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# Soil Survey

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## Coos County New Hampshire

By

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United States Department of Agriculture, in Charge

and

W. H. COATES and P. N. SCRIPTURE

University of New Hampshire



UNITED STATES DEPARTMENT OF AGRICULTURE  
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# SOIL SURVEY OF COOS COUNTY, NEW HAMPSHIRE

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<sup>1</sup> The field work for this survey was done while the Division of Soil Survey was a part of the Bureau of Chemistry and Soils.

## HOW TO USE THE SOIL SURVEY MAP AND REPORT

The soil survey map and report of Coos County, N. H., contain information—both general and specific—about the soils, crops, and agriculture of the county. They are prepared for the general public and are designed to meet the needs of a wide variety of readers. The individual reader may be interested in some particular part of the report or in all. Ordinarily he will not have to read the whole report to gain the information he needs.

Readers of soil survey reports may be considered as belonging to three general groups: (1) Those interested in limited areas, such as communities, farms, and fields; (2) those interested in the county as a whole; and (3) students and teachers of soil science and related agricultural sciences. An attempt has been made to satisfy the needs of these three groups by making the report a comprehensive reference work on the soils and their relation to crops and agriculture.

Those readers whose chief interest is in limited areas, such as some particular locality, farm, or field, include the farmers, agricultural technicians interested in planning operations in communities or on individual farms, real-estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. The first step of a reader in this group is to locate on the map the tract with which he is concerned. The second step is to identify the soils on the tract. This is done by locating in the legend on the margin of the map the symbols and colors that represent the soils in the area. The third is to locate the name of each soil in the Contents, which refers the reader to the page or pages in the section on Soils where each soil is discussed in detail. Under the soil-type heading he will find a description of the soil and information as to its suitability for use and its relationships to crops and agriculture. He also will find useful information in the sections on Productivity Ratings and Land Uses and Agricultural Methods.

The second group includes persons who are interested in the county as a whole, such as those concerned with land-use planning, the placement and development of highways, power lines, urban sites, industries, community cooperatives, resettlement projects, private or public forest areas, recreational areas, and wildlife projects. The following sections are intended for such users: (1) County Surveyed, in which such topics as physiography, vegetation, water supply, population, and cultural developments are discussed; (2) Agriculture, in which a brief history of the agriculture is given and the present agriculture is described; (3) Productivity Ratings, in which the productivity of the soils is given and a grouping of soils according to their relative physical suitability for agricultural use is presented; and (4) Land Uses and Agricultural Methods, in which the present use and management of the soils are described, their management requirements are discussed, and suggestions for improvement in management are made.

The third group of readers includes students and teachers of soil science and allied subjects, such as crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology. The teacher or student of soils will find the section on Morphology and Genesis of Soils of special interest. He will also find useful information in the section on Soils, the first part of which presents the

general scheme of classification and a discussion of the soils from the point of view of the county as a whole, and the second part of which presents a detailed discussion of each soil. If he is not already familiar with the classification and mapping of soils he will find them discussed in Soil Survey Methods and Definitions. The teachers of other subjects will find the sections County Surveyed, Agriculture, and Productivity Ratings and the first part of the section on Soils of particular value in determining the relationships between their special subjects and the soils in the county. Soil scientists or students of soils will find their special interest in the section Morphology and Genesis of Soils.

### COUNTY SURVEYED

Coos County, with a total area of 1,798 square miles, or 1,150,720 acres, embraces the entire northern part of New Hampshire and extends about 70 miles southward from the Canadian border (fig. 1).

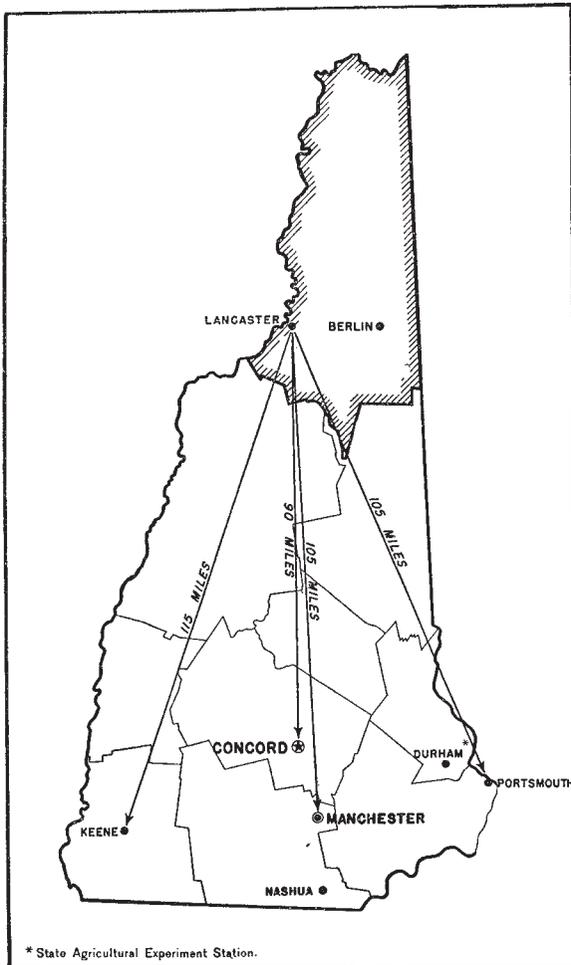


FIGURE 1.—Sketch map showing location of Coos County, N. H.

It is roughly rectangular in outline, with a maximum width of about 37 miles near the southern end. The Connecticut River and a tributary, Halls Stream, form the western boundary, and the New Hampshire-Maine State line forms the eastern boundary. Grafton and Carroll Counties join this county on its irregular southern boundary. Lancaster, the county seat, in the southwestern part of the county, is about 110 miles from Portland, Maine, and 200 miles from Boston, Mass.

Coos County is in the New England physical province. The highest and some of the most massive and rugged areas of the White Mountains are within the county. Mount Washington, the highest peak of this range, rises to an elevation of 6,288 feet above sea level.

Physiographically the county presents features of a sloping plateau or rolling uplands, interrupted by narrow alluvial valleys and steep mountains (fig. 2). The plateau is best developed in the southwestern, east-central, northern, and northwestern parts. It covers about 50 percent of the area of the county. It has a southward slope of about 22 feet to the mile and lies 500 to 700 feet above the main stream valley. In the northern part of the county the average elevation is 2,300 to 2,500 feet above sea level, in the central part 1,700 to 1,800 feet, and in the southwestern part about 1,300 feet. Scattered over the plateau are small monadnocks, ridges, and secondary mountains that rise well above the level of the plateau. Some of these are steep-sided, rough, and stony. Around the base of the mountains elevations are 200 to 300 feet higher than the average level of the plateau.

The mountain section covers about 40 percent of the county. The Presidential Range, which forms the backbone of the White Mountains in Coos County and extends about 25 miles northward through the center of the county, has seven peaks (named for former presidents of the United States) that rise more than 5,000 feet above sea level. East of this range is the Carter and Moriah group of peaks, which range in elevation from 3,750 to 4,860 feet; and to the west is Cherry Mountain having numerous peaks over 3,500 feet above sea level. A narrow valley separates this mountain from Crescent, Pilot, and Pliny Ranges, which include Mount Starr King, Mount Waumbek, Mount Cabot, Pliny Mountain, and Round Mountain. Elevations in this group range from 3,605 to 4,080 feet.

The continuity of the mountains is broken again by the narrow Upper Ammonoosuc River Valley, north of which is a large mountain mass with numerous peaks that rise 3,200 to 3,800 feet above sea level. In places the steep slopes rise sharply nearly 2,000 feet from the Connecticut River Valley. The higher mountains just north of the Upper Ammonoosuc River are Long, Stratford, and Whitcomb Mountains, Mount Kelsey, and Sugarloaf and Percy Peaks. Extending in an easterly and northeasterly direction from this area to the New Hampshire-Maine State line and into Maine, the mountains lose little of their rugged features but are not so high, rising to about 3,000 feet. In places the rough, broken areas extend to the valley levels at an elevation of about 1,500 feet. Dixville Notch, through which the highway passes between Colebrook and Errol, is a narrow defile with precipitous rock-walled sides rising nearly 1,000 feet above the highway.

An additional outlying rough mountain area having elevations of more than 3,000 feet extends from Second Lake to the Canadian border

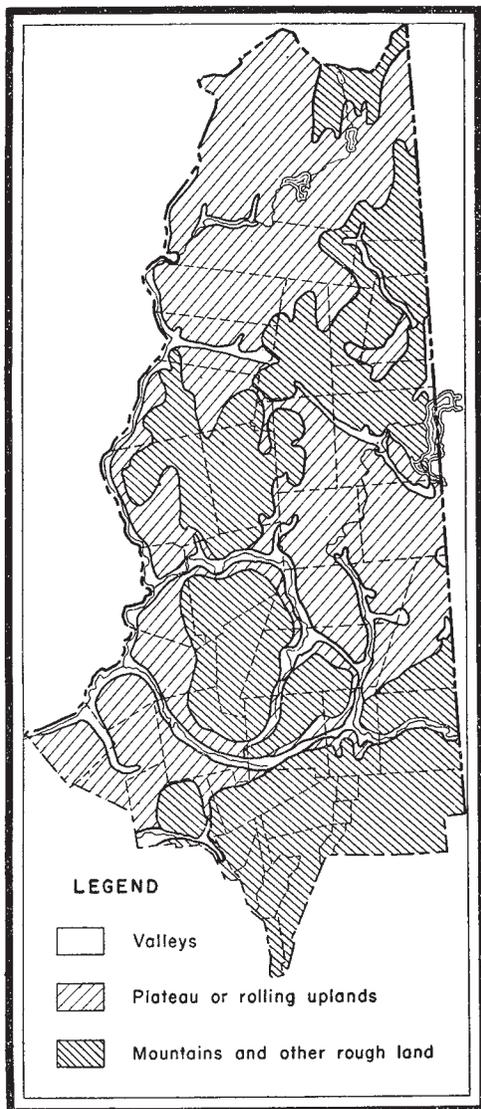


FIGURE 2.—Sketch map showing physiographic divisions of Coos County, N. H.

and northeasterly along the border, passing into Canada and Maine at the northeastern corner of New Hampshire.

The plateau section is dissected, and only a few small remnants having the original surface level remain. The streams, in general, have cut rather narrow deep valleys, which range in width from  $\frac{1}{2}$  to 1 mile or more in places. The valley walls range from gently to strongly or steeply sloping. The edges of the plateau along the Connecticut River Valley from Colebrook southward are moderately to steeply sloping, whereas along the tributary streams where the slopes lengthen they are more mild. North of Colebrook and on the head-

water tributaries of the Connecticut River the slopes range from moderately steep to steep, and here the valleys consist of narrow overflow bottoms and, in places, narrow terraces.

The valley walls along the Androscoggin River and its tributaries for the most part rise steeply from the bottom lands or low terraces, which range from  $\frac{1}{4}$  to  $\frac{1}{2}$  mile in width. In the vicinity of Milan the valley is broader and has longer and less steep slopes.

Glacial ice that spread over most of New England thousands of years ago moved in a general southeasterly direction and in some measure modified the land forms. Many examples of the smoothing out of the northwestern slopes can be seen where the glacier exerted great pressure, but on the leeward slopes the land form is more harsh and broken because of the movement of the ice.

As the glaciers melted, they left many valleys blocked and filled with rock debris and alluvium. Some of the lakes and ponds thus formed were shallow enough to support plant life and have become filled with peat deposits since the glaciers disappeared, so that throughout the plateau and mountain sections there are many rather large swampy areas. Sluggish streams meander through some of the partly filled valleys, and narrow or comparatively wide swampy areas lie along the streams.

Mountain streams and small tributaries rising on the plateau have a rapid flow. Many cataracts and falls occur along all streams coming from the higher elevations. As the streams reach the valleys the rate of flow is not so rapid, and there are only a few stretches of swift-flowing water.

The county is drained by two major river systems—the Connecticut and Androscoggin Rivers. Numerous lakes, ponds, and swamps act as catch basins for run-off waters and form the sources of many streams. Drainage waters from the western two-thirds of the county empty into the Connecticut River, and most of the remaining area drains into the Magalloway and Androscoggin Rivers. A small area in the south-central part of the county drains into the Saco River. Umbagog Lake along the New Hampshire-Maine State line is the largest body of water in the county. It covers about 8 square miles in New Hampshire and a few square miles in Maine. This lake receives considerable water from adjacent areas in the northwestern part of Maine.

Natural and artificial lakes in Maine and a dam on the Androscoggin River, together with power and reservoir dams near Milan, Berlin, and Gorham, largely control floodwaters and give the river a uniform flow throughout most of the year. This control of water is necessary to the extensive lumbering operations in the Androscoggin River Basin, as pulpwood is floated down the river to large paper mills at Berlin. Electric power is generated at some of the dams to supply the adjacent areas.

Similarly, three reservoir dams have been built near the headwaters of the Connecticut River to enlarge natural lakes or to create additional storage areas for floodwaters, which can be drawn off as needed during periods of low rainfall.

First Connecticut Lake covers an area of about 4 or 5 square miles, Second Lake about half this area, and Third Lake 1 square mile. To a limited extent these reservoirs lessen the effects of floodwaters in

Coos County and adjacent overflow areas in Vermont, but they are not adequate for complete flood control.

Local and interstate power developments on the Connecticut River from Pittsburg southward supply the present demand for electricity in this part of the Connecticut River Valley. A few sawmills are operated by water power.

The Connecticut River at its source in Third Lake is 2,191 feet above sea level. At Pittsburg, 18 miles below, the elevation is 1,331 feet, which shows a drop in the river of 860 feet for this distance. The general land level or plateau dips about 600 feet in the same distance. From this point southward the slope of the plateau is less sharp and the river gradient more mild. Between Pittsburg and Lancaster, a distance of about 50 miles, the river drops about 475 feet and the adjacent plateau dips about 500 feet. At the point where the Connecticut River leaves the county—the southwest corner—the elevation is 780 feet. The gradient for its entire length corresponds very closely to the tilt of the plateau.

The Magalloway River, which forms a part of the headwaters of Androscoggin River, has a rapid drop similar to that of the upper Connecticut River; whereas the Androscoggin River has a gentle gradient like the lower Connecticut River. At the point where the Androscoggin River passes into Maine the elevation is less than 680 feet. Between this point and the crest of Mount Washington, 16 miles by air line, the difference in elevation is about 5,600 feet.

Practically all of the forests of Coos County have been cut-over, and the present forest vegetation is largely second growth. Extensive areas in the northern part of the county, however, support large hardwood trees. Between elevations of 1,500 and 2,500 feet the forest consists mainly of yellow birch, sugar maple, beech, spruce, and fir, with a few white pine and hemlock. Between elevations of 2,500 and 4,800 feet spruce and fir predominate, but yellow birch, beech, and maple are mixed with them. Above an elevation of 3,000 feet there is little merchantable timber except for use as pulpwood. Between elevations of 3,800 and 4,500 feet the trees are mainly stunted spruce. Most of the land above the timber line is covered with rock outcrops, but grass and low shrubs grow on some areas.

The forest cover in all parts of the county varies considerably with relief and to a less extent with the soil. In low wet or swampy situations, red maple (locally called soft maple), tamarack, northern white-cedar (*Thuja occidentalis* L.), and alder predominate; at higher elevations the principal trees in such swampy areas are spruce and fir. Imperfectly drained and seepy slopes and the more shaded draws support mainly spruce and fir. Forests on more open slopes are of the mixed hardwood-conifer types, whereas those on shallow and extremely stony soils are dominated by conifers. The undergrowth in the open forest consists chiefly of shadblow (locally called shadbush), striped maple, mountain maple, blueberry, ferns, and bracken.

Forest types or associations often change completely after the land has been logged. Virgin forest areas in the northern part of the county consist about equally of large spruce and yellow birch, with a few other hardwoods and firs. Adjacent areas from which the spruce has been removed for 40 or 50 years have a second growth of conifers, mainly fir. In areas where the conifers have been removed recently for

pulpwood a dense growth of hardwoods is coming up. Similarly white pine was followed by almost pure stands of hardwoods, and where hardwoods have been removed second-growth spruce and fir now predominate. At all except the higher elevations a dense growth of raspberries usually comes up after the timber has been cut, but this growth disappears as the forest increases.

Pastures in all parts of the county contain much spirea, and in addition at lower elevations they contain quaking aspen (locally known as popple) and birch sprouts, sweetfern, and some conifers. At higher elevations spruce and fir are the common invading trees. Alder and willow are abundant in wet or seepy spots. Along the more open stream courses in well-drained situations, at the edges of fields, and around farmsteads, American elm is the most common tree. In hedgerows, pin cherry, chokecherry, and raspberry are abundant. Some brushy pastures and more open woods contain scattered clumps of blackberry.

Bluejoint (*Calamagrostis canadensis* (Michx.) Beauv.) is the most common native grass. The common pasture grasses are junegrass, bentgrass, and poverty grass, with some Canada bluegrass, sweet vernalgrass, and fescue. Some white or Dutch white clover grows in many pastures. Reeds, rushes, and sedges, locally termed swale grass, grow in the low wet areas. The principal weeds and pests of pastures and mowings are devil's-paintbrush (yellow and orange hawkweed), wild carrot, buttercup, sorrel, wild mustard (kale), wild strawberry, goldenrod, moss, and quackgrass.

The earliest recorded explorations were made in what is now Coos County in the period 1632-42, and more than a century elapsed before there was further record of white men having been in the area. The first permanent settlement was made at Lancaster in 1764 by pioneers from Connecticut. Settlements were made at Gorham and Jefferson during the period 1773-79 by emigrants from Connecticut and eastern counties of New Hampshire. At the outbreak of the Revolutionary War the population was 227; in 1790, 882; in 1800, 2,658.<sup>2</sup>

The act establishing the county of Coos was passed December 24, 1803, and became effective March 5, 1805. Subsequent minor changes in the southern boundary gave it its present outline in 1853. At present the county consists of 19 organized towns,<sup>3</sup> 6 townships, 1 city, 8 grants, 6 purchases, and 3 locations. The Federal census for 1880 placed the county's population at 18,580. The census for 1940 reports the population as 39,274, or an average of 21.5 persons to the square mile. The composition of the population in 1940 has not been reported as yet (1941), but in 1930, when the population was 38,959, there were 29,893 native whites, 9,059 foreign-born whites, 3 Chinese, and 4 Negroes.

The population is well distributed along most of the broader valley areas and in the adjacent uplands of Whitefield, Lancaster, Jefferson, Milan, Columbia, Colebrook, Stewartstown, and Northumberland, and to limited areas of Berlin, Errol, Dixville, Stewartstown, Carroll, and Stratford. Berlin had a population of 19,084 in 1940. Smaller towns are Lancaster, 3,095; Northumberland, 2,740; and Gorham, 2,597.

<sup>2</sup> MERRILL, GEORGIA DREW, comp. HISTORY OF COOS COUNTY, NEW HAMPSHIRE. 956 pp., illus. Syracuse, N. Y. 1888.

<sup>3</sup> In this report the term "town" and "township" will generally be omitted in designating soil areas, in order to avoid repetition. The town of Gorham, for example, will be referred to as Gorham.

Large areas of similar rolling uplands in Success, Cambridge, Dummer, Millsfield, and Pittsburg are only sparsely settled or are not settled at all. The population of Whitefield, Lancaster, Jefferson, Carroll, and Gorham is considerably increased in summer.

All the towns and villages of the valley have a heavy transient tourist population throughout the summer and fall. Many sportsmen visit the Connecticut lakes section each year to enjoy the excellent fishing and hunting. Other more limited but equally good fishing and hunting areas throughout the county draw their quota of sportsmen.

The Mount Washington area of the White Mountain National Forest, with its well-marked hiking and ski trails, overnight huts, shelters, and supervised campgrounds, draws a large number of summer as well as winter tourists. An automobile road and a cog railway to the summit of Mount Washington make easily accessible one of the most scenic areas in New Hampshire.

Berlin is the fourth largest city in the State. It is situated on the Androscoggin River in the southeastern part of the county and is the leading wood-pulp and paper manufacturing center of northern New Hampshire. It serves as a local market for nearly all farm products from this part of the county. Lancaster, the county seat, is an important trading and shipping point in the Connecticut River Valley. The other leading trade centers in the Connecticut River Valley are Colebrook, Whitefield, West Stewartstown, Pittsburg, Northumberland, and Groveton. Pulp and paper mills in the latter two centers serve as a local market for pulpwood.

The western, southern, and central parts of the county have adequate rail transportation. Lines of the Grand Trunk Railway, the Boston & Maine Railroad, and the Maine Central Railroad touch the main centers of population and give direct service for milk trains to Boston. The villages of Milan, Errol, and Pittsburg are 5, 20, and 8 miles, respectively, from the nearest railroad shipping point. A system of Federal- and State-maintained hard-surfaced highways reach nearly every town, and each town, except in the mountains and the more remote and unsettled districts, has a number of gravel roads. All maintained unsurfaced roads are in good condition during the summer. The secondary roads are barely passable in spring and fall and usually are blocked with snow in winter. All main town, State, and Federal roads are kept open with snow plows in winter.

Schools and church facilities of each town are adequate for the population. Many farms in the more prosperous communities are supplied with telephones. Nearly all farms, especially the dairy farms, have water piped to barns and dwellings. Rural free delivery of mail reaches most parts of the county. Rural electrification has extended little beyond the main highways.

Boston is the principal outside market for milk. Truck routes throughout the county collect the milk and deliver it at shipping points and to local processing plants, where it is prepared for sale as fluid milk or is converted into dried milk, butter, or cheese.

Besides milk, potatoes are the only important commercial farm product of Coos County. The greater part of this crop is sold locally or in centers of population farther south in New Hampshire. The production of certified seed potatoes in New Hampshire is con-

fined to Coos County, and the crop is sold throughout the State. Poultry, beef cattle, hogs, and lambs are sold locally.

A number of cooperative buying and selling agencies, State-wide or interstate in scope, render important services to the county, such as the sale of milk, milk products, and potatoes and the purchase of a wide variety of products for farmers. Cooperative sales of forest products, such as pulpwood, Christmas trees, and fence posts, have a prominent place in these enterprises.

The production and manufacture of timber and wood products is the principal nonagricultural industry. Large pulp and paper mills at Berlin and smaller ones at Groveton and Northumberland directly support probably more than one-half the population. A furniture factory at Canaan, Vt., and a large sawmill at North Stratford, N. H., both draw on New Hampshire and Vermont forests for their timber supplies. The sawmill at North Stratford puts most of its product on the market as finished building material and wood products, and some of the choice hardwood logs go into export trade and veneer mills outside the State. A number of small sawmills sell both finished and rough building materials and rough timber that is finished at points outside the county and State. Approximately half a million cords of wood are manufactured into pulp and paper products each year. Much of this comes from forest areas in the northwestern part of Maine and some from Vermont.

## CLIMATE

The climate of Coos County is continental. It is marked by long cold winters, with heavy snowfall, and short cool summers. Owing to the great differences in elevation, there is a wide range in climatic conditions.

The records of the United States Weather Bureau station at Berlin, 1,110 feet above sea level, may be taken as fairly representative of the valley section and the lower plateau areas south of Colebrook and Errol. The Weather Bureau station at Pittsburg, near the head of the Connecticut River Valley, 1,660 feet above sea level, represents the northern parts of the county and the high plateau levels.

The average length of the frost-free season at Berlin is 106 days, from May 31 to September 14. At Pittsburg the average frost-free season is 93 days, from June 15 to September 16. Dates of the latest frost are July 5 at Berlin and July 4 at Pittsburg; the earliest are August 7 and September 1, respectively. The mean annual temperature at Pittsburg is 3.3° F. lower than at Berlin, and the mean annual rainfall is 8.69 inches higher.

The average annual snowfall is 104.5 inches at Berlin and 168.3 inches at Pittsburg. Snowfall in the valleys is comparatively light in the fall, and snow is seldom sufficient to remain on the ground before the middle of December or in January. As the elevations increase, the fall becomes heavier and snow is less likely to melt

except in the more exposed places. In the mountains snow accumulates from late fall onward and does not wholly disappear until the following June.

Precipitation is well distributed throughout the year, and usually there is sufficient rain during the growing season to supply crop needs. Seasonal variations during some years will result in a drop of yields of potatoes and a shortage of pasture grasses in late summer or fall. Generally sufficient moisture is stored in the soil in the fall and early winter to insure good yields of hay, even though there is a shortage of rainfall in spring and early summer.

On the higher mountains the climate is arctic. During the winter extremely low temperatures, high winds, and heavy snows sweep the heights.

The normal monthly, seasonal, and annual temperature and precipitation at Berlin and Pittsburg are given in tables 1 and 2, respectively.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Berlin, Coos County, N. H.

[Elevation, 1,110 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1926)	Total amount for the wettest year (1936)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	18.8	66	-44	2.58	1.97	5.14	18.8
January.....	13.5	60	-41	2.86	1.92	6.08	23.6
February.....	15.6	63	-38	2.56	2.88	2.12	24.1
Winter.....	16.0	66	-44	8.00	6.77	13.34	66.5
March.....	27.5	72	-24	3.99	2.10	10.46	19.7
April.....	39.7	86	-9	2.73	2.67	3.60	7.0
May.....	52.0	94	13	2.71	1.72	3.02	.2
Spring.....	39.7	94	-24	9.43	6.49	17.08	26.9
June.....	61.0	98	24	3.32	3.12	2.16	.0
July.....	66.2	100	30	3.28	3.38	1.71	.0
August.....	63.2	94	31	3.71	2.52	1.88	.0
Summer.....	63.5	100	24	10.31	9.02	5.75	.0
September.....	56.4	90	20	3.18	2.36	4.30	.0
October.....	45.9	88	8	2.81	2.72	5.81	1.1
November.....	32.5	73	-12	2.90	3.21	2.41	10.0
Fall.....	44.9	90	-12	8.89	8.29	12.52	11.1
Year.....	41.0	100	-44	36.63	30.57	48.69	104.5

TABLE 2.—Normal monthly, seasonal, and annual temperature and precipitation at Pittsburg, Coos County, N. H.

[Elevation, 1,660 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1926)	Total amount for the wettest year (1936)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December.....	17.0	57	-34	3.08	2.35	6.72	32.9
January.....	10.2	54	-46	2.83	2.03	2.04	37.6
February.....	11.6	62	-45	2.27	1.92	2.93	29.2
Winter.....	12.9	62	-46	8.18	6.30	11.69	99.7
March.....	23.9	66	-36	2.95	3.52	3.56	26.7
April.....	35.0	79	-10	3.20	2.75	4.45	12.4
May.....	48.0	85	18	3.73	1.94	1.11	4.3
Spring.....	35.6	85	-36	9.88	8.21	9.12	43.4
June.....	57.4	91	26	4.53	2.22	5.83	.0
July.....	62.6	102	30	3.95	2.13	8.19	.0
August.....	60.7	88	30	4.40	4.17	3.22	.0
Summer.....	60.2	102	26	12.88	8.52	17.24	.0
September.....	53.9	85	22	5.26	2.91	7.14	.0
October.....	42.0	81	3	4.76	3.91	2.52	6.3
November.....	30.5	67	-18	4.36	5.37	2.75	18.9
Fall.....	42.1	85	-18	14.38	12.19	12.41	25.2
Year.....	37.7	102	-46	45.32	35.22	50.46	168.3

## AGRICULTURE

The early agriculture consisted of growing wheat, oats, buckwheat, and some vegetables and keeping some livestock, a system that was largely subsistence farming. As agriculture expanded, although still mainly on a subsistence basis, cattle and sheep became the leading farm interest and source of cash income. This condition continued until about 1880, after which there was some shift to dairying for the production of cheese. It was not until the increasing demand for fluid milk in industrial centers, in the early part of the present century, that there was a marked increase in dairy farming. As early as 1880 the growing of potatoes became important, for use mainly in the manufacture of starch for spinning mills. Because of lack of uniformity in the manufactured product, however, spinners turned to other sources for their supply, with the result that a considerable number of small starch factories scattered throughout the county disappeared. About 1900 competition from the cheap meat and grain produced in the West began to have its effect on the agriculture of this county, and at the same time heavy lumbering operations and development of the wood-pulp industry began within its borders. From 1900 on there was a general decline in the number of farms, the

total acreage of land in farms, and the acreage of cultivated land. Farm population decreased, even though the total population increased, owing to a decided increase in the urban population.

At present dairy farming is the chief agricultural enterprise. A cash income is derived from the sale of potatoes and poultry products. Vegetables and some fruits are grown for home use and for local sale. Many of the small farms are operated on a subsistence basis, as the owners depend on work in the forest for most of their cash income.

In 1900, the peak of agricultural development, 329,066 acres, or 28.6 percent of the total area of the county, represented farm land, of which 124,786 acres, or 37.9 percent, was improved land (cropland and plowable pasture). In 1935, 217,271 acres, or 18.9 percent of the area of the county, represented farm land, of which 55,964 acres, or 25.8 percent, was improved land. There were 1,895 farms having an average size of 173.6 acres in 1880. By 1935 the number had fallen to 1,289 and the size to 168.6 acres.

The area of cropland likewise decreased between 1880 and 1935. Total production has declined with the decrease in acreage farmed, although acre yields of almost all of the crops have remained about stationary.

In 1935 the total area in cropland and pasture land, including plowable pasture, woodland pasture, and other pasture, was 165,349 acres, or 14.4 percent of the total area of the county. The rest of the land in farms, including woodland not pastured and all other land in farms, was 51,922 acres, or 4.5 percent of the area of the county.

By 1935 the acreage in oats for grain had dropped to about one-fourth, barley to one-fifth, corn for all purposes to one-half, and potatoes to three-fifths of the acreages reported harvested in 1879. Wheat, a comparatively important crop until about 1880, ceased to be grown when the grain areas in the West were opened. A temporary increase of the acreage in grain occurred during and immediately after the World War. Although the total acreage of hay is considerably below the one-time high, the number of acres to a farm has increased more than 17 percent. Alfalfa and soybeans, especially valued by dairymen, are grown on small but increasing acreages.

The marked curtailment of acreages in crops is due to the change from raising beef cattle and sheep to dairying, the use of purchased concentrated feeds rather than feeds grown on the farm, and the loss of a market for hay following the advent of motorized transportation. Growth of subsistence crops was discouraged by the introduction of cheap grains from the West, and potato markets were lost with the passing of the manufacture of starch. The present revival of potato growing is stimulated because the soils and climate are admirably suited to this crop, the additional income is needed, and the growing of this crop fits in well with dairy farming.

Table 3, compiled from the United States census reports, gives selected crop data for Coos County.

TABLE 3.—*Acreage of the principal crops in Coos County, N. H., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
Corn:	<i>Acres</i>						
For grain.....	350	137	325	177	70	15	16
For silage and forage.....			567	673	471	224	369
Oats threshed.....	5,666	5,616	4,167	2,754	4,090	1,380	1,110
Barley.....	82	303	280	130	261	50	58
All hay.....	49,560	55,327	55,593	49,979	46,660	43,744	44,083
Timothy and clover mixed.....				45,009	40,969	31,137	30,925
Clover alone.....			92	103	193	213	77
Alfalfa.....				4	39	160	154
Other tame grasses.....			54,048	2,348	2,781	10,945	11,877
Small grains cut for hay.....			1,048	1,429	1,408	901	775
Annual legumes cut for hay.....					140	107	275
Wild grasses.....			405	1,086	1,130	281	
Soybeans.....						151	272
Potatoes.....	3,148	2,339	2,554	2,502	1,647	1,427	1,575

<sup>1</sup> Includes wild grasses.

Table 4 gives the value of agricultural products by classes in 1929, as reported by the 1930 census for Coos County.

TABLE 4.—*Value of agricultural products, by classes, in Coos County, N. H., 1929*

Crop	Value	Livestock product	Value
Cereals.....	\$40,871	Butter, cream, and whole milk sold.....	\$1,440,575
Other grains and seeds.....	1,549	Poultry and eggs produced.....	160,746
Hay and forage.....	646,880	Wool shorn.....	7,160
Vegetables (including potatoes and sweetpotatoes).....	428,762	Honey produced.....	336
Fruits.....	14,156		
All other field crops.....	38,142		
Farm garden vegetables (excluding potatoes and sweetpotatoes) for home use only.....	32,009		
Forest products, cut on farms, for home use and for sale.....	426,518		
Nursery, greenhouse, and bothouse products sold.....	2,995		

The census for 1930 gives the value of farm land and buildings as \$30.44 an acre, which is only about \$2 an acre higher than the comparable value in 1920, but it is nearly 50 percent higher than that for 1910. The average value per farm of all farm property in 1930 was \$7,607, of which land represented 32.1 percent; buildings, 38.9 percent; implements, 9.9 percent; and domestic animals, 19.1 percent. Since 1900 there has been a decrease in land values in relation to the value of all farm property, a small increase in the value of buildings, and a somewhat larger increase in the value of livestock, with a marked increase (about 50 percent) in the value of implements. The value of all farm property was not reported in 1935, but the value of land and buildings was \$3,844 a farm, or \$22.81 an acre.

In 1935, 88.5 percent of all farms were operated by owners, 10.1 percent by tenants, and 1.4 percent by managers. These figures have remained fairly constant over the last 30 years, prior to which only about 5 or 6 of each 100 farms were operated by tenants.

The number of work animals kept on the farms is usually adequate for the work done. The number of livestock on farms for stated years is given in table 5.

TABLE 5.—Numbers of livestock on farms in Coos County, N. H., in stated years

Livestock	1910	1920	1930	1935
	Number	Number	Number	Number
Horses.....	4,808	4,919	2,677	2,303
Mules.....	9	37	18	4
Asses and burros.....	13	2	15	
Cattle.....	18,499	18,985	19,766	16,207
Sheep.....	4,295	4,107	4,100	1,945
Goats.....	13	19	2	12
Swine.....	3,567	2,966	1,248	1,226
Chickens.....	39,208	31,482	24,955	25,428
Bees (hives).....	164	282	93	( <sup>2</sup> )

<sup>1</sup> All poultry.<sup>2</sup> Not reported.

