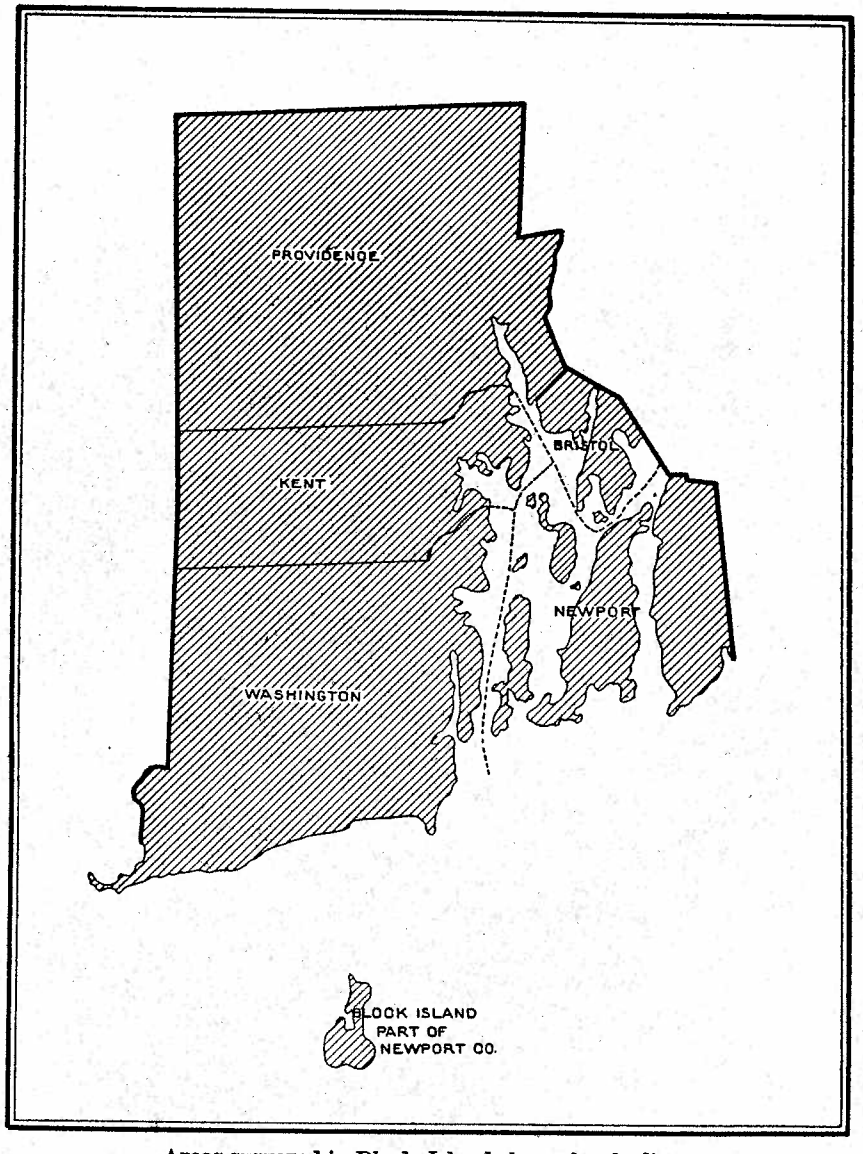

Areas surveyed in Rhode Island shown by shading.

Series 1938, No. 3 Issued April 1943

Soil Survey

Providence County Rhode Island

By
A. E. SHEARIN
United States Department of Agriculture, in Charge
and
S. V. MADISON, W. S. COLVIN, and VLADIMIR SHUTAK
Rhode Island State College Agricultural Experiment Station

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
In cooperation with the
Rhode Island State College Agricultural Experiment Station

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RHODE ISLAND STATE COLLEGE AGRICULTURAL EXPERIMENT STATION

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Series 1938, No. 3 Issued ——— 194—

SOIL SURVEY OF PROVIDENCE COUNTY, RHODE ISLAND

By A. E. SHEARIN, Division of Soil Survey,[1] Bureau of Plant Industry, United States Department of Agriculture, in Charge, and S. V. MADISON, W. S. COLVIN, and VLADIMIR SHUTAK, Rhode Island State College Agricultural Experiment Station

Area inspected by W. J. LATIMER, Inspector, District 1

United States Department of Agriculture, Bureau of Plant Industry, in cooperation with the Rhode Island State College Agricultural Experiment Station

CONTENTS

HOW TO USE THE SOIL SURVEY MAP AND REPORT

The soil survey map and report of Providence County, R. I., 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 of it. Ordinarily he will not have to read the whole report to gain the information he needs.

[1] The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

Readers of the 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.

The 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, and 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 county. The third is to locate the name of each soil in the table of contents, which refers the reader to the page or pages in the section on Soils and Crops 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 of readers includes persons interested in the county as a whole, such as those concerned with land use planning, or the placement and development of highways, power lines, docks, 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) Agricultural History and Statistics, 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 and Crops, 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 these subjects discussed in Soil Survey Methods and Definitions. The teachers of other subjects will find the sections on County Surveyed, Agricultural History and Statistics, Productivity Ratings, and the first part of the section on Soils and Crops of particular value in determining the

relationships between their special subjects and the soils in the county. Soil scientists or students of soils as such will find their special interest in the section on Morphology and Genesis of Soils.

COUNTY SURVEYED

Providence County is in the northern part of Rhode Island (fig. 1) and comprises a little over one-third of the total area of the State. Providence, the county seat, is about 44 miles south of Boston, Mass., and 70 miles east of Hartford, Conn. The area of the county is 426 square miles, or 272,640 acres.

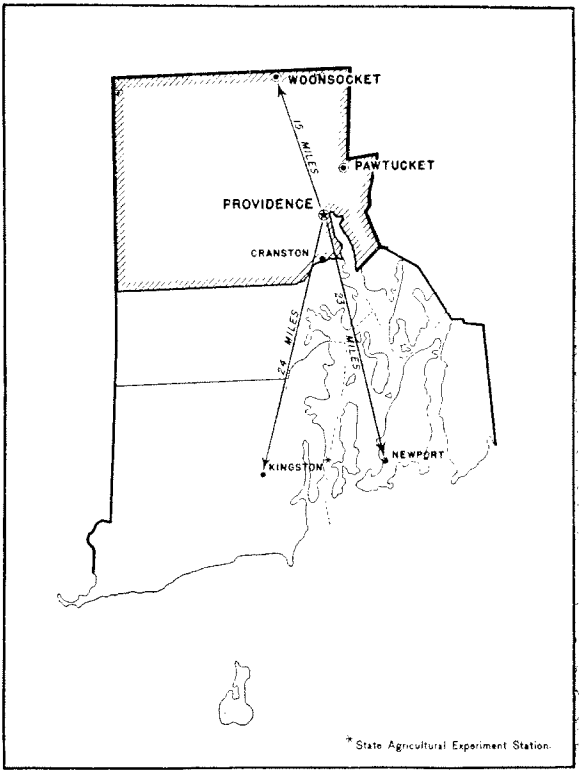

FIGURE 1.—Sketch map showing location of Providence County, R. I.

The county is situated in two distinct physiographic sections—the Seaboard Lowland section, or the Narragansett Basin, covers the southeastern part, and the hilly New England Upland section covers the rest.[2] In the southeastern part less than one-sixth of the total area consists of a comparatively smooth glacial plain interspersed with several fairly smooth gently sloping rounded glacial hills not exceeding 200 feet in height. This area is underlain by bedrock consisting of conglomerate, shales, and sandstone of the Carboniferous period. The outwash materials laid down in this area are variable in character,

[2] FENNEMAN, N. M. PHYSIOGRAPHIC DIVISIONS OF THE UNITED STATES. United States Geological Survey. 1930. [Map.]

composition, and depth and have given rise to soils that differ in texture. The glacial hills were covered with a mantle of glacial drift composed largely of conglomerate, sandstone, and shale, together with a small quantity of granitic material that has given rise to soils of loam or fine sandy loam texture.

The Seaboard Lowland section is separated from the hilly New England Upland section by rather steep hills or escarpments. This hilly section includes medium stony to very stony and rough hills, ranging in height from 100 to about 800 feet, and of narrow, comparatively smooth valleys along the larger streams. The dominant relief is gently rolling to rolling. Despite their moderate elevation, these hills in some places present a decidedly mountainous appearance. They have been subjected to long-continued erosion and probably to several glacial invasions. The slopes are steep and fairly short and choppy in places, and bare igneous bedrock outcrops in many places. The usual covering of glacial till is either missing or shallow. Over much of the area the surface is uniformly smoothly sloping or rolling, and the covering of glacial till averages about 10 feet in thickness. Most of the hilltops are nearly level or gently sloping instead of being sharp crests. This condition is probably due to the grinding and shearing work of the glaciers; and this action of the glaciers, no doubt, also reworked much of the material and deposited it as kames and glacial plains at lower levels.

The glacial outwash plains areas occur in small strips along the main drainageways and consist of fine sandy loams, sandy loams, and loamy sands. The relief ranges from nearly level to hummocky and rolling. In this hilly division the underlying rock formations consist principally of granite, gneiss, and schist, together with small quantities of sandstone and conglomerate. Several crystalline limestone outcrops occur in the northeastern part of the county.

The elevation ranges from sea level to a maximum of about 805 feet above sea level on Durfee Hill in the western part of the county.[3] At Chepachet the elevation is about 400 feet, at Greenville about 290 feet, at Foster Center about 550 feet, and on Hunting Hill in the northeast corner of the county about 400 feet.

