044	—	25.50
Bf	9–17	7.6	3.05	0.15	33.33	—	—	0.22	0.62	0.68	0.048	—	20.63
C	17–36	3.6	0.90	0.07	34.00	—	—	0.22	0.77	0.94	0.018	—	22.67
						Holmesville gravelly loam							
L-H	2–0	56.7	28.39[1]	0.55	17.30	0.90	1.35	0.46	0.18	—	0.075	20.4	
Ae	0–2	2.3	0.59	0.05	40.40	0.57	3.78	0.19	0.01	—	0.013	19.2	
Bfh	2–5	12.5	4.39	0.21	29.90	3.11	7.52	0.86	0.15	—	0.061	6.3	
Bf	5–7	9.5	3.18	0.19	28.30	3.70	9.50	0.40	0.43	—	0.022	4.8	
BC	7–17	5.0	1.66	0.10	31.40	2.73	8.28	0.56	0.65	—	0.013	6.3	
C1	17–48	1.6	0.75	0.52	36.20	2.31	7.23	0.53	0.62	—	0.008	8.3	
C2	48–54	1.4	0.20	0.04	32.20	1.71	10.95	0.14	1.45	—	0.026	5.2	
						Holmesville sandy loam							
L-H	1–0	64.6	39.45[1]	1.33							0.097		
Ae	0–2	2.7	1.13	0.08							0.018		
Bfh	2–5	20.3	7.48	0.15							0.072		
Bf	5–9	11.8	3.50	0.20							0.066		
BC	9–13	1.5	0.39	0.05							0.026		
C	13–40	1.5	0.39	0.05							0.030		

TABLE 17.—Total Chemical Analyses of Representative Soil Profiles—Continued

Percentages of Oven-dry Weights

Horizon	Depth Inches	Loss on ignition	C	N	Si	Fe	Al	Ca	Mg	K	P	SiO_2 / R_2O_3	Total sesquioxides
					Interval loam								
Ahj	0–9	5.9	2.00[2]	0.09	33.9	—	—	0.45	0.59	1.13	0.062		16.40
C1	9–18	5.1	1.25	0.07	33.1	—	—	0.45	0.81	1.11	0.073		18.90
C2	18–27	4.0	0.90	0.05	33.2	—	—	0.47	0.82	1.22	0.057		19.80
C3	27–38	4.0	0.70	0.03	32.8	—	—	0.48	0.83	1.21	0.048		19.60
					Johnville gravelly olam								
H	3–0	64.8	33.00[1]	2.80	11.9	0.52	1.18	0.65	0.19	—	0.057	—	—
Aeh	0–1	11.1	5.20	0.32	32.1	1.67	7.32	0.34	0.48	—	0.043	—	—
Aeg	1–13	1.8	0.60	0.07	35.8	1.40	7.35	0.41	0.55	—	0.013	—	—
Bfhg	13–24	1.1	0.90	0.05	34.7	2.04	8.76	0.41	0.76	—	0.013	—	—
Cg	24–36	1.1	0.70	0.04	33.6	1.90	9.40	0.75	0.46	—	0.008	—	—
					Juniper sandy loam								
L–H	2–0	81.5	31.87[2]	1.90	5.13	—	—	0.31	0.14	0.38	0.110	—	2.77
Ae	0–2	1.4	1.03	0.06	39.80	—	—	0.31	0.10	1.25	0.013	—	9.45
Bfh	2–12	6.7	2.21	0.13	36.00	—	—	0.25	0.38	1.44	0.004	—	18.80
Bf	12–20	3.9	1.15	0.07	33.80	—	—	0.14	0.53	1.57	0.035	—	18.62
C	20 +	2.5	0.55	0.04	37.00	—	—	0.80	0.67	1.58	0.026	—	18.98
					Kingsclear clay loam								
L–H	2–0	56.8	24.34[2]	1.26	19.40	—	—	0.44	0.24	0.25	0.074	—	5.40
Ae	0–2	2.6	0.98	0.07	40.30	—	—	0.02	0.22	0.29	0.013	—	7.85
Bfht	2–5	6.3	2.05	0.13	34.00	—	—	0.03	0.94	1.09	0.013	—	18.66
Bft	5–9	2.7	0.65	0.07	34.40	—	—	0.04	1.10	1.14	0.022	—	18.52
Bt	9–24	1.5	0.22	0.04	34.70	—	—	0.96	1.57	0.93	0.026	—	22.64