Farm buildings in general are good. The dwellings are well built and are planned to withstand the rigorous northern winters of this section. Nearly all of the farms along the main highways and in the more thickly settled communities have a prosperous well-kept appearance, whereas in the more remote sections many of the buildings and the farms appear run-down. Many modern dairy barns have been built in recent years, and other barns have been remodeled to house the larger herds of cattle. A few farms are equipped with silos.

In 1929, according to the census reports, 812 farms, or 66.9 percent of all farms, reported the hire of labor at an average expenditure of \$390.96 a farm. Most of the farm labor is performed by the farmer and members of his family, and much of that hired is required only during the rush seasons of haying or potato harvest. The larger dairy farms employ help the year round. Cutting and peeling pulpwood and other occupations in the woods furnish off-season employment for part-time farm laborers.

In 1929, 1,076 farms, or 88.6 percent, reported an average expenditure of \$457.06 a farm for feed, which consisted mainly of concentrated feeds for dairy cattle and to a less extent for poultry and swine. Fertilizers are not used extensively, but their use is becoming more general. In 1929, 53.2 percent of the farms reported a total of \$54,457 expended for fertilizer.

Practically no fruit is grown. Many of the once numerous home orchards have been winter-killed and have not been replaced. A few strawberries are grown for home use and local sale. The abundant wild blueberries and raspberries are used extensively for canning and are marketed locally in considerable quantities. In 1929, 39,255 pounds of maple sugar and 10,703 gallons of maple sirup were produced and provided an additional cash income to some farms. This, however, is only about 10 percent of the reported production for 1889, when 339,506 pounds of sugar and 3,367 gallons of sirup were produced.

## SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil<sup>4</sup> and its content of lime are determined by simple tests. Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to the features that influence the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics, soils are grouped into mapping units, the three principal of which are (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a map but must be mapped as (4) a complex. Areas of land, such as coastal beach or bare rocky mountainsides, that have no true soil are called (5) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from one type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics, the same natural drainage conditions, and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may differ within a series. The soil series are given names of places or geographic features near which they were first found. Colebrook, Groveton, Greensboro, and Dixville are names of important soil series in this county.

Within a soil series are one or more types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Colton sandy loam, Colton fine sandy loam, and Colton gravelly sandy loam are soil types within the Colton series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, differing from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and degree of accelerated erosion are frequently shown as phases. For example, within the

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<sup>4</sup> The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values indicate alkalinity, and lower values indicate acidity.

normal range of relief for a soil type, some areas may be adapted to the use of machinery and the growth of cultivated crops, and others may not. Even though there may be no important difference in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. Similarly, soils having differences in stoniness may be mapped as phases, even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

## SOILS

The well-drained soils of the uplands and terraces of Coos County have a well-defined gray leached layer 1 to 4 inches thick just beneath the forest cover. It changes abruptly to a dark-brown layer several inches thick before passing into the yellow subsoil. The mineral soils are developed from unconsolidated deposits of glacial till and alluvium through soil-forming processes. Organic soils consist mainly of shallow to deep deposits of partly decomposed organic matter accumulated under marshy or swampy conditions. The soil types differ widely in character and composition.

The soils are grouped to bring out the relationship of one group to another, the relationship of soils within the group, their use, and their development for agriculture. For convenience in discussing the soils of Coos County and the agriculture developed on them, they may be placed in four main groups: (1) Soils of the valleys; (2) soils of the rolling uplands; (3) soils of the very stony, rough, and mountainous areas; and (4) soils of the swamps.

The soil materials in the valleys are alluvial in origin. In general the soils are nearly level, stone free, and light-textured, and they have sandy or gravelly substrata.

The moderately stony or very stony soils of the rolling uplands are developed on shallow to deep deposits of glacial till, with gently rolling or strongly rolling relief. They have friable surface soils and, for the most part, friable or at least permeable subsoils.

Rough, stony, and mountainous lands are essentially **nonagricultural**. The soils are developed from material similar to that of the rolling uplands, but they are steeper, much more stony, or occur at elevations too high for most crops to mature.

The soils in the swamps consist mainly of shallow or deep deposits of partly decomposed organic matter accumulated under wet or swampy conditions.

In the following pages the soils of Coos County are described in detail and their agricultural importance is discussed. Their distribution is shown on the accompanying soil map, and their acreage and proportionate extent are given in table 6.

TABLE 6.—*Acreage and proportionate extent of the soils mapped in Coos County, N. H.*

Soil type	Acres	Per- cent	Soil type	Acres	Per- cent
Hadley very fine sandy loam.....	2, 112	0. 2	Peru loam.....	1, 664	0. 1
Hadley very fine sandy loam, high- bottom phase.....	2, 752	. 2	Hermon stony fine sandy loam.....	32, 320	2. 8
Hadley silt loam.....	896	. 1	Hermon stony fine sandy loam, slope phase.....	50, 624	4. 4
Ondawa fine sandy loam.....	2, 816	. 2	Becket stony loam.....	3, 904	. 3
Ondawa fine sandy loam, high- bottom phase.....	1, 344	. 1	Becket stony loam, slope phase.....	4, 416	. 4
Ondawa loamy fine sand.....	1, 728	. 2	Canaan stony fine sandy loam.....	4, 160	. 4
Podunk-Rumney fine sandy loams..	2, 048	. 2	Canaan stony fine sandy loam, smooth phase.....	2, 752	. 2
Alluvial soils, undifferentiated.....	11, 840	1. 0	Berkshire stony loam.....	67, 840	5. 9
Riverwash.....	256	( <sup>1</sup> )	Berkshire stony loam, smooth phase.....	12, 352	1. 1
Groveton very fine sandy loam.....	1, 856	. 2	Berkshire stony silt loam.....	15, 104	1. 3
Groveton fine sandy loam.....	1, 408	. 1	Lyman stony loam.....	21, 568	1. 9
Groveton loamy fine sand.....	704	. 1	Woodbridge stony silt loam.....	12, 416	1. 1
Colton fine sandy loam.....	5, 632	. 5	Greensboro stony loam.....	5, 376	. 5
Colton fine sandy loam, slope phase.	4, 096	. 3	Greensboro stony loam, smooth phase.....	1, 216	. 1
Colebrook fine sandy loam.....	1, 728	. 2	Peru stony loam.....	47, 616	4. 1
Colebrook fine sandy loam, slope phase.....	1, 728	. 2	Waumbek stony fine sandy loam.....	7, 936	. 7
Colebrook gravelly fine sandy loam.	832	. 1	Hermon stony fine sandy loam, steep phase.....	8, 768	. 8
Colebrook gravelly fine sandy loam, slope phase.....	384	( <sup>1</sup> )	Becket stony loam, steep phase.....	1, 152	. 1
Colebrook loamy fine sand.....	320	( <sup>1</sup> )	Berkshire stony loam, steep phase..	8, 768	. 8
Colton sandy loam.....	1, 856	. 2	Lyman stony loam, steep phase.....	7, 040	. 6
Colton sandy loam, slope phase.....	1, 600	. 1	Woodbridge stony silt loam, steep phase.....	1, 408	. 1
Colton loamy sand.....	4, 288	. 4	Hermon very stony fine sandy loam.	81, 152	7. 0
Colton loamy sand, slope phase.....	1, 600	. 1	Canaan very stony fine sandy loam.	1, 216	. 1
Colton gravelly sandy loam.....	3, 264	. 3	Berkshire very stony loam.....	35, 328	. 3. 1
Suffield silt loam.....	512	( <sup>1</sup> )	Peru very stony loam.....	26, 112	2. 3
Sudbury loam.....	3, 200	. 3	Rough stony land (Hermon soil material).....	67, 072	5. 8
Scarboro fine sandy loam.....	5, 184	. 4	Rough stony land (Berkshire soil material).....	31, 808	2. 7
Danby fine sandy loam.....	11, 904	1. 0	Rough stony land (Canaan soil material).....	18, 176	1. 6
Dixville fine sandy loam.....	2, 432	. 2	Rough stony land (Lyman soil material).....	75, 264	6. 5
Danby loamy sand.....	8, 576	. 7	Rough mountainous land (Hermon soil material).....	252, 224	21. 9
Dixville loamy fine sand.....	1, 728	. 2	Rough mountainous land (Berk- shire soil material).....	17, 536	1. 5
Windsor fine sand.....	640	. 1	Rock outcrop.....	30, 400	2. 6
Danby gravelly fine sandy loam.....	8, 448	. 7	Whitman stony loam.....	44, 544	3. 9
Dixville gravelly fine sandy loam.....	1, 664	. 1	Muck.....	1, 984	. 2
Hermon fine sandy loam.....	5, 568	. 5	Peat.....	18, 496	1. 6
Hermon fine sandy loam, slope phase.....	896	. 1	Peat, shallow phase.....	6, 720	. 6
Becket loam.....	1, 344	. 1			
Berkshire loam.....	3, 264	. 3	Total.....	1, 150, 720	100. 0
Berkshire loam, smooth phase.....	1, 856	. 2			
Lyman loam.....	1, 536	. 1			
Lyman loam, smooth phase.....	2, 048	. 2			
Woodbridge silt loam.....	576	. 1			
Greensboro loam.....	1, 024	. 1			
Greensboro loam, smooth phase.....	3, 200	. 3			
Greensboro fine sandy loam.....	896	. 1			
Greensboro fine sandy loam, smooth phase.....	704	. 1			

<sup>1</sup> Less than 0.1 percent.

## SOILS OF THE VALLEYS

The soils of the valleys include those developed on recent alluvial deposits of overflow bottom land along streams, locally termed "meadow," and terraces and gravelly moraines (kames) that lie from a few feet to more than 100 feet above stream bottoms. The terraces and kames are composed of alluvium, more or less coarse, deposited by rapidly moving water, mainly during recession of the glacier. A few terraces are composed of finer textured material deposited in lake basins during the glacial epoch. Through subsequent dissection by streams these deposits have become well drained and are now high above the present stream courses, and some are at a considerable distance from any large stream or body of water. These deposits have been in place long enough for the regional soil characteristics to develop.

## SOILS OF THE BOTTOM LANDS

The soils of the bottom lands are young and unleached and are inherently the most productive of the valley soils. Members of the well-drained Ondawa and Hadley series and small areas of the imperfectly and poorly drained Podunk-Rumney complex are mapped. Alluvial soils, undifferentiated, include poorly drained and mixed soils subject to frequent floods. Riverwash consists of recently deposited sand and gravel adjacent to streams, and the deposits are subject to change with each successive overflow. The Hadley and Ondawa soils are the most productive in the bottom lands. They are well drained and slightly to strongly acid in reaction. The high-bottom phase of Ondawa fine sandy loam is subject to overflow only during periods of extremely high water. It is well suited to mowing, grain, potatoes, and corn for silage. The normal Ondawa soils are subject to overflow during the growing season; consequently they are used mainly for mowing and to a less extent for pasture. The Podunk-Rumney soils are imperfectly and poorly drained and are used almost entirely for mowing and pasture. Alluvial soils, undifferentiated, where cleared are associated with well-drained soils and are used for pasture or mowing. Where these soils occur along small streams, they are usually in a semiswamp condition and have a cover of alder and willow brush.

**Hadley very fine sandy loam.**—Hadley very fine sandy loam is the most important soil of the valleys and one of the most important in Coos County. It has supported a stable agriculture over many years. Its rather high inherent fertility and good moisture-holding capacity are due to the deposition of its parent materials in fairly recent times and the absence of appreciable leaching. The parent materials are derived from both light-colored granitic and dark-colored schistic rocks of the uplands that have been deposited along stream courses. Much of the land is subject to overflow at times of normal high water, receiving fresh deposits of alluvium, but probably a larger proportion is subject to overflow only at times of extremely high water.

Hadley very fine sandy loam is characterized by an 8- to 10-inch dark grayish-brown or brown surface soil, which changes to light brown or yellowish brown and becomes paler with depth. At a depth of 20 to 24 inches this soil passes into yellowish-brown or brownish-yellow friable very fine sandy loam, which grades abruptly into gray or grayish-brown loose or friable loamy very fine sand or loamy fine sand generally faintly mottled or streaked with light gray at a depth of 30 to 36 inches. The soil contains a fair quantity of organic matter, is mellow, and has a soft-crumbs structure when cultivated. The underlying material is rather mealy in consistence, and at a lower depth the soil materials fall apart into single grains when handled. The soil has a good moisture-holding capacity and affords an excellent medium in which plant roots can develop. It ranges from slightly acid to strongly acid in all layers.

The soil is rather uniform in color, texture, and consistence in the surface soil and upper subsoil layer, but the subsoil varies from place to place. Near the confluence of Indian Stream with the Connecticut River some included small areas have a darker surface soil than is normal for the type.

Hadley very fine sandy loam, associated with its high-bottom phase, occurs on the broad Connecticut River meadows mainly south from Colebrook, to a less extent northward to Pittsburg, on the meadows of the Upper Ammonoosuc and Androscoggin Rivers, and in a few small areas along some of the smaller streams.

The surface is nearly level, having a few low swells extending in the same general direction as the current of the streams that deposited the materials composing the swells. Drainage is good, except in a few included imperfectly drained strips 1 to 3 rods wide in depressions. Such strips, where sufficiently wide, are mapped with the Podunk-Rumney soils. Hadley very fine sandy loam lies from 6 to 12 feet above normal stream level at an elevation ranging from 820 feet in the southern part of the county to 1,200 feet in the vicinity of Pittsburg.

Practically all of the land is cleared and cultivated to crops that support dairying, such as timothy, clover, oats, and some corn for silage. A small proportion is used for pasture and for growing potatoes.

Manure is generally used once in the rotation. Where hay sods are allowed to stand for a long time without plowing, manure is applied once in 3 to 5 years. Land devoted to potatoes receives 1 ton of 4-8-8<sup>5</sup> fertilizer or its equivalent of double-strength analysis (8-16-16), and the residue is utilized by the succeeding oat and hay crops. In addition to manure, which is applied before the land is plowed, cornland receives 400 to 600 pounds of a similar high-grade fertilizer. Under normal conditions corn yields from 12 to 15 tons of silage an acre, although yields as high as 20 to 25 tons have been reported; and potatoes yield from 175 to 350 bushels, and hay 1½ to 2½ tons.

The total area of this soil, together with the high-bottom phase, is not large, but its influence on the agriculture of the county is greater than its small total area would indicate. Hay (timothy and clover) occupies by far the larger acreage, and probably not more than 15 percent of the land is plowed in any one year for other crops.

**Hadley very fine sandy loam, high-bottom phase.**—Hadley very fine sandy loam, high-bottom phase, occupies a position comparable to the typical Hadley very fine sandy loam, except that it lies slightly higher above stream levels. Because of its higher position, it is not subject to frequent overflow and therefore is used more for the production of potatoes and oats than is the typical soil. Its profile characteristics resemble those of the typical soil, except that the upper subsoil layer is yellow and the lower subsoil layer is brownish yellow.

This phase occurs mainly on the Connecticut River meadows south of Colebrook, and the larger areas are in the vicinity of Lancaster and Northumberland. Small areas occur on the Androscoggin River meadows, mainly east of Gorham.

A larger proportionate acreage on some farms located mainly on this soil is devoted to potatoes, oats, and corn than is common. Growing these crops shortens the rotation periods or gives an increase in the number of cultivated crops during the rotation. Such a practice increases the need for more frequent or heavier applications of

<sup>5</sup> Percentages, respectively, of nitrogen, phosphoric acid, and potash.

manure and an increase in the quantity of fertilizer used in any one year in order to maintain soil fertility and keep up production.

**Hadley silt loam.**—Hadley silt loam occurs in small disconnected areas on the Connecticut River meadows between Colebrook and Pittsburg, along Halls Stream, on the lower reaches of Indian Stream, and along other tributary streams of the Connecticut River, in the northern part of the county. It represents alluvium washed from the uplands occupied by loam and silt loam soils developed mainly from schist material. The surface soil to a depth of about 8 inches is brown or dark-brown mellow silt loam having a weak- or soft-crumb structure. This changes abruptly to olive- or greenish-yellow friable silt loam, which, in turn, at a depth of 15 to 20 inches, grades abruptly into grayish-brown friable very fine sandy loam having a slight olive tinge. At a depth of 24 to 30 inches the subsoil layer is stratified gray or greenish-gray loose sand or loamy sand.

The largest area mapped, along Indian Stream just above its junction with the Connecticut River, has about normal characteristics in the surface soil and upper subsoil layer, but at a depth of 16 to 24 inches the lower part of the subsoil consists of stratified coarse sands and fine and medium gravel. The loose sand and gravel lower subsoil layer ordinarily would indicate excessive underdrainage, but the water table is within 4 feet of the surface and insures a sufficient supply of moisture for crops to develop normally.

The total area of Hadley silt loam is very small. Although a minor soil, this soil comprises most of the land devoted to mowing on several farms adjacent to Halls and Indian Streams. It is suited more for mowing than for crops because the heavy texture causes it to warm later in spring and because it lies at elevations of 1,000 to 1,200 feet above sea level. The growing season is too short for most grain crops to mature. Yields of hay average about 2 tons an acre. Combined with this soil are areas of a high-bottom phase of Hadley silt loam too small to indicate as a separate soil type.

**Ondawa fine sandy loam.**—Ondawa fine sandy loam is developed on the bottom lands of the Israel River in Lancaster and Jefferson, along the Upper Ammonoosuc River for its entire length, and on the Connecticut River bottoms. Narrow strips occur along Clear Stream northwest of Errol, and small areas are widely scattered along the smaller streams throughout the county. Just west of Colebrook on the Connecticut River bottoms an average profile has the following characteristics: 0 to 8 inches, brown mellow friable fine sandy loam; 8 to 18 inches, light-brown friable fine sandy loam; 18 to 30 inches, grayish-brown loose loamy fine sand; and below 30 inches, gray loose coarse sand. Ondawa fine sandy loam occupies positions similar to Hadley very fine sandy loam, which is associated with the Ondawa soil in many places. It occurs more commonly along streams, which drain the more sandy granitic till areas, and this accounts for its more sandy texture.

Because of the light texture of the soil, internal drainage is good; and the soil warms early in the spring, which enables it to be plowed and seeded about a week earlier than Hadley very fine sandy loam and Hadley silt loam. Otherwise, the crops grown, methods of management, and crop yields are approximately the same as those on Hadley very fine sandy loam.

**Ondawa fine sandy loam, high-bottom phase.**—Ondawa fine sandy loam, high-bottom phase, is closely associated with the typical

soil. It lies 4 to 6 feet higher with relation to streams, is subjected less frequently to overflow, and has a stronger color profile, as compared with that soil. The surface soil is brown or light brown. The upper part of the subsoil is brownish yellow or pale yellow, grading into gray or grayish brown in the lower part, at a depth of 20 to 30 inches.

The total area of this soil is not large. One of the largest areas is just south of North Stratford. Smaller areas occur throughout the county, mainly along the smaller streams and in association with other Ondawa and Hadley soils. Yields of crops and methods of handling are similar to those on the typical soil and Hadley very fine sandy loam.

**Ondawa loamy fine sand.**—Ondawa loamy fine sand occurs mainly in narrow strips along the bank of the Connecticut River where movement of water is rapid and along smaller streams draining soils developed on uplands of granitic till. It is more common on the Upper Ammonoosuc River bottoms. It includes a few areas of high-bottom phases of Ondawa loamy fine sand and Ondawa loamy sand on high bottoms of the Ammonoosuc River in the vicinity of Twin Mountain and elsewhere. A fairly large body lies along the Androscoggin River east of Gorham.

The 8- to 10-inch surface soil is gray or light grayish-brown loose loamy fine sand. The subsoil is light grayish-brown friable loamy fine sand, which grades into gray loose incoherent loamy sand or sand at a depth of 20 to 24 inches. On the Connecticut River bottoms this soil is subject to flooding by swift waters, and at times it receives 2- to 4-inch deposits of fine sand or loamy fine sand on the sod. During floods occurring after the land has been plowed the soil in places is carried away by the stream or spread over adjacent fields. Such eroded or scooped-out areas have a hummocky or rough surface. In places along the Upper Ammonoosuc River these areas occupy the entire width of the bottom land. The included high-bottom phase in the vicinity of Twin Mountain is somewhat lighter in texture and is developed on high bottoms of the Ammonoosuc River where it emerges from the White Mountains. The surface soil of the inclusion is light grayish-brown loose loamy sand to a depth of 10 inches. The subsoil is grayish-yellow or pale-yellow loamy sand, which grades into light-gray incoherent sand at a depth of about 20 inches. In some places stratified sand and gravel are reached at a depth of 30 inches.

The total area of Ondawa loamy fine sand is very small. In general, the management and the crops grown are about the same as on adjacent Ondawa fine sandy loam and Hadley very fine sandy loam. Hay sods are renewed less frequently on Ondawa loamy fine sand than on those soils, because the Ondawa soil is very susceptible to erosion during the time that the land is bare. Some areas are reported to have been in mowing for 50 years without plowing. The larger areas more susceptible to erosion are used for pasture. Even in the more favorable areas, yields of hay are somewhat less than those on Ondawa fine sandy loam and Hadley very fine sandy loam, and the quality generally is not so high as on those soils because the hay contains little or no clover and much witchgrass.

**Podunk-Rumney fine sandy loams.**—This complex represents areas of Podunk fine sandy loam and Rumney fine sandy loam that are

too closely intermingled to be separated on a small-scale map. The areas of Podunk fine sandy loam have dark-brown mellow fine sandy loam surface soils, which grade at a depth of about 6 to 8 inches into light-brown or yellowish-brown fine sandy loam faintly streaked with rust brown. At a depth of about 18 to 20 inches this material changes rather abruptly to gray or brownish-gray light fine sandy loam containing mottlings of light gray and rust brown. At a depth of 26 to 30 inches the material is dull-gray wet loamy sand stained with rust brown. The soil is strongly acid, has a soft-crumbs structure in the surface soil, and readily falls apart into single grains. It is variable in texture but is predominantly fine sandy loam. Rumney fine sandy loam is darker colored and more poorly drained than Podunk fine sandy loam.

The total area of this complex is small. It occupies imperfectly drained bottoms widely scattered over the county and patches and strips along the outer edges and running through the broader bottom lands. The latter situation represents flat or slightly depressed areas having slow surface drainage and imperfect subdrainage. The largest area mapped, about 1 mile west of Groveton, remains in second-growth timber. Most of the rest is cleared and included in the same fields with adjacent mowings or pasture. Hay consists mainly of timothy and redtop, together with coarse native grasses when the sod is not renewed for a long time. Mowings yield about  $1\frac{1}{2}$  tons an acre. Oats are about the only other crop planted and usually are cut for hay, yielding about 1 ton or less an acre.

**Alluvial soils, undifferentiated.**—Alluvial soils, undifferentiated, consist of various kinds of soil material, mainly poorly drained and semiswampy. On most areas a shallow muck or peatlike duff has accumulated. These soils occur mainly on narrow imperfectly and poorly drained bottoms and to less extent in depressed imperfectly drained spots and strips in the broader well-drained bottom lands.

Where associated with the well-drained soils, alluvial soils, undifferentiated, are generally cleared and included in mowing. They support an abundant growth of coarse wild grass, which is usually mowed by hand because wet-bog conditions will not allow cutting it with the other hay. In the narrow valleys, where the land rises sharply on each side, seepage keeps the soils wet to the point of saturation, except along the immediate stream banks. Most of these valleys are wooded. Many of them, at short intervals for distances of several miles, are blocked by beaver dams that keep much of the soils in a semiflooded condition. Flooding kills many of the more desirable trees, and a dense growth of alder brush replaces them. On some farms a few of the small better drained areas are cleared and used for mowing, and cultivated crops are grown largely on the adjacent rolling uplands.

Although the alluvial soils, undifferentiated, do not at any place assume the proportions of a major soil type, the total area is rather large. They are unimportant agriculturally.

**Riverwash.**—Riverwash represents mainly sand and gravel deposits along the Connecticut and Androscoggin Rivers where areas of alluvium are being built up, owing to the shifting of the stream channel, and along some of the smaller streams where heavy deposits of the same kind have been thrown out by swift water. Riverwash is subject to frequent shifting by swift currents. It is nonagricultural and

largely bare of vegetation, but it supports in places a sparse growth of brush, small trees, weeds, and clumps of grass.

#### SOILS OF THE TERRACES

Soils of the terraces are generally level to undulating, but those of the kames are hilly or hummocky. They are subject to leaching and are light colored, strongly acid, mainly light textured, and in some places excessively drained. These soils are about equally divided between nonstony and stony types and are inherently less productive than the soils of the bottom lands.

The soils of the terraces are members of the Groveton, Colton, Colebrook, Suffield, Sudbury, and Scarboro series. The Colton and Colebrook soils have medium-textured friable surface soils and gravelly well-drained subsoils. The Suffield soil has a silt loam surface soil and a heavy silt loam or silty clay loam subsoil that retards internal drainage. Members of the Groveton series have surface soils and subsoils of medium texture. The Sudbury soils are imperfectly drained, and the Scarboro soils are poorly drained. Of these, Groveton, Colebrook, and Colton fine sandy loams, Groveton very fine sandy loam, and Suffield silt loam are the most productive.

The Groveton soils are mellow and friable throughout, have good moisture-holding qualities, and make an excellent medium for the development of plant roots. They resemble the Agawam soils mapped farther south along the Connecticut River Valley but differ in having light-gray mineral surface soil layers beneath the leaf litter. Colton fine sandy loam is only slightly less productive than the Groveton soils and in surface appearance is much the same, but it has a gravelly or coarse sandy lower subsoil layer and is subject to some leaching. Under forest conditions, the Colton soils, like the Groveton, have light-gray mineral surface soil layers; otherwise the Colton soils resemble the Merrimac soils mapped farther south and at lower elevations in New Hampshire. The Colebrook soils are similar in all respects to the Colton soils, except that they occur in areas where the alluvial parent material consists chiefly of fragments of schist. In a few places sufficient surface stone is present on the Colton and Colebrook soils to make the use of farm machinery difficult. Cleared stony areas are used for pasture. The gravelly subsoil of the Colebrook contains more fine material than the corresponding layer of the Colton soil, and the Colebrook soil is apparently less subject to leaching than is Colton fine sandy loam, and yields on it seem to hold up better than on the latter soil under the same management and much better than on the lighter textured members of the Colton series.

Colton sandy loam, Colton gravelly sandy loam, and Colton loamy sand are subject to rather severe leaching. Colton loamy sand is not farmed extensively and returns low yields, owing to lack of moisture in dry weather and rapid loss of plant nutrients. Yields on Colton sandy loam and Colton gravelly sandy loam are considerably below those on Colton fine sandy loam under the same management.

The heavy texture and slow subdrainage of Suffield silt loam make it difficult to manage for cultivated crops but give it a good moisture-holding capacity that makes it excellent hay land. Because of imperfect drainage, Sudbury loam also is suited mainly to mowing and pasture. Scarboro fine sandy loam occupies poorly drained positions

near the contact of broader terraces with the uplands and narrow strips along small streams and depressed situations in terraces. Since it is not practicable to drain most of Scarboro fine sandy loam, most of it remains in timber or as brushy semiswamp areas in pastures.

**Groveton very fine sandy loam.**—Although only a small area is mapped, Groveton very fine sandy loam ranks next to the Ondawa and Hadley soils because of its comparatively high productivity. It is developed mainly on the terraces of the Connecticut River, in narrow strips on the Androscoggin River terraces, and in small areas along the tributary streams of these rivers. Although developed from old alluvium, this is a comparatively young soil. The profile is less well developed, and leaching has not progressed so far as on the older post-glacial terraces. The soil is medium to strongly acid.

In cultivated fields Groveton very fine sandy loam has a brown mellow surface soil 6 to 8 inches thick, depending on plow depth. Beneath this, the material changes abruptly to brownish-yellow friable very fine sandy loam, which becomes lighter in color with depth and at a depth of 15 to 18 inches grades into pale-yellow friable very fine sandy loam having a light-green or olive tinge. At a depth of about 24 to 26 inches this material, in turn, changes abruptly to gray or light-olive firm loamy fine sand, which is underlain by bedded sands or fine sands that are firm or slightly compact in place but break easily into a loose single-grained mass when taken out.

Groveton very fine sandy loam is developed from the same kind of deposits as the Agawam soils of the Connecticut River Valley in southern New Hampshire and Vermont. It differs from the Agawam soils in that, under forest conditions, the accumulation of duff is thicker and is underlain by a 1- to 3-inch light-gray leached mineral surface soil layer. This material is underlain by a 4- to 6-inch dark rust-brown layer containing considerable organic matter and iron compounds. Beneath this, the brownish-yellow or yellow and pale-yellow subsoils of the Groveton and Agawam soils are about the same. The gray and dark-brown layers are mixed when the land is cultivated and thus lose their distinguishing characteristics. Mixing produces the uniformly brown surface soil as seen in freshly plowed fields, but the color is somewhat darker than in the Agawam soils.

Like Hadley very fine sandy loam, this soil has a good moisture-holding capacity. This characteristic, together with the friable consistence and excellent structure, allows easy penetration and development of roots. The soil is free of stone and gravel. Along the Connecticut River it lies 20 to 60 feet above stream level, but along the Androscoggin River few areas are more than 20 feet above normal stream flow and some are lower and subject to slight inundation with excessive high waters. The surface is smooth and the relief mild. One fairly large area northwest of Whitefield and a few smaller areas occupy gently rolling land.

Practically all of Groveton very fine sandy loam is farmed except along the Androscoggin River. The leading crops are hay (timothy and clover), some oats, potatoes, and corn for silage. Yields compare favorably with those obtained on the Ondawa and Hadley soils. Most of the land is included in dairy farms where only a small acreage is devoted to grain or cultivated crops. Manure is the principal fertilizer.

**Groveton fine sandy loam.**—Groveton fine sandy loam occurs almost entirely on smooth terraces along the Connecticut River southward from Colebrook. A greater proportion is farmed than of Groveton very fine sandy loam, because of its occurrence in sections where nearly all of the smooth land has been cleared. The profiles of the two soils are similar, except that the coarser texture of the fine sandy loam has allowed somewhat greater development of the light-gray mineral surface layer. Under forest conditions the light-gray surface layer and the brown subsurface layers are thicker. In most places the lower part of the substratum includes enough coarse sand and fine gravel to provide good subdrainage, but the soil above this is sufficiently compact to store moisture for most crops. This soil occurs on terraces of the same level or slightly higher than those occupied by Groveton very fine sandy loam, but they are generally lower than the older glacial terraces that filled the valleys during the postglacial times and that have been reduced to remnants along the edges of the valley adjacent to the uplands.

In cultivated fields the 7- or 8-inch surface soil consists of brown mellow fine sandy loam. Beneath this the material changes to light rust-brown or yellowish-brown firm fine sandy loam, which grades rather abruptly, at a depth of 12 to 15 inches, into yellow or pale-yellow firm but friable very fine sandy loam. At a depth of 20 to 26 inches the material is pale-olive or greenish-yellow loamy fine sand or loamy sand, and this grades into the gray sandy substratum containing an appreciable quantity of fine gravel in places. In close association with Colton fine sandy loam, this soil partakes somewhat of the Colton characteristics in the surface soil and upper subsoil layer, but it is included with the Groveton soil because of the absence of gravel in the subsoil, a more favorable texture for crops, and a higher moisture-holding capacity.

Along the northern and northwestern edges of Lancaster is an area of several hundred acres of Groveton fine sandy loam, the subsoil of which, below a depth of 20 inches, is faintly to strongly mottled with gray and light brown and below a depth of 30 inches is yellowish-gray fairly compact loamy fine sand, mottled with pale yellow and brown. The substratum underlying this is hard, compact, stratified sand and fine sand. Water moves laterally along the seams of this material. On slight pressure the material breaks into a single-grain mass. Two or three small bodies in which the soil has a similarly mottled subsoil are mapped at other places. If the area of this inclusion were greater and more significant agriculturally, the soil would be mapped separately as a different type.

Groveton fine sandy loam occurs in a few fairly large bodies, and many farmsteads are located on it. A larger proportion of this soil is planted to crops, small grains, potatoes, and corn than any other soil of the valleys, because of its smooth surface, absence of stone, favorable texture and structure, good moisture-holding capacity, and freedom from overflow. Amendments are used frequently enough and in sufficient quantities to maintain the soil at a productive level that equals or exceeds that of much of Groveton very fine sandy loam and almost equals that of farms located mainly on the Ondawa and Hadley soils. Quick warming in spring insures an early start for all crops.

**Groveton loamy fine sand.**—The 7- or 8-inch surface layer of Groveton loamy fine sand is grayish-brown or light-brown mellow

loamy fine sand. Beneath this the material changes to yellowish-brown loamy fine sand, which grades rather rapidly, at a depth of 12 or 14 inches, into yellow loose loamy very fine sand. This sand becomes lighter in texture and color with depth, and at a depth of about 30 inches it passes into gray or very pale yellow loamy sand. This material continues to a depth of 4 feet or more, where it passes into gray sand. The entire soil is single grain in structure, leached, and strongly acid. Some accumulation of the finer soil particles in the middle subsoil layer makes it slightly heavier textured than the layer above or below. This layer in places is firm or weakly cemented.

Groveton loamy fine sand occurs in association with Groveton fine sandy loam, Groveton very fine sandy loam, and Colton loamy sand, as narrow strips or small patches on the lower terraces, mainly of the Connecticut River between Colebrook and Lancaster, and there are small areas along the tributaries of the Connecticut River and along the Androscoggin River. The largest areas are 1 mile northwest of Groveton, immediately south of Riverton in Jefferson, and near Milan. The total area is very small.