Drainage is effected largely through the Blackstone, Pawtuxet, Branch, and Chepachet Rivers, which receive the waters of the smaller rivers, brooks, and intermittent drains. Drainage for the most part is toward the southeast. The Branch and Chepachet Rivers flow to the northeast and empty into the Blackstone River. In places the larger streams have carved out narrow valleys ranging from 100 to 300 feet below the level of the adjoining uplands. Narrow strips of recent alluvial material occur along these streams as well as along some of the smaller ones. Such areas are most common along the Blackstone and Pawtuxet Rivers. Numerous textile mills are situated along the Blackstone, Branch, Nipmuc, and Woonasquatucket Rivers, which supply a part or all of the operating power. The smaller streams generally are rather sluggish and in many places are bordered by long, narrow, swamplike areas consisting of either muck and peat or poorly drained mineral soils. After heavy rains the water in the streams is stained with dissolved organic matter, but there seems to be very little mineral soil in suspension.

[3] Elevations from United States Geological Survey topographic sheets.

Providence County has many lakes, ponds, and reservoirs, the largest of which is Scituate Reservoir in Scituate Town.[4] This reservoir covers several square miles and supplies water for the city of Providence. Smaller reservoirs supply water to the towns and villages. The water supply for most of the farm homes is obtained from springs or open wells. The areas around inland lakes and ponds near the city are desirable for summer or permanent homes, and those around the lakes and ponds farther from the city offer desirable sites for summer cottages and fishing and hunting camps. Most of the lakes and ponds have sandy bottoms, contain fresh water, and are good for boating, fishing, and bathing.

Originally the forest growth of Providence County consisted of mixed conifers and deciduous trees, the distribution of which was determined largely by the texture and structure of the soils and by drainage conditions. On the well-drained soils the trees[5] included chestnut, eastern white pine (commonly called white pine), white, red, black, scarlet, and chestnut oaks, beech, pignut hickory, black walnut, redcedar, gray birch, yellow birch, hemlock, elm, and pitch pine. The tree growth of the poorly drained and organic soils consisted of red maple, elm, alder, swamp white oak, yellow birch, gray birch, white-cedar, and black tupelo (locally called sour gum). At present a large proportion of the total acreage of the county is in forest consisting of second- and third-growth trees of the above-mentioned species. On the lighter textured, shallow, and well to excessively drained soils, white oak, scrub oak, and pitch pine predominate, together with some red and black oaks and chestnut sprouts. Highbush blueberry, sumac, and sweetfern are the most common shrubs. Red, black, scarlet, and chestnut oaks predominate on the soils with good but not excessive drainage, together with some white oak, eastern white pine, red maple, gray birch, hemlock, hickory, redcedar, chestnut sprouts, and flowering dogwood. The underbrush consists of a thick growth of blueberry, huckleberry, mountain-laurel, bull brier, sumac, poison-ivy, and other shrubs and herbs. The poorly drained and organic soils support a forest growth mainly of red maple, gray birch, swamp white oak, white-cedar, yellow birch, alder, ash, sour gum, and a thick undergrowth of shrubs and herbs, consisting of huckleberry, hardhack, sumac, bayberry, catbrier or bull brier, summersweet or sweet pepperbush, royal fern and other common ferns, and cattail.

Most of the present forest growth in Providence County, except that in small scattered areas, is small and of little value except for cordwood. The forests, as well as the shade trees in the cities and villages, were badly damaged by the hurricane of September 21, 1938.

On land that has been recently cut over, the new growth is about the same as the previous stand. Areas that have been burned over reforest with a thick growth of gray birch, poplar (aspen), and oaks. Abandoned fields support a scattered growth of gray birch and pitch pine, with an undergrowth of shrubs and herbs. The most common

[4] In Rhode Island, as in the other New England States, the chief political subdivision is the town. This corresponds somewhat to the township in other sections of the country, although in some respects it is more like a county in its political functioning. In order to avoid repetition, the term "town" will be omitted hereafter throughout the report where this can be done without confusion.

[5] ARNOLD, SAMUEL GREEN. HISTORY OF THE STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS. Ed. 3, 2 v., illus. New York. 1878.

shrubs are sumac, low juniper, sweetfern, dewberry, blackberry, wild-indigo, and lambkill or sheep laurel.

The most common grasses in the county are broomsedge, Rhode Island (Colonial) bentgrass, sheep fescue, hair fescue (fine-leaved fescue), Kentucky bluegrass, Canada bluegrass, redtop, and sweet vernalgrass. The most prevalent weeds are quackgrass, ragweed, wild carrot, yarrow, crabgrass, dandelion, goldenrod, poison-ivy, hairy-cap moss, cinquefoil, sheep sorrel, field daisy, narrow-leaved plantain, and thistle. Most of these are serious pests in hayfields and lawns.

Following is a list of scientific and common names of native plant species in this county:

TREES

Scientific name	*Common name*
Acer rubrum L.	Red maple
Alnus incana (L.) Moench	Speckled alder
Alnus rugosa (Du Roi) Spreng.	Hazel alder or smooth alder
Betula lenta L.	Black birch
Betula lutea Michx. f.	Yellow birch
Betula populifolia Marsh.	Gray birch
Carya glabra (Mill.) Sweet (syn. *Hicoria glabra*).	Pignut hickory
Castanea dentata (Marsh.) Borkh.	Chestnut
Chamaecyparis thyoides (L.) B. S. P.	White-cedar
Cornus florida L.	Flowering dogwood
Fagus grandifolia Ehrh.	Beech
Fraxinus americana L.	White ash
Juglans nigra L.	Black walnut
Juniperus virginiana L.	Redcedar
Nyssa sylvatica Marsh.	Black tupelo or sour gum
Pinus rigida Mill.	Pitch pine
Pinus strobus L.	Eastern white pine
Populus grandidentata Michx.	Largetooth poplar
Populus tremuloides Michx.	Poplar (aspen)
Quercus bicolor Willd.	Swamp white oak
Quercus coccinea Muenchh.	Scarlet oak
Quercus ilicifolia Wangh.	Scrub oak
Quercus maxima (Marsh.) Ashe	Red oak
Quercus prinus L.	Chestnut oak
Quercus velutina Lam.	Black oak
Tsuga canadensis (L.) Carr.	Hemlock
Ulmus americana L.	Elm

SHRUBS

Amelanchier sp.	Shadbush
Clethra alnifolia L.	Summersweet or sweet pepperbush
Comptonia peregrina (L.) Coult. (syn. *Myrica asplenifolia*).	Sweetfern
Gaylussacia baccata (Wangh.) K. Koch	Huckleberry
Gaylussacia frondosa (L.) Torr. and Gray	Dangleberry
Ilex opaca Ait.	Holly
Juniperus communis L.	Low juniper
Kalmia angustifolia L.	Lambkill or sheep laurel
Kalmia latifolia L.	Mountain-laurel
Myrica pennsylvanica Lois. (syn. *M. carolinensis*).	Bayberry
Rhus glabra L.	Sumac
Rhus toxicodendron L.	Poison-ivy
Rhus vernix L.	Poison sumac
Rubus allegheniensis Porter	Blackberry
Rubus flagellaris Willd.	Dewberry
Rubus hispidus L.	Trailing blackberry

SHRUBS—Continued

Scientific name	*Common name*
Smilax rotundifolia L.	Bull brier or catbrier
Spiraea spp.	Hardhack and meadowsweet
Vaccinium angustifolium Ait. (syn. *V. pennsylvanicum*) var. *laevifolium* House.	Lowbush blueberry
Vaccinium corymbosum L.	Highbush blueberry
Viburnum dentatum L.	Arrowwood

HERBS AND GRASSES

Achillea millefolium L.	Yarrow
Agropyron repens (L.) Beauv.	Quackgrass
Agrostis alba L.	Redtop
Agrostis tenuis Sibth.	Rhode Island (Colonial) bentgrass
Ambrosia artemisiifolia L.	Ragweed
Andropogon scoparius Michx.	Beardgrass or broomsedge
Anthoxanthum odoratum L.	Sweet vernalgrass
Baptisia tinctoria (L.) R. Br.	Wild-indigo
Chrysanthemum leucanthemum L.	Field daisy
Cirsium sp.	Thistle
Dactylis glomerata L.	Orchard grass
Danthonia spicata (L.) Beauv.	Poverty oatgrass
Daucus carota L.	Wild carrot
Digitaria sanguinalis (L.) Scop.	Crabgrass
Festuca capillata Lam.	Hair fescue or fine-leaved fescue
Festuca ovina L.	Sheep fescue
Fragaria virginiana Duchesne	Strawberry
Onoclea sensibilis L.	Sensitive fern
Osmunda cinnamomea L.	Cinnamon fern
Osmunda regalis L.	Royal fern
Phleum pratense L.	Timothy
Plantago lanceolata L.	Narrow-leaved plantain
Poa compressa L.	Canada bluegrass
Poa pratensis L.	Kentucky bluegrass
Polytrichum sp.	Hairy-cap moss
Potentilla canadensis L.	Cinquefoil
Pteridium aquilinum (L.) Kuhn (syn. *Pteris aquilina*).	Bracken
Rumex acetosella L.	Field sorrel or sheep sorrel
Rumex crispus L.	Yellow dock
Solidago sp.	Goldenrod
Stellaria media (L.) Cyrill.	Common chickweed
Taraxacum officinale Weber	Dandelion
Trifolium hybridum L.	Alsike clover
Trifolium pratense L.	Red clover
Trifolium repens L.	White clover
Typha latifolia L.	Cattail

The first settlement of white men[6] in this county was made in 1636, on the east side of the Seekonk River in East Providence, by Roger Williams and a band of followers who were banished from Massachusetts because of their religious views. At this time the land east of the Seekonk River and Narragansett Bay was occupied by the Wampanoag Indians, and the Narraganset Indians controlled the land west of the river and bay. Settlements of white men gradually spread to nearby areas along the Seekonk, Providence, and Blackstone Rivers and Narragansett Bay. Settlement in the western part of the county was rather slow until years later. Providence County was originally incorporated June 22, 1703, as the county of "Providence Plantations" and included the present territory of Providence,

[6] EAYLES, RICHARD M. HISTORY OF PROVIDENCE COUNTY, RHODE ISLAND. 2 v., illus. New York. 1888.