TABLE 17.—Total Chemical Analyses of Representative Soil Profiles—Continued

Percentages of Oven-dry Weights

Horizon	Depth Inches	Loss on ignition	C	N	Si	Fe	Al	Ca	Mg	K	P	SiO_2 / R_2O_3	Total sesquioxides
					Maliseet sandy loam								
L–H	2–0	21.5	9.90[2]	0.34	29.50	—	—	0.34	0.12	0.71	0.007	—	12.38
Ae	0–3	3.7	1.50	0.06	39.00	—	—	0.11	0.25	0.83	0.031	—	10.56
Bfh	3–7	8.7	2.60	0.09	32.50	—	—	0.25	0.62	0.53	0.126	—	18.54
Bf	7–11	5.9	1.50	0.05	33.30	—	—	0.17	0.68	0.92	0.005	—	18.70
BC	11–17	4.5	1.20	0.05	33.80	—	—	0.27	0.85	0.56	0.031	—	18.01
C	17–40	3.0	0.80	0.03	34.85	—	—	0.31	1.04	0.75	0.022	—	18.70
					Muniac gravelly sandy loam								
L–H	2–0	51.8	14.65[2]	1.35	14.60	—	—	0.96	0.36	1.16	0.010	—	7.00
Ae	0–3	5.3	2.55	0.16	39.30	—	—	0.06	0.24	1.29	0.026	—	10.30
Bfh	3–7	10.8	3.40	0.21	27.40	—	—	0.13	0.86	0.71	0.062	—	23.65
Bf	7–13	4.5	1.85	0.09	34.22	—	—	0.15	0.72	1.44	0.040	—	22.36
C1	13–48	1.2	0.30	0.03	29.50	—	—	0.15	0.77	0.81	0.022	—	20.11
C2	48–96	0.7	0.20	0.03	31.62	—	—	2.78	1.08	1.60	0.026	—	21.21
					Parleeville gravelly sandy loam								
L–H	2–0	66.2	—	0.82	11.18	—	—	1.14	0.13	0.42	0.093	—	5.88
Ae	0–4	3.6	—	0.05	38.03	—	—	0.12	0.08	0.56	0.009	—	11.65
Bfh	4–8	7.2	—	0.12	29.60	—	—	0.23	0.17	0.64	0.009	—	22.28
Bf	8–13	5.7	—	0.10	30.80	—	—	0.06	0.47	0.76	0.026	—	21.11
BC	13–21	4.4	—	0.09	31.10	—	—	0.18	0.49	1.00	trace	—	22.83
C	21+	4.3	—	0.07	32.12	—	—	0.13	0.70	1.00	0.035	—	22.79
					Poitras stony clay								
Ah	0–2	71.0	35.20[1]	1.44	3.00	0.13	trace	0.80	0.94	—	0.039	96.4	—
Aeh	2–9	23.6	4.80	0.66	25.30	1.27	8.97	0.71	0.56	—	0.013	5.1	—
Aeg	9–13	6.2	3.10	0.13	31.20	2.36	8.67	0.88	0.66	—	0.018	6.1	—
Cg	13–24	1.9	0.70	0.06	33.80	1.68	8.46	1.04	0.84	—	0.013	7.0	—

TABLE 17.—Total Chemical Analyses of Representative Soil Profiles—Concluded

Percentages of Oven-dry Weights

Horizon	Depth Inches	Loss on ignition	C	N	Si	Fe	Al	Ca	Mg	K	P	SiO_2 / R_2O_3	Total sesquioxides
					Washburn silt loam								
L–F	4–2	84.4	49.70[1]	1.38	2.57	1.09	0.10	3.24	0.30	—	0.022	7.9	—
H	2–0	63.7	42.80	1.42	8.15	1.04	1.40	4.97	0.22	—	0.026	8.2	—
Ah	0–4	24.2	12.10	0.60	22.20	2.50	7.75	2.29	0.45	—	0.043	4.7	—
Cg1	4–17	3.4	1.20	0.14	30.40	2.40	10.60	0.59	0.48	—	0.008	5.0	—
Cg2	17–24	1.6	0.50	0.11	29.60	2.76	11.65	0.91	0.80	—	0.013	4.4	—
Cg3	24–38	6.5	3.40	0.28	31.10	1.89	8.50	1.20	0.77	—	0.013	6.6	—

[1] Method of C. J. Schollenberger; see reference under analytical methods.
[2] Method of A. Walkley and J. A. Black.