At one time most of the land in farming sections was cleared for crops. These cleared areas have been largely abandoned for crops because of low inherent fertility and the need for frequent and heavy applications of manure and other amendments to insure good or average yields. Areas that have been abandoned for a long time support dense stands of small to large white pines, some of which are now being cut for lumber and poles for building log houses. Pasture land is being rapidly covered with birch, quaking aspen (locally known as popple), and white pine. Cultivated areas are used for mowing, potatoes, and home gardens. Hay yields about 1 ton an acre, and potatoes 150 to 200 bushels, with the use of one-half ton of fertilizer analyzing 8-16-14 or its equivalent. Along the Androscoggin River this soil supports dense stands of spruce and fir, with some yellow birch, popple, soft maple, and hard maple.

**Colton fine sandy loam.**—In cultivated fields of Colton fine sandy loam, the surface soil is brown or light-brown mellow fine sandy loam to a depth of 7 or 8 inches. Beneath this the material changes to yellowish-brown or light rust-brown firm but friable sandy loam, which grades abruptly, at a depth of 12 or 14 inches, into yellow or brownish-yellow friable light fine sandy loam or loamy fine sand. The sand becomes lighter in both color and texture with increasing depth, and at a depth of 18 to 24 inches it passes into pale-yellow or gray sand and gravel, which in most places is stratified below a depth of 3 feet. The entire soil mass has little or no well-defined structure, but the material falls apart into single grains when handled. This soil is highly acid, absorbs water readily, and retains a fair supply of moisture in the surface layers, although water moves rapidly downward through the loose open gravel.

Mineral and organic compounds have been leached from the surface layers, and these compounds have been precipitated in the subsoil and substrata, in places forming weak to fairly hard cemented layers, spots, or zones. This cementation, if continuous, would form a hardpan, which would be practically impervious to water and plant roots. Although this condition is common, it is not fully developed and for the most part is noticeable only in open cuts where profiles are exposed

for a considerable distance. The cementation is more pronounced in the lighter textured Colton soils and in the soils of the kames.

Colton fine sandy loam occupies fairly large areas on the terraces of the Androscoggin River and its main tributaries and on the tributaries of the Connecticut River south of North Stratford. Only small areas are on the Connecticut River terraces. This soil occupies old high glacial-terrace remnants of outwash material that once may have filled the valley and, to a less extent, areas around lakes and ponds where water levels were once much higher than they are at present. Other areas are at considerable distances from present streams or bodies of water that could have had any relation to their formation.

The parent material of this soil is largely granitic gravel, and the soil occurs along streams draining mainly the sandy soils of the upland that are developed from granitic glacial till. This material is light-colored, owing to the high content of granitic and other light-colored rocks, but is darker where drainage is in part from areas of till composed largely of schist and other dark-colored rocks.

Colton fine sandy loam is important because it comprises most of the smooth land on a number of farms. About 70 percent of it is cleared, and the rest supports excellent stands of second-growth spruce, fir, birch, popple, some maple, and white pine. The principal crops are hay (timothy and redtop with some clover), oats for grain and hay, potatoes, vegetables, a soybean-millet mixture for hay, and some dry edible beans for local markets.

Yields on this soil are about average for the county. Considering the fact that it is not an inherently fertile soil, the turning under of sod and the use of amendments are responsible for the yields obtained. Hay yields about 1 to 1½ tons an acre, oats 30 to 40 bushels, potatoes 200 bushels, and beans 15 to 25 bushels. These yields are obtained through the use of high-grade commercial fertilizers at the rate of ½ to 1 ton an acre for potatoes, 400 pounds for oats, and 600 pounds for beans.

On the surface Colton fine sandy loam resembles the Groveton soils. It has the same favorable structure as those soils have in the surface soil and upper subsoil layer and is fairly retentive of moisture, but the porous gravelly subsoil allows more leaching and more rapid loss of plant nutrients than does the corresponding layer of the Groveton soils. A shortage of moisture seldom affects crops, because of the normally well-distributed and abundant summer rainfall and the low precipitation-evaporation ratio for latitudes this far north.

A few areas of Colton fine sandy loam are sufficiently stony or cobbly to hinder or prevent cultivation. Most of these areas are used for either pasture or mowing. Yields of mixed hay are less than 1 ton to the acre.

Colton fine sandy loam, as mapped, includes a variation in which the lower subsoil layer and substrata range in texture from fine sand to coarse sand. The absence of gravel in the subsoil adds to the value of the soil, in that water moves downward at a slower rate and leaching is less severe. In this respect the variation resembles Groveton fine sandy loam, but it is associated with the normal Colton soils on the older and generally higher lying terraces and is more leached than the Groveton soils. The total area of this inclusion is less than 1 square mile, and the largest body is adjacent to Northumberland village. About the same use is made of the two soils, but yields of crops are

slightly higher on the included soil than on normal Colton fine sandy loam.

A stony phase of Colton fine sandy loam is included on the map with the stone-free soil. It occurs adjacent to steep uplands or along old glacial drainageways where the movement of water was rapid at the time the soil material was deposited. In these places many large rounded stones and boulders were deposited. They are embedded in the soil and scattered over the surface in sufficient quantities to hamper greatly or to prevent tillage operations. In farming sections this included soil is largely cleared and used for pasture. Small areas of the less stony parts or areas from which some of the stones have been removed are used for mowing, mainly timothy and redtop. Hay yields only about 1 ton an acre. The largest area of this stony soil is near Emerson School in the town of Stark.

**Colton fine sandy loam, slope phase.**—This soil is associated with the normal soil, is very similar in profile characteristics, and has about the same use and agricultural importance. The main difference is that of topography and its bearing on land-use and farm practices. Stream channels and storm drains from hillsides crossing areas of this soil have given it an uneven, choppy, or up-and-down relief with short slopes at right angles to the general dip of the terrace toward the main streams. Some of these short slopes are fairly steep and difficult to cultivate with farm machinery. The steeper slopes tend to erode somewhat when plowed, when run-off increases at times of heavy rains, when the soil has become thoroughly soaked, or when the ground is frozen. Plowing, seeding, and harvesting are not hampered very much by the slope, but there is a tendency to concentrate tillage operations on the longer slopes and to follow longer rotations on the steeper ones. Some of the land is included in pasture fields with a larger proportion of other soils having still steeper slopes. Only the smoother parts of this soil receive appreciable quantities of soil amendments, and crop yields are not so uniformly high as on the normal Colton fine sandy loam that receives amendments regularly on nearly all areas under cultivation.

**Colebrook fine sandy loam.**—In cultivated fields Colebrook fine sandy loam is brown mellow fine sandy loam to a depth of 6 or 8 inches. This is underlain by a thin layer of rust-brown fine sandy loam, which extends to a depth of 9 or 10 inches, where it grades into brownish-yellow or yellow fine sandy loam. This material becomes lighter in both color and texture with increasing depth, and at a depth of 20 to 30 inches it gives way to dark-gray or pepper-and-salt (dark- and light-colored) sands and gravel. The underlying material is definitely stratified at a depth of 3 to 4 feet below the surface. The surface soil in good tilth may have a soft-crumbs structure, but the rest of the soil material breaks with handling into single grains. The subsoil and substrata consist of loose open gravelly sand.

Owing to the larger content of fine material throughout, Colebrook fine sandy loam retains moisture better in both the surface soil and the subsoil and allows slower movement of water downward through the substratum than does Colton fine sandy loam. Because of the presence of dark-colored minerals and a slightly higher content of organic matter, it has a darker brown surface soil than the Colton soils. Like the other Colebrook soils, this soil is acid in the upper layers but is only slightly acid or neutral in the lower subsoil layer and substrata, whereas the Colton soils are generally strongly acid throughout.

Included small areas of a soil northeast of North Stratford, lighter textured than the typical soil, consist mainly of sandy loam. Nearly all of the areas mapped along Halls Stream have a loam or very fine sandy loam texture, an olive- or greenish-yellow subsoil, and substrata that consist almost entirely of dark-gray and nearly black minerals. The fragments of gravel in the subsoil and substratum are small, somewhat flat, semirounded pieces of dark-colored schist. In some small areas the soil is normal in all other respects but contains little or no gravel in the lower part of the subsoil. These areas would be mapped separately were they of greater extent. The largest body with the sandy subsoil is about 2 miles east of Colebrook, in a small basinlike area that lies about 100 feet above the level of the Mohawk River.

Colebrook fine sandy loam occurs on the terraces of the Connecticut River and its tributaries in the northern part of the county where the streams drain soils of the uplands developed mainly from schist till. A few small areas are mapped outside the Connecticut River Basin. The parent material of the Colebrook soils contains some limestone and calcareous schist, which apparently came from a narrow belt of impure limestone and calciferous schist, extending northward from a point just southeast of Colebrook through the towns of Colebrook, Stewartstown, Clarksville, and into Pittsburg along Indian Stream. Leached, brown limestone gravel and cobbles are scattered through the substrata of most Colebrook soils. Lime leached from the upper layers has formed a coating over some of the gravel of the substrata, and in places the gravel and sand beds are weakly cemented with lime deposits.

Colebrook fine sandy loam, developed on nearly level terraces, embraces a small total area. Both surface and internal drainage are good. This soil occupies narrow terraces in sections where many of the farms include soils of both the valleys and the rolling uplands and a small number include only the Colebrook soils. About 80 to 90 percent of this soil is cleared and is used almost entirely for crops. Farms are of the dairy type, and their owners grow potatoes as a cash crop in addition to a farm supply of hay and some small grain, mainly oats, together with some barley and buckwheat. In addition to these crops a few farmers plant mixed soybeans and millet for hay, which in some instances takes the place of grain in the rotation. In favorable seasons most grains are allowed to mature before they are harvested. When the crop is late and there is danger of damage by frost, it is harvested for hay. Under favorable conditions and the use of soil amendments, good yields are obtained. This soil produces equally as good yields as the Groveton soils, higher yields than the Colton soils, and only slightly lower yields than the soils of the bottom lands. In some fields potatoes seem to develop more normally and give higher yields than on the Ondawa and Hadley soils. Hay (mixed timothy and clover) yields  $1\frac{1}{2}$  to  $2\frac{1}{2}$  tons an acre, oats 35 to 50 bushels, barley 20 to 35 bushels, buckwheat 15 to 25 bushels, and soybean-millet hay  $1\frac{1}{2}$  to 2 tons, depending on the season. Much of this soil in Pittsburg has not been cleared and supports a good stand of second-growth timber of indigenous species.

Colebrook fine sandy loam as mapped includes a stony phase that resembles the stony phase of Colton fine sandy loam. Areas of this soil are indicated on the map by stone symbols. There are enough

large stones on the surface to hinder seriously or to prevent cultivation. The total extent of this variation is about 320 acres, and it occurs in both level and sloping areas. About one-half of the land is cleared and used almost entirely for pasture because of the presence of stone. Pastures are fair to good most of the summer. Pasture sod consists mainly of junegrass, Canada bluegrass, native grasses, and some white clover. One of the larger areas is northwest of First Connecticut Lake and supports a dense stand of second-growth spruce and fir.

**Colebrook fine sandy loam, slope phase.**—Colebrook fine sandy loam, slope phase, has a somewhat choppy relief caused by shallow storm drains that cross it or by uneven deposition. The profile is essentially the same as that of the normal Colebrook fine sandy loam. The slope makes tillage operations somewhat more difficult, and when the land is plowed 2 years or more in succession a slight loss of soil through erosion occurs on the steeper slopes. The total area is small. In the vicinity of Kidderville are included some areas of a lighter textured soil, and  $2\frac{1}{2}$  miles northwest of Colebrook is an area of soil having a sandy rather than the typical gravelly subsoil.

The largest area of Colebrook fine sandy loam, slope phase, is just north of Colebrook. This soil is used in much the same way as typical Colebrook fine sandy loam, but as a whole it is not plowed so often and produces slightly lower yields than that soil. Where mowings are not renewed for fairly long periods, clover largely disappears from the hay mixture and yields rarely exceed  $1\frac{1}{2}$  tons an acre.

**Colebrook gravelly fine sandy loam.**—Colebrook gravelly fine sandy loam is very similar in soil material and soil development to Colebrook fine sandy loam. The main difference is the presence of considerable gravel in the surface soil and in the upper part of the subsoil. The pieces of gravel are as much as 2 inches in diameter. This soil has a more open, loose structure and contains more granitic material than the nongravelly soil. In this respect it is similar to the Colton soils. Inherently it is less productive than Colebrook fine sandy loam and about equally as productive as Colton fine sandy loam.

In cultivated fields the 7- or 8-inch surface soil is brown gravelly fine sandy loam. This changes to rust-brown gravelly fine sandy loam, which grades at a depth of 9 or 10 inches into brownish-yellow gravelly light fine sandy loam. This material becomes lighter in both color and texture with depth, and at a depth of 20 inches it grades into grayish-yellow or grayish-brown gravelly loamy sand. At a depth of about 30 inches this material, in turn, grades into dark-gray or mixed light- and dark-colored sands and gravels of the parent material. The soil is friable, mealy, and single-grained throughout. It is medium to strongly acid in reaction.

The larger bodies occupy fairly smooth terrace remnants along the Connecticut River southward from Colebrook to North Stratford, and a few small bodies are along the Mohawk River and Halls and Indian Streams. Only a very small total area is mapped. Surface drainage is adequate, and, although internal drainage is very rapid, the soil is not very droughty. Practically all of the land is cleared and used for growing crops. Farms on which this soil occurs generally include other soils that are gravel free and on which soil amend-

ments are used more often than on this soil, with the result that the Colebrook soil is not given an opportunity for maximum production. Most of the land is in mowing, and a few small fields are in oats or potatoes. Hay, mainly timothy, yields from 1 to 1½ tons an acre, and potatoes, with an application of ½ to 1 ton of high-grade fertilizer, yield 175 to 250 bushels. Oats following potatoes usually are cut for hay.

**Colebrook gravelly fine sandy loam, slope phase.**—This soil, which has a very small total area, occurs on the more sloping edges of the terraces in association with the normal level Colebrook fine sandy loam and in places where small drains cross the terraces. The soil is much the same as the typical soil, but the surface soil is generally thinner and is more leached than the corresponding layer of that soil.

The 6- or 7-inch surface soil is brown or light-brown gravelly fine sandy loam, changing to brownish-yellow gravelly fine sandy loam at a depth of 20 inches. This grades into grayish-yellow gravelly loamy sand, which passes into gravelly and cobbly sands at a depth of about 30 inches. It has an open, friable consistence and in most places is strongly acid.

This soil is largely cleared and used as mowing in connection with adjacent more desirable lands. In comparison with the nearby lands that receive more amendments, hay yields are low—about 1 ton an acre. Some of the rougher areas furnish fair pasturage.

**Colebrook loamy fine sand.**—There is not the uniformity in Colebrook loamy fine sand that occurs in Colebrook fine sandy loam, with which it is associated. Some areas include sandy edges of terraces that are somewhat broken; others are nearly level. The subsoil shows a similar lack of uniformity. It ranges from the normal gravelly subsoil of Colebrook fine sandy loam to loamy sand, or sand, and in places it is cobbly coarse sand having a high water table. The loamy fine sand is differentiated on the basis of the texture of the surface soil and the origin of the parent material.

The better developed areas have a 7- or 8-inch brown mellow loamy fine sand surface soil that grades abruptly through a 1- or 2-inch layer of rust-brown loamy fine sand into yellow or brownish-yellow loamy sand. This material at a depth of 18 to 24 inches passes into loose sand or gravelly sand that is gray or grayish yellow in the upper part and dark gray below a depth of 30 inches. The largest area mapped, just north of Back Lake in Pittsburg, shows the following profile characteristics: 0 to 7 inches, brown loamy sand or light loamy fine sand; 7 to 10 inches, rust-brown loamy sand; 10 to 20 inches, yellowish-brown gravelly loamy sand; 20 inches +, dark-gray cobbly gravelly sand splotched and stained with rust brown. The lake level here and the surrounding swamps hold the water table within 3 to 5 feet of the surface of the ground. Most of this area supports a dense stand of second-growth spruce and fir.

The small areas scattered along the Connecticut River, and tributary streams are, for the most part, cleared and used for mowing or pasture. Yields of timothy and clover hay may be as much as 2 tons an acre on the better lands. This soil occupies a very small total area, and it is of little agricultural importance.

**Colton sandy loam.**—Colton sandy loam is widely scattered over the county in association with other Colton soils. It comprises most

of the smooth or level land on some farms. In some places it is associated with Colton fine sandy loam, but it occurs more in valleys where the soil texture is coarse. The parent soil material has the same origin as that of Colton fine sandy loam, and the profile characteristics of the two soils differ little except in texture of the upper layers. The sandy loam is more strongly developed and is inherently somewhat less productive than Colton fine sandy loam.

In cultivated fields Colton sandy loam consists of brown or light-brown mellow sandy loam to a depth of 6 to 8 inches. A 1- to 3-inch layer of light rust-brown sandy loam intervenes between the surface layer and the layer below of brownish-yellow sandy loam, which becomes lighter in color and texture with increasing depth. At a depth of about 20 inches this material is pale-yellow rather loose loamy sand or coarse loamy sand, which passes into gray or yellowish-gray gravelly sand at a depth of 24 to 26 inches. The substratum lies 3 to 4 feet below the surface. In places where the proportion of schist fragments is high, the material is gray or medium dark gray, but even more abundant granitic fragments give the material a sandy loam texture and a rather coarse gritty feel when rubbed between the fingers. The subsoil and the substratum contain less fine material than Colton fine sandy loam and considerably less than Colebrook fine sandy loam. This variation of Colton sandy loam is more strongly developed than the soils mentioned, is strongly acid, and falls apart into single grains when handled. Like Colton fine sandy loam, it has a 2- to 4-inch light-gray layer beneath the duff in forested areas, and in places the podzolic soil-development processes have resulted in semicemented or weakly indurated spots in the brownish-yellow and yellow layers of the subsoil. This induration, however, has neither reached the proportions of a hardpan nor is it sufficiently continuous to affect the use of the soil for agriculture.

Colton sandy loam occurs on nearly level terraces, in association with Colton gravelly sandy loam and Colton loamy sand, along streams tributary to the Connecticut and Androscoggin Rivers. The largest areas are in the vicinity of Akers Pond in Errol, west of Twin Mountain in Carroll, and in the vicinity of Crystal in Stark. The soil embraces a small total area. It includes a few bodies having a sandy subsoil in which there is little or no gravel.

Practically all of this land is cleared, except in remote sections that are little farmed, and it is used mainly for the production of hay in connection with dairy farming. Some farms have a small acreage in potatoes. Oats and buckwheat are used in the rotation for grain or hay and as nurse crops when hay sods are renewed. Clover largely disappears after 2 successive years of mowing without renewing the sod, and hay consists mainly of timothy and redtop, with more of the latter in old sods. Yields of hay average about 1½ tons an acre; but, where sods are run out, yields are 1 ton or less. On farms where good management is practiced and amendments of manure, lime, and fertilizer are used, hay yields about 2 tons and potatoes 200 to 250 bushels an acre. Oats are harvested mainly for hay. Some fields, through lack of amendments, have dropped so low in production that they are more or less abandoned or are included in pasture.

A few small areas of Colton sandy loam have enough stones on the surface and embedded in the soil to hinder materially or to prevent tillage operations. These are indicated on the map by stone symbols. One fairly large area adjoins the Grafton County line west of Twin Mountain. Most of this included soil was at one time cleared of the original timber. It is now used for pasture, and much of it is coming into brush and small trees. The total area of this inclusion is less than 1 square mile.

**Colton sandy loam, slope phase.**—The slope phase of Colton sandy loam is essentially the same as the typical Colton sandy loam. Here and there areas of a lighter textured soil are included, and in these the soil is more subject to leaching and is less productive than this soil as a whole. These inclusions of a lighter textured soil and the uneven slopes are the main differences between this soil and the normal soil. This soil is associated with the level areas of the normal soil as billowy or gently rolling areas and in places as short fairly steep slopes. Many of the smaller elongated areas along narrow valleys, like areas of the slope phase of Colton fine sandy loam, slope rather sharply across the shorter axis to the edge of the terrace, and in places elongated areas are cut by many shallow brooks and storm drains, which give it a somewhat choppy relief. The larger areas are mapped in Errol, Stark, and Carroll. The total area mapped is small.

At one time about 75 to 80 percent of this soil was cleared and farmed, but not more than half of the land is now in crops. There has been considerable abandonment of this soil and curtailment of the acreage in crops on the remaining farms. The large areas in Errol along the west side of Akers Pond are used for pasture and are about half overgrown with small to fairly large spruce and fir. Similar areas in the vicinity of Crystal and Twin Mountain are in part or wholly abandoned for farming, and white pine and hardwood brush are rapidly covering the land.

Farms that are well managed produce almost if not quite as well as those on the typical soil. Hay to support dairying is the main crop. Small acreages are devoted to potatoes, oats, buckwheat, and mixed soybeans and millet. Land that receives manure alone at long intervals yields 1 ton or less of hay an acre. Some of the farms on this soil are of the subsistence type, and the owners depend on work in the forest for their cash income.

**Colton loamy sand.**—Colton loamy sand in cultivated fields has a light-brown loose surface soil to a depth of 6 or 8 inches, which grades into rust-brown firm loamy sand or light sandy loam at a depth of 10 to 12 inches. This grades abruptly into brownish-yellow or yellow loamy sand, the yellow color gradually fading with depth, and at a depth of about 20 inches the material grades into pale-yellow gravelly loamy sand. This is underlain by gray gravelly sand at a depth of 28 or 30 inches. The soil is highly leached, is strongly acid in reaction, and breaks into single grains when crumbled. It is open and loose, except where strong podzolization has resulted in weak to firm cementation of the subsoil. This phase of soil development is more pronounced in Colton loamy sand than in the less sandy Colton soils. It is more in evidence along old root channels and around rotting stumps and the immediately surrounding areas of soil. In places the cementation has an almost rocklike consistence, but this condition in no place extends for more than a few feet.

Colton loamy sand is widely scattered over the southern half of the county where the streams flow from granitic till uplands. It occurs on level terraces mainly along the tributaries of the Androscoggin and Connecticut Rivers. Only small patches are on the Connecticut River terraces. The larger bodies are in the towns of Jefferson, Whitefield, and Carroll and in the vicinity of Bretton Woods on the Ammonoosuc River. The total area is not large.

At one time nearly all of this soil was farmed. Owing to low inherent fertility, excessive leaching, and droughty condition of the soil at times, it has since been largely abandoned for farming. Many of the remaining farms are of the subsistence type, the owners depending on outside employment for cash income. About 25 percent of the land is now in crops, mainly around farmsteads where a good supply of manure is available, and most of the land in crops is more productive than the average. Hay is the principal crop, and some garden and subsistence crops are grown. Timothy and redtop hay averages less than 1 ton an acre, but, with heavy applications of manure and lime yields of  $1\frac{1}{2}$  tons may be obtained. Potatoes for home use grown with little or no fertilizer yield 60 to 125 bushels an acre. Some of the land not farmed is used for the scant pasturage it affords, and much of it is returning to forest, mainly of birch, popple, and white pine, and some spruce and fir.

Colton loamy sand as mapped includes a soil with sandy rather than gravelly substrata. It is pale-yellow loamy sand to a depth of 28 to 36 inches, grading into gray sand, which continues downward for a number of feet. Induration probably is a little more in evidence to a greater depth than in the normal soil, though of little if any greater extent. The soil is highly acid, falls apart into single grains, and is severely leached.

Some areas on the Connecticut River terraces in the vicinity of Groveton and south to Lancaster are associated with areas of the lighter textured Groveton soils. Here the soil resembles the Groveton soils in that it is developed over deep beds of sand. This variation of Colton loamy sand is lighter in texture, is more leached, has a deeper profile development, generally lies at higher elevations, and is inherently much less productive than Groveton loamy fine sand.

Although widely scattered over the southern part of the county in association with other Colton soils, this soil occurs only in small bodies, and its total area is not very large. Some of this soil parallels United States Highway No. 3 for a good part of the distance from Stratford village northward to Stratford Center School. Along the highway a number of farmsteads are located on this soil, with farming operations largely on the Connecticut River bottoms. Most of the land is taken up in the farmsteads, home gardens, and exercise lots and night pasture for livestock, and a few patches are in hay.

This soil occupies both smooth and sloping or gently rolling areas. Not much of it is farmed. A small acreage is devoted to beans, potatoes, and hay in the vicinity of Northumberland on what are mainly subsistence farms. Because of lack of amendmets, yields are generally low.

Colton loamy sand includes areas, indicated by stone symbols, that are too stony to be cultivated successfully. This inclusion is widely scattered over the county and embraces a total area of about  $1\frac{1}{2}$  square

miles. A number of small areas occur on lateral prongs of the Androscoggin River Valley in the vicinity of Gorham and extend as a series of narrow disconnected strips along the Peabody River south of Gorham, where it lies in places only a few feet above this stream and in others high above. Some of these areas extend into the main terraces as fanlike deltas where small brooks emerge from the steep mountain areas. One area of considerable size, projecting from the Maine State line as a peninsula into Umbagog Lake, has the appearance of an old lake shore terrace. This area is mainly loamy fine sand and loamy very fine sand, with evidence of considerable soil blowing having taken place on it.

The more favorably situated areas with reference to farms are cleared or partly cleared and included in pastures. About 75 percent of this included soil remains in second-growth timber of indigenous species of trees.

**Colton loamy sand, slope phase.**—Colton loamy sand, slope phase, occupies a small total area. It is either widely separated from or occurs in close association with the normal level areas of Colton loamy sand. Some small bodies on the Connecticut River terraces between Groveton and North Stratford are associated with areas of Colton sandy loam.

Soil development is essentially the same as on the level Colton loamy sand. The main difference is that of relief and use. Less of the short slopes, choppy billowy areas, and terrace edges was put into cultivation. Other areas were only partly cleared for pasture, and some of the less accessible areas never were cleared. Crops on this soil are about the same as on typical Colton loamy sand under the same kind of management, and yields are comparable. Forested areas support good stands of mixed second-growth conifers and hardwoods.

A few areas of Colton loamy sand, slope phase, too stony for cultivation, are shown on the map by stone symbols. One fairly large stony area is near Twin Mountain.

**Colton gravelly sandy loam.**—Colton gravelly sandy loam, to a depth of 6 or 8 inches, is brown or light-brown gravelly sandy loam, changing to rust-brown gravelly sandy loam at a depth of about 10 inches. This material changes abruptly into brownish-yellow gravelly sandy loam, which becomes paler and more gravelly, and at a depth of about 18 inches the material is yellow or pale-yellow gravelly and cobbly loamy sand. At a depth of 24 to 30 inches this grades into gray or grayish-yellow gravelly and cobbly sand and coarse sand. It has a single-grain loose open consistence, is rather severely leached, and is strongly acid.

This soil differs from Colton sandy loam in the high content of gravel in the surface soil and upper subsoil layer. Individual pebbles range from very small to 2 or 3 inches in diameter. The loose open lower subsoil layer contains more and larger pebbles and less fine soil material. As a whole, this soil is less retentive of moisture in the subsoil than any other Colton soil. It is greatly deficient in organic matter, has a low crop-producing capacity, and is a difficult soil on which to maintain fertility.

Some of the included soil has a cropping value considerably above the average. The largest such area is near Blake School on a low terrace of the Upper Ammonoosuc River. Here the terrace is appar-

ently younger than the terraces occupied by most of the soil, the soil is less leached than elsewhere, and the surface soil is fine sandy loam. The pebbles are neither so abundant nor so large as elsewhere.

Colton gravelly sandy loam embraces a small total area and is widely scattered over the county in association with other Colton soils. It occurs on smooth, gently rolling, or choppy terraces, mainly near the place where small streams emerge from the mountains. In places it extends from the main terraces up along these small streams, and in these places the soil is the most gravelly. The larger areas are in the vicinity of Twin Mountain, along the upper Ammonoosuc River, and along the Androscoggin River between Gorham and Milan.

About 60 to 75 percent of this land has been cleared and at one time was used for the production of crops. Approximately half has now been turned to pasture or abandoned and is coming back to timber. Only the more level and less gravelly parts are now farmed. Some of it supports good dairy farms, and the soil is maintained at a high level of production. There are other farms, more of the subsistence type, on which little care is given to the land and yields are low. The average yields under the same management practices are slightly below those of Colton sandy loam and considerably below those of Colton fine sandy loam.

Colton gravelly sandy loam includes stony areas covering a total area of about 1 square mile. They are indicated on the map by stone symbols. The soil material is the same as in the normal type, and there is no apparent difference in soil development. The areas mapped near the head of the Upper Ammonoosuc River in the vicinity of York Pond embrace a large part of this stony inclusion. Small areas occur in association with Colton gravelly sandy loam and other Colton soils. Little or none of the land is farmed. It supports a good second growth of timber.

**Suffield silt loam.**—Suffield silt loam is developed from fine-textured terrace material laid down during periods of slack water or as lake deposits. It is developed on level and undulating terraces and on choppy terrace edges. Surface drainage is good—in places excessive. Underdrainage is retarded by the heavy-textured subsoil, so much so in places that the subsoil becomes mottled. In cultivated areas the 6- to 8-inch surface soil is dark-brown or dark grayish-brown silt loam or heavy loam having a fine-granular or crumb structure, depending on the organic-matter content and state of cultivation. This material changes to yellowish-brown silt loam having a crumb structure and streaked or stained with organic compounds, and at a depth of about 12 inches this passes into olive-yellow firm but not compact silt loam. At a depth of about 20 to 24 inches the material is gray silty clay loam or bedded silts and clays.

In the included areas that have a mottled subsoil the soil is much the same in the surface layer and upper subsoil layer, but about 14 to 16 inches below the surface the subsoil is gray or yellowish-gray silt loam mottled with rust brown. This material has a nutlike structure. At a depth of about 24 inches this, in turn, passes into firm silty clay loam or silty clay that is intensely mottled with brown and rust brown.

Under natural conditions Suffield silt loam is medium to strongly acid in reaction. Under good farm management it is well supplied with organic matter, and lime is applied in sufficient quantities to leave

the reaction only slightly acid. Because of the heavy subsoil, roots of plants do not penetrate far into this layer, but because of good moisture-holding capacity in the upper layers the supply of moisture is generally ample for crop needs.

Suffield silt loam embraces a very small total area. The principal bodies on the Israel River are near Lancaster and just west of Colebrook, and on the Androscooggin River 4 miles northwest of Milan. Smaller areas are scattered along the lower reaches of Halls Stream. Part of the area at Colebrook and the area southeast of Lancaster have mottled subsoils. The area northwest of Milan is gently rolling and somewhat broken.

All this land is cleared and in crops, except the more rolling parts and broken terrace edges, which are in pasture. Considerable hay is cut from this land. Some oats and corn for silage are grown on it. Some of the best managed farms in the county are located in part on this soil, southeast of Lancaster. Timothy and clover yield as much as 3 tons of hay an acre, oats 60 bushels, and corn for silage 20 tons. Average yields, however, are one-third or more below this. The small area of this soil included in pasture affords good grazing most of the summer.

**Sudbury loam.**—Sudbury loam occurs in small bodies on all the larger terraces and all the terrace formations along some of the small streams, but the total area is not very large. It occupies nearly flat or slightly depressed positions and edges of the broader terraces adjacent to the uplands and some gently sloping areas that have a high water table.

In cultivated fields the 7- or 8-inch surface soil is brown or dark-brown mellow loam having a comparatively high organic-matter content and a weak crumb structure. This material changes to light-brown or grayish-brown friable loam, which passes into yellow or pale-yellow very fine sandy loam or fine sandy loam mottled with brown and rust brown at a depth of 12 to 15 inches. At a depth of 20 to 26 inches this material, in turn, grades into gray stratified silts or sands and gravel that are splotched and stained or mottled with yellow, brown, and rust brown.

Sudbury loam, as mapped, includes all the terrace soils that have imperfect underdrainage. In some areas drainage is poor. Surface drainage is slow in most places. The texture of the surface soil is dominantly loam, but in places areas of silt loam, fine sandy loam, and sandy loam are included. The largest included areas having the lighter textures are near the junction of the Johns River with the Connecticut River, at Stark village, and 1½ miles south of Success Pond. The areas of heavier texture are associated with the Groveton and Suffield soils in Lancaster. A total of about 50 acres of stony soil is included and is indicated on the map by stone symbols.

The subsoil and substrata vary from place to place almost as much as the surface soil. A few areas are included with lower subsoil layers that are silty clay loams, whereas on the other extreme the subsoil is composed largely of loose sands and gravel. Drainage conditions of this soil determine its use and agricultural value.

About one-third of the soil occurs in areas that are not used for agriculture and is in second-growth timber of species of trees indigenous to the uplands. In farming districts this soil is largely cleared. More

than one-half of the cleared land is used for crops, and the rest is in pasture. The land is used mainly for hay. Oats are seeded as a nurse crop when the land is plowed and reseeded, in order to renew sods that have become run out or thin. Oats are usually mowed for hay, because the land warms slowly in spring and plantings are too late for the crop to mature fully. Hay consists mainly of timothy and some clover, with considerable redtop in old sods from which clover has disappeared. Applications of lime give a marked increase in the clover content of hay and also in total yields. Average yields of hay are probably less than  $1\frac{1}{2}$  tons an acre and range from less than 1 to 2 tons. The soil usually receives the same amendments as the surrounding soils, but it is plowed less often. Under good management hay yields are as high as or higher than on the Groveton and Colebrook soils and the better Colton soils.

**Scarboro fine sandy loam.**—Scarboro fine sandy loam, under forested conditions, has a 4- to 6-inch covering of brown peatlike moss and fibrous duff. The 2- or 3-inch surface layer is dark grayish-brown single-grain fine sandy loam, but it has a loamy feel because of incorporated organic matter. This material changes abruptly to gray firm single-grain fine sandy loam that is splotched or mottled and stained with brown and rust brown. At a depth of about 12 or 14 inches this grades into light-gray fine sandy loam or loamy fine sand mottled with pale yellow and rust brown. At a depth of 20 to 24 inches the material is bluish-gray firm or compact sand that is saturated during most of the year.