Kent, and Washington Counties, except the present towns of Cumberland, East Providence, and Pawtucket. The name was changed to Providence County June 16, 1729. Kent County was later formed from Providence County and Cumberland, Pawtucket, and East Providence were annexed, rounding out the present boundaries.

Agriculture was the chief pursuit of the early settlers. Such crops as Indian corn, rye, barley, beans, and potatoes were grown for consumption at home. This food supply was supplemented with fish and wild game from the nearby streams and forests. The early settlers were prosperous, owing in large part to their friendly relations with the Narraganset and Wampanoag Indians.

According to the Federal census, the population of Providence County was 550,296 in 1940, of which 2.7 percent was classed as rural. Providence, the capital of the State, is situated in the southeast corner of the county. It is the center of concentration, having a poulation of 253,504 in 1940. Pawtucket, with a population of 75,797; Cranston, with 47,085; Central Falls, with 25,248; and Woonsocket, in the northern part, with 49,303, are the other cities of the county. These cities are manufacturing centers, trading centers, and shipping points, as well as markets for agricultural products produced in this and other nearby counties of Rhode Island and Massachusetts. The rural population is descended largely from the original settlers of this and surrounding counties. Many people of foreign extraction have moved into the county in the last few decades and have settled largely in or near the cities. The composition of the population in 1940 is not yet available (1941), but, according to the census of 1930, 68.6 percent of the total population of Rhode Island was either foreign-born white or native-born white of foreign or mixed parentage. Italian, French-Canadian, English, Irish, and Polish represent the largest five foreign stocks.

Transportation facilities are good. The main line of the New York, New Haven & Hartford Railroad passes through Providence, Pawtucket, and Central Falls. The Providence and Worcester branch passes through Pawtucket, Central Falls, and Woonsocket between Providence and Worcester, Mass. Branch lines handle freight between Providence, Woonsocket, and the small manufacturing villages in the northern part of the county. United States Highway No. 1 passes through Providence from north to south, and Nos. 6 and 44 from east to west. Good State highways radiate from Providence to all important points. More than 20 local and interstate bus and truck lines operate in and out of Providence, carrying both passengers and freight. Good State and town roads reach all parts of the county. Many of the town roads are surfaced or graveled, and the secondary roads are fair to good during most of the year. Every community has adequate schools, churches, and free delivery of mail. Many State, town, and city parks, golf courses, lakes, and ponds within the county and the nearby beaches in other counties of Rhode Island furnish excellent recreational facilities to the people of Providence County. Probably 60 to 75 percent of the farmers have electricity in their homes, and probably 40 to 50 percent have telephones.

Steamship service for passengers is maintained daily between Providence and New York. Providence is also an important shipping center. The bulk of goods transported by ships to and from its port averages around 5,000,000 tons annually. It is the principal

market for the agricultural products produced in the county and in nearby counties of Rhode Island and Massachusetts. Most of the farm produce is handled by motortrucks. Roadside stands are common on the main highways, especially near the cities, during the summer and fall, and they offer to the public fresh eggs, poultry, and a variety of vegetables and fruits.

Rhode Island is the most highly industrialized State in the Union, and most of the industries are centered in and around Providence, Pawtucket, Central Falls, Cranston, and Woonsocket, in Providence County. In 1930, 43.2 percent of the working population of the State was engaged in industry. At present the most important industries are textiles, metal working, jewelry, silverware, and rubber goods. The textile industry, which includes the manufacture of woolen and cotton goods, is the most important. Woonsocket is the textile center of the county and State. Many smaller industries give employment to a number of people.

CLIMATE

The climate of Providence County is typical of the coastal part of southern New England. Because of the proximity of Narragansett Bay and the Atlantic Ocean, the climate is modified and tempered in winter and correspondingly is cooled in summer. Minor variations in temperature and rainfall in different parts of the county are due to position in reference to Narragansett Bay and the ocean and to differences in elevation. In general the winters are cold, but extreme temperatures are of short duration. The summers are comparatively cool, although there are some periods of hot weather, usually of short duration.

The mean annual precipitation at the United States Weather Bureau station at Providence is 39.19 inches, and it is well distributed over the seasons. The moisture supply is usually sufficient and is uniformly distributed for the growth of crops, although occasional droughts or excessive rainy periods damage growing crops. The climatic conditions are favorable for general farming, market gardening, dairying, orcharding, livestock raising, and poultry raising. The total amount of precipitation for the driest year recorded at Providence is 29.50 inches, whereas the total amount for the wettest year is 63.50 inches.

The length of the frost-free season is ample to mature a wide variety of crops, although frosts may occur somewhat later in the spring and earlier in the fall in the northern and western parts of the State than in the southeastern part. The average length of the frost-free season at Providence is 188 days—from April 18 to October 23. Killing frost has been recorded at Providence, however, as late as May 10 and as early as September 23.

Violent thunderstorms and some hailstorms occur occasionally during the summer, but as a rule they do not cause heavy damage to crops and property. On September 21, 1938, a destructive hurricane, accompanied by a tidal wave, hit the State of Rhode Island, killing nearly 300 persons and causing much damage to farm, residential, and industrial property.

The fairly cool summer climate, combined with easily accessible beaches and lakes, makes this county a very popular summer resort.

Table 1 gives the more important climatic data as recorded by the Weather Bureau station at Providence.

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TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Providence, Providence County, R. I.*

[Elevation, 8 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1914)	Total amount for the wettest year (1898)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	31.6	68	−12	3.38	2.93	2.54	5.8
January	27.2	64	−9	3.70	3.56	6.01	8.9
February	29.0	69	−10	3.64	2.99	6.45	10.0
Winter	29.3	69	−12	10.72	9.48	15.00	24.7
March	35.7	84	4	3.49	3.38	2.95	5.5
April	46.6	88	11	3.21	3.94	6.08	1.6
May	58.5	94	32	2.96	1.88	4.07	(1)
Spring	46.9	94	4	9.66	9.20	13.10	7.1
June	68.3	96	42	2.68	.58	1.16	0
July	73.4	100	50	3.27	2.81	10.26	0
August	71.0	97	46	3.50	2.02	6.00	0
Summer	70.9	100	42	9.45	5.41	17.42	0
September	63.2	95	33	3.18	.48	2.26	0
October	52.2	87	27	3.12	2.97	8.43	(1)
November	40.4	75	12	3.06	1.96	7.29	.6
Fall	51.9	95	12	9.36	5.41	17.98	.6
Year	49.8	100	−12	39.19	29.50	63.50	32.4

[1] Trace.

AGRICULTURAL HISTORY AND STATISTICS

The early agriculture of Providence County centered around Narragansett Bay and the Providence and Seekonk Rivers in the southeastern part of the county. Settlements spread rather slowly to the northern and western parts because of poor transportation facilities and because the land in these parts was considered of little value. Agriculture was the chief pursuit of the early settlers. Indian corn, barley, rye, beans, and potatoes were the first crops grown. Apples were introduced in the early days, and small fruits, such as blueberries and blackberries, were important. Practically every family had a few domestic animals. Fish and wild game were plentiful. Transportation facilities were meager and travel difficult, so the settlers were compelled to be practically self-sustaining. Very little produce was exchanged between communities, and trading was chiefly with the Indians. Clearing the land of stones and trees was a slow process, but, despite this task, agriculture developed fairly rapidly, especially near Narragansett Bay. The colonial system of farming was developed on the lands near the bay; that is, the land was divided into large plantations and worked by slaves. The raising of horses and cattle, together with other farming enterprises, became important. For the rest of the county the prevailing system was largely one of small, self-sufficient farming enterprises.

Fishing and shipbuilding were early industries and Providence soon became a leading shipping point. Rhode Island merchants traded with the West Indies and parts of continental Europe, and early in

the eighteenth century coastwise trade along the North American coast became important. Horses and such products as rum, pork, butter, cheese, and wool were available for export in the early days.

As manufacturing became established early in the nineteenth century, the population began to concentrate in the villages and cities. The needs of these growing centers for the products of the farm and the development of transportation facilities placed farming on a commercial basis.

Agriculture developed fairly rapidly until around 1880. Still further improvement in transportation facilities, the opening up of the more fertile and easily tilled lands of the West, and the development of manufacturing in New England, however, brought about a decline in the importance of agriculture.

According to the Federal census in 1880, 70.3 percent of the total area of the county was in farms; in 1940 this proportion had declined to 33.3 percent. The number of farms in 1880 was 2,575, and in 1940 it was 1,339.

Table 2, compiled from the reports of the Federal census, gives the acreages of the principal crops grown in Providence County in stated years.

TABLE 2.—*Acreages of principal crops grown in Providence County, R. I., in stated years*

Crops	1879	1889	1899	1909	1919	1929	1939
Corn:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
For grain	2,814	1,373	1,955	2,216	1,399	111	117
For silage					1,019	1,840	1,648
Oats	479	247	237	124	34	5	15
Barley	178	72	16	18	2	3	
Rye	454	208	174	142	66	27	14
Dry edible beans			88	16	33	24	8
Potatoes	2,616	1,774	1,916	1,325	757	349	374
Market garden vegetables harvested for sale			[1] 2,646	[1] 2,625	1,094	1,322	1,084
All hay	41,016	33,089	25,625	22,438	15,543	11,924	10,536
Timothy and clover, alone or mixed				15,587	10,229	9,484	3,854
Sweetclover						36	120
Alfalfa				5	35	185	429
Grains cut green			1,856	1,019	964	311	548
Legumes cut for hay					462	17	116
All other tame hay			23,522	5,306	3,556	1,756	5,094
Wild grasses			247	521	297	135	384
Strawberries			69	53	34	31	27
Raspberries			32	22	33	22	11
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples		109,003	120,458	92,867	108,410	100,638	94,450
Peaches		2,096	24,373	24,203	35,703	20,206	9,148
Pears		10,210	13,432	7,736	7,096	5,939	3,572
	Vines	*Vines*	*Vines*	*Vines*	*Vines*	*Vines*	*Vines*
Grapes			8,639	4,539	37,788	51,943	78,983

[1] All vegetables, other than potatoes or sweetpotatoes, for home use or sale.

The acreage in corn harvested for grain has fluctuated considerably since 1879, whereas the acreage in corn for silage has increased somewhat since 1919. The acreage in oats, barley, and rye steadily decreased from 1879 to 1929, and the same is true of hay crops. The acreage in potatoes, which was 2,616 acres in 1879, decreased to 374 acres in 1939.

Table 3 gives the value of agricultural products by classes in stated years, and table 4 gives the number and value of livestock on farms.

TABLE 3.—*Value of agricultural products by classes in Providence County, R. I., in stated years*

Product	1909	1919	1929	1939
Cereals	$76,323	$135,265	$6,371	3,093
Other grains and seeds	1,265	3,374	2,160	636
Hay and forage	581,838	965,890	437,833	422,749
Vegetables (including all potatoes and sweetpotatoes)	441,190	497,463	265,112	129,474
Fruits	150,190	608,040	367,970	172,253
All other field crops [1]	484,533	306	116	
Farm garden vegetables for home use (excluding potatoes and sweetpotatoes)			62,115	73,985
Receipts from sales of nursery, greenhouse, and hothouse products, etc.			758,879	352,542
Forest products, cut on farms, for home use and for sale			143,473	[2] 63,020
Livestock products:				
Dairy products sold	1,140,602	1,795,999	2,010,810	1,584,075
Poultry and eggs produced	370,564	407,271	758,452	850,743

[1] Listed as all other crops in 1909 and 1919.
[2] Forest products for sale only.

TABLE 4.—*Number and value of livestock on farms in Providence County, R. I., in stated years*

Livestock	1910		1920		1930		1940 [1]	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Horses	3,617	$505,093	2,446	$345,624	1,018	$128,100	679	$100,800
Mules	31	6,330	34	3,892	24	2,661	4	568
Cattle	13,735	564,371	11,647	1,227,982	11,724	1,121,675	9,140	669,313
Sheep	517	2,372	457	6,464	233	2,078	237	1,680
Goats	64	615	86	1,213	63	441	106	1,060
Swine	6,791	58,973	5,567	136,604	2,677	41,258	3,451	44,012
Chickens	[2] 128,227	[3] 112,478	81,077	[3] 160,293	113,656	153,436	172,204	154,984
Bees (hives)	466	2,222	289	2,511	238	2,023	101	774

[1] The census of 1940, taken April 1, excludes horses, mules, and cattle under 3 months of age, pigs and chickens under 4 months, and sheep under 6 months. Comparable numbers on April 1, 1930, are 1,009 horses, 24 mules, 10,403 cattle, and 159 sheep. The number of swine over 3 months of age was 2,048, and the number of chickens over 3 months old in 1930 is as given.
[2] Includes other poultry.
[3] Includes value of other poultry.

The present agriculture is based on dairy farming, poultry raising, fruit growing, market gardening, and potato growing. Other enterprises of less importance consist of growing of small fruits, nursery stock, and flowers, and the raising of beef cattle and hogs. Cranston, Glocester, Lincoln, Cumberland, and East Providence include the principal dairying sections and also the most important market-garden farms. The principal apple- and peach-growing district comprises the northern part of Scituate, the eastern part of Glocester, and the southwestern part of Smithfield. The apple trees were severely damaged by the hurricane in September 1938. It was estimated that at least 50 percent of the trees were uprooted, broken off, or otherwise badly damaged. Foster is probably the leading poultry-raising district, but the poultry farms are fairly well distributed throughout the county. The income on poultry farms is derived from the sale of eggs and dressed or live poultry.

Tame hay occupies the largest acreage of any crop, and a large percentage of the hay is mixed. Mixed hay consists of timothy with red or alsike clover, redtop, orchard grass, or Rhode Island bentgrass in varying combinations. Smaller acreages are devoted to alfalfa, clover alone, millet, oats, and wheat and vetch for forage. Of these, alfalfa is the most important. All the hay and forage is consumed locally, largely in connection with dairy farming. Hayfields are often pastured after the first or second cutting and alfalfa after the second cutting.

Improved permanent pastures are not common. A large acreage is devoted to pasture, but it consists mainly of recently abandoned and brushy lands, cut-over lands, and forested areas. Of the open areas devoted to pasture, Rhode Island bentgrass, Kentucky bluegrass, sweet vernalgrass, and sheep fescue are the most common grasses on the better soils. On the lighter textured soils broomsedge, poverty oatgrass, Rhode Island bentgrass, and fine-leaved fescue are the most common.

Corn for silage and grain occupies the largest acreage of the cultivated crops. A large percentage of the corn crop is cut for silage, especially in the eastern part of the county. More corn for grain is grown in the western part than in the eastern. Sweet corn occupies a fairly large acreage in the vicinity of Providence, and when the sweet corn is harvested most of the fodder is cut for silage. Sweet-corn fodder is plowed under as a green-manure crop on a few farms.

Vegetables for home use and for sale as market-garden crops occupy the next largest acreage. Most of the large market-garden farms are in the eastern part of the county near the cities, whereas most of the vegetables grown in the western part of the county are for home use. The most common market-garden crops are cabbage, tomatoes, beets, carrots, beans, spinach, peas, squash, peppers, lettuce, onions, and cucumbers. Providence, the nearby cities, and Woonsocket offer excellent markets for these crops.

Potatoes are grown for market and for home use on a small scale. Green Mountain and Irish Cobbler are the principal varieties.

Commercial fruit growing is important in certain parts of the county. Apples are the most important of the tree fruits, and peaches are fairly important, but the number of pear, plum, and cherry trees is small. McIntosh, Baldwin, Gravenstein, and Rhode Island Greening are the most imporant varieties of apples. Elberta and Champion are the main varieties of peaches. Grapes, mainly Concord, are grown near the cities. Small fruits, such as strawberries and raspberries, are grown to a small extent for market and home use.

The growing of nursery stock and flower culture are centered largely in and around the cities.

Commercial fertilizers and lime are used extensively on the soils near the cities and less extensively in the more remote parts of the county. Most farmers recognize the value of lime in growing legumes, for increasing crop yields in general, and as an economical method of improving cropland. Much of the limestone used is taken from a limestone quarry just north of Providence. Quarries have been operating in this vicinity for many years, and at present limestone is quarried both for building purposes and for agricultural use.

According to the Federal census of 1930, 603 farms, or 45 percent of the total number, used commercial fertilizer in 1929; the expenditure reported was $90,060, or an average of $149.35 for each farm reporting. Ready-mixed commercial grades are most commonly used, although a few farmers mix their own, and some unmixed chemicals are applied separately. The grades of fertilizer in general use for the different crops are 5–8–7,[7] 4–12–4, 4–8–4, 5–10–10, 8–16–16, and 4–8–10.

On the dairy farms most of the available manure is used on land in corn grown for silage, and this treatment is sometimes supple-

[7] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

mented with commercial fertilizer. Corn is usually followed by grass, for which 200 to 400 pounds of fertilizer and about 1 ton of lime to the acre is commonly applied at seeding time. For vegetables, sweet corn, and potatoes, all available manure and from ½ to 1 ton of commercial fertilizer is used. Rye and buckwheat are the most common green-manure crops.

In 1929, 54.9 percent of the farms hired labor at a total expenditure of $957,957, or an average of $1,301.57 for each farm reporting. According to the county agent, the wages paid for labor in 1940 were about $40 a month with board or about $60 without board. Much of the farm labor, especially on the poultry farms and small dairy farms, is performed by the farmer and his immediate family. Farm labor is rather scarce.

The total expenditure for feed in 1929 was $1,291,021, or an average of $1,181.17 on each of the farms reporting, which represented 81.6 percent of the total number of farms. A large part of this feed bill is for concentrated feed sold to dairymen and poultrymen.

Farm tenure has changed little since 1880. In 1940, as reported by the Federal census, 90.4 percent of the farms were operated by owners, 7.9 percent by tenants, and 1.7 by managers. Most of the farms operated by tenants are rented on a cash basis, and the amount of rent varies, depending on location, improvements, and character of the soil. Some tenants lease farms for a number of years.

In 1940 the total number of farms was 1,339, the average size of the farms was 63.2 acres, and the average area of improved land (cropland and plowable pasture) to the farm was 24.2 acres. The average assessed value of farm land and buildings was $7,424 a farm, or $117.42 an acre, but there is a wide range in land values over the county. The range in size of farms is considerable, but most of the farms are comparatively small. Most of the farmhouses are well built, large, and well cared for. In general the barns are sufficiently large to shelter the livestock and to store hay and other crops. Farm machinery and farm equipment are adequate for the size of farms and for the type of farming practiced. Most of the heavy work and hauling is done by tractors and trucks.

Dairying is an important enterprise. As reported by the Federal census, there were 9,140 head of cattle in 1940, of which 7,858 were milked during 1939, producing 6,126,835 gallons of milk. The cattle are principally good grade dairy cattle of the Holstein-Friesian, Jersey, and Guernsey breeds. Some purebred herds of these breeds are kept, and at least one farm has a herd of purebred Ayrshire cattle. Very few beef cattle are kept. Most of the dairy products are marketed in the form of fluid milk, of which 5,630,572 gallons was sold in 1939. Practically all of these products are consumed in Providence and the other cities. Most of the roughage for the cattle is produced in the county, but most of the grain and other concentrated feed is shipped in. Sheep raising is not important.