Like Sudbury loam, Scarboro fine sandy loam occurs in small to fairly large areas on nearly all of the terraces throughout the county. It occupies depressed or flat areas that have very slow surface drainage and underdrainage. The larger bodies are on baylike indentures of the lower terraces that are surrounded on three sides by the uplands where seepage waters keep the soil permanently wet and water stands on or near the surface during wet seasons. In places the soil lies only slightly above and merges into swamp areas that have developed on terraces. In many of these places it represents an intermediate soil between the swamps and the well-drained or imperfectly drained terrace soils. Scarboro fine sandy loam in its broad inclusion of all wet terrace soils covers a considerable range in texture of surface soil but is mainly a fine sandy loam. Drainage alone or lack of it determines the use of the soil. Only a few small areas and the better drained edges of some of the larger areas have been cleared and used for pasture. A small part of the cleared area north of Lancaster near Coos Junction is used for mowing. With applications of lime to reduce the acidity of the soil, which is strongly acid under natural conditions, and applications of manure, this area yields  $1\frac{1}{2}$  to 2 tons an acre of timothy or mixed timothy and clover hay.

Wooded areas support mainly a mixed second growth of spruce, fir, popple, soft maple, gray birch, tamarack, and cedar, but in places there is a swamp type of brushy vegetation and a ground cover of moss.

#### SOILS OF THE KAMES, GRAVELLY MORAINES, AND WIND-BLOWN SAND DEPOSITS

The soils of the kames, gravelly moraines, and wind-blown sand deposits are light textured and have gravelly or sand subsoils and a hummocky or strongly rolling relief. The Danby and Dixville soils

are developed on gravelly moraines (chiefly kames, but including some eskers), and the Windsor soils are developed on wind-blown sand deposits.

The Danby series is represented by Danby fine sandy loam, Danby loamy sand, and Danby gravelly fine sandy loam. Because of the light texture and open, loose condition of their subsoils, and because of their rolling relief, these soils are subject to rather severe leaching. The Danby soils are similar to and have the same origin as the Hinkley soils mapped at lower elevations in the southern part of Grafton County. The main difference is the gray mineral surface soil layer in the Danby soils that is not present in the Hinkley soils. The Dixville soils developed on kames and eskers are associated with the Colebrook soils of the terraces. They are developed over similar dark-colored parent material, but the relief is rolling or hummocky, like that of the Danby soils. The parent material includes a higher proportion of fine material than that of the Danby soils. The Danby and Dixville soils are farmed to only a slight extent because of their rough surface and excessive underdrainage. Large areas are cleared and used for pasture, and some of the smoother parts are used for mowing. Owing to a higher content of fine soil material, the Dixville soils give somewhat higher yields of hay than the other soils of this group. The fine sandy loam, loamy fine sand, and gravelly fine sandy loam of the Dixville series are mapped. A few areas of the Dixville and Danby soils are somewhat stony.

The Windsor soils have developed in wind-deposited sands that form low dunes, ridges, and hills along the edges of the valleys adjacent to the uplands and in a relatively thin covering of the alluvial valley sands that have been blown over the kames and glacial-till uplands. The mantle of wind-blown sand is not thick enough to cover the large boulders contained in the till and these are exposed at many places. The dunes and sand deposits became fixed by a vegetative covering after a long period of active drifting, and the soils that have since formed on them have profiles similar to those of the Danby series. Windsor fine sand is the only type mapped in this series and it includes many stony areas. Overgrazing and trampling by livestock of some areas of this soil has induced active wind erosion. Many small Windsor areas were at one time cleared for pasture or crops, but owing to droughtiness, extreme leaching, and the sand's tendency to drift they have been allowed to revert to forest or brushy pasture.

**Danby fine sandy loam.**—In forested areas—and much of this soil is forested—a well-developed gray layer of loose loamy fine sand 2 to 4 inches thick underlies the forest duff. This rests on a dark rust-brown firm loamy layer about 1 inch thick that contains considerable colloidal organic matter. Below this is rust-brown loose and friable fine sandy loam, which, at a depth of 10 or 12 inches, gradually changes to brownish-yellow fine sandy loam with the same consistence as the material in the layer above. This material becomes lighter in color and texture and passes into pale-yellow gravelly loamy sand at a depth of 16 to 18 inches. This, in turn, grades into yellowish-gray cross-bedded loose sand and gravel at a depth of 28 to 30 inches. The soil is severely leached and strongly acid.

Under cultivation the gray and dark-brown layers mix, forming a surface soil of brown mellow fine sandy loam 6 or 7 inches thick. This

is underlain by a 3- or 4-inch layer of rust-brown fine sandy loam, which grades into the brownish-yellow or yellow lower subsoil layer.

In many respects this soil is similar to Colton fine sandy loam developed on adjacent level terraces. It differs from that soil mainly in being rough and hummocky, more leached, and inherently less productive. The indurated subsoil has about the same extent as that of Colton loamy fine sand and is somewhat more strongly developed where the soil occurs at higher elevations.

Danby fine sandy loam is developed from glacial outwash material occurring in hillocky kames that lie above and border the level terraces along most of the valleys in the southern part of the county, and it completely fills some of the valleys. It is composed largely of granite and gneiss material and other crystalline rocks that are deposited along valleys of the tributaries of the Connecticut and Androscoggin Rivers.

This soil comprises moderately sloping to hummocky and rolling land. The rough relief, together with severe leaching and comparatively low moisture-holding capacity, makes it unsuited to farming. Probably 25 percent of the land has been cleared and is used largely for pasture. Some of the included slopes that are only moderately steep are used for mowing. When the land is plowed, in order to renew sods, oats are usually planted as a nurse crop and harvested as a hay crop. On some of the slopes that are too steep for mowing by improved machinery, hay is mowed by hand. The large area northwest of Whitefield is only moderately steep and is in pasture, supporting a fair sod of bluegrass that affords good grazing during most of the summer, because it is better supplied with moisture than most of the soil. Generally the pastures are poor and become very short in summer.

The land used for hay crops receives only occasional applications of manure, and that used for oats receives light applications of fertilizer. Yields of hay, mainly timothy, average about 1 ton an acre or less. Forested areas in the more remote districts lie at about the maximum valley elevations and support good stands of mixed second-growth timber, mainly spruce, fir, hard maple, popple, and yellow and white birch. In the more open valley areas the trees are mainly popple, maple, and birch, with some white pine, spruce, and fir.

As mapped, Danby fine sandy loam includes many areas where the subsoil is sandy instead of gravelly. Beneath the duff this included soil has a 3- or 4-inch gray surface layer over a dark-brown sub-surface layer, which grades into a brownish-yellow and, in turn, into a pale-yellow loamy sand subsoil containing little or no gravel. Gray loose cross-bedded sands rather than the sands and gravel of the normal soil occur at a depth of 28 to 30 inches. The origin and deposition of soil material is the same as in typical Danby fine sandy loam, with which it is closely associated. This inclusion covers about 2 square miles. Whitefield is situated in part on one of the largest of these included areas. The higher content of fine material in the subsoil makes possible the retention of more moisture than in the gravelly subsoil of the normal soil, and for this reason this soil is somewhat more desirable for the production of crops. This included soil is used for the production of hay and oats only where the smooth parts occur in close proximity to farmsteads. Additional areas are cleared and included in pastures that are largely on land more desirable for

such use. Most of the pasture areas are very brushy and probably will eventually revert to forest because of their low value for grazing. Mowings yield about 1 ton of timothy hay an acre, with somewhat higher yields where amendments are added fairly regularly.

Danby fine sandy loam also includes many areas of stony soils, indicated on the map by stone symbols. The origin of soil material and soil development in the surface soil and in the upper part of the subsoil are essentially the same as those features of the stone-free Danby fine sandy loam. The lower part of the subsoil and deep substrata, however, are variable. Deep exposures show the normal gravelly subsoil and substrata generally associated with the Danby soils, but in some places there are bedded sands; in others the layers are extremely gravelly and cobbly and may contain boulders from 2 to 3 feet in diameter. The quantity of stones on the surface limits its use for agriculture to pasture land. The relief ranges from gently rolling or hummocky to strongly rolling and, in places, steep.

Rather large areas occur in Dummer, Milan, Sheburne, and Carroll, in districts that are little developed for agriculture. In some instances these large areas completely fill the small valleys at the foot of the steep mountains. Areas along the Androscoggin River northward from Berlin are to a considerable extent cleared or partly cleared and included in pasture. The same is true along the Upper Ammonoosuc River from Gróveton to West Milan. Owing to position or character of the substrata, some of the smoother and steeper areas seem to have more than a normal supply of moisture and furnish fair to good grazing most of the summer. As a whole, however, the pastures contain much brush, hardhack, and weeds.

**Dixville fine sandy loam.**—In cultivated fields, the 7- or 8-inch surface soil of Dixville fine sandy loam is dark-brown mellow fine sandy loam. This rests on brownish-yellow fine sandy loam, which, at a depth of 14 to 16 inches, passes into rather loose loamy fine sand of the same color. With increase in depth this material becomes somewhat gravelly and the color changes to grayish yellow. It passes into dark-gray bedded sand and gravel from 20 to 24 inches below the surface.

In forested areas, beneath the 3- or 4-inch duff layer there is a 1- to 3-inch light-gray leached layer, which rests on rust-brown mellow or fluffy loam having a high content of colloidal organic matter. At a depth of about 6 or 7 inches this passes into brownish-yellow friable fine sandy loam. At a depth of about 10 to 12 inches this rests on a layer of loamy sand, which is yellow or pale yellow in the upper part and grayish yellow below. Strata of sand and gravel lie below a depth of 18 to 22 inches.

Like Danby fine sandy loam, this soil is developed from glacial outwash material occurring in hillocky kame and esker forms, and it is composed of a large proportion of gray and dark-gray schist. A small quantity of gray calciferous schist and bluish-gray siliceous limestone and other dark-colored rock material, together with some quartzite and other light-colored rock material, give it a dark-gray or pepper-and-salt color. The material consists of water-worn semirounded schist and quartz gravel, quartz sand, and sandy schist grains, together with quartzite cobbles and boulders in the deeper substrata. The comparatively soft schist rock and the limestone material weather more

rapidly and more completely than the more resistant quartz material, leaving the soil a much lighter color in contrast with the parent material or substrata. This contrast in color is greater than that between the Danby soils and their substrata, which are developed from light-gray or grayish-yellow parent material.

The soil is single-grained, and the small quantity of lime once contained in the surface soil has been largely or completely leached to a depth of several feet into the substratum, leaving the surface soil moderately to strongly acid; where the influence of lime was negligible, the reaction is very strongly acid. The deeper substratum generally has a neutral or alkaline reaction, as it contains, in places, accumulated lime that has been leached from above and that now forms a coating around the gravel and stone. In some places from 10 to 15 feet below the surface the gravel and sand deposits are rather firmly cemented with lime.

Dixville fine sandy loam occurs in the northern part of Coos County along streams that rise in or flow through the uplands where the soils are developed from schist till. It is developed on the choppy, rolling, and, in places, steep and higher lying terrace edges, associated with the Colebrook soils that are developed from the same kind of material on the generally lower and more nearly level terrace positions. It is not an extensive soil. The largest areas are just south of Brackett School in Colebrook and near the headwaters of the Mohawk River.

This soil is important locally for crops, and the smoother and even some of the fairly steep slopes are cleared and used for mowing. It occurs in narrow valleys, where dairy and potato farms are on soils of both the rolling uplands and the valleys. Potatoes and small grains are grown on the less steep lands, and mowings are concentrated on the soils of stronger relief. The comparatively high content of fine material in this soil and in the substrata gives it a fair to good moisture-holding capacity that insures good yields of hay even in dry years. Usually hay is mature before the driest part of the summer. The land, when plowed to renew hay sods, is seeded to oats, buckwheat, or millet and soybeans and is fertilized to some extent. Manure and some lime are applied in sufficient quantities to maintain it at a high level of production. Yields of timothy and clover hay are about  $1\frac{1}{2}$  to 2 tons an acre or, in places, higher. Small grains are sometimes allowed to mature, but usually they are cut for hay, giving yields of 1 to 2 tons an acre.

Forested areas support good stands of second-growth yellow and white birch, hard maple, and some spruce, fir, hemlock, beech, and popple. Some areas included in pasture support a fair to good blue-grass sod, together with some white clover, redtop, and native grasses.

About 1 square mile of stony Dixville fine sandy loam is shown on the map by stone symbols, as in the areas northeast of North Stratford. Areas of the stony soil and the typical soil occur in close proximity or in the same general localities, but the stony areas are not suitable for cultivation. The stony soil is used in part for pasture, but it remains largely in forest of the same kinds of trees as on the stone-free soil. Pastures have a fair carrying capacity, but the stones and some brush reduce the pasturage available.

**Danby loamy sand.**—Danby loamy sand has the most pronounced development of a profile of any soil in Coos County. It is severely

leached and is strongly to very strongly acid. Podzolic soil-development processes have progressed far enough to cause more or less induration in the subsoil in nearly all the areas. Induration is not consistent enough, however, to produce a continuous hardpan except in spots. Moisture and roots of trees penetrate the subsoil fairly readily in most places, but here and there roots concentrate above and around the hard spots.

In forested areas, beneath the 3- to 5-inch duff layer, the soil is light-gray loamy sand to a depth of 4 to 6 or more inches. The upper part of the subsoil is dark rust-brown loam containing a fairly large proportion of colloidal organic matter that is firm or lightly indurated in place but breaks into a loose fluffy mass with slight pressure. This material, at a depth of 10 to 12 inches, grades into firm or slightly to strongly indurated yellow-brown loamy sand that breaks into a structureless mass when pressed in the hand. At a depth of about 16 inches this sand passes into yellow or pale-yellow structureless loamy sand containing some gravel, and it is only slightly, if at all, indurated. At a depth of 28 or 30 inches this material passes into gray incoherent sand and gravel.

Under cultivation the duff and the gray layer and part of the brown layer become mixed, producing a grayish-brown, light-brown, or brown loamy sand surface soil, 6 to 8 inches thick, that rests on the 1- to 4-inch remnant of the rust-brown layer. Below this the brownish-yellow and yellow subsoil is the same as that of the soil in forested areas. In a few small areas the gray surface layer is 8 or more inches thick, so that plowing has not mixed it with the rust-brown layer. Under such conditions the cultivated surface soil is grayish brown or light brown, depending on the quantity of organic matter incorporated in it.

Danby loamy sand occurs in fairly large widely separated areas mainly in the southern half of the county, including variations with sand subsoils and areas containing stone. The largest areas are in Whitefield on high terraces of the Johns River, and in Stratford along Stratford Bog Brook, along Clear Stream, and along the Upper Ammonoosuc, Ammonoosuc, and Peabody Rivers. The relief is billowy or choppy to strongly rolling like that of Danby and Dixville fine sandy loams. The loose surface soil absorbs water readily, allowing little or no run-off of rain water, and the water moves rapidly down through the subsoil and substrata.

About 25 percent of this soil is cleared and included in pasture, and a few small areas of the smoother parts are used for mowing. Pastures generally contain much hardhack, brush, and some white pine. The grass is of poor quality and becomes short in summer. Hay yields about 1 ton or less to the acre, but when amendments are applied freely it yields about 1½ tons.

In a small area of Danby loamy sand the subsoil consists of sand rather than gravel and sand. In places this variation is associated with typical Danby loamy sand, whereas in small valleys it is more or less widely separated from the typical soil. The largest areas are south of Bretton Woods, along Mollidgewock Brook in Errol and Cambridge, and in Stratford, occurring as elongated narrow terrace edges extending from a point near Stratford village to North Stratford. These narrow terrace edges are in reality broken phases of

Colton loamy sand, with which they are associated, and would be separated as such if they were more extensive. The soil is more like the hillocky kame soils than those on terraces and for this reason was included with Danby loamy sand. Owing to the isolation of some of the larger areas of this inclusion and the broken relief of the terrace edges, very little of the land is cleared. Some small areas are now in brushy pasture. Timbered areas support, for the most part, good second-growth stands of hard maple, white birch, popple, some white pine, and some yellow birch, spruce, and fir—the last three where the soil occurs in the higher valleys.

Danby loamy sand, as mapped, also includes an area of about  $7\frac{1}{2}$  square miles of a stony soil, indicated on the map with stone symbols. This stony inclusion has the same color profile as typical Danby loamy sand, with which it is associated and from which it differs mainly in the presence of numerous granite, gneiss, and quartzite cobbles and boulders on the surface and embedded in the soil. The subsoil is variable, including both sandy and gravelly material, and in places large boulders are present in the subsoil and substrata. In Dixville, Stark, Shelburne, and Carroll the stony and cobbly outwash almost completely fills the valleys. Such material once blocked the valley of Stratford Bog Brook, but the stream has cut through, leaving the soil on the steep valley wall some 200 to 300 feet up the slope. The soil for the most part remains in timber and supports good second-growth stands of spruce, fir, yellow birch, and hard maple in the higher valleys and white birch, popple, hard maple, and white pine at the lower elevations. Some areas in brushy pasture support only fair to poor sod.

**Dixville loamy fine sand.**—Dixville loamy fine sand is a light-textured soil developed in dark-colored outwash material on kames that border the valleys in the northern part of Coos County. It occurs mainly along the Mohawk River, Bishop Brook, and the Connecticut River as far south as Meriden Hill in Columbia.

The areas mapped along Bishop Brook are sandy in the subsoil and substrata. In the vicinity of Meriden Hill some areas are billowy and gently rolling and some form steep valley walls. One area near Cone School is very stony. The main body of this soil, in the vicinity of Dixville Notch, is on a shallow to fairly deep outwash deposit that is laid down on a steeply sloping or rolling till area. In places the outwash deposit is a veneer of sand and gravel over till; in others mounds and knolls of the outwash material are interspersed with till and boulder outcrops. The large area near Dixville Notch was once used for mowing and pasture, but it is now used as a golf course and recreational area for summer guests of a hotel at Dixville Notch. Most of the other areas are cleared and used for pasture, not because of any special adaptation to grass, but because of their inclusion in pasture areas mainly on other soils. The smoother areas in the vicinity of Meriden Hill and along Bishop Brook are used in part for mowing. Under good management these areas give yields of about 1 ton of hay an acre.

Like Dixville fine sandy loam, Dixville loamy fine sand is medium to strongly acid, contains a large proportion of fine schist material, and has fair to good moisture-holding capacity. Its inherent fertility is considerably above that of the Danby soils.

**Windsor fine sand.**—Windsor fine sand is dominantly stony, but about 25 percent of it is nonstony. It occurs mainly in small widely scattered areas of wind-blown sandy material along the high terrace edges of the Connecticut River, banked against or as a sandy covering over the low hills along the valley edge, and extending northward from Coos Junction in Lancaster to the southern edge of Stratford. Other small patches occur along the east side of the Androscoggin River between Berlin and Milan, and one fairly large area is 3 miles west of Crystal in Stark.

The wind-blown material was originally deposited as a thin covering of fine sands over gravelly kames and glacial till. The sand has lain long enough to have a profile similar to that of the light-textured Danby soils, but it is not nearly so deep. A sample of this soil taken in a pasture had profile characteristics as follows: About 3 inches of structureless gray fine sand, bound firmly in place by grass roots; rust-brown loose loamy fine sand; and, at a depth of 10 inches, pale-yellow fine sand, which continues downward to bedrock or till material only a few feet below the surface. In other places the depth to glacial till or gravelly kame material is 3 to 10 feet. In places large boulders and bedrock protrude above the surface.

Nearly all of this soil lies adjacent to valley farmsteads, and most of it has been cleared and is included in pasture. Overgrazing and trampling by livestock have started numerous blow-outs, and in several places run-off from the adjacent hills is further mutilating the soil. In one area in the vicinity of Milan where the land is fairly smooth and was cultivated at one time, the soil and even the parent sand have been blown off to a depth of 3 to 4 feet, and the material has drifted in the edge of nearby woods. Only a few years ago this area was planted to white pine and red pine, and at the time the county was mapped (1937-38) the trees were 3 to 6 feet in height and had checked the blowing sufficiently for 50 percent of the land to be covered with weeds and grass. The soil is so loose and so low in fertility that it is hardly capable of supporting a sod that livestock will not trample out. Roots of trees, however, penetrate deeply enough to get an adequate supply of moisture and plant nutrients to develop normally. White pine seems to do especially well.

**Danby gravelly fine sandy loam.**—Danby gravelly fine sandy loam occupies the high outer edges of the valley areas and for the most part is associated with Danby fine sandy loam. It has the same kind of choppy and rolling relief as that soil but contains an abundance of gravel throughout. There is little or no run-off of rain water, and underdrainage is very rapid.

A few comparatively large areas are in Milan, Stark, and Shelburne, and there are numerous widely separated small areas. The land remains largely in forest, except for parts of it in Stark and Shelburne, which are cleared and used for pasture and for growing a home supply of potatoes and other vegetables. Several small farms, chiefly of the subsistence type, are located on this soil in Stark, whereas the cleared areas in Shelburne are used almost entirely for pasture in connection with dairy farms situated on the terraces and bottoms of the Androscoggin River.

Amendments are applied sparingly on most of the land where grain is grown for hay, and yields of hay average little if any more than 1

ton an acre. Pastures are fairly good in spring, but they become short in summer, because of an insufficient supply of moisture. The forested areas support good second-growth timber, mainly white birch, hard maple, popple, and white pine, together with some spruce, fir, and hemlock. On areas in Shelburne, adjacent to the Maine State line, there are some red pines and a few red oak trees growing on this soil.

Danby gravelly fine sandy loam, as mapped, includes widely separated small areas of stony soils, associated with typical Danby gravelly fine sandy loam, along nearly all the valleys in the southern half of the county. This inclusion is indicated on the map by stone symbols. The largest of these are at the valley head of the Israel River in Jefferson and at the head of the Upper Ammonoosuc River in Berlin. Areas of this gravelly, cobbly, and stony outwash material and other stony Danby soils almost completely fill the valley, and in places the soil extends 200 to 300 feet up the sides of the valley where it is very stony. This inclusion has the characteristic gray leached mineral surface soil and brown and yellow subsoil layers of the other Danby soils, but the sand is more abundant, coarser, and more gritty throughout than in typical Danby gravelly fine sandy loam. Even where it occurs in valley areas that are largely farmed, this inclusion has little value except for growing timber. The gravelly and stony character of the soil, its choppy and rolling relief, and its low moisture-holding capacity make it unsuited even for pasture. Excellent stands of indigenous trees cover most of this land. Spruce and fir predominate in the higher valleys and white pine and popple at the lower elevations.

**Dixville gravelly fine sandy loam.**—Dixville gravelly fine sandy loam is for the most part forested. Beneath the forest litter or duff is a 2- or 3-inch light-gray leached layer of gravelly fine sandy loam containing considerable rounded schist and quartzite gravel. This rests on a dark-brown or rust-brown gravelly loam layer. At a depth of 9 or 10 inches this material changes to brownish-yellow gravelly loamy sand, which becomes yellower with depth, and at a depth of about 20 to 24 inches passes into yellowish-gray gravelly and cobbly loamy sand. From 30 to 40 inches below the surface are dark-gray or mixed light- and dark-colored outwash sand, gravel, and cobbles, made up of about 75 percent of dark-colored rocks. Like the Colebrook soils and other Dixville soils, this soil has some lime in the deep substratum. The soil proper is leached and is medium to strongly acid in reaction. Deposits of this gravelly material are much sought after as local road metal because of certain qualities that cause it to bind firmly and form a good road surface.

This soil is not extensive. It includes all the gravelly soils developed on kames and eskers from dark-colored gravel. The surface ranges from comparatively smooth and hummocky to strongly rolling and steep. The soil occurs mainly on terraces of the Connecticut and Mohawk Rivers and Bishop Brook in Columbia, Colebrook, and Stewartstown and in widely scattered areas in Clarksville and Pittsburg. Some of the smoother and less gravelly areas along Bishop Brook and the Mohawk River are used for mowing, yielding about 1½ tons an acre of timothy and clover hay.

#### SOILS OF THE ROLLING UPLANDS

The soils of the rolling uplands range in elevation from 1,000 to 1,500 feet above sea level in the southwestern part of the county. The

elevation increases gradually northeastward until it reaches nearly 2,800 feet above sea level in the northeastern part. The soils are derived from glacial till accumulated from granite, gneiss, schist, and some limestone or calcareous schist.

The land for the most part is gently rolling to strongly rolling, although some areas are fairly steep. The soils range from moderately stony to very stony. Where stone has been removed to facilitate cultivation and mowing, the areas are mapped as stone free. Under forest vegetation the soils have a thick mat of peatlike duff and forest litter, but little humus is incorporated in the mineral part of the soil. As a result of this they are low in lime, and they are naturally low in nitrogen and other necessary plant nutrients. Inherently the soils have low fertility, but because of favorable texture, good structure, and the absence of severe leaching they lend themselves readily to soil management and improvement practices and can be made very productive.

Because of high elevations and northerly latitudes, crop adaptations are restricted. Even in the more favorable situations at the lower elevations corn does not always mature, therefore the small amount planted is used for silage or coarse forage. Because of the small size of farms, the uneven surface, and the presence of stones, which do not allow the general use of improved harvesting machinery, the production of small grain is not profitable. With all other factors favorable, the short growing season would make the growing of grain at higher elevations uncertain because of danger of frost before maturity. A cool climate, together with a high rainfall, especially favors the growing of grass and the quick maturing of hay crops and potatoes. For these reasons the rolling uplands are best suited to a grazing and hay economy. This, together with a ready market for dairy products, has resulted in the development of dairy farming as the chief agricultural enterprise in the uplands.

The land furnishes excellent grazing for about 5 months each year, and little or no supplementary feeding is required during this period. Hay from about 2 or 3 acres, supplemented by grain (purchased), meets the winter feeding requirements for each dairy cow. The increasing use of legumes in the hay mixture or legumes alone cuts the grain protein requirements and adds to soil improvement. Potatoes fit in well with the dairy-farm crop rotation and add to the cash income. Isolation of certain areas is a greater drawback to their use for farming than a lack of productive possibilities.

Soils of the rolling uplands in the southern half of the county belong mainly to the Hermon, Becket, Canaan, and Peru series and are developed over till composed largely of granite, gneiss, and coarse crystalline rocks. A large proportion of the soils are fine sandy loams, with varying proportions of stone. In the northern half most of the soils are included in the Berkshire, Lyman, Woodbridge, Greensboro, and Peru series. Textures of surface soils range from fine sandy loam to silt loam. Members of the Berkshire, Lyman, and Woodbridge series are developed on till deposits consisting mainly of schist material. The parent materials of the Greensboro soils also include much noncalcareous schist but in addition include some calcareous schist and nearly pure limestone. The Greensboro soils are

developed on glacial till over or in close association with bedrock having a high lime content.

On the basis of natural land-use suitability, the various types and phases of these soils can be classed as (1) nonstony well-drained soils suitable for crops, (2) imperfectly drained soils suitable for pasture and hay, (3) stony well-drained soils suitable for pasture, (4) stony imperfectly drained soils suitable for pasture, and (5) stony soils suitable only for forestry.

The nonstony soils are sufficiently cleared of stone to allow the use of farm machinery. Soils with rolling relief are subject to sheet and shallow gully erosion when planted to cultivated crops several years in succession. At present the type of farming and the length of rotation are such that erosion is not a major problem, but on a number of fields erosion has begun.

The stony soils are suited mainly to pasture. Soils classed as stony are devoted to hay on some farms, and some of the stones have been removed to facilitate mowing. Stony soils of steep areas have some value for pasture but are suitable mainly for forestry.

#### NONSTONY WELL-DRAINED SOILS SUITABLE FOR CROPS

The nonstony well-drained soils suitable for crops are Hermon fine sandy loam; Hermon fine sandy loam, slope phase; Becket loam; Berkshire loam; Berkshire loam, smooth phase; Lyman loam; Lyman loam, smooth phase; Woodbridge silt loam; Greensboro loam; Greensboro loam, smooth phase; Greensboro fine sandy loam; and Greensboro fine sandy loam, smooth phase. Most of the areas are gently rolling, but some are strongly rolling. These soils produce all the potatoes, most of the hay, and the small quantity of grains grown on the farms of the uplands.

In the vicinity of Colebrook some of the most stable agricultural and most prosperous appearing farms occupy areas of Berkshire and Greensboro soils. These soils have mellow friable surface soils, subsoils of good moisture-holding capacity, and a fair quantity of organic matter incorporated in the surface layer. Woodbridge silt loam and Becket loam have compact hardpanlike lower subsoil layers that check the downward movement of water and restrict the penetration of plant roots. Surface drainage is good, and most crops develop normally. The soils warm late in the spring and are used mainly for mowing. The Lyman soils are developed on shallow deposits of till over bedrock, and in places the bedrock protrudes above the surface. In seasons of low rainfall they become droughty. Only the included areas of deeper soil are used for cultivated crops, and most of the land is used for mowing, as dry periods during midsummer seldom materially affect yields of perennial hay crops.

Most of the soils of this subgroup are well suited to the growing of potatoes, and this crop seems to develop more normally and gives more satisfactory results with less injury from insect pests and disease than is usual on the best of the valley lands. With careful selection of fields and good management, some farms have given average yields of 300 bushels or more to the acre, with maximum yields of 400 to 500 bushels.

**Hermon fine sandy loam.**—The 6- to 8-inch surface soil of Hermon fine sandy loam is brown mellow loose fine sandy loam, which rests

on yellowish-brown fine sandy loam of the same consistence. At a depth of about 12 inches this passes into yellow fine sandy loam, which grades into pale-yellow firm but friable fine sandy loam at a depth of about 18 inches. This material continues to a depth of 24 to 26 inches, where it passes into gray or yellowish-gray firm or slightly compact gritty sandy loam glacial till that is slightly weathered. The surface layer is generally only medium to strongly acid, whereas the subsurface layer and the subsoil are very strongly acid and the substratum is strongly acid. Sod and manure that are plowed under supply the soil moderately well with organic matter. Favorable texture allows water to penetrate readily, and a good supply is retained for the use of plants. Plant roots penetrate the soil easily. Although there are many rock fragments and large stones below plow depth, most of the large stones have been worked out of the surface soil and removed from the fields.

Under forest conditions there is a comparatively thick covering of duff, or raw humus of leaves and plant remains, which is rather well decomposed just above the mineral soil. This covering is dark brown and is somewhat mixed with mineral soil. Beneath this is a light-gray or almost white leached very strongly acid fine sandy loam or loamy fine sand layer, 2 to 4 inches thick, which rests on very dark brown (coffee-brown) very strongly acid loam containing considerable very finely divided organic material. This layer becomes lighter in color with depth, and from 6 to 8 inches below the surface it grades into brownish-yellow fine sandy loam that is less acid than the material in the layer above. Mixing of the light-gray and dark-brown surface layers through plowing gives the soil its brown color in plowed fields.

Although classed as a nonstony soil, Hermon fine sandy loam in some places includes soils that have a number of stones on the surface or large embedded boulders that protrude above the surface. The stone content of these included soils, however, is not sufficient to interfere materially with tillage and mowing. Loose stones that are brought to the surface at the time of plowing are removed from the land before crops are planted or before the land is again seeded to grass.

Hermon fine sandy loam includes comparatively large areas of stone-free or nearly stone-free soils in Lancaster, Jefferson, Whitefield, and Dalton on the gently rolling uplands adjacent to the Connecticut River Valley and its larger tributaries in the southwestern part of the county. Small widely separated areas occur throughout the southern and east-central parts.

This soil occurs in areas of gentle relief, from which the stone has been removed to facilitate farming operations. None of it could have been classed as nonstony before clearing, but all of it once ranged from moderately stony to very stony. Fields surrounded by very large stone fences show evidence that the soils originally were very stony.

The soil is developed over rather deep deposits of glacial till composed mainly of granite and gneiss. Its original condition was not different from that of the adjoining extensive areas of Hermon stony fine sandy loam that remain in forest. Drainage is largely internal. Rainfall is readily absorbed, and the water reappears as seep springs

around drain heads and at the foot of slopes along streams that thoroughly dissect the land.

The original timber covering on this land was of the mixed conifer-hardwood type and consisted of the several varieties of birch and maple, together with some spruce, fir, hemlock, and white pine. Probably the hardwoods predominated.

Nearly all of the land is used for crops that support dairy farming—mainly hay, together with some oats, and corn for silage—and some farms have a small acreage in potatoes. This soil represents all or nearly all of the mowing on many farms and receives amendments of manure regularly and some lime. For oats the land usually receives some fertilizer, for corn 400 to 600 pounds an acre, and for potatoes it is still more heavily fertilized.

In the southern part of the county Hermon fine sandy loam supports some of the most stable agriculture of the rolling uplands. Dairying has been adapted to meet conditions of comparatively high altitude—1,200 to 1,800 feet—and short growing season, as well as certain economic changes that have affected the area during the last 50 years. As all forage crops produced on the land and some purchased grains are fed to cattle, the land has benefited from the manure returned to it, and the plowing under of sod gives it an average crop production higher than would be expected from land of originally low fertility.

Yields of timothy and clover hay are about 1 to 1½ tons an acre, oats 30 to 50 bushels, and corn (silage) about 15 tons, with maximum yields of 20 tons or more when fertilizer and heavy applications of manure are used. Some of the oats are cut for forage, yielding 1 to 1½ tons an acre. The growing of soybeans and millet to take the place of oats in the rotation is the practice on some farms, and yields are about the same as those of timothy and clover. Potatoes average about 200 to 250 bushels an acre.

Because it is level and permeable, Hermon fine sandy loam is not subject to serious erosion.

**Hermon fine sandy loam, slope phase.**—A small area of Hermon fine sandy loam, slope phase, is separated on the map from the typical soil because of its stronger relief, which modifies the use value. If plowed frequently the soil becomes rather loose, and if cultivated 2 or 3 years in succession it is subject to a certain degree of erosion because of run-off during periods of heavy rainfall. Because of the comparatively steep slopes, tillage operations are more difficult than on the typical soil; therefore plowing is done only when it is necessary to renew mowing, for which the land is largely used. Under the same management, hay yields are about the same as on the normal fine sandy loam; but as a whole this soil probably receives fewer amendments, with the result that yields average slightly lower.

**Becket loam.**—In cultivated fields Becket loam to plow depth—6 to 8 inches—is brown or dark-brown loose mellow loam, which rests on brownish-yellow or yellowish-brown loam of the same consistence. This material extends to a depth of about 12 inches, where it grades into pale-yellow firm loam that is streaked or stained with rust brown in places. At a depth of about 20 to 22 inches this material in turn passes into gray or yellowish-gray gritty loam or heavy sandy loam that is slightly compact or firm in place and has a weakly laminated

structure. This layer at a depth of 28 or 30 inches changes to gray hard and compact gritty till that has a definite laminated or platy structure.

The soil generally is medium to strongly acid throughout but may become only slightly acid from lime contained in the manures. The compact subsoil does not completely check the downward movement of moisture, but it holds a good supply for growing crops. Roots do not penetrate the compact till so readily as they do the Hermon subsoil. In wet seasons there is some lateral movement of water along the hard layer and seep spots develop along the lower slopes and in depressions.

Becket loam is not so severely leached as Hermon fine sandy loam. Under forest conditions the light-gray layer in few places exceeds 1 inch in thickness and in some places is absent or is present only as a mere film. In spots it is replaced by a dark-gray layer containing some finely divided organic matter. Beneath this weakly developed gray layer is a dark-brown layer, which extends to a depth of 6 to 8 inches, where it grades into the brownish-yellow or yellowish-brown subsoil.

Becket loam, like Hermon fine sandy loam, originally was a stony soil. Many of the stones have been removed, and the remaining ones do not interfere materially with tillage operations and mowing.

Some areas included with Becket loam show variations in soil texture and soil material, but these variations are of minor importance and do not extend over large areas. The distinguishing characteristic of the Becket soils—the compact substratum—is present and well developed in the included soils. Areas mapped on Cates Hill in Berlin have sandy loam or light loam surface soils containing considerable medium sand and coarse sand. In the vicinity of First Connecticut Lake the glacial till is composed of finely ground schist and fine-textured quartzite fragments. Here the soil has a thicker gray layer than is average, and the substratum is very fine sandy loam or silt loam in texture. It is olive green or greenish yellow, like the Woodbridge soils. This included soil has a much more strongly developed light-gray mineral surface soil than the Woodbridge soils.

Included with the normally gently rolling or sloping areas of Becket loam are a few small rolling or rather steeply sloping areas, which would be separated as Becket loam, slope phase, if they were of greater total extent.

Becket loam is not an extensive soil. It occurs in widely separated small areas associated with Becket stony loam and represents fields that have been cleared of stone. It is most common in Berlin, Milan, Lancaster, and Dalton. It is developed on till, largely of granite and gneiss origin, much the same in composition as the parent material of the Hermon soils, and it occurs on the western and north-western slopes of the higher rolling uplands. Becket loam extends over the tops of the lower hills in the vicinity of the Hermon soils, apparently where the glacier exerted great pressure to bring about the hard or compact condition of the till over which it is developed. Surface drainage is good, and internal drainage is slow though adequate for the most part.

Because of slow underdrainage, the soil dries out and warms slowly in the spring, but it is not sufficiently cold to retard greatly the growth and development of crops. It is used for the production of crops that support dairy farming and to a limited extent for growing potatoes in the dairy-farm crop rotation. Hay sod usually holds up longer without renewing than on the associated Hermon fine sandy loam, and the clover content of hay is usually greater on the unlimed land than on unlimed Hermon soils. Hay sods that have been renewed not more than three or four times in the nearly 50 years that some of this land has been farmed still produce an average acre yield of about  $1\frac{1}{2}$  tons and a maximum yield of 2 tons or more with no amendments except manure. With an application of half a ton or more of 8-16-14 fertilizer, or its equivalent, potatoes yield 225 to 300 bushels an acre. Oats usually are cut for hay. All the land is used for crops.

**Berkshire loam.**—Berkshire loam is a nonstony soil because the stones have been removed from the land. Under forest conditions, beneath the duff or raw humus, this soil has a well-defined light-gray layer of loam or fine sandy loam 2 or 3 inches thick, which overlies a dark-brown or coffee-brown loam layer, about 1 or 2 inches thick. This grades into rust-brown loam. At a depth of 6 to 8 inches this material, in turn, grades into yellowish-brown loam. Under cultivation the light-gray, dark-brown, and rust-brown layers are mixed to form a brown or dark-brown mellow loam surface soil to plow depth—6 or 7 inches. Under good cultural practices the plow layer may have a soft-crumb structure. It rests on brownish-yellow loose friable loam that grades, at a depth of about 12 inches, into olive-yellow or greenish-yellow somewhat heavy firm loam or silt loam without definite structure. This material grades into greenish-gray firm or slightly compact but friable gritty loam at a depth of 18 to 22 inches. The subsoil and substratum contain many stones and boulders, mainly of the different kinds of schist and some fine-grained quartzite, granite, and gneiss.

In the natural state the light-gray surface soil is extremely acid, the subsoil layers are very strongly acid, and the substratum is strongly acid. Alkaline earth compounds released by the decay of organic matter plowed under on areas that are farmed reduce the acidity of the surface soil to a certain extent, and soils in cultivated fields generally give only a strongly acid reaction.

Because of favorable texture and consistence, Berkshire loam absorbs water readily and retains a sufficient supply within reach of plant roots to insure good development of crops. Roots penetrate the soil easily.

In Pittsburg a few small areas of Berkshire silt loam are included, and in the vicinity of Kitterville in Colebrook the surface soil is light gritty loam and the subsoil is sandy loam over greenish-gray gritty sandy glacial till. These variations are not of sufficient extent to separate as different types.

Berkshire loam covers a small total area, mainly in the northern rolling uplands section of the county. The soil is developed in rolling areas over glacial till derived mainly from schist and other fine-textured rocks. Surface drainage is rapid at times of heavy rainfall, and internal drainage is good. The largest areas and nu-

merous small ones are in Colebrook, Columbia, and Stewartstown; and there are widely separated small areas in Pittsburg, Clarksville, and Dixville. One area is near the Connecticut River in the extreme southwestern corner of the county adjoining the Coos-Grafton County line.

This soil is used mainly for mowing to support dairy farming. Sodshold up well, and the land is seldom plowed except for reseeding. Oats, barley, or buckwheat are planted as nurse crops for the newly seeded hay. In favorable seasons these crops are allowed to mature for grain; otherwise they are cut for hay. At times some of the smoother areas of included soils are plowed and planted to potatoes before they are again seeded to grass. Most of the land receives amendments of manure every 2 or 3 years, or at least once in the rotation. Yields of timothy and clover hay average about  $1\frac{1}{2}$  tons an acre, potatoes 200 to 250 bushels, oats 30 to 50 bushels, and barley 20 to 30 bushels.

Since some of the steeper areas are difficult to mow and till, and because they tend to erode under cultivation, they have been converted into pasture. A few areas in Pittsburg support subsistence homesteads, and the owners obtain their cash income from guiding hunting and fishing parties and from work in the forest.

**Berkshire loam, smooth phase.**—Berkshire loam, smooth phase, is separated from the typical soil because of the gentler relief, which makes it better adapted to tillage. As the total area is small, this soil is important only locally. Some of the leading dairy and potato farms in Columbia and Colebrook are situated on this soil and are among the most stable farms of the rolling uplands. They are about as good as the best farms in the valleys. Rather large dairy herds are kept on these farms, and the cattle are grazed on the adjacent stony lands. The smoother lands are maintained in a short rotation, which, with the use of amendments and the inclusion of legumes, keeps the land near maximum production. Mowings contain a large proportion of clover and yield about  $1\frac{1}{2}$  to 2 tons of hay an acre in the first cutting and in favorable years about 1 ton in a second cutting. Potatoes, when applications of  $\frac{1}{2}$  to 1 ton of 4-8-7 fertilizer or its equivalent are applied to the land, yield 250 to 350 bushels an acre.

**Lyman loam.**—Lyman loam probably includes the only soil of the rolling uplands in Coos County that in its original state would not be classed as stony. Some of this soil had very little loose stone on it; consequently it was cleared of timber, and most of it at one time was used for growing hay.

Lyman loam is developed on shallow till deposits over bedrock, which outcrops in places, and a few rock ledges stand several feet above the surface of the land. The parent material is largely schist.

Where bedrock lies 2 feet or more below the surface, development of the soil does not differ much from that of Berkshire loam. Under virgin conditions the gray surface layer, so uniformly developed in the Berkshire soils, is absent in many places or is only incipiently developed between the duff and the 4- to 6-inch brown layer. Below this is a yellowish-brown and olive or greenish-yellow subsoil similar to that of Berkshire loam.

In cultivated fields the surface soil to plow depth—6 or 7 inches—is brown mellow loam. This grades into brownish-yellow loam,

which at a depth of 12 or 14 inches passes into olive or greenish-yellow loam. This material extends to bedrock at a depth of 18 to 20 inches, or in the deeper deposits grades into greenish-gray gritty loam till.

Lyman loam occurs in areas where there has been some abandonment or consolidation of farms, and only the included less steep soils are used for mowing. It is managed in much the same way as Lyman loam, smooth phase, and hay yields on the two soils are comparable. Pastures furnish fair grazing for a good part of the summer. For late summer and fall pasturage cattle are turned on the mowings.

**Lyman loam, smooth phase.**—Lyman loam, smooth phase, in all essentials is the same as the normal soil except that it occupies smoother and not such steep areas.

In a belt from 2 to 3 miles wide extending northward from Colebrook through Stewartstown and Clarksville this soil is associated with the Greensboro soils, which are developed on till derived partly from calcareous schist and sandy limestone. The lime influence on the Lyman soils is so weak that it has largely been dissipated through complete leaching of the shallow till deposits. In places the influence of sandy limestone has given Lyman loam, smooth phase, a light loam or fine sandy loam surface soil and correspondingly lighter textures in the subsoil. Some of the shallow deposits rest on the brown decomposed sand residue of the limestone, from which all the lime has been leached.

Originally some of the shallow Lyman soils had considerably fewer loose surface stones than the Hermon soils and most of the Berkshire soils, and the problem of clearing was less. This is probably the reason why a comparatively large proportion of this land was used for crops in spite of the shallow soil.

Lyman loam, smooth phase, has a small total area. It has a milder, more gently rolling relief than typical Lyman loam. The downward movement of water is checked at bedrock; thence water moves laterally in the soil above the rock and comes to the surface in places to form wet spots. Because of the shallow till and the limited quantity of water the soil can absorb, there is some run-off, but the rate is not sufficient to cause any appreciable loss of soil through erosion.

Not many farms are situated entirely on this soil, as generally there is some more desirable land that can be used for tilled crops; consequently the soil is maintained in mowing with extended rotations. Even with the limiting factors of shallow soil and a possible shortage of moisture, this soil is not maintained at its best producing possibilities, because amendments are little used and sods become thin and run out. Hay yields, mainly timothy and some redtop, probably average less than 1 ton an acre.

**Woodbridge silt loam.**—Woodbridge silt loam occurs in small areas in association with soils that are probably better for general farming soils. The total area is small.

In cultivated fields Woodbridge silt loam to plow depth—6 to 8 inches—is brown or dark grayish-brown silt loam, in most places having a soft crumb structure. This material grades into yellowish-brown or light-brown silt loam that has no definite structure but is friable. At a depth of 12 to 14 inches is dull-gray firm or slightly compact loam that is faintly mottled with brown, rust brown, and light gray and

has an imperfectly laminated structure. This material, at a depth of about 20 inches, rests on gray, hard, very compact platy and vesicular glacial till that is fairly gritty when crumbled. The soil is strongly acid in all layers. The substratum checks but does not entirely stop the downward penetration of water and plant roots. The lateral movement of water above the hard layer causes seep spots on slopes, and in roadside ditches and gullies water may be seen flowing along the surface of the hard layer. In its original condition the soil was stony, but the surface stones were removed after the land was cleared. Considerable buried stone occurs throughout the soil.

Woodbridge silt loam occurs mainly along the west- and northwest-facing slopes and valley walls in the eastern parts of Columbia, Colebrook, and Stewartstown, in positions where the glacier supposedly exerted great pressure as it surged slowly over the hills from the northwest. Geologists suppose that this accounts for the compactness of the glacial till. The soil for the most part occupies comparatively steep or rolling areas and some gently sloping ones. Surface drainage is medium to very rapid. The parent glacial till is composed mainly of fine-textured schist material similar to that of the Berkshire soils, but it is much more compact.

This soil is excellent for hay and pasture but warms too late in the spring for grain crops to mature. Most of it is in mowing, and some of the steeper areas are in pasture. With the usual additions of manure as an amendment, the meadows yield 1½ to 2 tons of timothy and clover hay. Pastures hold up well in summer and support good sods of bluegrass with some admixture of redtop and timothy.

**Greensboro loam.**—Greensboro loam occurs on rolling to comparatively steep slopes. This makes it less desirable for tillage than Greensboro loam, smooth phase, because of the added difficulty of handling farm machinery on the slopes. A small total area is mapped.

Under forested conditions Greensboro loam has a definite Podzol profile, although this is not so deeply developed as in the Berkshire soils with which the Greensboro soil joins. The gray surface layer beneath the forest litter or duff is 1 or 2 inches thick and grades into a dark-brown or coffee-brown layer about 1 inch thick. This material grades into a rust-brown layer about 2 inches thick, which, in turn, grades into the yellowish-brown subsoil. Under cultivation the gray and brown layers lose their identity through mixing, and the brown or dark-brown plow soil rests directly on the yellowish-brown subsurface layer or the upper subsoil layer. Roots and moisture penetrate the soil with ease, and there is always sufficient moisture for the development of crops.

This soil is developed from schist till that has some calciferous or limy schist and siliceous limestone incorporated in the material. It occurs mainly east of a belt of lime-bearing rocks that begins a few miles to the southeast of Colebrook village and extends northward across Colebrook, Stewartstown, and Clarksville.

The movement of the glacier from northwest to southeast across this lime belt incorporated considerable of the lime-bearing rocks with the till. The visible easterly and southerly limits of this lime influence is the boundary that separates the Greensboro soils from the Berkshire soils. The presence or absence of the brown or dark-brown weathered soft remains of calcareous rock fragments or boulders in stone fences or buried in the soil was a deciding factor in mapping the

Greensboro soils. Some of the larger limestone boulders still contain a core of the hard bluish-gray unweathered rock.

Inherent fertility is just as high as it is in the soils of smoother areas, and where the soil is maintained in mowings under the same management yields are as high. The threat of erosion is present if the land is plowed 2 years or more in succession. During the survey several fields were observed on which potatoes had been grown 2 years in succession. During heavy fall rains following the potato harvest the second year the fields were cut out by numerous shallow gullies or rills. Near the foot of the slopes accumulated run-off waters had removed the soil to plow depth in shallow gullies as much as a foot wide. There is little of this kind of farming in practice, but with the increased importance of the potato crop there will probably be a tendency to plow the steeper lands in order to have additional or new land for potatoes. Most of the land is maintained in long rotations in which mowing occupies most of the time. Under such a practice there is little or no accelerated erosion.

**Greensboro loam, smooth phase.**—In cultivated fields the 7- or 8-inch surface soil of Greensboro loam, smooth phase, is brown or dark brown, mellow, and inclined to a weak crumb structure. It is underlain by yellowish-brown loose friable loam. This material, at a depth of about 11 or 12 inches, grades into olive- or greenish-yellow loam of the same structure, which is only 2 or 3 inches thick and grades into greenish-gray firm but friable till. The soil throughout is strongly to very strongly acid.

Included in Greensboro loam, smooth phase, in the vicinity of East Colebrook Church are areas of light loam containing considerable coarse sand that gives the material a gritty feel when rubbed in the hand. In the vicinity of North Hill School in Stewartstown and south of East Columbia Church in Columbia, small areas of Greensboro silt loam are included with this soil, as they are not large enough to separate on the map.

Greensboro loam, smooth phase, occurs only in the eastern part of Columbia, central parts of Colebrook and Stewartstown, and a small part of Clarksville. A small total area of this soil is mapped on the gentler relief of the undulating to gently rolling upland areas in this section.

Practically all this soil is used for the production of crops. On this soil, as well as on some of the smoother Berkshire soils, is developed some of the most stable agriculture of the rolling uplands of the county and of the State. Although not so well suited to the growing of grains, compared with some of the soils of the valley, because of elevation (1,200 to 2,000 feet above sea level), this soil produces equal yields of other crops and higher average yields of potatoes. There are many farms on which dairy farming and potato farming are combined.

Farming is rather intensive, with comparatively short rotations, heavy applications of manure and commercial fertilizer, growing of legumes for hay, and liming of land where this practice will not be unfavorable to potato growing. Because of favorable soil and climatic conditions, some farmers specialize in potato growing and consider dairying as a side line to furnish an outlet for forage crops as a source of manure to keep up soil fertility.

The section in which the Greensboro and associated soils occur is comparatively free from disease and insect pests that affect potatoes, therefore much of the crop is certified for sale as seed potatoes to other sections.

Timothy-and-clover hay yields  $1\frac{1}{2}$  to 2 tons or more an acre, mixed soybean and millet hay about the same, and grains cut for hay slightly lower on the average. Grains harvested are almost negligible, but in favorable years good yields are obtained. Potatoes under average farm practice yield from 200 to 300 bushels an acre; when the potatoes are planted close with additions of fertilizer, yields of 400 bushels are not uncommon; and maximum yields are above 500 bushels.

**Greensboro fine sandy loam.**—Greensboro fine sandy loam occurs in association with the other Greensboro soils in Colebrook and Stewartstown. The soil is derived from weathered schist till containing a small proportion of limestone and calcareous schist material and is in close association with limestone or lime-schist bedrock. The total area is not large, but this soil is important in localities where it occurs. It is mapped in small scattered areas. Under virgin conditions, the soil, like Greensboro loam, has a Podzol profile or successive layers of light gray, dark brown, olive, and greenish gray, respectively, in the surface soil, subsurface soil, subsoil, and substratum.

In cultivated fields the gray and dark-brown layers become mixed, producing a brown mellow fine sandy loam to plow depth—7 or 8 inches. This grades into yellowish-brown or light-brown loam or fine sandy loam, which passes into olive- or greenish-yellow fine sandy loam at a depth of about 12 inches. This material at a depth of 18 to 20 inches grades into greenish-gray fine sandy loam till that is firm in place but not compact. The entire soil is fairly loose and friable and is strongly to very strongly acid.

Fragments and boulders of the limestone and some of the associated calcareous schist, that occur abundantly in the till material, are largely leached or weathered. These materials may hold their form when undisturbed beneath the soil, but when struck a light blow they break into a loose sand or sandlike mass. Only the more resistant schist, quartzite, and granite boulders and stones remain on the land or in the soil as hard stone. These occurred, however, in sufficient quantities to class the soil as stony before the surface stones were removed to facilitate farming operations.

In places the soil rests directly on leached and partly weathered limestone and calcareous schist, which gives it a brown, loose, sandlike substratum at a depth of 18 to 24 inches. In the vicinity of Brackett School some of the included soil has a surface covering of sandy outwash material from a few inches to a foot thick.

Greensboro fine sandy loam occupies rolling areas for the most part and some steep ones. The smoother areas are separated as a smooth phase. Farms situated mainly on the typical rolling land are dairy farms on which a few potatoes are grown for sale. Hay is the main crop, and oats are used as a nurse crop and cut for forage when mowings are renewed. Manure or other amendments are not used regularly. Hay yields from 1 to  $1\frac{1}{2}$  tons an acre. Some of the steeper areas now in pasture furnish only fair grazing. Pastures do not generally do so well on this soil as on most of the soils of the rolling uplands.

**Greensboro fine sandy loam, smooth phase.**—Greensboro fine sandy loam, smooth phase, is separated from the typical soil because of the milder relief, which makes it more readily adapted to tillage and mowing. It differs little from typical Greensboro fine sandy loam in characteristics other than slope. Only a small total area is mapped.

The smooth land is used more for tilled crops than the rolling land, because it is the only soil of mild relief on some farms. Like Greensboro loam, it is used in short rotations. It receives more amendments than the steeper land. Mowing is the main crop, in rotation with potatoes and oats. All yields are slightly below those obtained on Berkshire and Greensboro loams and probably are higher than those on Hermon fine sandy loam.

#### IMPERFECTLY DRAINED SOILS SUITABLE FOR PASTURE AND HAY

Only one soil—Peru loam—is imperfectly drained because of its position. It is suited to pasture and hay crops.

**Peru loam.**—In cultivated fields Peru loam, to a depth of 6 or 7 inches, is brown or dark-brown loam containing a comparatively large quantity of organic matter. It has a weak crumb structure and shows streaks or stains of rust brown. At a depth of about 11 or 12 inches this material grades into yellowish-brown light loam or fine sandy loam mottled with rust brown and some gray, which, in turn, at a depth of about 20 or 22 inches, grades into gray gritty loam or sandy loam till that is intensely mottled with yellow and rust brown.

As mapped, Peru loam is variable within narrow limits as regards drainage and texture. On one extreme it approaches the well-drained Hermon soils and has the beginning of a Podzol soil profile, whereas on the other extreme it grades toward the poorly drained Whitman soils. The texture of the surface soil ranges from heavy loam or silt loam to fine sandy loam in places, but under cultivation the high organic-matter content gives it the physical qualities of a loam. The subsoil has a similar range in texture but in most places is loam or fine sandy loam. The soil is strongly to very strongly acid in all layers.

Peru loam occurs on gentle slopes around drain heads, along the foot of slopes, in shallow basins where surface drainage is slow and underdrainage imperfect or poor, and in places where bedrock or a hard substratum causes a high water table for at least part of the year. Seepage from the higher slopes keeps the subsoil in a semiwet condition for long periods, and in spring and during heavy rains it is largely saturated to the surface. The seepy condition extends well up the fairly steep parts of long slopes to the hills and mountains.

The soil occurs in widely separated small areas in association with all the well-drained upland soils of the county. It is developed from both granitic and schist till and consists of areas of Peru stony loam from which the stones have been removed from the surface. The stones have been cleared away in order to have uniform stone-free fields of regular outline to facilitate mowing. The land is used entirely for mowing and is managed with the surrounding land. Hay, mainly timothy and coarse wild grasses, yields about  $1\frac{1}{2}$  tons an acre. The total area of these widely scattered areas is small.

## STONY WELL-DRAINED SOILS SUITABLE FOR PASTURE

The stony well-drained soils of the rolling uplands suitable for pasture are Hermon stony fine sandy loam; Hermon stony fine sandy loam, slope phase; Becket stony loam; Becket stony loam, slope phase; Canaan stony fine sandy loam; Canaan stony fine sandy loam, smooth phase; Berkshire stony loam; Berkshire stony loam, smooth phase; Berkshire stony silt loam; Lyman stony loam; Woodbridge stony silt loam; Greensboro stony loam; and Greensboro stony loam, smooth phase. The relief ranges from gently to strongly rolling, but the latter condition is dominant.

These soils constitute about one-half of the rolling uplands and are by no means all used for pasture. It is on the soils of this group that there are possibilities for the expansion of agriculture to meet future demands. If the stones were removed, many of the less stony, gently rolling areas could be planted to crops, leaving the steeper parts in pasture. At this time much of the area supports excellent stands of second-growth timber, and some is still in a virgin condition.

The Woodbridge and Becket soils almost equal the Peru and Waumbek soils for pasture because of the compact substratum that retains moisture for the grass roots. The carrying capacity for pasture is fair to average, but during seasons of low rainfall pastures become short and infested with weeds. Owing to shallowness over bedrock, the Canaan and Lyman soils are not so desirable for pasture as the Berkshire, Hermon, and Greensboro soils.

**Hermon stony fine sandy loam.**—Hermon stony fine sandy loam, embracing a total area of 50.5 square miles, occurs in rolling areas, where the relief in general is subdued, or on gentle slopes of the rolling areas. Areas of this soil from which the stone has been removed are now classed as Hermon fine sandy loam and compose the majority of farm land in the rolling uplands in the southern part of the county. The stony fine sandy loam is not extremely stony, and at the comparatively low value at which it is held in the wild state, considerable time or money could be expended in clearing the land of stone without incurring a large total expense.

The present use of this soil is mainly for forestry, although areas adjacent to farms are cleared for pasture. A somewhat larger proportion of the cleared areas is used for mowing than of the soil separated as a slope phase. Some of these stony mowings once had enough large boulders on the surface to be classed as very stony. The smaller stones and boulders were removed from the land, and present tillage operations are carried on around the large boulders that would have to be blasted for removal. A few farms, on which the mowing is limited, situated mainly on this stony land, are marginal or of the subsistence type, and the owners sell a small quantity of milk and depend on work in the forests for most of their cash income.

**Hermon stony fine sandy loam, slope phase.**—Hermon stony fine sandy loam, slope phase, although classed as suitable for pasture, is covered mainly with forest. In the forested areas the surface is covered with a mat of organic matter several inches thick. It consists of forest debris, for the most part firm and partly decomposed and dark brown in the lower part. This rests on a 2- to 5-inch layer of light-gray or nearly white fine sandy loam or loamy fine

sand that is somewhat darkened by incorporated organic matter in the upper part. This material grades abruptly into dark-brown or coffee-brown firm loam that is loose and fluffy when rubbed in the hand and contains a large proportion of colloidal organic matter. At a depth of 6 or 8 inches this material, in turn, grades into rust-brown or yellowish-brown fine sandy loam, and at a depth of 10 or 12 inches this grades into yellow or pale-yellow fine sandy loam that is firm in place but friable. It becomes lighter in color with depth, and at a depth of 20 to 24 inches it grades into gray, firm, or slightly compact but friable, gritty sandy loam glacial till. The soil has no well-defined structure and is very strongly acid in all layers.

The entire soil contains many rock fragments and boulders, mainly of granite and gneiss. An abundance of these rocks on or at the surface makes it highly impracticable to cultivate the soil with improved farm machinery.

On slopes immediately adjacent to the Connecticut and Androscoggin River Valleys the soil contains considerably more sand than is typical. Sand and gravel in places are somewhat segregated in layers and spots through the soil and underlying till, and in other places small areas of mixed till and outwash material having definite kame characteristics are included on the map. On long slopes and adjacent to the Peru soils the till substratum is mottled with pale yellow and rust brown.

Hermon stony fine sandy loam, slope phase, covers a total area of 79.1 square miles and is one of the extensive soils in Lancaster, Whitefield, Dalton, Jefferson, Success, and Milan. Numerous small and large widely separated areas occur in other towns of the southern half of the county and along the eastern side of the county as far north as Errol. Isolated areas occur along the Swift Diamond River and in the Connecticut Lakes section. The soil material in the glacial till of these two areas is mainly from fine-textured quartzite sandstone and approximates very fine sandy loam in texture. The substratum is olive or greenish gray because of some included schist material. Some of the areas along the Swift Diamond River have orange or ochreous-yellow upper subsoil layers similar to those of the Brookfield soils mapped in other counties in New Hampshire. This is because of the incorporation of some pyritiferous schist in the soil material. The pyrite weathers rapidly to form yellow oxides of iron.

For the most part the soil is developed from till composed of granite and gneiss and occurs on rolling or strongly rolling land at elevations of 1,200 to 2,000 feet or more above sea level. Drainage is good and mainly internal, especially under forest conditions, where the thick organic mat acts as an absorbent to hold the rainfall until it can move downward through the soil.

Adjacent to the farms of the rolling uplands, much of this soil is cleared and used for pasture, furnishing fair to good grazing most of the summer. Some of the included soil has had part of the stones removed and is used for mowing, but enough stones remain on the land for it to be classed as stony. The larger stones are left and must be passed around in tillage and mowing operations. Such stony mowing yields about 1 ton or less of timothy or mixed timothy and clover hay to the acre. Forests consist of mixed conifers and hardwoods and some nearly pure stands of each. Conifers, mainly

spruce and fir, are medium-sized and small second-growth trees mixed with similar-sized hardwoods are filling in the more open spaces between large hardwood trees of birch, maple, and beech. Considerable hardwood and softwood pulp and large hardwood timber for lumber are being cut from many acres of this soil. The pulp harvest from timbered land in farms is largely sold cooperatively.

**Becket stony loam.**—About 75 percent of Becket stony loam is in forest. Under forested conditions the soil is covered with a 3- to 5-inch mat of raw humus, composed of leaves and forest litter that is partly decomposed and dark brown in the lower part. The 1- to 2-inch mineral surface soil is gray or gray brown and contains some rather well-decomposed humus. This is underlain by brown or dark-brown loam that extends to a depth of 5 or 6 inches, where it grades into brownish-yellow loam. The material in this layer becomes lighter in color with depth, and at a depth of about 12 inches it is yellow or pale-yellow firm loam or fine sandy loam. This, in turn, at a depth of 20 or 22 inches, grades into rather hard or compact gray gritty till having a platy structure. The soil is single grained and is strongly acid.

The compact substratum acts as a hardpan that hinders the downward penetration of water and plant roots. Many stones and boulders, mainly granite and gneiss, occur throughout the soil and are scattered over the surface in sufficient numbers to interfere materially with or to prevent the use of improved farm machinery.

Becket stony loam embraces a small total area in widely separated bodies in Milan, Stark, Dummer, Lancaster, and Dalton. It occupies west- and northwest-facing slopes and low ridge tops where supposedly the glacier exerted great pressure. Typically, the relief is gently rolling. Strongly rolling and steep areas are separated as phases. This soil is developed from granite and gneiss till. Surface drainage is good, and internal drainage is slow. About 25 percent of the land is cleared and used for pasture in connection with dairy farms.

Its compact substratum holds an abundance of moisture near the surface, pasture grasses grow well throughout the summer, and the land has a higher carrying capacity than the associated soils having more open and loose substrata. Some small areas, used for mowing, have had part of the stone removed from the land in order to facilitate haying operations. Hay, mainly timothy, yields about 1 ton an acre. Forested areas support good stands of second-growth birch, maple, and other hardwoods, as well as spruce, fir, and some hemlock and beech. Some areas support many large hardwood trees that are rather widely spaced.

**Becket stony loam, slope phase.**—Becket stony loam, slope phase, occupies the more rolling or steeply sloping areas in association with Becket stony loam. Because of stronger relief and rapid run-off of rain water, it is less desirable for pastures. The hard substratum does not allow ready absorption of water; consequently there is danger of erosion if the land is cultivated.

The soil is very little if any different from Becket stony loam on the smoother slopes, except probably that the light-gray or leached surface layer is better defined and a little more continuous.

The total area of this soil is small. It is not used as much as the typical soil for pasture and not at all for crops because less sloping

land is available in sections where it occurs. Areas in pasture apparently have just as high carrying capacity as the more gently sloping areas of the typical soil.

**Canaan stony fine sandy loam.**—The soil material and the soil development of Canaan stony fine sandy loam are essentially like those features of Hermon stony fine sandy loam, with which the Canaan soil is closely associated, except that the glacial till is much shallower. Beneath the forest litter is a well-defined light-gray layer of loamy fine sand 1 to 4 inches thick, which is underlain by dark-brown or rust-brown mellow loam or fine sandy loam without definite structure. At a depth of 6 to 7 inches this material passes into yellowish-brown or yellow friable fine sandy loam that becomes lighter in color with depth, and at a depth of 12 or 14 inches it passes into pale-yellow firm but friable sandy loam or fine sandy loam. At a depth of 20 to 22 inches this grades rather abruptly into gray gritty sandy loam glacial till, which extends to bedrock, in most places no more than 4 feet below the surface. Rock outcrops are common over most of the soil. Immediately adjacent to these outcrops the soil is only 1 to 2 feet thick over bedrock and the brownish-yellow or yellow subsoil rests on the rock. Generally some mottlings or stains of rust brown occur in the layer just above the underlying rock. Embedded and surface stones are mainly granite and gneiss. In some places the bedrock is granite; in others it is schist or gneiss.

Canaan stony fine sandy loam is not an extensive soil. It occurs in widely separated small areas and in some fairly large areas, mainly in the southern part of the county. The land is rolling and is generally surrounded by the Hermon soils, which are developed on deeper deposits of the till. Canaan stony fine sandy loam includes a few steep areas of soils that are shallow over bedrock and that are not of sufficient extent to separate as types or phases. Included also are a few patches of soil from which loose surface stones have been removed in order that the land might be used for crops. The total area of such nearly stone free land is probably not over 200 acres and is of little significance to agriculture. Many of the areas of this soil in Lancaster have been cleared or partly cleared and used for pasture, and some areas, from which part of the loose stones has been removed, are used for mowing. The small acreage of included nearly stone free soils is used in part for oats and potatoes but mainly as mowing. Hay yields about 1 ton an acre, potatoes 200 bushels or less, and oats 20 to 30 bushels. Pastures are fairly good for most of the summer, but they become short during dry seasons where the soil is less than 3 feet thick over bedrock. In normal seasons hay crops seldom suffer from a lack of moisture even on the shallow soils, as the crop matures before the drier summer season. Forests are mainly hardwoods of white and yellow birch, hard maple, and soft maple together with some spruce, fir, hemlock, and white pine. In the vicinity of Prospect Mountain in Lancaster there are some scattered northern red oak trees.

**Canaan stony fine sandy loam, smooth phase.**—Canaan stony fine sandy loam, smooth phase, has a small total area. It is separated from the typical rolling stony fine sandy loam because of the more favorable lay of the land and its greater desirability for pasture or as land more suitable for improvement to be used for crops. The

soil differs little from that on the more rolling relief. Rock outcrops are neither so common nor so massive as on the steeper land, and there are more included spots of soils having a nearly normal Hermon profile.

Approximately 25 to 30 percent of this land is cleared or partly cleared and used for pasture. A number of small patches, where the stones have been removed from the surface soil, are included and would have been mapped as a stone-free soil had they been of greater total extent. These small comparatively stone free areas are used to some extent for growing potatoes and oats but mainly for mowing. All mowings average probably a little more than 1 ton of timothy hay an acre. Some of them include a small quantity of clover.