Poultry raising is an important source of farm income. In 1929 the total value of poultry and eggs was $758,452, when 857,440 dozen eggs were produced and 198,659 chickens were raised. In 1939, 1,645,200 dozens of eggs were produced and 435,763 chickens were raised. In the western part of the State the White Leghorn is the leading breed and the Rhode Island Red, Plymouth Rock, and New Hampshire Red are less important breeds. In the vicinity of Providence the Rhode

Island Red is the leading breed and the Plymouth Rock, New Hampshire Red, and White Leghorn are less important breeds.

Very little feed for poultry is produced in the county, except some green feed for birds on the range in summer. The number of turkeys, ducks, and geese raised is comparatively small.

The raising of hogs is not important. According to the Federal census there were 3,451 swine in the county in 1940, and most of these were probably on farms where the raising of hogs is a specialty.

The number of horses decreased from 2,446 in 1920 to 679 in 1940. Most of the horses are of the draft type and are used for work on the farms. Horses are becoming less and less important, especially on the dairy and poultry farms.

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 [8] and its content of lime are determined by simple tests. The drainage, both internal and external, and other external features, such as stoniness and the relief or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation are studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into classification units. The three principal ones are (1) series, (2) type, and (3) phase. Some areas of land, such as coastal beach or bare rocky mountainsides, which have no true soil, are called (4) miscellaneous land types.

The most important of these groups 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 a particular 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. Narragansett, Gloucester, and Merrimac are names of important soil series in Providence 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

[8] 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, alkalinity; and lower values, acidity. Indicator solutions are used to determine the reaction of the soil. The presence of lime in the soil is detected by the use of a dilute solution of hydrochloric acid.

loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Narragansett loam and Narragansett fine sandy loam are soil types within the Narragansett 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 a type, differing from the type in some minor soil characteristic that may, nevertheless, have an important practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type, certain areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though no important differences may be apparent 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 plants. 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, 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 AND CROPS[9]

Providence County lies in the glacial region of the northeastern United States. The soils have developed under a forest cover and largely from materials accumulated through glacial action and deposited by the receding glacier as till or by the melting glacier as outwash. Small areas have developed from recent alluvial material and from organic accumulations.

The soils are comparatively young, and the mode of deposition and the character of the parent material are strong contributing factors to the soils and control their distribution.

The bedrock underlying most of the county consists of granite, gneiss, and schist. Small local areas are underlain by conglomerate, sandstone, shale, and slate. These rocks were covered by a mantle of glacial drift varying in thickness. The soils of the uplands have been influenced largely by this drift and to a less extent by the underlying rock. The surface ranges from nearly level to rolling and steep. The soils developed largely from granitic materials are the most extensive and belong to the Gloucester and Narragansett series. The Hollis and Charlton soils, developed from till containing a large proportion of schist, occur in the northeastern part of the county. The Hollis soils are very stony and shallow and have been influenced

[9] No attempt is made in this survey to join with the soil survey of Windham County, Conn., because of the more advanced methods of soil classification and the greater detail used in mapping the soils of Providence County. For similar reasons, many discrepancies occur along the State line where Providence County joins Worcester and Bristol Counties, Mass. In the closely built-up sections in and around the city of Providence and in Woonsocket the soils are not classified.

considerably by the underlying bedrock and by rock outcrops. Glacial material consisting mainly of conglomerate and sandstone, together with some granite material, is confined to one small area in the northeastern part of the county and one in the southeastern part. This material has given rise to the Attleboro and Tiverton soils. A small area of the Cheshire soils in the northeastern part of the county has developed largely from pink sandstone. In a small area southwest of Providence, materials derived largely from shale, slate, and sandstone have given rise to the Newport soils.

The outwash material, from which the soils on the glacial plains have developed, is variable in texture and composition. The Merrimac soils have formed from predominantly granitic material and the Warwick soils from material composed largely of shale, slate, and sandstone. The texture of these soils varies from very fine sandy loam to loamy sand. The Hinckley and Quonset soils have developed from the same kind of material on the kames or uneven relief and are shallow and droughty.

On a large part of the uplands the quantity of stones on the surface is the limiting factor for crop use. Areas of cropland that have been cleared of stones are scattered over the county but are more common in the eastern than in the western part. A large acreage that was at one time cleared of trees and part of the surface stones has been abandoned and has been allowed to revert to forest. Land recently abandoned supports a scattered growth of gray birch, oaks, pitch pine, and redcedar, together with an undergrowth of shrubs and herbs consisting mainly of sumac, bayberry, hardhack, wild-indigo, sweetfern, blueberry, broomsedge, poverty oatgrass, Rhode Island bentgrass, sweet vernalgrass, hairy-cap moss, and dewberry. Forests have always occupied the rough, steep, and stony lands. In general, the texture and structure of the upland soils are conducive to good penetration of roots, good percolation of water, good drainage, and a fairly high water-holding capacity. With fertilization and care these soils produce fair to good yields of general crops where the surface stones are not sufficiently numerous to interfere with cultivation.

The soils on the outwash plains are free of stone; the surface is nearly level to gently undulating; and drainage is good to excessive, depending on texture and structure. These soils are easy to till and respond to fertilization, but in general they are less fertile than the soils of the glaciated uplands because they have developed from coarser materials. They are also more droughty and more highly leached. The supply of moisture is the limiting factor on the lighter textured soils. Fairly large bodies of soils developed from outwash materials are in the southeastern part, and small ones are scattered over the rest of the county.

All the soils are acid.[10] The surface soil ranges from extremely acid to medium acid, and the subsoil is slightly less acid. Of the soils formed from glacial till, the members of the Gloucester series are the most acid and those of the Newport series the least acid. North of Providence, in Cumberland, there are several outcrops of crystalline limestone. Calcareous material, however, seems to have had little or no effect on the development of the soils in this district, as the soils

[10] Field tests made with Soiltex.

are acid and no calcareous till was found. Sweetclover grows along the roads in this part of the county, but it has probably been encouraged by the limestone gravel used on the roads.

According to the Federal census, in 1939 about 12 percent of the total area of Providence County was in improved land, including cropland and plowable pasture. Cranston, Johnston, East Providence, Smithfield, and Lincoln, not including the built-up areas, have a higher percentage of improved farm land than the other towns of the county. Over most of the county the agriculture consists of patch farming; that is, the farms are scattered and the improved farm land is generally in small tracts.

In this county there is little or no correlation between soil types and systems of agriculture practiced or crops grown.

For convenience in discussing the agricultural relationship of the soils of Providence County they have been placed in seven broad groups based on agricultural usage and adaptations, stoniness, relief, and drainage, as follows: (1) Nonstony well-drained soils from till, (2) stony well-drained soils from till, (3) well-drained soils of the outwash plains, (4) soils of the kames, (5) imperfectly and poorly drained soils of the bottom lands, (6) imperfectly and poorly drained soils of the uplands and outwash plains, and (7) miscellaneous land types.

In the following pages the groups of soils and individual soil types are described and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map, and their acreage and proportionate extent are given in table 5.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Providence County, R. I.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Narragansett loam	4,032	1.5	Cheshire stony loam	576	0.2
Narragansett loam, slope phase	512	.2	Cheshire stony loam, level phase	128	(1)
Narragansett fine sandy loam	2,432	.9	Merrimac very fine sandy loam	1,600	.6
Narragansett fine sandy loam, level phase	1,536	.6	Merrimac fine sandy loam	7,040	2.6
Gloucester fine sandy loam	1,472	.6	Merrimac fine sandy loam, shallow phase	960	.4
Gloucester fine sandy loam, level phase	1,216	.4	Merrimac sandy loam	3,392	1.3
Charlton loam	3,712	1.4	Merrimac loamy sand	256	.1
Charlton loam, level phase	1,792	.7	Warwick fine sandy loam	832	.3
Newport loam	384	.1	Warwick sandy loam	2,752	1.0
Newport loam, level phase	512	.2	Hinckley gravelly sandy loam	12,608	4.6
Cheshire loam	320	.1	Hinckley loamy coarse sand	896	.3
Tiverton gravelly fine sandy loam	768	.3	Hinckley gravelly fine sandy loam	10,624	3.9
Tiverton gravelly fine sandy loam, level phase	320	.1	Quonset gravelly sandy loam	640	.2
Attleboro gravelly loam	640	.2	Podunk silt loam	640	.2
Gloucester stony fine sandy loam	42,624	15.6	Alluvial soils, undifferentiated	6,080	2.2
Gloucester stony fine sandy loam, level phase	4,544	1.7	Scituate stony loam	4,992	1.8
Gloucester stony fine sandy loam, steep phase	26,176	9.6	Scituate loam	128	(1)
Narragansett stony loam	2,624	1.0	Whitman stony loam	34,688	12.7
Narragansett stony loam, slope phase	1,408	.5	Whitman loam	1,408	.5
Narragansett stony fine sandy loam	14,208	5.2	Whitman silty clay loam	256	.1
Narragansett stony fine sandy loam, level phase	5,696	2.1	Mansfield stony silty clay loam	3,456	1.3
Charlton stony loam	4,096	1.5	Mansfield silty clay loam	704	.3
Charlton stony loam, level phase	384	.1	Mansfield stony loam	192	.1
Hollis stony loam	7,552	2.8	Scarboro loam	832	.3
Hollis stony loam, rolling phase	1,664	.6	Muck and peat	3,520	1.3
Newport stony loam	320	.1	Muck and peat, shallow phases	3,392	1.3
Tiverton stony gravelly fine sandy loam	256	.1	Rough stony land (Gloucester soil material)	11,776	4.3
Attleboro stony gravelly loam	1,344	.5	Tidal marsh	64	(1)
			Coastal beach	64	(1)
			Made land	1,216	.4
			Unclassified city land	24,384	9.0
			Total	272,640	100.0

[1] Less than 0.1 percent.