**Berkshire stony loam.**—Berkshire stony loam is the most extensive soil in the rolling uplands and covers a total area of 106 square miles. Although classed as suitable for pasture, much of this soil lies too far from farms to be used as pasture land, therefore it remains largely in forest. Under forested conditions there is a 4- to 6-inch mat of raw humus on the soil, which represents an accumulation of leaves and forest debris that is loose in the upper part and matted, partly decomposed, and dark brown in the lower part. The mineral surface soil beneath the mat, to a depth of 2 to 4 inches, is light-gray loose loamy fine sand or fine sandy loam, somewhat darkened in the upper part by incorporated humus. This material rests on a 1- or 2-inch layer of dark-brown or coffee-brown firm loam or silt loam that breaks into a loose fluffy mass. Below this is an equally thick layer of dark-brown or rust-brown mellow loam without definite structure. At a depth of 5 to 7 inches this material changes to yellowish-brown friable loam, having a somewhat olive or greenish-yellow tinge and the same structure as the material above. This, in turn, grades, at a depth of 12 to 14 inches, into olive or greenish-yellow firm but friable loam, also without definite structure. At a depth of 20 to 22 inches is greenish-gray firm or slightly compact glacial till. Water and plant roots penetrate the upper part of the till fairly easily. The soil is very strongly or extremely acid in all layers, and the underlying till is strongly or very strongly acid.

Numerous rock fragments and boulders, consisting mainly of gray and dark-colored schist and some fine-textured quartzite sandstone and greenstone, are distributed throughout the soil and substrata. They are sufficiently numerous on the surface to interfere materially with or to prevent the use of improved farm machinery, but in general the stones are neither so abundant nor so large as in the Hermon soils.

Berkshire stony loam occurs in widespread continuous or almost continuous areas in the northern and north-central parts of the county and in outlying areas as far south as Stark, Berlin, and Milan. One isolated body is in the extreme southwestern corner of the county. The soil occupies areas of the rolling uplands that lie mainly 1,400 to 2,400 feet above sea level. The relief is generally rolling, and some gently rolling and steep areas that are too small to separate on the map are included. In the remote districts, small areas of very stony and rough Berkshire soils are also included.

The soil has developed over till composed mainly of schist fragments, but where areas of it are interspersed with or adjacent to soils

developed mainly from granitic materials, a considerable amount of gritty material is intermixed and some granite and gneiss boulders are scattered over the surface. Drainage, which is well established, is largely internal in forested areas. There is some run-off of rainfall from areas in pasture.

Much of this soil included in farms is cleared for pasture, but the area cleared is only a small fraction of the total area of the soil, because so little of the land is in farms. It is among the best of the well-drained soils of the rolling uplands for pasture but probably is not quite so good as the Becket and Woodbridge soils, which have a larger available supply of moisture near the surface. The soil absorbs and holds a good supply of moisture, and pastures are good most of the summer.

Around the outlying edges of the better developed farming districts some of the cleared areas have had part of the stones removed, and the land is either in mowing or in small patches of subsistence crops. Farms are largely of the subsistence type, and farmers receive their cash income from the sale of pulpwood and timber or from work in the adjacent forests. Some of the pastures in Stewartstown, Clarksville, and Pittsburg are used for grazing small flocks of sheep, which are used mainly as a local supply of meat and for the production of some wool. The raising of sheep has been greatly curtailed in this section, because of heavy losses from bobcats and bears.

Forested areas for the most part support good to excellent stands of timber. Here and there comparatively large areas support nearly pure stands of spruce and fir, but these trees grow mainly in mixed stands with such hardwoods as yellow birch, white birch, hard maple, and beech, together with some hemlock and some white pine at the lower elevations. Early lumbering operations took the large softwood trees that could be floated down the streams, and only the most easily accessible hardwoods were cut. Present cuttings are second-growth spruce and fir for pulpwood and large hardwoods for lumber, as well as both large and second-growth hardwoods for pulpwood. Temporary truck roads into the remote forested areas allow much otherwise inaccessible timber to be taken out in winter when the ground is frozen. Forested areas included in farms supply the needs for fuel as well as pulpwood and some large timber for sale. Pulpwood is marketed largely through a farm-forest products cooperative agency. Some groves of large hard maple are maintained as a source of home supply of maple sugar and sirup and for local sale, but this once common farm practice has been largely abandoned.

**Berkshire stony loam, smooth phase.**—This soil is not so stony as most of the Berkshire soils on steeper relief; nevertheless the stones on the surface are abundant enough to prevent extensive use of the soil for crops. This is not an extensive soil, compared with Berkshire stony loam, but the total area is large compared with some of the highly important and well-developed agricultural soils. It occupies an area of 19.3 square miles and is separated from the rolling areas of the Berkshire soils because of the milder relief and because of the future possibilities of agricultural development. This soil can be as easily cleared of stones as were most of the soils now

classified as stone free in the rolling uplands. When cleared of stones, the soil is highly desirable for mowing and potatoes.

This soil is similar to the typical soil, but it is more desirable as cropland because it is little affected by accelerated erosion. It occupies the gently rolling or sloping uplands and the smoother slopes within areas of the more rolling Berkshire stony loam. The largest areas are east of First Connecticut and Second Lakes in Pittsburg, and many widely separated small and large areas occur throughout the areas where the Berkshire soils are dominant. Areas of this soil occur mainly in sections not developed for agriculture, but where associated with farmed areas probably more than half the land is cleared for pasture. In these places much of the less stony parts or fields from which some of the stones have been removed is in mowing, and a few patches of oats are planted when mowings are renewed. Hay (timothy and clover) yields 1 to 1½ tons an acre, which is relatively high in comparison with yields on other equally stony soils of the uplands used for hay.

**Berkshire stony silt loam.**—Berkshire stony silt loam has a soil profile much like Berkshire stony loam, but the light-gray layer is not thick and the surface soil contains more fine material. Nearly all of the soil is forested, and beneath the covering of forest litter the gray layer is only 1 to 3 inches thick. The dark-brown and rust-brown subsurface layers are nearly if not equally as thick as in Berkshire stony loam. The brownish-yellow silt loam of the upper subsoil layer grades into olive or greenish-yellow silt loam, and this, in turn, into greenish-gray firm loam or silt loam till at a depth of 16 to 20 inches.

The stones in Berkshire stony silt loam, mainly angular and somewhat flat blocks of dark-colored and green very fine textured schist, are abundant through the soil and over the surface.

Berkshire stony silt loam occupies a fairly large total area in large continuous or almost continuous areas in the northwestern part of the county in the basins of Halls and Indian Streams in Pittsburg. One outlying body, including less than 1 square mile is in the vicinity of Phillips Pond in Odell. The land is rather strongly rolling. Some included gently rolling or gently sloping areas are not of sufficient extent to separate on the map. Comparatively small widely scattered bodies that occur on steep slopes are separated and included with Berkshire stony loam, steep phase. A few small areas are cleared and used for pasture in conjunction with farms located mainly in the narrow valleys of Halls and Indian Streams and the Connecticut River in Pittsburg. Pastures furnish fair to good grazing most of the summer. Forests are mainly second-growth conifers and large hardwoods. Near the head of Indian Stream some of this soil still supports the original forest of large hardwoods and spruce, with a few hemlock and fir.

**Lyman stony loam.**—Lyman stony loam comprises large areas in Colebrook, Stewartstown, Clarksville, and Pittsburg and widely scattered large and small areas in the other towns in the northern part of the county. It is developed from shallow schist till deposits over bedrock. The till material is largely the same as that from which the Berkshire soils are developed, but it is generally less than 3 feet thick over bedrock.

Beneath the forest duff the light-gray surface layer of mineral soils is nearly everywhere present, but it is less than an inch thick where the thickness of soil over the underlying rock ranges from 1 to 2 feet. Below it brown or dark-brown loam extends to a depth of 4 to 6 inches, where it passes into brownish-yellow loam. This material reaches to bedrock, which lies at a depth of 12 to 15 inches, or the material grades into olive or greenish-yellow loam. The latter material, at a depth of about 20 inches, grades into greenish-gray firm or slightly compact till, which rests on bedrock at a depth of about 30 inches. Small spots where the bedrock lies as much as 4 feet below the surface are included on the map because they are too small to show separately as Berkshire stony loam. The soil has no definite structure. It is very strongly acid in reaction.

Rock outcrops are common, and loose stones occur throughout the soil and over the surface. In Clarksville the soil had fewer stones on the surface than any other soil of the rolling uplands did in the original condition. In the vicinity of Kidderville the soil is fine sandy loam in texture, and there is a small proportion of granite and gneiss in the till. Where Lyman stony loam is mapped in association with the Greensboro soils there is a very small proportion of lime-bearing rocks in the till. The effect of lime has been thoroughly dissipated through leaching, however, and the soils are not thought to be sufficiently different to give them a separate classification. Some of the closely underlying rocks that contained lime are leached and weathered, and the normal Lyman subsoil at a depth of 15 to 25 inches passes into decomposed rock material that is dark brown and very sandy.

Lyman stony loam, like the associated soils, occurs on rolling land and ranges in elevation from 1,200 to 2,600 feet above sea level. Some areas of gently rolling soils are included, but the total of such areas is not large and does not warrant mapping as a separate type. Absorption of water and underdrainage are limited by the slight thickness of soil over bedrock, and there is considerable run-off of heavy rainfall. Lateral movement of water along the rocks causes seepy spots, in which the soils are like the Peru and Whiteman soils, but they are too small to show on the map.

Probably 25 percent of Lyman stony loam in Colebrook, Stewartstown, and Clarksville was at one time cleared and used as pasture for sheep and beef cattle. At present more than half of the cleared areas has returned or is returning to forest, mainly spruce and fir. In many of the pastures, trees that are small, uncrowded, and well formed are cut for Christmas trees. Several carloads are shipped from West Stewartstown and Colebrook each year. Old pastures that have been abandoned for 40 to 50 years are now yielding a harvest of pulpwood as high as 10 to 12 cords an acre. Many of the Christmas trees and nearly all of the pulpwood are sold cooperatively.

Areas still used for pasture are on dairy farms that have sufficient stone-free soils for the production of crops. A few small flocks of sheep are still grazed on some of the land, but the number of sheep continues to decline. Fair to good grazing is had on this land during spring and early summer, but the grass usually becomes short in late summer, and, after the hay is cut, dairy cows are often allowed to graze in the fields.

**Woodbridge stony silt loam.**—Woodbridge stony silt loam is one of the better soils for pasture when cleared for this use, but most of it remains in forest. In this condition it has a surface mat of raw humus several inches thick, composed of a recent accumulation of leaves and forest debris in the upper part and well-decomposed dark-brown humus in the lower part. Below this the mineral surface soil is dark-gray or grayish-brown loam or silt loam 2 to 4 inches thick, with considerable incorporated organic matter and without definite structure. This material changes quickly to dark-brown or rust-brown heavy silt loam with a soft-crumb structure. This layer is 2 or 3 inches thick, and at a depth of 6 or 7 inches it passes into yellowish-brown friable silt loam, which, in turn, at a depth of 12 to 14 inches grades abruptly into green or olive firm but friable silt loam. From 20 to 24 inches below the surface this rests on greenish-gray hard compact gritty loam till having a platy structure. The surface soil and the subsoil are very strongly acid, whereas the substratum is only strongly acid. The compact or hard layer acts as a hardpan in that it checks even though it does not entirely prevent the downward penetration of water and plant roots. The rock fragments, stones, and boulders throughout the soil and scattered over the surface are mainly schist and are abundant enough to prevent the use of improved farm machinery.

Woodbridge stony silt loam is developed on west- and northwest-facing lower slopes of the higher elevations in the eastern parts of Columbia, Colebrook, Stewartstown, and Clarksville and on similar slopes that parallel Halls and Indian Streams in Pittsburg, where in places it extends well up to the top or over the ridges. It occurs as elongated areas or nearly continuous bands or belts running at right angles to the slopes on which it occurs. For the most part the slopes are fairly steep, but some areas on gentle slopes are included that are not large enough to separate as a soil type. Surface drainage is free and internal drainage slow. Water moves laterally along the hard underlying substratum, resulting in wet spots in low places, and seeps along road and stream banks where the hard layer is exposed. Water runs down over the face of the exposed hard layer, which, when dug into, is only moist.

A fairly large total area is mapped. The soil is developed over very compact schist till in association with the stony Berkshire soils. Although the composition of the till is similar to or the same as that underlying the Berkshire soils, the till is far more compact. Where associated with other soils of loam texture, it is commonly a loam or light silt loam in the surface layers.

Most of the areas of this soil in Colebrook and Stewartstown have been cleared and used in the past as pasture, chiefly for grazing beef cattle. Since the discontinuance of the beef cattle enterprise, a large proportion of these pasture areas is only partly used as back pastures for young dairy cattle from nearby dairy farms. Several hundred acres of land along the lower part of Halls Stream have been cleared and are used for grazing dairy herds from farms located on the adjacent valley soils.

The abundant supply of moisture within reach of plant roots insures a good growth of grasses throughout the summer. Sods consist of 50 percent or more of bluegrass, some redtop, timothy, and white clover,

and native grasses. Forested areas support a good second growth of conifers and large hardwoods, and some of the soil adjacent to the Canadian border near the head of Indian Stream is still in virgin forest.

**Greensboro stony loam.**—Greensboro stony loam has a small total area. Most of it is used for wood lots and stony pastures in the well-developed farming sections of Columbia, Colebrook, and Stewartstown. Like the adjacent Berkshire stony loam, it has a well-defined Podzol profile under forest conditions. Beneath the duff or forest litter are successive layers of light-gray, dark rust-brown, yellowish-brown, and olive- or greenish-yellow loams underlain by greenish-gray firm till, which is derived mainly from schist with some incorporated calcareous schist and limestone material. The soil is strongly acid and has no well-defined structure. It occurs on rolling land with some rather steep slopes included. Surface drainage is rapid, and underdrainage is medium. Pastures furnish good grazing most of the summer, and wood lots provide a home supply of fuel and some for sale. Pulpwood cut from areas of this soil is sold through a forest-products cooperative.

**Greensboro stony loam, smooth phase.**—This soil is separated from typical Greensboro stony loam because of its potential value as a crop soil. The total area is small, and it represents the remaining areas of undulating and gently rolling Greensboro soils that have not been cleared or from which the surface stone has not been removed. This stony soil could be similarly improved and used for cultivated crops. Much of the land at present is included in pasture that in most places supports good sods having a large proportion of bluegrass and some white clover. Farm wood lots occupy the rest of the area.

As mapped, Greensboro stony loam, smooth phase, includes a small area of soil that has a gray fine sandy loam surface soil. In other respects the profile is much like that of Greensboro stony loam. Most of this included soil is in Colebrook and Stewartstown. It includes the areas of stony soil developed from till deposits that are in close association with or laid down over calcareous schist and an impure siliceous limestone. The till deposits are in general fairly deep, but in places they are shallow, and here and there the partly weathered calcareous rock outcrops on the steeper slopes. In places where the till deposits are shallow the surface soil or the substratum rests on brown or dark-brown partly weathered rocks from which the lime has been leached. Some of the brown decomposed or soft rock fragments occur throughout the soil and on the surface, together with more numerous hard noncalcareous schist rocks. The land is generally rolling.

Drainage is largely internal and good. Water passing through the limestone formations is highly charged with lime. Deep-seated subterranean drainage water from these formations, which emerges in Lime Pond, about 2 miles southeast of Colebrook, is so charged with lime that through precipitation and the action of mollusks or other agencies, a marl deposit several feet thick covering 10 acres or more has formed.

Approximately 50 percent of this included stony fine sandy loam is cleared and used for pasture in connection with dairy and potato farms. Most of the cropland is on the typical Greensboro soils, from

which the stones have been removed. The rest is in wood lots or is semiwooded and included in pasture. Grasses come early and furnish fair to good grazing in spring and early summer, but, because of its sandy texture and in places the loose sandy residue of closely underlying leached limestone formations, the soil does not retain sufficient moisture to maintain good pasturage in late summer or in dry seasons.

#### STONY IMPERFECTLY DRAINED SOILS SUITABLE FOR PASTURE

The imperfectly drained Peru stony loam and Waumbek stony fine sandy loam are among the best of the rolling uplands for pasture, and they almost equal the best soils of the bottom lands in this respect.

**Peru stony loam.**—Peru stony loam is the best soil for pasture in the rolling uplands, but, because of its widespread occurrence in all parts of the county including forested areas, only a comparatively small part of the total area is cleared and used for pasture. Much of it is remote from agricultural districts and remains in forest as there is no present need for additional pasture.

Under forest conditions there is an organic-matter covering over the soil, ranging from several inches to as much as a foot in thickness, which consists of a rather loose accumulation of leaves, moss, and forest debris in the upper part and of dark-brown partly decomposed and mucky humus in the lower part. The mineral surface soil to a depth of 5 or 6 inches is dark-brown loam containing a high percentage of organic matter, and in places it is somewhat mucky. This grades into grayish-brown loam that is faintly mottled with some gray and rust brown. This material grades, at a depth of 10 or 12 inches, into yellowish-brown, yellow, or pale-yellow loam or fine sandy loam that is mottled or streaked with gray and rust brown. Below a depth of 18 to 20 inches is gray till conspicuously mottled with yellow and rust brown and saturated with water for at least much of each year. Owing to incorporated organic matter, the surface layer has somewhat of a crumb structure, but for the most part the soil has no well-defined structure. It is strongly acid in all layers.

Peru stony loam is developed from both granitic and schist till and occurs around drain heads, along shallow drains, as marginal areas around swamps and ponds, and along the foot of slopes. It occupies mainly gentle slopes that have fair to good surface drainage, but because of its position underdrainage is not well established. In places it extends well up on the long slopes; in others it occupies fairly steep slopes where conditions induce considerable seepage from above.

Where it is associated with the Hermon soils, the underlying till is gritty and sandy and the surface and embedded stones are largely granite and gneiss. In these places the surface soil contains more sand than where it is associated with Berkshire, Greensboro, and related soils. Although the subsoil is variable in texture, the surface soil is a loam because of the high organic-matter content.

The largest areas of this soil are in Pittsburg, Clarksville, and Success, and numerous large and small areas are in all towns in the northern half of the county. Many smaller areas are in the southern half. Some large and some small areas of Peru stony loam occur on nearly every farm on the rolling uplands and in upland pastures that are included with valley farms where most or all of the crops are grown on the alluvial soils. On farms where the total area of Peru

stony loam is small, it is all cleared, and on farms where the total area is large, enough of it is cleared to meet the pasture needs of livestock kept on the farm. The abundant moisture supply and high organic-matter content of the soil insures good growing conditions for grass throughout the summer season. Most of this land has a 50 to 100 percent higher carrying capacity than most of the adjacent well-drained uplands, under the same management. Pasture sods include a high proportion of bluegrass, and many of them contain much white or Dutch white clover.

Forested areas support vigorous stands of large and second-growth hardwoods and second-growth conifers of nearly all species indigenous to the adjacent well-drained lands and, in addition, more soft maple and some tamarack and white cedar. Spruce and fir dominate a large part of this land and yield heavy cuts of pulpwood at 40 to 50 years of age.

**Waumbek stony fine sandy loam.**—Waumbek stony fine sandy loam includes areas of soil where underdrainage is not sufficiently well established for the development of a typical Hermon profile and is not sufficiently slow for the development of the Peru profile. Beneath the forest litter the mineral surface soil to a depth of 1 or 2 inches is gray or grayish-brown fine sandy loam, rather than light gray or nearly white as in the Hermon mineral surface layer. This passes into dark-brown or rust-brown heavy fine sandy loam, which, at a depth of 5 or 6 inches, changes to yellowish-brown fine sandy loam. This material becomes lighter in color with depth, and at a depth of 12 to 14 inches it grades into pale-yellow fine sandy loam mottled with some gray and rust brown. The color continues to become lighter and mottlings increase with depth, and at a depth of 18 or 20 inches this material grades into gray till that contains an abundance of pale-yellow and rust-brown mottlings. The soil has no well-defined structure in any layer except in some of the underlying glacial till, which is platy where the soil is associated with the Becket soils. All layers are very strongly acid in reaction. Surface and embedded stones are largely granite and gneiss.

The soil occurs mainly in rather large areas in Dummer, Whitefield, and Jefferson and in smaller widely separated areas in nearly all sections where the Hermon soils are mapped. It is developed largely from granitic till, and in the larger areas it occurs on broad benchlike gentle slopes where underdrainage is not well established or where seepage from the adjacent higher slopes keeps the subsoil and substratum wet for a part of the year.

Only a few of the small widely separated areas have been cleared and included in pasture. Most of this soil occurs at a rather long distance from the farming sections. Forested areas support vigorous stands of mixed large and second-growth conifers, mainly spruce and fir.

#### STONY SOILS SUITABLE ONLY FOR FORESTRY

The stony soils of the rolling uplands suitable only for forestry are Hermon stony fine sandy loam, steep phase; Becket stony loam, steep phase; Berkshire stony loam, steep phase; Lyman stony loam, steep phase; and Woodbridge stony silt loam, steep phase. Because of their sharp relief and high content of stone, these soils are better

adapted for growing timber than for any other purpose. The steep phases, although not excessively stony, are not suitable for grazing the heavy-type dairy cattle ordinarily kept. Some areas of less steep or less stony included soils could be profitably included with pastures located on more favorable soils.

**Hermon stony fine sandy loam, steep phase.**—The steep phase of Hermon stony fine sandy loam has a profile similar to that of Hermon stony fine sandy loam, but it occurs on steep hillsides and valley walls where the degree of slope is over 15 percent, in some places as much as 30 percent. In this position the soil can be used for pasture or forest, but, owing to the steepness of slopes, there is a considerable run-off of rainfall when the forest litter is destroyed, and the land furnishes only fair grazing. It is too steep and stony for other use, and, even if the stones were removed and the land were plowed, there would be a considerable loss of soil through erosion.

This soil occurs in widely separated small to large areas in association with less steep areas of other Hermon soils. The larger areas are in Berlin, Gorham, and Shelburne, where agriculture is little developed. Only a few small areas are cleared and included in pasture. The land supports stands of timber about equal to those on Hermon stony loam. It is well suited to the growth of timber and should remain in forest.

A total of 13.7 square miles of this steep soil is separated from other Hermon soils.

**Becket stony loam, steep phase.**—This soil occupies only a small total area. It is separated from areas of other Becket soils on more favorable relief, because of the comparatively steep gradient of the slopes on which it occurs. Nearly all of the soil occurs on the steep west- and northwest-facing upper slopes of Dalton Mountain and adjacent ridges, in Lancaster and Dalton. The soil profile is not very different from that of the typical soil on rolling or moderately rolling relief, but the stones on the surface in some places are more abundant than they are on the typical soil.

Even under forest conditions, where there is a thick cover of forest litter over the mineral soil, water moves down the slope at a rather rapid rate. If the land were cleared on the steep slopes, it is doubtful whether sufficient sod could be established to prevent some if not severe erosion. Some small areas on slopes of not much more than 15 percent gradient are cleared and support fair to good grazing. The steeper slopes should not be cleared, not only because of the danger of erosion, but because the water that would be released might damage soils on the lower and gentler slopes, which can be used safely for crops and pasture. This soil supports timber stands about equal to those on typical Becket stony loam.

**Berkshire stony loam, steep phase.**—This soil occurs on steep valley walls and on the steep upper slopes of some of the higher parts of the rolling uplands that are as much as 3,000 feet above sea level. At some of these higher elevations development of the soil profile is not so deep as the average for Berkshire soils and the soil is not particularly stony; otherwise it does not differ greatly from the normal soil on more favorable relief, except for the slope.

A total of 13.7 square miles is mapped. The large areas are in Errol, Dummer, Millsfield, and Cambridge, and many smaller ones are widely separated wherever Berkshire soils occur. Included with

this stony soil are a few comparatively small areas of Berkshire stony silt loam, steep phase.

Only a few small areas have been cleared and included in pasture. This soil supports good stands of mixed hardwoods and conifers, the conifers prevailing on the higher elevations.

**Lyman stony loam, steep phase.**—The steep phase of Lyman stony loam includes a total of 11 square miles in comparatively small widely scattered areas of steep soils, separated from the rather extensive typical soil on rolling relief. The soil profile and the underlying material of shallow deposits of till resemble those features of the typical soil. Rock outcrops are somewhat more common and included spots of deeper soil are fewer than in the typical soil. The largest areas are mapped in the southwestern part of Pittsburg on the steep slopes and steep valley walls along the Connecticut River and along the steep upper slopes between Indian Stream and the Halls Stream.

Even in a forested condition, with a comparatively thick cover of litter over the surface, the movement of water down the steep slopes is rather rapid. If the soil were cleared for pasture, severe erosion would result before sod could be established. The forest growth and types of trees are about the same as on the typical soil, and the land should be left in forest.

**Woodbridge stony silt loam, steep phase.**—The steep phase of Woodbridge stony silt loam occurs on steep slopes and valley walls both above and below areas of typical Woodbridge soils. Except for slope, the soil differs little from the normal soil, except probably that the hard compact till averages a few inches closer to the surface.

Only a small total area of this soil is mapped. It occurs largely on the northwest-facing slopes to Halls and Indian Streams. Some of the areas lying on the slopes rising sharply from the Halls Stream Valley are cleared for pasture, and these afford fair to good grazing, as they are liberally supplied with moisture through seepage along the hard layer from slopes above. The slopes of some of the shallow hillside drains are not well grassed, and there is a slow but rather continuous sloughing of the soil in such places, so that loose soil material is carried down the drains to be spread on the terraces or bottoms at the foot of the slopes or washed directly into Halls Stream and carried away. Many of the hillside cattle paths have been eroded through combined trampling and action of water until they have cut into the underlying hard till layer. No erosion was observed on slopes that were less than 15 percent in gradient, although used similarly as pasture land. This steep land is well suited to the growing of pasture grasses, but care should be taken to protect the land from erosion. It is best not to clear the steeper parts. This soil supports excellent stands of both second-growth and large trees and probably would be more profitable if left in forest.

#### SOILS OF THE VERY STONY, ROUGH, OR MOUNTAINOUS LANDS

Soils of the very stony, rough, or mountainous lands include extensive undifferentiated soils in the White Mountains lying at high elevations, alpine areas on the crest of the Presidential Range, and other high mountaintops and rock ledges, as well as large areas of rough stony land lying along the lower mountain slopes bordering the rolling uplands, numerous widely separated smaller broken areas at the higher

elevations of the rolling uplands, and extremely stony areas that are comparatively smooth.

Although known areas of comparatively smooth and not very stony soils are included on the map with the rough mountainous land, most of them lie too high or are too remote to be of agricultural value; but, for the most part, they produce good timber. Rough stony land has little value except for forest and for spots that can be pastured. Rock outcrop is practically valueless even for forest. Subalpine areas included in rough mountainous land support only scrub forest.

#### VERY STONY SOILS SUITABLE ONLY FOR FORESTRY

Very stony soils suitable only for forestry include Hermon very stony fine sandy loam, Canaan very stony fine sandy loam, Berkshire very stony loam, and Peru very stony loam. Large and small boulders are common on these soils, and many of the larger ones would require blasting to remove them. In addition, the Canaan soil has many rock outcrops.

**Hermon very stony fine sandy loam.**—The soil profile of Hermon very stony fine sandy loam is the same as that of Hermon stony fine sandy loam, except that it contains many more stones. Many of these stones are boulders too large to remove from the land without blasting. This classification comprises the more stony areas in all towns where the Hermon soils are mapped.

This soil occupies gently rolling, rolling, and to some extent steep areas. A total of 126.8 square miles is mapped, and about 20 percent of the soil is on gently rolling land. Small and large areas are widely distributed through the rolling uplands and in continuous belts along the foot of mountains as an intermediate soil on the valley walls between the less stony soils and rough stony land and rough mountainous land. The smoother areas of this soil, when cleared, furnish fair pasturage between the rocks, but the quantity of forage afforded is not sufficient to warrant extensive clearing of these very stony soils.

Some time ago, in Whitefield and Carroll, stones were removed from some of this land to such an extent that it was used for mowing and classed as Hermon stony fine sandy loam. Such areas still have large boulders scattered over the fields, and these must be passed around in tillage and mowing operations. Many of the cleared areas have been abandoned because the stones do not allow the use of improved farm machinery, and the remaining cleared areas are included mainly in subsistence farms.

Most of the land remains in forest and supports good stands of mixed conifers and hardwoods about equal to those growing on the normal or less stony Hermon soils.

**Canaan very stony fine sandy loam.**—Canaan very stony fine sandy loam is not an extensive soil. It occurs in widely separated areas in association with other Canaan soils and includes very stony areas of soil developed on shallow deposits of granitic till over bedrock. Perhaps the largest area is the one south of Lancaster near Prospect Mountain.

Rock outcrops are common. This feature, together with the abundance of loose stones on the surface and the shallowness of the soil, makes the soil of little value other than for forest. Some small areas once cleared and included in pastures are returning to forest because

the limited grazing they furnish does not warrant keeping the pastures open. Forested areas support fair to good stands of indigenous hardwood and coniferous trees.

**Berkshire very stony loam.**—Berkshire very stony loam differs from Berkshire stony loam in having a much higher content of stones, many of which are too large to remove except by blasting.

A total area of 55.2 square miles is mapped. It occupies rolling and steeply rolling or steeply sloping areas and is essentially a nonagricultural soil. Included with it are a few small areas of Berkshire very stony silt loam, mainly in the western part of Pittsburg.

Some of the small areas included in farms have been cleared and included in pasture. These areas furnish fair grazing, although most of them are now returning to forest of spruce and fir. Timber stands and tree growth are as good as on the less stony soils, and the land should remain in forest.

**Peru very stony loam.**—Peru very stony loam occurs in large and small areas throughout the county. It comprises the imperfectly drained very stony soils and is developed from both granitic and schist till. It differs from Peru stony loam only in containing more stones, some of which are large boulders several feet in diameter. Included with it in the south-central and southwestern parts of the county are a few small areas of Waumbek very stony fine sandy loam that are not mapped separately because of their small extent.

Peru very stony loam, when cleared, furnishes excellent pasturage, but the large stone content makes it less desirable than Peru stony loam for this use. On the other hand, even with the greater stone content, it furnishes better grazing than the adjacent less stony well-drained upland soils because of a more favorable moisture supply. For this reason nearly all of the small areas included in farms have been cleared. Much of this soil occurs in places remote from farming districts and remains in forest, supporting excellent stands of conifers and hardwoods.

#### ROUGH, STONY, OR MOUNTAINOUS LAND SUITABLE ONLY FOR FORESTRY

Rough, stony, or mountainous land suitable only for forestry is not differentiated. Rough stony land includes spots of nearly all of the major soils of the uplands. This group includes rough stony land (Hermon soil material), rough stony land (Berkshire soil material), rough stony land (Canaan soil material), and rough stony land (Lyman soil material). Rough mountainous land is divided into two classes to conform with the two known major classes of soil material of which it is composed. They are rough mountainous land (Hermon soil material) and rough mountainous land (Berkshire soil material).

**Rough stony land (Hermon soil material).**—This land type includes steep slopes and mountainsides, associated with Hermon stony fine sandy loam and Hermon very stony fine sandy loam. The soil material is similar to that of the Hermon soils except that it has a higher content of stone and steeper relief. Under a thick covering of forest duff is a gray layer from 1 inch to several inches thick, which rests on a rich-brown or rust-brown layer. The textures of these two layers generally are loamy fine sand and fine sandy loam, respectively, and the structure is single grain. Below this the yellowish-brown fairly firm but friable subsoil extends to

a depth of 12 to 15 inches, where it grades into yellow or pale-yellow friable fine sandy loam. The material has a single-grain structure. The substratum lies 18 to 22 inches below the surface and consists of gray sandy till that is firm or slightly compact in place. Drainage is good.

A total of 104.8 square miles of this land is mapped. Large areas are along the lower slopes of the mountains, adjacent to the rolling plateau uplands, and in the more broken parts of the rolling uplands; smaller areas are on short steep slopes throughout the rolling uplands. This land has little agricultural value, much of it is inaccessible, and nearly all of it is steep and stony. A few included areas of excessively stony soil are gently rolling to rolling. A few of the best areas may be used for pastures, but they furnish only poor grazing.

The forest is mixed conifers and hardwoods, white birch, beech, and maple predominating at the lower elevations and spruce, fir, and yellow birch at elevations above 2,500 feet.

**Rough stony land (Berkshire soil material).**—Beneath the forest duff, which is 2 or more inches thick, this type of rough stony land has a well-defined  $\frac{1}{2}$ - to 2-inch layer of light-gray very fine sandy loam. It rests on a dark-brown loam layer about 1 inch thick. This grades into rust-brown loam that becomes yellowish brown at a depth of 5 to 7 inches. At a depth of about 12 inches this material passes into olive or greenish-yellow loam, which changes to greenish-gray somewhat gritty till that is firm in place or slightly compact at a depth of about 18 inches. The soil of small included areas in the western part of Pittsburg is compact or hard and platy in the substratum and represents rough stony land (Woodbridge soil material), which is not mapped separately. Numerous stone fragments and boulders occur on the surface, and in places the soil is shallow and contains a few rock outcrops. The land is generally steep and more or less broken. Drainage is well established.

This soil occurs on the more broken areas of the rolling uplands, in association with Berkshire stony loam and Berkshire very stony loam, and on the lower mountain slopes where the areas above are classed as rough mountainous land. It has little agricultural value, but a few areas adjacent to farms have been cleared and used for pasture, furnishing poor to fair pasturage. Most of such cleared areas are now returning to forest.

The forests are composed mainly of mixed conifers and hardwoods, spruce and fir predominating at the higher elevations. The hardwoods are largely hard maple, birch, and beech at the lower elevations, and yellow birch with some maple at the higher elevations.

A total of 49.7 square miles of this kind of rough stony land is mapped.