NONSTONY WELL-DRAINED SOILS FROM TILL

The nonstony well-drained soils from till include the members of the Narragansett, Gloucester, Charlton, Newport, Cheshire, Tiverton, and Attleboro series that are free or practically free of stones on the surface. A few scattered stones are present in places, but not enough to interfere with cultivation. A large proportion of the acreage of these soils is under cultivation, and agriculturally they are the most important soils in the county. They occur in comparatively small scattered areas in all parts. The nonstony Narragansett and Charlton soils are productive and are the most extensive soils of the group; the Newport, Tiverton, Attleboro, and Cheshire soils are productive but inextensive; the nonstony Gloucester soils are inextensive and are considered the least productive.

The relief ranges from nearly level or gently sloping to gently rolling or rolling, the slope ranging from 2 to about 15 percent. Both surface and internal drainage are fair to good. The Gloucester soils are underlain by loose and gravelly glacial till and are the best drained soils of the group. The other soils have fairly compact to compact substrata, which restrict the percolation of water to some extent, and drainage is not so rapid as in the Gloucester soils.

All the soils of the group allow good penetration of roots and have high water-absorbing capacity and, with the exception of the Gloucester soils, high water-holding capacity. These soils are managed easily and respond to fertilization and care. The heavier textured soils, such as Narragansett loam and Charlton loam, are the most productive soils in the county for hay, corn, and certain other crops. The fine sandy loam types are not quite so productive for corn and hay but are well suited to general farming.

Narragansett loam.—Narragansett loam is one of the most important of the cultivated soils. It occurs in nearly level to gently sloping areas, and drainage is good but not rapid. In cultivated fields the surface soil is dark grayish-brown mellow and friable loam 6 to 8 inches thick. The upper subsoil layer is yellowish-brown mellow friable loam that grades into grayish-yellow fairly loose and friable loam or fine sandy loam at a depth of 14 to 18 inches. The lower subsoil layer becomes lighter in color and texture with depth and rests on gray or dark-gray compact glacial till 24 to 28 inches below the surface. This till is composed largely of granite and gneiss, together with a small quantity of schist and other materials in places; and, although compact, it is easily broken down. It is compact enough to restrict the downward movement of water. Locally it is called a hardpan, but it does not have the plasticity or hardness of a true hardpan. Rust-brown, yellow, and gray mottlings are common just above this layer, and in places the till is mottled or streaked with the same colors. The reaction is acid in all layers. A few scattered stones are present on the surface in places, and a small quantity of gravel in the form of angular or flat rock fragments is common. The subsoil generally contains a small quantity of gritty material and small rock fragments, which increases with depth.

Narragansett loam is fairly uniform in texture, structure, and depth. It is one of the most productive soils in the county for general crops, and practically all of it is under cultivation. The soil is easily managed, works up into a good tilth, is responsive to fertilization, and is

capable of being built up to and maintained in a productive state. Because of the favorable structure of the surface soil and the subsoil and because of the compact substratum, the water-absorbing and water-holding capacities are high and crops seldom are injured by lack of moisture. The relief is favorable for all farming operations, and most of the fields are sufficiently large to allow the use of tractors and other modern machinery. Erosion is not a problem, owing to the smooth surface and favorable structure.

Narragansett loam occurs in scattered areas in all parts of the county except the extreme eastern part. The total acreage is not large, but the soil is productive. Dairy farming is the most important agricultural enterprise on this soil (pl. 1); therefore, hay and silage corn are the most important crops. Corn for grain, market-garden crops, and apples are other important crops. Small acreages are devoted to sweet corn, potatoes, red clover, alfalfa, oats, millet, and small fruits. Commercial fertilizers are used extensively near the cities but not so extensively in the more remote districts.

This is one of the most productive soils in the county for hay and corn. Hay yields from 1½ to 3 tons to the acre. Land for hay usually receives an application of stable manure and 1 to 2 tons of lime an acre at the time the grasses are seeded. Some farmers apply 200 to 400 pounds of commercial fertilizer, but this is not a general practice. Land devoted to corn for silage receives a heavy application of manure and 300 to 400 pounds to the acre of a 5–8–7 or 4–8–4 commercial fertilizer and yields 10 to 15 tons an acre. Alfalfa yields 3 to 4 tons and red clover 1½ to 3 tons. Millet yields 3 to 5 tons. For sweet corn the land usually receives about one-half ton to the acre of a 5–8–7 commercial fertilizer, in addition to manure, and yields 600 to 1,200 dozen ears an acre. Land devoted to potatoes and market-garden crops is usually fertilized with ½ to 1 ton of commercial fertilizer; and in addition, for market-garden crops, about 1 ton of lime is applied every 3 or 4 years. Potatoes are limited to a small acreage, and the yield ranges from 150 to 350 bushels an acre. Market-garden crops also occupy a small acreage. Cabbage yields about 300 to 400 bushels, tomatoes 300 to 500 bushels, and string beans 250 to 350 bushels.

Probably 50 percent of the commercial apple orchards and several peach orchards are located on this soil. McIntosh, Baldwin, and Rhode Island Greening are the principal varieties of apples, and the yields range from 100 to 300 bushels an acre, depending on fertilization, care, and weather conditions. Most of the apples are fertilized with a complete fertilizer mixture and one-half to 1 ton of lime to the acre. Some farmers fertilize with a nitrogen fertilizer only.

Narragansett loam, slope phase.—The slope phase of Narragansett loam is essentially the same as the typical soil except in relief. This soil occurs on gently sloping to sloping relief, the gradient ranging from 4 to about 10 percent. Surface drainage is more rapid than on Narragansett loam, and more care must be exercised to control erosion when this soil is planted to clean-cultivated crops. Cultivation should conform to the contour of the land as closely as possible. The more rolling areas should be left permanently in grasses for hay or pasture.

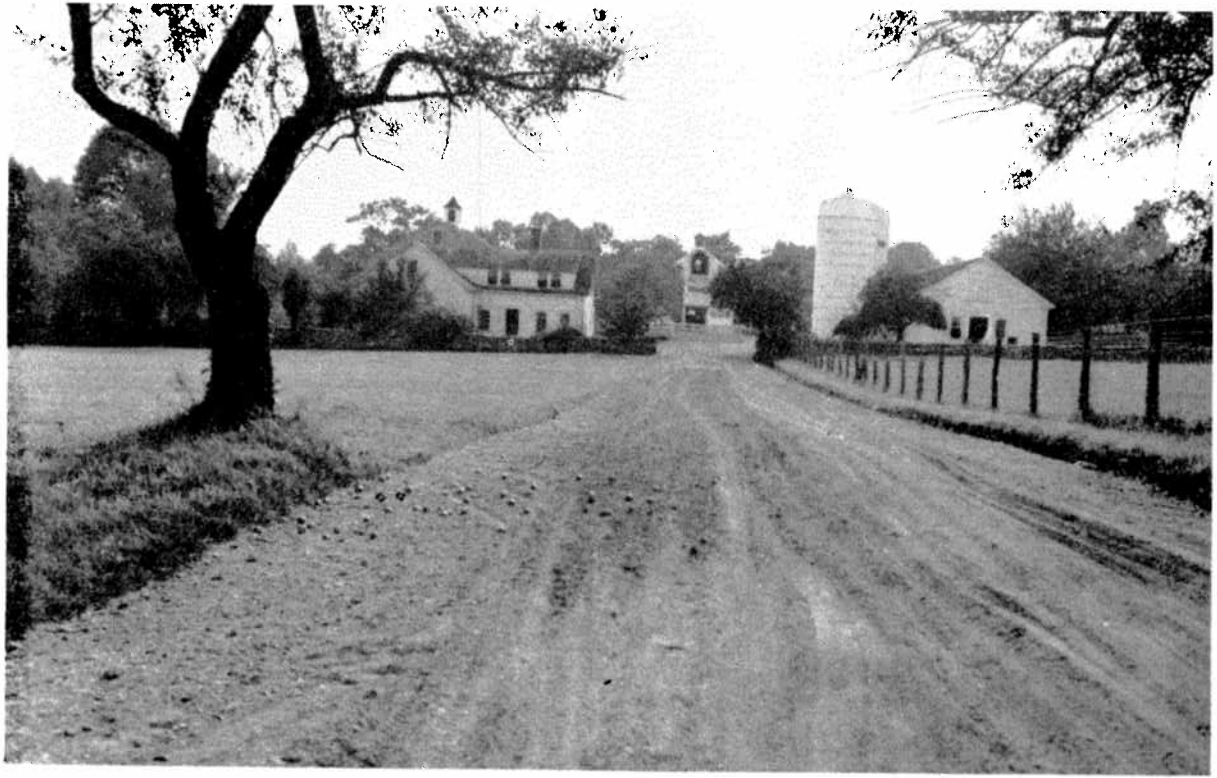
The surface soil is generally not so thick as that of the typical soil, because some of the surface soil has been lost by erosion.

Narragansett loam, slope phase, is of small extent. It is closely associated with typical Narragansett loam and occurs in small areas throughout the greater part of the county. Practically all of this soil is under cultivation to the same crops and in about the same proportion as on Narragansett loam. Fertilizer treatments and management practices are similar, and crop yields average about the same or a little lower.

Narragansett fine sandy loam.—Narragansett fine sandy loam occupies small scattered areas throughout the county on gently rolling or gently sloping to rolling relief (pl. 2, *A*). Practically all of this soil is under cultivation or in pasture. In cultivated fields the surface soil is brown or grayish-brown mellow friable fine sandy loam about 6 inches thick. Areas that have not been plowed for several years are matted with small roots and have a weak granular structure. The upper subsoil layer is yellowish-brown friable fine sandy loam that grades into a grayish-yellow gritty and friable lower subsoil layer from 14 to 20 inches below the surface. The lower part of the subsoil contains a small quantity of small angular rock fragments and rests on dark-gray fairly compact till at a depth of 24 to 30 inches. Yellow, brown, and gray mottlings, which are caused by retarded drainage, are common just above the till. The glacial till from which this soil has developed is composed largely of granite and gneiss, together with a small quantity of schist or other materials in places. In some places a few stones and a small quantity of gravel in the form of small angular rock fragments are scattered over the surface. Neither stone nor gravel occurs in sufficient quantity to interfere with cultivation.