**Rough stony land (Canaan soil material).**—This kind of rough stony land includes a total area of 28.4 square miles of steep and stony soils developed on shallow deposits of granitic till. The underlying bedrock in general is only a few feet below the surface, and numerous outcrops of this occur on most areas of the soil. The soil material between the rocks, like Canaan stony fine sandy loam, for the most part has a well-developed Podzol profile, and where the till deposits are as much as 3 feet thick the profile is about the same as that of rough stony land (Hermon soil material).

The larger areas occur in the east-central part of the county on the more broken parts of the plateau area and adjacent lower mountain slopes. This land is essentially nonagricultural and remains in forest. The types of trees are the same as on adjacent less steep and stony land. Conifers develop normally and grow to a good height, but hardwoods do not reach their best development on these shallow soils, and the quality of the lumber produced is somewhat lower.

**Rough stony land (Lyman soil material).**—Rough stony land (Lyman soil material) occurs widely distributed and associated with the Berkshire soils in the northern part of the county. In the north-eastern part it covers many square miles in almost continuous areas. A total area of 117.6 square miles is mapped. This classification represents shallow soils, both steep and stony, having numerous outcrops of bedrock. The soil material is mainly of schist origin, but much of the land in the Dead Diamond River Basin is strongly influenced by fine-textured quartzite sandstone. Here the outcrops and the underlying rock are largely of the latter material.

The soil between the rocks has a Podzol profile, but the intensity and depth of development varies considerably with the depth of the till deposits. On the shallower deposits the gray and brown layers are thin and the yellowish-brown subsurface and upper subsoil layers extend to the underlying rocks, whereas on deposits 2 feet or more in thickness the profile is much like that of the Berkshire soils.

Owing to the shallowness of the soil material, storage of water is limited, and there is a rather rapid movement of water down the steep slopes. Under forest conditions the movement of water is sufficiently impeded by the duff covering to prevent erosion.

Nearly all of this land remains in forest. Spruce and fir predominate on the extremely shallow parts and seepy spots around the rock outcrops. They develop about normally, but the rate of growth is slower than on deeper soils. Hardwoods, mainly maple and yellow birch, are more abundant where the depth of soil is 2 feet or more, but the trees do not reach the height and normal development that they do on deep well-drained soils.

**Rough mountainous land (Hermon soil material).**—Approximately 22 percent of the area of Coos County, or 394.1 square miles, represents rough mountainous land (Hermon soil material), which occurs in the southern, south-central, and west-central parts. It consists of massive land areas of the White Mountains that are cut by steep-walled narrow valleys and rise in places from the rolling uplands at 1,500 to 2,000 feet above sea level to an elevation of about 4,500 feet, where alpine or subalpine conditions prevail. It contains much soil representative of rough stony land, rock outcrop, other areas of less steep and stony soils, and some low basins of swamp soils and peat bogs. All this land is more or less inaccessible for farming operations, and it would be of little value for this use even if it were better located. The rocks and soil material are largely granitic, similar to those giving rise to the Hermon soils.

Rough mountainous land (Hermon soil material) includes large areas suitable for growing timber as well as areas where the soils are so shallow and stony that the growth is sparse and stunted. The trees that grow above an elevation of 3,500 feet are too small to have any value except for limited cuts of pulpwood.

Nearly all of this land in the southern and south-central parts of the county is included in the White Mountain National Forest, where it has been largely cut-over and at present supplies only a small cut of pulpwood and large timber. In the west-central part it is in private holdings as timber reserves for pulpwood. The tree growth below an elevation of 3,000 feet consists of mixed conifers and hardwoods; above 3,000 feet spruce and fir predominate and there is some birch.

**Rough mountainous land (Berkshire soil material).**—Rough mountainous land (Berkshire soil material) comprises rough broken areas in the northern part of Coos County, where the soil material and rocks are mainly schist. The total area is 27.4 square miles. Rock outcrops are less common, and as a whole the land supports a better growth of timber than does mountainous land with granitic soil material. The soil between the rocks is similar to or the same as the Berkshire soils of the rolling uplands. It has a definite Podzol profile, but the gray surface layer in few places exceeds 1½ inches in thickness.

A few small patches of this land adjacent to farming districts have been cleared and included in pasture. Much of the land is remote from farming sections, and, even if it were more accessible, it should remain in forest because it could afford only very limited grazing. At higher elevations nearly pure stands of conifers—spruce and fir—occupy this land. In lower positions these trees, together with yellow birch, some beech, and maple, constitute the greater part of the timber having a commercial value. Nearly all of this land, together with additional smoother land, is held in extensive tracts by pulp and paper companies as timber reserves. Heavy cuts of pulpwood and some hardwoods for lumber are made each year. Such timber reserves are large enough for harvesting of trees to continue at the present rate for many years without materially reducing the visible supply.

#### BARREN LAND

**Rock outcrop.**—Rock outcrop consists of steep rock cliffs, bare rock mountain peaks, and the high rough crest of the White Mountains lying mainly above the timber line. For the most part, the timber line is coincidental with climatic conditions, but in some places it is at lower elevations because of the absence of soil to support a growth of timber. Rock outcrop, as mapped, in some places includes sparsely timbered areas and in others areas supporting stunted trees that have no commercial value.

Most of the rock outcrop occupies the crest of the Presidential Range in the White Mountains and is included in the White Mountain National Forest area. It is developed as a recreational area and is crossed by numerous foot trails. An automobile road and a scenic railway lead to the crest of Mount Washington in the heart of the recreational center. Trail huts are conveniently located and rest houses are scattered throughout the area to accommodate the thousands of tourists who visit this section each year, both for summer recreation and for winter sports.

## SOILS OF THE SWAMPS SUITABLE FOR FORESTRY

Soils of the swamps are not peculiar to any physiographic section of the county but are widespread throughout the county. They consist of organic deposits classed as peat and muck, a shallow phase of peat, and Whitman stony loam.

**Whitman stony loam.**—Whitman stony loam has a surface soil of brown peatlike duff that rests on dark-brown or gray-brown loam having a high organic-matter content. This material at a depth of 6 to 8 inches grades into pale-yellow, gray, or light-gray loam or fine sandy loam streaked or mottled with rust brown; and this, in turn, at a depth of about 18 inches grades abruptly into gray gritty till mottled with rust brown. It has no well-defined structure in any layer and is very strongly acid in reaction. It is saturated with water for a good part of each year.

Whitman stony loam includes all the poorly drained or wet soils developed from till and occupies depressions or poorly drained situations around lakes and ponds, at the foot of slopes, and along shallow seepy drains. In places it is intermediate between the organic swamp soils and the imperfectly drained Peru soils. It includes areas of both granitic and schist till, and the stones present on the surface and in the soil are either granite and gneiss or schist, depending on the source of parent material. This soil ranges from moderately stony to very stony; some of it is a virtual pavement of duff-covered stone. The stone content, however, has little bearing on the value of this kind of land. Owing to the wet condition, it has little or no value for agriculture, and its position is such that drainage for the production of crops is impracticable.

A total of 69.6 square miles of this soil is mapped. It occurs mainly in numerous small areas throughout the county, but the larger ones are in the northern half, associated with areas of the Berkshire and related soils. A number of small areas have been cleared and support an abundant growth of coarse wild grasses that furnish fair to good grazing in spring but become tough, woody, and of poor quality in summer.

Nearly all of this land is in forest and supports dense stands of spruce, fir, soft maple, gray birch, and other hardwoods, together with some tamarack, arborvitae, and other species. In the more open places a dense growth of grasses, alder, and willow brush comes in with a ground cover of mosses.

**Muck.**—Muck consists of dark-brown or almost black well-decomposed organic matter containing some mineral material. Most of the muck is woody, but in places it is developed from rushes and coarse grasses. The reaction is highly acid. Muck occurs in depressions, mainly in old cut-off channels of the present overflow lands and in poorly drained situations along sluggish streams. It ranges from 2 to 6 feet or more in depth and rests on gray or bluish-gray sandy material. Some areas of shallow muck are included, in which the muck is not more than 18 inches thick over the mineral soil.

The total area of the numerous bodies is very small. Most of the muck occurs along the Connecticut River bottoms. The largest single area is along a tributary of the Upper Ammonoosuc River in the vicinity of West Milan. Many of the small areas along the Connecticut River are cleared and included in mowings. Coarse wild grasses yield

from 1 to 2 tons of hay an acre. The hay is mowed by hand, as the land is too wet and boggy for the use of teams. Areas in timber support alder and willow brush, soft maple, tamarack, and arborvitae, with some spruce and fir. Most of the muck areas lie too low for adequate drainage to make them of any use other than for wild hay.

**Peat.**—Peat occurs in depressions and filled-in lakes, both in the valleys and at the higher elevations. It consists of brown or light-brown raw organic deposits and is made up partly of woody material and partly of fibrous remains of sedges, grasses, and moss, accumulated in standing water or under extremely wet conditions. Its depth ranges from 3 to 10 feet or more. All the land is forested. The present growth is mainly spruce and fir, although many areas support considerable tamarack, arborvitae, alder, and willow brush, with some gray birch and soft maple.

A total of 28.9 square miles is mapped. Peat occurs in large and small areas throughout the county.

**Peat, shallow phase.**—A total of 10.5 square miles of peat, shallow phase, is separated from the deeper deposits. The deposit is the same as the typical peat, but the underlying mineral soil lies only 18 to 30 inches below the surface. Where peat occurs in depressions in the valley areas it rests on gray sandy material, and in the rolling uplands on bluish-gray stony till.

Some 2 or 3 square miles of peat, shallow phase, in the Magalloway River, Umbagog Lake section, represent a peat deposit 12 to 18 inches thick that has formed on low stream and lake terraces, which are flooded a part of each year by backwaters of the Errol Dam. The underlying mineral soil is gray and bluish gray mottled with rust brown.

## PRODUCTIVITY RATINGS

The principal factors affecting the productivity of land are climate, soil (including many physical, chemical, and biological characteristics), slope, drainage, and management (including the use of the amendments). No one of these factors operates separately from the others, although some one may dominate. In fact, the factors listed may be grouped simply as the soil factor and the management factor, since slope, drainage, and most of the aspects of climate may be considered as characteristics of a soil type, in that it occupies geographical areas characterized by given range of slope and climatic conditions. Crop yields over a long period of years furnish the best available summation of the influence of the associated factors on production and therefore are used where available.

Table 7 lists the soils of Coos County in the approximate order of their general productivity under the prevailing practices of soil management.

TABLE 7.—Productivity ratings for the soils of Coos County, N. H., under prevailing practices

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Soils (soil types, phases, complexes, and land type) <sup>1</sup>	Crop productivity index <sup>2</sup> for—											General productivity		Principal crops or dominant present use		
	Corn (silage), 100=12 tons		Oats, 100=50 bu.		Potatoes, 100=200 bu.		Mixed hay, 100=2 tons		Clover, 100=2 tons		Pasture, 100=80 cow-acres-days <sup>3</sup>	Grade <sup>4</sup>	Group <sup>5</sup>			
	A	B	A	B	A	B	A	B	A	B	A	A	B			
Hadley very fine sandy loam, high-bottom phase.	100	180	80	100	80	140	80	100	60	90	100	2	1+	Very high	Hay, potatoes, oats, corn.	
Ondawa fine sandy loam, high-bottom phase....	100	180	80	100	80	140	80	100	60	90	100	2	1+		Do.	
Suffield silt loam.....	100	180	80	100	70	140	80	100	60	80	100	3	1+		Hay, oats, corn, pasture.	
Hadley silt loam.....	100	180	80	100	80	100	90	100	60	90	100	2	1+		Hay, small grains.	
Greensboro loam, smooth phase.....	80	150	50	90	60	150	60	100	50	80	80	4	1+		Potatoes, hay, small grains.	
Hadley very fine sandy loam.....	100	160	80	90	80	130	80	90	60	80	100	2	1+		Hay, potatoes, oats, corn.	
Ondawa fine sandy loam.....	100	160	80	90	80	130	80	90	60	80	100	2	1+		Do.	
Colebrook fine sandy loam.....	80	160	70	90	70	120	70	100	60	80	70	3	1+		Hay, potatoes, small grains.	
Groveton very fine sandy loam.....	80	160	70	90	70	120	60	90	50	70	90	4	1		Hay, potatoes, oats, corn.	
Groveton fine sandy loam.....	80	150	70	90	70	120	60	90	50	70	76	4	1		Do.	
Becket loam.....	70	150	50	80	70	120	60	90	40	70	90	5	1		Hay, oats, potatoes.	
Hermon fine sandy loam.....	70	150	40	70	60	120	50	70	30	60	60	5	1		Hay, oats, corn, potatoes.	
Greensboro fine sandy loam, smooth phase.....	60	120	50	70	60	110	50	80	40	80	60	5	1		Hay, potatoes, small grains.	
Colton fine sandy loam.....	70	140	60	80	60	100	50	80	40	60	60	5	1		Hay, oats, potatoes, beans.	
Colebrook gravelly fine sandy loam.....	70	130	60	80	60	100	60	80	50	70	60	4	1		Hay, some oats, potatoes.	
Colebrook fine sandy loam, slope phase.....	70	130	60	80	60	100	60	80	50	70	60	4	1		Hay, potatoes, small grains.	
Greensboro loam.....	80	120	50	70	60	120	60	80	40	60	70	5	1		Do.	
Berkshire loam, smooth phase.....			50	80	60	150	60	90	40	70	80	6	2		High	Do.
Dixville fine sandy loam.....	70	120	40	70	60	100	40	70	40	70	50	5	2			Hay, small grains, potatoes.
Colebrook gravelly fine sandy loam, slope phase.	70	120	60	80	50	80	50	70	40	60	50	5	2	Hay, pasture.		
Ondawa loamy fine sand.....	70	100	60	80	60	80	70	80	50	60	70	4	2	Hay, potatoes, oats, corn, pasture.		
Colton fine sandy loam, slope phase.....	70	100	60	70	60	90	50	70	40	50	60	5	3	Hay, oats, potatoes.		
Greensboro fine sandy loam.....	60	100	40	60	50	100	40	60	30	50	50	6	3	Hay, small grains.		
Berkshire loam.....			50	70	60	120	60	80	40	60	75	6	3	Hay, small grains, potatoes.		
Colton sandy loam.....			40	60	50	90	40	60	30	50	50	6	3	Hay, oats, potatoes.		
Sudbury loam.....			60	70	60	90	80	90	60	70	90	5	3	Hay, oats, pasture, forest.		
Hermon fine sandy loam, slope phase.....	70	100	40	50	60	90	50	60	30	50	50	5	3	Hay, small grains.		

SOIL SURVEY OF COOS COUNTY, NEW HAMPSHIRE

TABLE 7.—Productivity ratings for the soils of Coos County, N. H., under prevailing practices—Continued

Soils (soil types, phases, complexes, and land type)	Crop productivity index for—											General productivity		Principal crops or dominant present use	
	Corn (silage), 100=12 tons		Oats, 100=50 bu.		Potatoes, 100=200 bu.		Mixed hay, 100=2 tons		Clover, 100=2 tons		Pasture, 100=80 cow-acre-days <sup>2</sup>	Grade			Group
	A	B	A	B	A	B	A	B	A	B	A	B			
Danby fine sandy loam	60	90	40	60	50	90	30	50	30	50	40	6	4	Medium	Forest, pasture, hay.
Dixville gravelly fine sandy loam	60	100	40	60	50	80	40	50	40	50	40	6	4		Forest, hay.
Colebrook loamy fine sand	60	80	50	60	40	70	50	60	40	50	40	6	4		Hay, pasture.
Woodbridge silt loam			60	80			60	90	50	80	95	7	4		Do.
Colton gravelly sandy loam	50	90	40	50	50	80	40	50	30	40	40	6	4		Pasture, hay, small grain.
Groveton loamy fine sand	50	100	40	50	50	70	40	50	30	40	40	6	4		Idle, forest, hay.
Lyman loam, smooth phase			40	70	50	100	30	60	30	50	45	7	4		Hay, pasture.
Colton sandy loam, slope phase	50	80	40	50	50	80	40	50	30	40	50	6	4		Hay, idle, small grains.
Dixville loamy fine sand	50	90	30	50	40	60	30	50	30	50	30	7	4		Recreational grounds, pasture.
Lyman loam			40	60	50	90	30	50	30	50	30	8	4		Hay, pasture.
Danby gravelly fine sandy loam	50	80	40	50	50	80	30	40	30	40	30	7	5		Forest, pasture, gardens.
Colton loamy sand	30	70	30	40	30	60	30	40	20	40	30	8	5		Idle, hay.
Canaan stony fine sandy loam, smooth phase				50		90		50			40	9	5		Forest, pasture, hay, potatoes.
Canaan stony fine sandy loam				50		90		40			30	9	5		Pasture, hay, oats, potatoes.
Colton loamy sand, slope phase	30		30		30		30		20		30	8			Low
Peru loam							70				90	9		Hay, pasture.	
Podunk-Rumney fine sandy loams							60				80	9		Hay, pasture, forest.	
Berkshire stony loam, smooth phase							40	50			55	9		Forest, pasture, hay.	
Hermon stony fine sandy loam							30	40			40	9		Do.	
Danby loamy sand							20	40			20	9		Do.	
Peru stony loam											80	9		Forest, pasture.	
Waumbek stony fine sandy loam											80	9		Forest, a small area in pasture.	
Woodbridge stony silt loam											80	9		Forest, pasture.	
Peru very stony loam											70	9		Do.	
Woodbridge stony silt loam, steep phase											70	9		Do.	
Alluvial soils, undifferentiated								100			50	9		Hay, pasture, forest.	
Greensboro stony loam, smooth phase											50	9		Pasture, wood lots.	
Greensboro stony loam											50	9		Forest, pasture.	
Berkshire stony loam											50	9		Do.	
Berkshire stony silt loam											50	9		Do.	
Scarboro fine sandy loam								100			50	9		Forest, pasture, hay.	
Becket stony loam											50	9		Forest, pasture.	
Muck								100			30	9		Forest, hay, pasture.	
Berkshire very stony loam											40	9		Forest, some pasture.	
Berkshire stony loam, steep phase											40	9		Forest, a small area in pasture.	
Becket stony loam, slope phase											40	9		Forest, pasture.	
Hermon stony fine sandy loam, slope phase											40	9		Do.	

Lyman stony loam.....										30	10	} Very low..	Forest, pasture.
Hermon very stony fine sandy loam.....										30	10		Nearly all in forest.
Becket stony loam, steep phase.....										30	10		Forest, a small area in pasture.
Canaan very stony fine sandy loam.....										20	10		Forest, idle, pasture land.
Lyman stony loam, steep phase.....										20	10		Nearly all in forest.
Windsor fine sand.....										20	10		Pasture, forest.
Hermon stony fine sandy loam, steep phase.....										20	10		Forest, a small area in pasture.
Whitman stony loam.....											10		Nearly all in forest.
Peat.....											10		Forest.
Peat, shallow phase.....											10		Nearly all in forest.
Rough stony land (Berkshire soil material).....											10		Do.
Rough stony land (Canaan soil material).....											10		Forest.
Rough stony land (Lyman soil material).....											10		Do.
Rough stony land (Hermon soil material).....											10		Nearly all in forest.
Rough mountainous land (Berkshire soil material).....											10		Do.
Rough mountainous land (Hermon soil material).....											10	Forest.	
Riverwash.....											10	Waste land.	
Rock outcrop.....											10	Do.	

<sup>1</sup> The soils are listed in the approximate order of their general productivity under the prevailing practices of soil management, the most productive first.

<sup>2</sup> The soils are given indexes that indicate the approximate average production of each crop to the nearest 10 percent of the standard of reference. The standard represents the approximate average yield obtained without the use of amendments on the more extensive and better soil types of those regions in the United States in which the crop is most widely grown. A absence of an index shows that the crop is not grown on the particular soil type. The indexes are based on estimates of yields, as yield data are too fragmentary to be adequate. The indexes in the column headed A under each crop refer to yields obtained without the use of commercial fertilizer and lime and only the infrequent use of manure and legumes in the rotation; the indexes in column B refer to yields obtained by the prevailing and more intensive practices, which include the use of commercial fertilizers, lime, crop rotation, and manure. Land for potatoes commonly receives about 1 ton of complete fertilizer at time of planting. The usual analyses are 4-8-8, 4-8-7, or 5-8-7. Cornland receives from 400 to 600 pounds of fertilizer. Land devoted to oats is not commonly fertilized but responds to the residue of the previous potato or corn crop. Lime is used on the dairy farms for the establishment of hay crops at about the rate of 2 tons an acre. Its use is somewhat restricted because of the effect

of overliming upon the development of scab in potatoes. Manure is commonly used every 2 or 3 years or once in the rotation. Quantities applied vary with farms, depending upon such factors as size of dairy herd, area of cropland, and kind of crop. Generally, less manure is added to the fields in the longer rotations. Most intensive practices generally prevail on the medium-textured Hadley, Ondawa, Groveton, Colebrook, Greensboro, Hermon, and Colton soils.

<sup>3</sup> The term "cow-acre-days" is used to express the carrying capacity or grazing value of pasture lands. It represents the number of days that 1 animal unit can be supported on 1 acre without injury to the pasture, or the product of the number of animal units to the acre multiplied by the number of days of grazing. For example, a soil that would provide grazing for 1 cow to the acre for 100 days, or for 2 cows for 50 days, would rate 100 cow-acre-days; and 1 cow to 4 acres for 100 days would equal 25 cow-acre-days. The animal unit is a means of measuring the feed requirements of livestock. It is the equivalent of a mature cow, steer, or horse, or 5 hogs, or 7 sheep or goats.

<sup>4</sup> These numbers indicate the general productivity of the soils for the common crops. Refer to the text for further explanation.

<sup>5</sup> This is a simple grouping on the basis of relative general productivity.

<sup>6</sup> These indexes refer to the production of wild hay with 1 ton as the standard yield of 100.

The rating compares the productivity of each of the soils for each crop on the basis of a standard of 100. This standard index represents the approximate average yield per acre obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. The standard yield for each crop shown in table 7 is given at the head of the column. Soils given amendments, such as lime and commercial fertilizers, or special management, such as irrigation, and unusually productive soils of small extent may have productivity indexes of more than 100 for some crops.

The indexes in table 7 are estimates of yields that are based primarily on interviews with farmers, the county agricultural agent, members of the staff of the University of New Hampshire Agricultural Experiment Station, members of the staff of the College of Agriculture and the Mechanic Arts, and others who have had experience in the agriculture of the county and State. These estimates are not for yields of specific tracts of land, inasmuch as the soils as shown on the map vary somewhat, management practices differ slightly from farm to farm, and climatic conditions fluctuate from year to year. On the other hand, these estimates appear to be as accurate information as can be obtained without further detailed and lengthy investigations, and they serve to bring out the relative productivity of the soils shown on the map.

The indexes in column A under each crop heading are estimates of the yields to be expected without the use of commercial fertilizer or lime and with only the occasional use of legumes in the rotation. In other words, these are estimated yields for a so-called low level of management. The indexes in column B are estimates of the yields that are obtained under the prevailing practices, which include the use of fertilizer for corn and potatoes together with manure once in the rotation. Lime is also used for the hay crops. In other words, these yields are for the more careful and intensive practices that are rather common in the cultivated areas of this county.

Coos County is essentially a forested area in which clearings for farming purposes are concentrated on the more favorable sites. These are represented by the smoother lying and less stony soils of the valleys (bottom lands and terraces) and lower slopes. Dairy farming, supplemented by the growing of potatoes, is the principal type of farming. Hay and other forage and potatoes are the principal crops. Timothy hay and red clover are the chief hay crops. Other forage includes corn silage, soybean hay, and oats for hay. Oats, barley, and buckwheat constitute nearly all of the small grains. The common rotation on the better soils is hay (1 or 2 years), potatoes (2 years), and oats. Corn and soybeans replace potatoes in part. On the higher elevations and less favorable soils the cultivated crops occupy a smaller part of the acreage and the rotation becomes one of hay and small grains, until on the less favorable sites hay becomes about the only crop, except for the use of oats or other small grain as a nurse crop to reestablish the hay.

General productivity grade numbers, assigned in the column headed "General Productivity, Grade," are based on the weighted average

of the indexes for the various crops, the weighting depending on the relative acreage and value of the crop.<sup>6</sup> If the weighted average was between 80 and 100, the soil type was given a grade of 1; if it was between 60 and 80, a grade of 2 was given, and so on. Since it is difficult to measure mathematically the exact significance of a crop in the agriculture of an area or the importance or suitability of a soil for particular crops, too much significance may be given to the order in which the soils are listed. On the other hand, the arrangement does give information as to general productivity. "General Productivity, Group" is a broad grouping to bring out in general terms the relative productivity of the soils of Coos County.

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables show the relative productivity of individual soils. They cannot picture in a given county the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops.

Economic considerations play no part in determining the crop productivity indexes. They cannot be interpreted, therefore, into land value except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. It is important to realize that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. Ease or difficulty of tillage and ease or difficulty with which productivity is maintained are examples of considerations other than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, presence or absence of stone, resistance to tillage offered by the soil because of its consistence or structure, and the size and shape of areas are characteristics of soils that influence the relative ease with which they can be tilled. Likewise, inherent fertility, susceptibility to erosion, and other factors, such as moisture-holding capacity and permeability to roots and water affect the ease of maintaining soil productivity. Productivity, as measured by yields, is influenced to some extent by all of these factors, and they are not to be considered entirely separately from productivity. Methods of land evaluation or classification to designate the relative suitability of land for agricultural use must give some recognition to such factors.

The table also gives information as to the principal crops or use that is made of each of the soil types. The most important crops from the point of view of acreage are listed first under each soil.

## LAND USES AND AGRICULTURAL METHODS

The present utilization of land in Coos County coincides with the suitability of the land for use. The level bottom lands, including the Ondawa and Podunk-Rumney soils, are inherently the most fertile, and their favorable texture and structure give them good moisture-holding capacity. The absence of stone allows easy cultivation and

<sup>6</sup> Instead of following the usual procedure for weighting the indexes of the individual crops by percentages, the general productivity grade numbers in table 7 have been assigned from visual inspection of the indexes, and no mathematical calculations have been used. The placing of the soils, therefore, results from an approximation of the average of the indexes.

the use of improved farm machinery. For these reasons the land is desirable for crops and is nearly all in cultivation or mowing. Similar favorable characteristics of the Colton and Colebrook fine sandy loams, Colton sandy loam, Colebrook gravelly fine sandy loam, and the Groveton, Sudbury, Scarboro, and Suffield soils on terraces favor their use for crops, and where they occur in districts that are farmed they are largely put to this use. The slope phases of soils on the terraces, including the choppy or lightly dissected terrace edges, do not lend themselves so readily to tillage operations and are in part used for pasture. The sandy stone-free soils of the level terraces were at one time nearly all cleared for crops, but, because of rather severe leaching, low inherent fertility, and insufficient moisture at times, which resulted in low crop yields, they have largely been turned back to pasture or allowed to become reforested. Stony terraces on which cultivation is difficult and on which improved farm machinery cannot be used were at one time largely cleared for pasture, but because of low carrying capacity the pastures for the most part have not been kept open and are reverting to forest. The rolling and hummocky relief of the soils developed on kames and eskers is not conducive to farming operations, and when cleared these soils are used mainly for pasture. They are best suited to forest and remain largely in this condition. The poorly drained soils, Scarboro fine sandy loam on terraces and alluvial soils, undifferentiated, on first bottoms, are not suited to crops and remain largely in forest.

Agricultural development of the rolling uplands, even during the expansion of farming in the East, was slow, because of stones that severely hindered tillage operations and largely prevented the use of improved farm machinery. The proportion of these lands that has been cleared of stones and is now classed as nonstony soil suitable for crops is limited. Stones have been removed for the most part only from gently rolling areas on which farm machinery can be used more easily. Where stone has been removed from rolling lands, tillage operations are confined largely to the renewal of hay sods, usually at intervals of 5 years or more.

Hermon fine sandy loam, Becket loam, Lyman loam, and Peru loam, of gently rolling relief, and Berkshire loam, Woodbridge silt loam, and Greensboro fine sandy loam, of rolling relief, together with the slope phases of the Hermon soils, the Lyman and Greensboro soils, and the smooth phases of the Berkshire and Greensboro soils, constitute the rolling soils of the uplands that have been cleared of stone. Approximately 65 percent of these soils classed as suitable for crops occur on slopes of less than 8 percent gradient. Probably 75 percent of the tilled land represents the soils of this group. This condition emphasizes further that the present use trend is toward suitability for actual use.

The stony Hermon, Becket, Canaan, Berkshire, Lyman, Woodbridge, Greensboro, and Peru soils of the gently rolling and rolling uplands, classed as suitable for pasture, are given this rating because of their present stony condition, and when cleared of timber they produce fair to good grazing but are too stony for economic utilization in crops. Although extensively used for pasture, only a comparatively small proportion of the land is cleared. This is because of the slight agricultural development that has taken place. About 50

percent of this land included in farms is cleared and used for pasture. On some farms it is all cleared, and the remaining timber stands occupy the very stony, steep, or rough stony land.

Extensive areas of stony soils, suitable for pasture and, if cleared of stone, suitable for crops, are held as timber reserves by lumber and paper companies and represent some of their best timberlands, from which the timber is more easily removed.

The steep phases of Hermon, Becket, Berkshire, Lyman, and Woodbridge stony soils might support good pasture, but owing to the steep slope they are best left in timber.

The very stony members of the Hermon, Canaan, and Berkshire series, because of the large size of the boulders and the abundance of stones on the surface, cannot be economically cleared for crops; and, as only limited pasturage is obtained between the rocks, these soils are best suited to timber. They should remain largely in forest. Peru very stony loam, because of the abundant and good quality of pasturage it affords on even the limited areas between the rocks, is utilized largely for pasture on farms where it occurs. This practice is justified by the quantity of feed produced, even though in the Soils section of this report this soil is classed as best suited to forest.

Rough stony land and rough mountainous land are suited only to forest.

Soils of the swamps, including Whitman stony loam, muck, peat, and peat, shallow phase, are nearly always saturated with water and are best suited to forest. Only a few small areas of muck are cleared and included in mowings.

The land uses and agricultural methods are an outgrowth of existing soil and climatic conditions that prevail in northern New England and an effort on the part of the farm population to adjust itself to the soil and to the economic trends of the last half century. Early agriculture was largely on a subsistence basis, and the widely separated farms and farm communities had to be self-sufficient. Nearly every farmer was concerned with immediate needs that would keep the home intact. This resulted in the planting of as great a variety of crops as climate and soils would allow, many of which were not particularly adapted to the section.

The opening up of western grain-producing areas and the extension of grazing lands for beef cattle and sheep, together with rapid and cheap rail transportation, enabled the marketing of these products in the East at prices lower than cost of production in New England. These events forced the farmers of this district to change their type of farming. Industrial development of the East, coincidental with the opening up of western farming areas, created a demand for perishable and other farm products that could be produced in nearby areas. This situation led to an increase in the production of garden and fruit crops, also poultry and dairy products to supply the nearby densely populated centers.

Because of the short growing season and the risk of damage by frost to fruits and vegetables, Coos County is more limited in the number of crops that can be grown successfully than is southern New England. The cool climate and the well-distributed rainfall of northern New Hampshire is highly favorable, however, for certain grasses, hay crops, and potatoes. The present-day agriculture is based

largely on the production and utilization of forage crops and the growing of potatoes.

Dairying is an important activity on most farms. The best use for the hay and forage produced is as feed for the dairy cattle. The milk produced for sale provides a cash income, and the keeping of the cattle in the pastures maintains soil fertility. The growing of potatoes fits in well with the dairy-farm rotation and gives an added cash income. Some farmers depend entirely on dairying; others, in connection with dairying, plant a small to fairly large acreage in potatoes; and still others supplement the dairy income with the sale of pulpwood and other forest products. A fairly large number of remote farms are somewhat on the subsistence basis, and the owners sell only a small quantity of milk or potatoes. They obtain much of their cash income from work in the forests. Many of the farmers exchange chickens and eggs for groceries or receive an additional small income from the sale of these products on the local markets.

The form of crop rotation followed, if any, varies within wide limits. The most general practice is to turn the sod, plant potatoes, then oats, and finally return the land to grass. The time elapsing between turning of the sod and starting the rotation a second time varies widely, depending on the needs of the individual farms. On farms where potatoes are not a crop, oats or substitute crops are the only change from grass. Corn for silage and soybeans for hay at times take the place of potatoes in the rotation. Barley and buckwheat are sometimes substituted for oats. The sod may be turned every 3 to 5 years, or it may run indefinitely, as on some of the meadows or overflow lands. In most instances, however, when the yield of hay falls below half a ton to the acre, the sod is turned and the land is reseeded. The increased acreage of potatoes on any farm has a tendency to shorten the rotation because of the limited area of tillable land. Where potatoes are the major farm crop they are grown 2 years in succession and are followed by oats or a soybean-millet mixture for hay. Grass and clover are seeded with the oats or soybean-millet mixture for making a perennial sod. The land is mowed 1 or 2 years before being plowed again for potatoes.

On most farms, especially on dairy farms, 15 to 20 loads of manure to the acre are used on cropland and 10 to 15 loads for a top dressing on the grassland. Commercial fertilizers are used to some extent but not on all farms. A 20-unit fertilizer, or a close approximation of it, is most commonly used and is selected from the following analyses: 4-8-8, 4-8-7, or 5-8-7. Through extensive experiments and general use, these formulas have proved to be the most satisfactory for potatoes and general crops. At the time of planting, land in potatoes receives applications of about 1 ton of fertilizer to the acre; land in oats, barley, and soybeans, 200 to 400 pounds; and land in corn for silage, 400 to 600 pounds. For oats following potatoes fertilizer is not commonly used, as the oats utilize the residue from the application made for the potatoes.

The higher grade or double-strength fertilizers are coming into general use and are preferred by some potato growers because of the advantageous price differential. Lime is not in general use, although many farmers use it occasionally, and the trend for its use is upward. On the all-dairy farms, where hay is the main crop,

ground limestone is applied at the rate of about 2 tons an acre. Lime for some farms is obtained from a local marl (lime) deposit in the vicinity of Colebrook, which has a calcium carbonate content about as high as the best limestone, and the lime is applied at the same rate as limestone, with comparable results. Exceeding care must be exercised in liming land where potatoes are grown in the dairy-farm rotation, because of the tendency of potatoes to develop scab when a large quantity of lime is used. Because of the desirability of clover in the hay mixture and the benefits of clover residue turned under on lands to be planted to potatoes, some lime is used in light applications to insure a catch and good growth of clover. It is usually applied at the rate of 500 to 1,000 pounds an acre. Following the use of such quantities there is no marked tendency of potatoes to develop scab. According to the 1930 census report, 53.2 percent of the farms reported the use of fertilizers in 1929.

Fertilizer experiments on potatoes<sup>7</sup> grown on Greensboro loam near Colebrook indicate a need for larger quantities of phosphorus and potash than are now generally used.

Table 8 gives differences in yields with fertilizer variables as compared with the standard application of 1 ton an acre of 5-8-7.

TABLE 8.—Average annual yield (4 years), Green Mountain variety of potatoes on Jackson farm, using various mixed fertilizers

Fertilizer treatment (tons per acre)	Yield per acre	Difference from check plots	Fertilizer treatment (tons per acre)	Yield per acre	Difference from check plots
	<i>Bushels</i>	<i>Bushels</i>		<i>Bushels</i>	<i>Bushels</i>
1 of 5-8-7	1 393		1 of 5-8-3	356	-37
1 of 5-0-7	285	-108	1 of 5-8-10	418	+25
1 of 5-16-7	432	+39	½ of 5-8-7	318	-75
1 of 5-8-0	231	-162	1½ of 5-8-7	431	+38

<sup>1</sup> Check plots.

Doubling the phosphorus increased the average yield 39 bushels an acre, whereas increasing the potash to 10 percent resulted in the gain of only 25 bushels an acre. The increase for phosphorus was greater the first year after the sod was plowed subsequently to the long rotation that had been followed before the experiment was begun. The use of 1 ton of 5-16-7 was as effective in increasing yields as the use of 1½ tons of 5-8-7 and was much less expensive.

The limited acreage of tilled crops in northern New Hampshire apparently has not justified the establishment of experimental fields for crops other than potatoes. The common rotation practice of oats following potatoes allows the former crop to utilize fertilizer residues with beneficial results. Growth and yield of oats planted on sod land are satisfactory when 200 to 400 pounds an acre of 5-8-7 fertilizer is applied.

Because of extensive rather than intensive pasturing, little has been done toward improving grazing land, either in amount of grazing or in quality of feed produced. A great deal could be done, through the control of weeds and other management practices, to improve the

<sup>7</sup> NEW HAMPSHIRE UNIVERSITY EXTENSION SERVICE. POTATO GROWING IN NEW HAMPSHIRE. N. H. Univ. [Agr.] Ext. Bul. 45, 32 pp., illus. 1934.

pastures and increase their carrying capacities. The strongly acid to very strongly acid reaction of all soils used for pasture indicates a need for lime, especially to encourage clovers. Experiments in top-dressing (and liming) pastures of similar degrees of acidity<sup>8</sup> in other sections of the State showed not only an increase in the total amount of dry matter produced but also an increase of Dutch white clover, which gave added value to the feed produced because of the greater protein content. The use of nitrogenous fertilizers, while increasing the total dry matter only about 50 percent, increased the total protein approximately 100 percent. The use of lime with a complete fertilizer increased the total acre yield of protein by approximately 200 percent above that of check plots that received no treatment.

Experiments with lime<sup>9</sup> on New Hampshire soils indicate that nearly all crops give profitable returns when the land has been limed. Potatoes show the least response to lime. Lime applied at the rate of 1 ton an acre on sandy lands on the first level of the Merrimack River Valley having a strongly acid reaction gave the most profitable returns. These soils in their physical structure, source of soil material, and acidity are somewhat like the valley soils of Coos County and might be used as an index of lime requirements of meadow soils in this county.

Table 9 gives the increases in value of crops from 1- and 2-ton applications of lime used in the 4-year dairy farm rotation, in which lime was applied once in the rotation.

TABLE 9.—Increase in value of crops from applications of lime in a 4-year dairy-farm rotation

Crop	Increase in value with—	
	1 ton	2 tons
Corn silage.....	\$6.29	\$9.29
Oat hay.....	3.86	3.81
Alsike-clover hay.....	9.26	12.28
Soybean hay.....	4.89	2.00
Total.....	24.30	27.38
Cost of lime.....	7.00	14.00
Net increase.....	17.30	13.38

The Connecticut River Valley soils on terraces near Claremont Junction, which are similar to the leached Groveton soils in Coos County, showed a gain of cured hay in five cuttings of 1,287 pounds and 3,096 pounds from applications of 1 and 2 tons of lime an acre, respectively. This would indicate a higher lime requirement for the leached sandy soils, and lime could be profitably applied at the rate of 2 tons an acre.

The average of increased timothy and alsike clover yields on very strongly acid Greensboro loam in the vicinity of Colebrook in a 3-year rotation of potatoes, oats, hay, was 2,511 pounds with an application of 2 tons an acre of ground limestone. Heavier applications of lime

<sup>8</sup> PRINCE, F. S., BLOOD, P. T., PHILLIPS, T. G., and PERCIVAL, G. P. TOP-DRESSING PASTURE LANDS WITH FERTILIZER. N. H. Agr. Expt. Sta., Sta. Cir. 48, 16 pp. 1935.

<sup>9</sup> PRINCE, FORD S., and BLOOD, PAUL T. LIMING NEW HAMPSHIRE FARM LANDS. N. H. Agr. Expt. Sta., Sta. Cir. 44, 12 pp., illus. 1934.

did not give comparable increases in hay, gave only a small increase in oats for hay, and gave no increase in potatoes.

Nearly all of the farms are equipped with mowers, hay rakes, and manure spreaders. Side-delivery rakes, tedders, and hay loaders are used on some farms. Many dairy farms, both in the valley and in the rolling uplands, that devote an appreciable acreage to grain and potatoes, have tractors and power machinery for preparing land, and to a less extent for cultivating it and for the operation of spray machines for potatoes. The small amount of land plowed each year on most farms does not warrant the use of other than horse-drawn machinery. Turn plows of the hillside type and disk, spring-tooth, and smoothing harrows are common on most farms, and the use of potato planters, harvesters, and spray machines is often shared among farmers.

Plowing land for potatoes is about equally divided between fall and spring. Planting dates vary according to season. Usually the greater part of the crop is planted between May 15 and May 30. The land is thoroughly prepared by disking and smoothing before the crop is planted. The rows are spaced from 30 inches to 3 feet apart, and the hills from 10 to 13 inches apart in the row. Seeding is at the rate of 15 to 18 bushels an acre. Cultivation begins as soon as the plants can be well distinguished and usually is completed at the fourth cultivation. Riding cultivators with shovel plows attached are used, and the soil is worked toward the plants until at the last plowing the soil is ridged well up around the plants. Potatoes are sprayed once a week for the control of insect pests and diseases. Usually two sprayings are sufficient to control insect pests, but the bordeaux mixture spray for disease must be continued throughout the growing season. The use of certified seed, produced within the county, has eliminated largely the need for treating seed potatoes for control of certain diseases that are transmitted to the crop in the seed.

Potatoes are the only crop of sufficient importance to create a specialized demand for seed. For the early crop, Irish Cobbler is the chief variety, and White Triumph is being tried; for the late crop, the Green Mountain variety is used exclusively.

Land for oats or substitute crops is prepared in the same manner as for potatoes, and the crop is usually seeded with grain drills. Nurse crops are usually mowed for hay. Oats, when harvested for grain, are mowed on many farms, but, where the crop is more important, binders are a part of the farm equipment or are rented for harvesting. Grain is threshed by machines moving from farm to farm.

## MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of forces of weathering and development acting on soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and has existed since accumulation, the plant and animal life in and on the soil, the relief, or lay of the land, and the length of time the forces of development have acted on the material. External climate is less important in its effects on soil development than is internal soil climate, which depends not only on temperature, rainfall, and humidity, but on the physical char-

acteristics of the soil or soil material and the relief, which, in turn, strongly influences drainage, aeration, run-off, erosion, and exposure to sun and wind.

Coos County occupies the entire northern part of New Hampshire, extending about 70 miles southward from the Canadian border, and lies wholly within the Podzol soil region. All well-drained virgin soils of the uplands show weak to normal Podzol profiles.

The parent soil materials consist of glacial till deposits that are shallow to deep over bedrock, fluvio-glacial deposits, alluvium, and organic materials. Local bedrock is reflected to a marked degree in the kinds of parent material from which many of the soils are developed. Granitic till deposits are closely associated with areas of granite and gneiss bedrock. These give rise to the Hermon and associated soils, most of which are loam or fine sandy loam in the surface soils. Likewise, the finer textured schist till is associated with areas of dark-colored schist rocks high in ferromagnesian minerals. The dominant soil series developed from this material is the Berkshire, which has a surface texture in few places lighter than a loam.

Through movement of the glacier there was a certain amount of dragging of granitic material over schist bedrock, similar dragging of schist material over granite bedrock, and mixing of these materials, which makes it difficult to differentiate between certain Hermon and Berkshire soils. The outwash and alluvium from areas of schist till is made up of a large proportion of dark-colored minerals, and the matrix contains a larger proportion of fine material than does similar outwash and alluvium from granitic till.

The soils are developed under forest conditions where conifers are abundant or dominant, in a region of comparatively high rainfall where evaporation is low, winters are long and cold, and summers short and cool. All these factors favor the accumulation of an abundance of duff that is highly acid in reaction and does not break down readily. As most of the parent material is low in minerals that furnish bases, the duff is more acid than it would be if the bases were more plentiful. Percolating waters remove organic compounds, bases, and soluble salts from the duff, and bases, soluble silica, alumina, and iron from the surface soil, leaving the remaining silica to form the light-gray leached A horizon. Part of the leached iron oxides and organic compounds are accumulated below to form the dark-colored B horizon, and much of the soluble silica, alumina, and bases are removed by drainage waters.

Depth of soil and the intensity of Podzol development are controlled by the texture and character of parent material. Sandy soils are deeper than the loams, and the several horizons are somewhat thicker, though not any more definite. Soils developed over compact till, through which water passes very slowly, show only weak Podzol development or, as in the heavy-textured soils, little or none in spots.

Hermon stony fine sandy loam, developed on sandy granitic till, is the normal and dominant soil over large areas. This soil is developed on gently rolling or rolling land from glacial till of granitic origin. Drainage is good internally and externally. The vegetative cover consists of spruce, fir (balsam), birch, maple, aspen, some hemlock, white pine, beech, basswood, and ash. Many granite and gneiss boulders and rock fragments are scattered over the surface and embedded

in the soil. A sample of this soil, collected 3 miles south of Riverton, is fairly representative of the Hermon soils, although the gray layer is near the minimum thickness for the type. A description of the profile follows:

1. 3 to 0 inches, brown partly decomposed duff, loose in the topmost part, matted and darker below.
2. 0 to 2 inches, gray loamy fine sand, slightly darkened in the upper part by organic matter. This layer in places is somewhat platy but breaks into a loose single-grain mass. (A<sub>2</sub>)
3. 2 to 4 inches, coffee-brown or dark rust-brown firm loam, inclined to have lumps in place that are not hard but tend toward induration, otherwise having no definite structure. The lumps are yellowish-brown or rust brown when broken. (B<sub>1</sub>.)
4. 4 to 10 inches, brownish-yellow mellow fine sandy loam, having no definite structure. (B<sub>2</sub>.)
5. 10 to 20 inches, yellow or pale-yellow fine sandy loam, firm in place but friable. There is no definite structure. (B<sub>2</sub>.)
6. 20 to 35 inches, gray or yellowish-gray slightly compact but friable gritty sandy loam till, showing evidence of some weathering but little affected by soil-development processes. (C.)

Ortstein spots are fairly common in the Hermon soils but are not sufficiently continuous to assume the proportions of a hardpan. Although the third, or B<sub>1</sub>, horizon is lumpy from place to place or very weakly indurated in spots, the yellowish-brown fourth, or B<sub>2</sub>, horizon is the one in which this condition is more pronounced. This semi-cemented condition is best developed around channels caused by the movement of water, in the soil surrounding boulders that extend to or near the surface, and around decaying stumps and tree roots. In many places a thin or spotted bleicherde extends down around these obstructions and a B horizon is on each side.

Berkshire loam is the extensive soil developed from medium-textured till and presents the dominant regional profile for the northern part of Coos County. It is developed on rolling or gently rolling land from glacial till that consists mainly of dark-colored green schist and to a less extent of fine-grained quartzite, sandstone, and greenstone. Drainage is good internally and externally. The vegetative covering is dominantly spruce and fir, but most stands include more or less hardwood—mainly yellow birch and some maple, beech, white birch, and others. Boulders and fragments of schist and quartzite are scattered over the surface and throughout the soil and substratum. Stones and boulders are about as numerous as on the Hermon soils, but generally they are not so large; so that, as a whole, the soil does not present so stony an appearance as the Hermon soils. A sample of Berkshire stony loam, taken 1 mile north of Millsfield Pond in the town of Millsfield, at an elevation of 2,000 feet above sea level, has a profile described as follows:

1. 5 to 0 inches, brown duff, loose at the surface; matted, rather well decomposed, and darker in the lower part.
2. 0 to 2 inches, gray friable very fine sandy loam, firm in place but loose and friable when disturbed. (A<sub>2</sub>.)
3. 2 to 3½ inches, dark-brown or coffee-brown firm loam that breaks into a loose fluffy mass, having somewhat of a soft- or weak-crumb structure. (B<sub>1</sub>.)
4. 3½ to 5 inches, rust-brown friable loose loam. (B<sub>2</sub>.)
5. 5 to 12 inches, yellowish-brown friable loam or silt loam having an olive or green tinge. There is no definite structure. (B<sub>2</sub>.)
6. 12 to 21 inches, olive or greenish-yellow firm but friable loam or silt loam. Like the horizon above, it has no definite structure. (B<sub>4</sub> or C.)

7. 21 to 31 inches, greenish-gray firm or slightly compact gritty loam glacial till that breaks into a friable mass when taken out. Few roots penetrate this layer. (C.)

The Greensboro soils, associated with the Berkshire soils, are developed from much the same till as the parent material of the Berkshire, but they contain some calciferous schist and siliceous limestone material. Soil development and profile characteristics of the Greensboro soils are very much the same as in the Berkshire soils. The weathered limestone fragments and boulders on the surface and embedded in the soil have lost practically all of the calcium carbonate, although some of the larger boulders contain a core of unweathered gray limestone or calciferous schist. Where the till deposits are shallow over limestone bedrock, the Greensboro soil rests on the brown or dark-brown sandy noncalcareous residue of weathered limestone.

All soils on kames and well-drained terraces have typical Podzol profiles, with the lighter textured members showing especially strong development. A sample of Colton fine sandy loam collected about 2½ miles southwest of Wentworth Location (village) is about average for profiles on terraces and is described as follows:

1. 2 to 0 inches, dark-brown rather coarse duff, partly decomposed near the bottom.
2. 0 to 4 inches, gray loose loamy fine sand. (A<sub>2</sub>.)
3. 4 to 8 inches, dark rust-brown or coffee-brown loose and fluffy loam. (B<sub>1</sub>.)
4. 8 to 14 inches, yellowish-brown friable fine sandy loam, having no definite structure. (B<sub>2</sub>.)
5. 14 to 20 inches, pale-yellow loose loamy fine sand. (B<sub>3</sub>.)
6. 20 to 38 inches, yellowish-gray stratified sands and gravel, slightly indurated. (C.)

Weak induration in spots is common to the third and fourth (B) horizons of this soil. It is more pronounced in the lighter colored second (B) horizon, extending in places into the underlying gravelly sandy substratum. Colton loamy sand and Danby loamy sand on kames have in places an ortstein development, and roots penetrating downward go around the hard spots. Colebrook fine sandy loam on terraces and Dixville fine sandy loam on kames and eskers, developed from alluvium and outwash containing a large proportion of dark-colored minerals and some material from till deposits, which are in part from calcareous rocks and limestone, have typical Podzol profiles but show little or no ortstein development.

Canaan stony fine sandy loam and Lyman stony loam, developed respectively from shallow deposits of granitic and schist till, are mainly a complex of zonal and azonal (Lithosol) soils; that is, the till deposits are too shallow for a typical Podzol profile to develop except on the deeper parts of the included soils.

Becket loam and Woodbridge silt loam are developed over compact or hard till that is slowly pervious to water. In the latter soil the hard platy till acts like a hardpan, as water moves along the surface of the hard layer and penetrates it but little. These two soils have only imperfectly developed zonal characteristics and approach the Brown Podzolic soils in character. Woodbridge silt loam only in places shows a faint development of the gray surface layer but has about the normal order of the region.

The Groveton soils, occurring on terraces of postglacial alluvium, have lain in place long enough to develop a typical Podzol profile. These soils do not have more than a slightly noticeable ortstein development, and this only in small spots on the higher lying parts.

Peru stony loam is a Half-Bog soil, and Waumbek stony fine sandy loam is an imperfectly drained soil intermediate in character between a Ground-Water Podzol and a Podzol. Both soils occupy imperfectly drained positions in the rolling uplands and are developed on till.

Sudbury loam and Scarboro fine sandy loam represent respectively the imperfectly drained and the poorly drained soils of the terraces. Sudbury loam is a hydromorphic soil, intermediate between a Ground-Water Podzol and a Podzol. Scarboro fine sandy loam is a Half-Bog soil with a true glei layer 18 to 24 inches below the surface.

Whitman stony loam, occupying poorly drained positions in the rolling uplands, is a Half-Bog soil developed over till. A mucky or peaty duff, ranging from several inches to more than a foot in thickness, covers most of it, and a glei layer lies at a depth of 10 to 20 inches.

The soils of the bottom lands are young alluvial soils, essentially azonal, and for the most part well drained. Hadley very fine sandy loam, Hadley silt loam, Ondawa fine sandy loam, and Ondawa loamy fine sand, together with high-bottom phases of Hadley very fine sandy loam and Ondawa fine sandy loam, occupy most of the bottom land. Small areas of an imperfectly drained complex of Podunk-Runney fine sandy loams and a complex of poorly drained alluvium—alluvial soils, undifferentiated—constitute the remaining soils. The high-bottom phases of the Ondawa and Hadley soils, because of their position above normal overflow and long periods between inundations, show the beginning of the development of a color profile in the upper subsoil layer.

Muck and peat deposits are shallow to deep organic deposits accumulated in depressions of both the rolling till uplands and the valleys. Muck occurs largely in depressions in the alluvial soils and is made up mainly of a mixture of decomposed woody, fibrous, and mossy materials that have received some mineral soil material during periods of overflow. Peat is forested and is made up partly of woody material and partly of remains of sedges, grasses, and moss.

Table 10 gives the pH determinations on a number of soils collected in Coos County.

There is not the difference in pH values between soils of the Hermon-Berkshire group and the Greensboro group that would normally be expected with the till material of the soils of the latter group originating in part from calcareous rocks and limestone. Leaching of bases, no doubt, from Greensboro soils has been complete, and they are now, as regards acid reaction, not greatly different from the Hermon-Berkshire soils.

The Becket and Woodbridge soils, resting on hardpanlike or hardpan substrata, are not severely leached. This is reflected in the higher pH values in all layers, especially in the 20- to 34-inch layer of the Woodbridge, which is a nearly water-impervious hard compact till that has been leached but little.

TABLE 10.—pH determinations on several soil profiles from Coos County, N. H.<sup>1</sup>

Soil type	Depth	pH	Soil type	Depth	pH
Hermon stony fine sandy loam.....	<i>Inches</i>		Groveton fine sandy loam (cultivated).....	<i>Inches</i>	
	3 - 0	4.5		0 - 8	5.1
	0 - 2	4.1		8 - 12	5.3
	2 - 5	4.5		12 - 15	5.5
	5 - 10	5.1		15 - 25	5.5
	10 - 20	5.3		25 - 36	5.7
Berkshire stony loam.....	20 - 35	5.3	Colton fine sandy loam.....	2 - 0	5.3
	5 - 0	3.6		0 - 4	4.2
	0 - 2	3.5		4 - 8	5.1
	2 - 3½	4.0		8 - 14	5.1
	3½ - 5			14 - 20	5.1
	5 - 12	4.4		20 - 38	5.1
Greensboro stony loam (forested).	12 - 21	4.4	Colton loamy sand, with sand subsoil (cultivated).....	0 - 6	5.5
	21 - 31	5.0		6 - 8	5.0
	2 - 0	3.9		8 - 13	4.8
	0 - 1½	3.6		13 - 18	5.1
	1½ - 3	3.8		18 - 28	5.3
	3 - 5	4.0		28 - 40	5.6
Greensboro stony loam (woodland pasture).....	5 - 11	4.7	Dixville fine sandy loam.....	3 - 0	5.0
	11 - 31	4.7		0 - 3	3.6
	0 - 1	5.1		3 - 6	4.2
	1 - 3	4.7		6 - 9	4.8
	3 - 4	4.4		9 - 19	5.3
	4 - 5½	4.6		19 - 37	5.3
Becket loam (cultivated).....	5½ - 12	4.9	Sudbury loam (cultivated).....	37 - 97	7.3
	12 - 17	5.0		0 - 7	5.2
	17 - 40	5.1		7 - 13	5.2
	0 - 6	6.5		13 - 19	5.2
	6 - 12	5.6		19 - 25	5.2
	12 - 20	5.4		25 - 34	5.4
Woodbridge silt loam (plowable pasture).....	20 - 28	5.4	Ondawa fine sandy loam (cultivated).....	0 - 8	5.2
	28 - 40	5.7		8 - 24	5.5
	0 - 7	5.2		24 - 34	5.5
	7 - 12	5.1		34 - 40	5.5
	12 - 20	5.3			
	20 - 34	6.2			
Colebrook fine sandy loam (cultivated).....	0 - 7	6.2			
	7 - 9	6.4			
	9 - 20	6.2			
	20 - 48	6.5			

<sup>1</sup> Determinations made by the quinhydrone electrode method in the laboratories of the University of New Hampshire Agricultural Experiment Station.

The soils of the terraces and bottom lands show a marked uniformity in reaction regardless of drainage, aeration, and soil development, especially where the soils have been cultivated. Acidity is reduced by cultivation; compare the pH value of 4.2 in the surface layer of Colton fine sandy loam (uncultivated) with the pH value of 5.5 in Colton loamy sand (cultivated). The release of bases through the decay of forest litter and grass sod more than offsets the lack of bases in the gray layer.

The relatively high pH value of Colebrook fine sandy loam is due to the influence of alluvium or outwash from areas of till that contained some lime material. This influence may be only local and was not given special consideration in separating the Colebrook from the Colton soils, with which they are included in other areas.

### SUMMARY

Coos County occupies the entire northern part of New Hampshire and has an area of 1,798 square miles. Physiographically, it is a plateau 1,300 to 2,500 feet above sea level, rising at the rate of about

22 feet to the mile from the southwestern corner of the county to its greatest height in the vicinity of the Connecticut lakes. The White Mountains rise sharply from the level of the plateau, extending from the southern and southwestern parts of the county in a northerly direction through the south-central and west-central parts and thence in a northeasterly direction into Maine. The mountains reach their greatest height in the southern part of the county. The plateau is severely dissected by streams. In a few places the topography is subdued, but most of the plateau is cut by comparatively narrow deeply entrenched stream valleys. The western two-thirds of the county is drained by the Connecticut River, and the eastern one-third is drained largely by the Androscoggin River. The valleys of these rivers and their larger tributaries comprise most of the level bottom lands and terraces.

The county was settled after the Revolutionary War largely by people from New England. The 1940 census reports a population of 39,274, of whom about three-fourths are native white and one-fourth foreign-born white.

Originally the area of which this county is a part was covered with a dense forest consisting of mixed conifers and hardwoods. Mixed stands of spruce, fir, yellow birch, beech, and maple grow at elevations of 1,500 to 2,500 feet above sea level; and spruce and fir are dominant between this elevation and the timber line at an elevation of 4,800 feet. Alpine conditions prevail above this level, where the land is mainly a mass of broken rock, although a few areas support a ground cover of grass, shrubs, and vinelike plants.

The climate is continental, with long cold winters accompanied by heavy snowfalls and comparatively short cool summers. There is a great variation in climate from the valley section to the top of the plateau and also to the mountainous section. The mean annual rainfall of 36.63 inches, the mean annual temperature of 41.0° F., the average annual snowfall of 104.5 inches, and the frost-free period of 106 days at Berlin are representative of the valley and lower plateau levels. The mean annual rainfall of 45.32 inches, the mean annual temperature of 37.7°, the average annual snowfall of 168.3 inches, and the frost-free period of only 93 days at Pittsburg, near the head of the Connecticut Valley, are representative of the high plateau section.

The comparatively short growing season in all parts of the county limits the crops to those that mature quickly, and on the high plateau elevations only grazing and hay crops can be grown with any degree of certainty.

Agriculture and lumbering have been the leading occupations of the inhabitants since the early days of settlement. The early subsistence type of agriculture, owing to the adaptability of the section to grass, soon turned to the raising of livestock. Later, dairying became the leading enterprise, as the market for dairy products increased. At present, although the sale of milk is the principal source of farm income, a large number of farms produce potatoes for sale. Many farmers receive part of their income from the sale of pulpwood and other forest products or from labor in the forests. Approximately 60 percent or more of the present population is engaged in or dependent on the harvest and manufacture of forest products—pulp, paper, and lumber. The leading crop is hay made from tim-

othy, with some redtop and other grasses and clover. Oats, potatoes, buckwheat, barley, soybeans, and corn also are produced. The most intensive agricultural development is in the Connecticut Valley, parts of the Androscoggin Valley, and in the smoother parts of the plateau or rolling uplands in Lancaster, Whitefield, Dalton, Milan, Columbia, Colebrook, Jefferson, and Stewartstown. Approximately 40 percent of the county is mountainous and is largely nonagricultural. An additional 40 percent of rough, steep, and very stony areas, as well as large areas of rolling uplands that are not unduly stony, are held by paper and lumber companies as timber reserves. Agriculture never was developed here to the extent that it was farther south in New Hampshire. Reduction in the number and size of farms represents an adjustment in land use and a shift of farming to the better lands, a change that entailed the complete abandonment of some farms. According to the Federal census for 1935, the total area in cropland and pasture land, including plowable pasture, woodland pasture, and other pasture, is 165,349 acres, or 14.4 percent of the total area of the county. The rest of the land in farms is 51,922 acres or 4.5 percent of the area of the county.

The original sources of material from which most of the soils are derived are granite, gneiss, and schist, which occur in rather well-defined areas. Granite and gneiss outcrop over most of the southern half of the county and in local areas farther north along the eastern side. Schist, including some that is calcareous, together with small areas of limestone in the vicinity of Colebrook and some quartzite in the northeastern part, comprises the bedrock of the rest of the county. The soil material was accumulated through glacial action, glacial outwash, lake deposition, recent stream deposition, and by weathering of the materials deposited by these means.

The soils developed from these materials differ considerably because of age, character of deposit, and condition of drainage. They are the most recent in origin and have not been subjected to severe leaching. They have not been in place long enough to be greatly influenced by the soil-forming processes that are operating in the region. Certain heavy materials have resisted these processes to some extent. Others, because of the compact character of the material and imperfect or poor drainage, have been little influenced by climatic conditions that are of primary importance in soil development. Most of the older soils, however, have developed profiles that reflect these climatic conditions and the influence of forest cover.

Conditions are favorable for the accumulation of a thick mat of organic matter or forest duff. This is underlain by a light-gray leached layer, which is generally 1 to 4 inches thick but in some of the lighter textured soils is as much as 6 or 8 inches thick. The gray layer rests on a dark-brown layer in which considerable organic and iron compounds have accumulated. This becomes lighter brown with depth and grades into yellowish-brown and yellow material 10 to 14 inches below the surface. The soil-forming processes in most of the soils of the rolling uplands have strongly affected the soil material to a depth of about 30 inches, below which is the greenish-gray or gray comparatively unaltered glacial till.

Practically all of the soils developed from glacial till in their original condition contained enough stone on the surface, in the form of

boulders or rock outcrop, to interfere seriously with or to prevent cultivation with machinery. Areas mapped as nonstony are so classed because most of the stones have been removed to facilitate cultivation and to allow the use of improved farm machinery. The soils developed from glacial outwash and old alluvium are about equally divided between stony and nonstony types.

The soils, based on physiographic features and character of material, fall into four main groups: (1) Soils of the valleys, (2) soils of the rolling uplands, (3) soils of the very stony, rough, or mountainous lands, and (4) soils of the swamps.

The soils of the valleys are alluvial in origin and are included mainly in the Hadley and Ondawa series on flooded bottoms, the Colton, Colebrook, and Groveton series on stone-free terraces, and the Danby and Dixville series on kames or gravelly moraines, and also wind-blown deposits, which are about equally stony and nonstony. Most of these soils are medium textured and light textured in the surface soils, and they have gravelly or sandy subsoils.

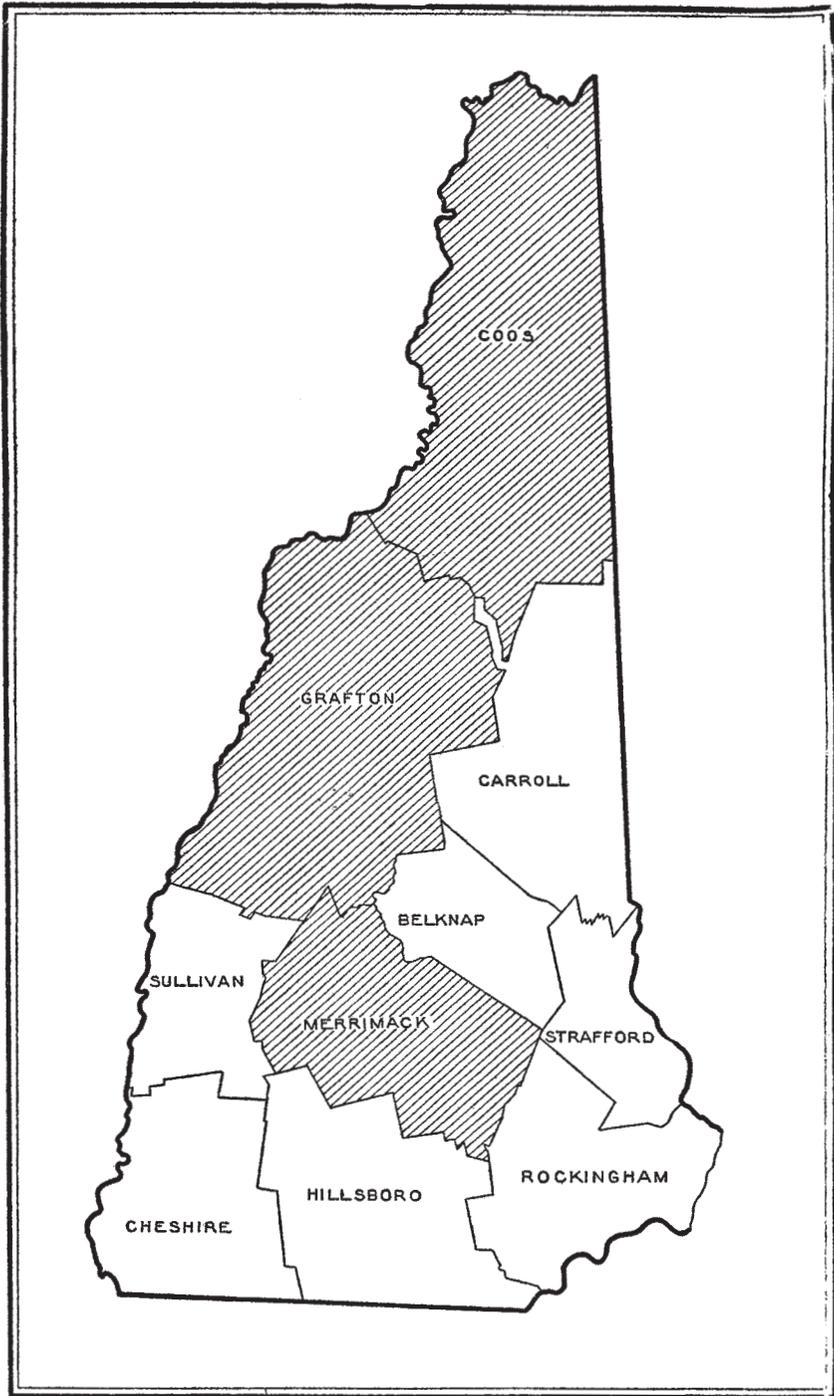
The soils of the rolling uplands include the well-drained Hermon, Becket, and Canaan soils on granitic till; the Berkshire, Lyman, and Woodbridge soils on schist till; and the Greensboro soils on schist that contains some lime. The Canaan and Lyman soils are developed on shallow deposits of till, and the Becket and Woodbridge soils on compact till. The Peru and Waumbek soils include all imperfectly drained soils developed from till. The nonstony soils are used in the production of crops, the stony ones for pasture; and steep areas are suitable mainly for forest.

Soils of the very stony, rough, or mountainous lands include very stony soils, rough stony land that is classified according to the soil material, and rough mountainous land. These soils and land types are suitable only for forest.

Soils of the swamps include Whitman stony loam, which is a Half-Bog soil, and organic deposits, muck and peat, which are nonagricultural.

The most stable agriculture is developed on the soils of the level valleys and on the smooth gently rolling parts of the uplands from which the stones have been removed. Most of the potatoes are grown on the latter soils.

Present land use, to a marked degree, coincides with suitability for use. Cultivation is confined mainly to the smooth and gently rolling lands. The comparatively large acreage in hay allows for rotations extending over a period of 3 or more years, the land being plowed mainly to renew hay sods. This system of farming holds erosion to a minimum, and most of the land has undergone practically no erosion.



Areas surveyed in New Hampshire shown by shading.

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