Narragansett fine sandy loam contains more gritty material in the subsoil than does Narragansett loam, and the underlying till, in general, is slightly less compact than that under the loam. This soil has a slope ranging from 4 to about 12 percent. Both surface and internal drainage are good. Internal drainage is retarded to some extent, however, by the compact till. Erosion is not a serious problem, although some care should be exercised for the control of erosion where the land is used for clean-cultivated crops. A large part of this soil is in grasses for hay or pasture the greater part of the time, and this use limits the amount of erosion.

Inherently this soil is not quite so productive as Narragansett loam for such crops as hay, corn, clover, millet, and cabbage, but it is a good general-purpose soil. Because of the slightly better drainage, it is better adapted than Narragansett loam to certain market-garden crops, such as beans and peas. Narragansett fine sandy loam is easily managed, is responsive to fertilization and care, and can be built up to and maintained in a fairly productive state. This soil occurs in scattered areas in all parts of the county except in Cumberland, North Providence, and East Providence, and it is closely associated with the loam. The total acreage is not large, but it is a fairly important soil in the agriculture of the county. The principal crops are hay, corn for silage, field corn, market-garden crops, and apples. Smaller acreages are devoted to potatoes, clover, alfalfa, oats, millet, and small fruits. Hay and corn for silage occupy the largest acreage. Fertilizer practices are essentially the same as on Narragansett loam. Commercial fertilizers and lime are used more extensively on this soil near the cities than in the western part of the county.



Dairy farm on Narragansett loam near Hope.

A, Recently cleared area of Narragansett fine sandy loam. *B*, Small fields on Narragansett loam. Note the characteristic stone fences.

Hay yields from 1 to 2½ tons, silage corn 8 to 12 tons, alfalfa 2½ to 3½ tons, and millet 3 to 4 tons an acre. Potatoes yield from 150 to 250 bushels, sweet corn 500 to 1,000 dozen ears, cabbage 250 to 350 bushel boxes, tomatoes 300 to 400 bushels, and string beans 200 to 300 bushels. Apple yields range from 100 to 300 bushels, depending on fertilization, care of the orchards, and weather conditions.

Narragansett fine sandy loam, level phase.—The soil profile characteristics of the level phase of Narragansett fine sandy loam are similar to those of Narragansett fine sandy loam. The level phase of this soil occupies nearly level to gently sloping areas. Because of the smooth surface, run-off is less rapid, the water-holding capacity is slightly higher, and susceptibility to erosion is less, as compared with those features of the typical soil. The surface soil probably averages a little thicker than that in the typical soil.

This soil occurs in scattered areas over most of the county. It is closely associated with Narragansett fine sandy loam and the other Narragansett soils. The total acreage is less than that of the typical fine sandy loam. Practically all of this land is under cultivation. The principal crops are hay, corn for silage, corn for grain, market-garden crops, and orchard fruits. Because of the more favorable relief, this soil is considered slightly better than Narragansett fine sandy loam for the general-farm crops. Fertilizer treatments and management practices are essentially the same for the two soils. Crop yields probably average a little higher on the level areas, especially for such crops as hay and corn. With similar care and fertilization, however, there is very little difference in yields on the two soils.

Gloucester fine sandy loam.—Gloucester fine sandy loam is inextensive and is unimportant agriculturally. It differs from Narragansett fine sandy loam in having more coarse material in the subsoil and in being underlain by loose gravelly till that has little or no compaction. This soil occurs in very small scattered areas closely associated with the stony Gloucester soils. The largest areas are in the northwestern part of Cranston and the southwestern part of Johnston. Small areas are in the other towns with the exception of North Providence and East Providence. The surface is practically free of large stones. In places there are a few scattered stones of granite or gneiss, but they are not numerous enough to interfere appreciably with cultivation. Small angular fragments of these rocks, however, are scattered over the surface.

The land ranges from gently rolling to rolling, having a gradient of 3 to about 12 percent. External drainage is good, and internal drainage is excessive, owing to the open and porous subsoil layers and to the loose coarse till underneath the soil. Crops are often injured during dry seasons by lack of moisture. This soil is easily managed, and with heavy fertilization fair yields of general crops are obtained. It is inferior, however, to the Narragansett soils for agricultural purposes.

In cultivated fields Gloucester fine sandy loam is characterized by a light-brown to light grayish-brown friable fine sandy loam surface soil about 6 inches thick. It contains some gritty material in places. The upper subsoil layer is yellow or brownish-yellow friable fine sandy loam containing a small quantity of gritty material and very small rock fragments. The upper subsoil layer grades into grayish-

yellow friable and gritty fine sandy loam or sandy loam at a depth of 16 to 20 inches. The lower subsoil layer rests on loose gravelly gray or yellowish-gray till at a depth of 24 to 30 inches. The till shows little or no compaction and is composed largely of granitic material including numerous stones and boulders. Included with this soil in mapping are a few small areas of very fine sandy loam and a few areas of sandy loam. The inclusion of very fine sandy loam is associated with Glocester stony very fine sandy loam in various parts of the county, but the inclusion of sandy loam occurs only in Glocester and Burrillville. The total area of these inclusions is very small, and they do not differ essentially in agricultural value from the typical fine sandy loam.

Probably 70 to 80 percent of this soil is under cultivation. The abandoned fields support a cover consisting mainly of broomsedge, poverty oatgrass, wild-indigo, sweetfern, and hairy-cap moss, together with scattered trees of gray birch, pitch pine, and scrub oak in places. The principal crops are vegetables, hay, corn, sweet corn, and potatoes. Several old apple orchards are on this soil. The trees are not given much care, and the yields are probably very low.

In the vicinity of Providence this soil and the level phase of Gloucester fine sandy loam are used largely for market-garden crops and sweet corn; whereas in other parts of the county hay and corn are the main crops. Fertilizers are used extensively on the market-garden farms near the city. On the areas in the western part, little commercial fertilizer is used, but stable manure is used if available. Tomatoes, early peas, string beans, and peppers produce fair returns on this soil if it is fertilized. Such crops as hay, corn, cabbage, and cauliflower do not yield so well as on the heavier loam soils. Tomatoes yield from 250 to 350 bushels an acre, early peas 100 to 200 bushels, string beans 250 to 350 bushels, and peppers 200 to 300 bushels. Sweet corn yields 500 to 800 dozen ears. Hay yields 1 to 2 tons an acre and field corn 20 to 30 bushels.

This soil is susceptible to some erosion if devoted to clean-cultivated crops, and care should be exercised in selecting crops and in the cultural methods practiced.

Gloucester fine sandy loam, level phase.—The level phase of Gloucester fine sandy loam is closely associated with Gloucester fine sandy loam on nearly level to gently sloping relief. These two soils do not differ in profile characteristics. Surface and subsurface drainage are good on this soil, but surface run-off is not so rapid as on the typical soil. The surface soil probably averages a little thicker, as this soil is subject to little or no erosion. Included with this soil, because of their small extent, are a few small areas of sandy loam and very fine sandy loam. The inclusion of very fine sandy loam is associated with Gloucester stony very fine sandy loam, and the inclusion of sandy loam is in Glocester and Burrillville.

The total acreage of Gloucester fine sandy loam, level phase, is small. Because of the smooth surface and the less rapid drainage, it is slightly superior to Gloucester fine sandy loam for agricultural purposes. It is used for the same crops in about the same proportion as the typical soil. Fertilizer treatments and management practices are the same on the two soils, and yields average about the same or slightly higher on the more level soil.

Charlton loam.—Charlton loam is cleared of trees and practically free of stone on the surface. Almost all of the land is under cultivation. This soil occurs largely in the northeastern part of the county. It is one of the important agricultural soils in this part for general farm crops and apples. The areas range from gently rolling to rolling, having a slope of about 4 to 15 percent. Both surface and internal drainage are good.

In cultivated fields the surface soil is rich-brown or dark-brown mellow and friable loam 4 to 8 inches thick. The upper part of the subsoil is reddish-brown mellow and friable loam grading into yellowish-brown friable loam. At a depth of 14 to 18 inches this grades into grayish-brown or grayish-yellow gritty and friable loam or fine sandy loam. In places the lower subsoil layer contains some gritty material and gravel and is very loose and friable. The lower part of the subsoil rests on gray or greenish-gray partly weathered till at a depth of 24 to 30 inches. This till is derived largely from schist and granitic materials and varies in structure and depth. In some places it is fairly compact; in others it is loose and friable. A small quantity of schist and granitic rock fragments is scattered over the surface in places, and the subsoil carries some slabs of schist and other rock fragments. All layers are acid. The pH value of the surface soil ranges from about 4 to 5.5, and the subsurface layers are slightly less acid. Charlton loam ranges in texture from light loam to heavy loam and in a few small areas is very fine sandy loam. This soil varies somewhat in color on the surface, and in some places where it joins Gloucester fine sandy loam the boundaries between the two soils are arbitrary. In the vicinity of Greenville this soil is influenced by a highly micaceous schist and the surface and subsoil layers contain a noticeable quantity of finely divided mica flakes. As mapped in Providence County, Charlton loam probably is not so uniformly compact in the C horizon as are the Charlton soils mapped in Worcester County, Mass. Several places were noted where the upper part of the till was loose and friable and became compact at a depth of 48 to 54 inches.

This soil is easily managed, is responsive to fertilization, and has a fairly high water-holding capacity. Good yields of general crops and apples are obtained. It occurs in fairly large to small scattered areas and is most common in Cumberland, Lincoln, Woonsocket, North Smithfield, Smithfield, and North Providence. A few small areas are in Burrillville, Glocester, and Johnston. A large part of this soil is susceptible to erosion if devoted to clean-cultivated crops. Care should be exercised in planning rotations for the different areas and in the cultural methods practiced. The more rolling areas should be left in grasses as much as possible, or cultivated along the contour.

The principal crops are hay, silage corn, orchard fruits, and market-garden crops. Alfalfa, sweet corn, oats for forage, potatoes, red clover, field corn, grapes, and small fruits are of less importance. Commercial fertilizer and lime are used extensively on most of this soil. Hay land and cornland receive most of the stable manure, supplemented by fertilizer and lime. The market-garden crops—potatoes, sweet corn, and small fruits—usually receive from ½ to 1 ton of commercial fertilizer an acre. Lime is used extensively for alfalfa and red clover and some for market-garden crops, sweet corn, and hay. Hay yields from 1½ to 3 tons an acre, alfalfa 3 to 4 tons, red clover 2 to 3 tons, corn for silage 10 to 15 tons, corn for grain 35 to 45 bushels,

potatoes 200 to 300 bushels, sweet corn 600 to 1,200 dozen ears, and cabbage 300 to 400 bushels.

Apples, peaches, and small fruits yield well. Apples are grown more extensively than any of the other fruits, and several large commercial orchards are located on this soil. McIntosh, Baldwin, and Rhode Island Greening are the most common varieties. The yields range from 100 to 300 bushels an acre and probably average between 150 and 200 bushels. Most of the apple orchards receive a complete fertilizer and occasionally lime. Some receive a nitrogen fertilizer only.

One or two commercial peach orchards are located on this soil. Very small acreages are devoted to strawberries, raspberries, and grapes. Grapes are grown largely in North Providence and around Thornton.

Charlton loam, level phase.—The level phase of Charlton loam is closely associated with typical Charlton loam in Cumberland, Lincoln, Woonsocket, North Smithfield, Smithfield, and North Providence, and it occurs in scattered areas elsewhere. The profile characteristics of the two soils are similar, but the level soil is more uniform in texture and is underlain by a more uniformly compact substratum. It occupies nearly level to gently sloping areas. The surface soil is rich-brown or dark-brown very mellow and friable heavy loam 6 to 10 inches thick. The upper subsoil layer is yellowish-brown mellow friable loam. The topmost few inches is reddish brown in places. The upper part of the subsoil grades at a depth of 14 to 18 inches into grayish-yellow or grayish-brown light loam, which becomes lighter in color and texture with depth and contains some gritty material and small rock fragments of schist, granite, and gneiss. The lower part of the subsoil rests on compact gray or bluish-gray till, generally mottled or streaked with brown, rust-brown, and yellow at a depth of 24 to 30 inches. The till breaks down easily and is loamy in texture. It is composed of finely ground fragments of schist, shale, and granitic rock and becomes coarser and less modified with depth. Included with Charlton loam, level phase, are several small areas of imperfectly drained soils, which are too small to separate on the map.

Charlton loam, level phase, is probably the most productive soil in the county for such crops as hay, corn, clover, oats, and cabbage and is one of the best soils for pasture. The surface is free or nearly free of stone. Both surface and internal drainage are good but not rapid, because of the smooth surface, favorable texture, and fairly compact substratum. The water-absorbing and water-holding capacities are high, and crops are seldom injured by lack of moisture. The soil is easily managed, responsive to fertilization, and capable of being built up and maintained in a productive state. Because of the smooth surface, it is subject to little or no erosion, even when devoted to clean-cultivated crops.

Almost the entire acreage is under cultivation. Dairy farming is the principal agricultural enterprise; therefore, hay and forage and corn for silage are the most important crops grown. Small acreages are devoted to alfalfa, red clover, oats, potatoes, market-garden crops, orchard fruits, small fruits, grapes, and corn for grain. Fertilizer treatments and management practices are essentially the same as on typical Charlton loam. Hay yields 2 to 3 tons an acre, alfalfa 3 to5

tons, clover 2 to 3 tons, and silage corn 10 to 16 tons. Yields of the less important crops average about the same as on Narragansett loam.

Newport loam.—Newport loam, as well as other soils of the Newport series, is confined to a small area in Cranston. The entire acreage of Newport loam has been cleared of trees and stones and is under cultivation. The 4- to 8-inch surface soil in cultivated fields is grayish-brown or brown mellow friable loam having a slight green tinge in places. On a freshly cut surface or when the material is pressed between the fingers, the brown color is intensified. The upper subsoil layer is very pale yellowish-brown or dingy-brown friable porous loam continuing to a depth of 16 to 20 inches, where it grades into olive-gray friable gritty and gravelly loam. The lower subsoil layer contains an increasing quantity of gravel and gritty material with depth and rests on dark olive-gray or bluish-gray fairly compact partly weathered till at a depth of 24 to 30 inches. This till, although fairly compact, breaks down easily and is friable and porous. It is composed largely of shales, sandstone, and conglomerate materials and becomes darker, coarser, and less modified as the depth increases. Small flat fragments of shale and fragments of sandstone and other rock are scattered over the surface and throughout the soil, but not in sufficient quantities to interfere with cultivation. Larger fragments of shale and sandstone are common in the lower part of the subsoil. All layers of this soil are acid in reaction. The pH value of the surface soil ranges from 4.5 to 5.5, and the subsurface layers are slightly less acid.

Newport loam occupies fairly long, smooth slopes ranging from 3 to 8 percent in gradient. Both external and internal drainage are good. Owing to the favorable structure of this soil and the fairly compact substratum, the water-absorbing capacity and water-holding capacity are comparatively high. Under proper management this soil can be built up easily and maintained in a productive state. The relief is favorable for all farming operations, and the fields are large enough to allow the use of improved machinery. Erosion is not a serious problem, although the more sloping areas are subject to some erosion if not properly managed. A large part of this soil is devoted to clean-cultivated crops, but the slope is so gentle that erosion will not be significant if proper tillage methods are practiced.

The total acreage of this soil is very small, but it ranks with the best soils in the county for general farming. It occurs only in the vicinity of the State hospital in Cranston. Vegetables, hay, corn for silage, sweet corn, potatoes, and alfalfa are the principal crops. Commercial fertilizers and lime are used extensively. Land devoted to vegetables and potatoes receives 1,000 to 2,000 pounds of commercial fertilizer and 1 to 2 tons of lime to the acre. Cornland and grassland receive about 300 pounds of commercial fertilizer to the acre, in addition to barnyard manure.

Hay yields 1½ to 3 tons an acre, alfalfa 3 to 4 tons, corn for silage 10 to 15 tons, cabbage 300 to 400 bushels, tomatoes 300 to 500 bushels, string beans 250 to 350 bushels, carrots 400 to 500 bushels, and beets 300 to 400 bushels.

Newport loam, level phase.—The level phase of Newport loam is closely associated with typical Newport loam and is essentially the same in all respects except slope. This soil occurs in nearly level to gently sloping areas. Because of the nearly level surface, erosion is

even less of a problem, surface run-off is not so rapid, and probably the water-holding capacity is slightly higher, as compared with those features of the typical soil.

Newport loam, level phase, is not extensive. Probably the entire acreage is under cultivation to the same crops as those grown on Newport loam, with the exception of one commercial apple orchard. Fertilizer treatments are the same, and crop yields average about the same or a little higher. Apples seem to do very well and probably average 150 to 200 bushels an acre.

Cheshire loam.—Cheshire loam occupies a very small area in the east-central part of Cumberland, south of the Pawtucket Reservoirs, in association with the other Cheshire soils. The surface is practically free of stones, and the entire acreage is under cultivation or in apple orchards. Hay, vegetables, corn, and potatoes are the main crops. On about 75 percent of the area the surface is nearly level or gently sloping, whereas on the rest the slope ranges from 3 to about 10 percent. Both external and internal drainage are good. On the smoother areas surface run-off is not so rapid and the water-holding capacity is slightly higher than on the sloping areas. The smooth areas are subject to little or no erosion, but the sloping areas are subject to some erosion if the land is used for clean-cultivated crops. The degree of erosion depends on the slope and on the cultural methods and rotations practiced.

Cheshire loam in cultivated fields is characterized by a rich-brown or brown mellow and friable loam surface soil about 6 inches thick. The surface soil contains a small quantity of gritty material, and small angular fragments of rock are scattered over the surface. The subsoil is yellowish-brown or reddish-brown gritty and friable loam becoming lighter in texture and color with depth. The number of small fragments of rock increases with depth, and the subsoil rests on reddish-gray or pinkish-red fairly compact partly weathered loamy till at a depth of 24 to 30 inches. The till is rather coarse and gravelly and contains many fragments of pink sandstone, granite, gneiss, and shale. The influence of the pink or red sandstone in the development of the soil is reflected in the somewhat red tinge of the subsoil and in the reddish-gray or pinkish-red color of the substrata. The pH value of the surface soil is about 4.5, and the subsurface layers are slightly less acid. Included with Cheshire loam are a few areas with a sandy loam texture, but they are not large enough to separate on the map.

This soil returns only slightly smaller yields of general crops than Newport loam. Apples yield from 100 to 300 bushels an acre, depending on care, fertilization, and season. For hay, corn, vegetables, and potatoes, this soil receives essentially the same fertilizer treatments as the other till soils of the county. Hay yields 1½ to 2½ tons an acre, corn for silage 10 to 15 tons, and potatoes 150 to 250 bushels. Vegetable crops yield almost the same as on the other loam soils of the county.

Tiverton gravelly fine sandy loam.—Tiverton gravelly fine sandy loam is not extensive. The surface soil in cultivated fields is grayish-brown or brown gravelly fine sandy loam about 6 inches thick. The subsoil is yellowish-brown mellow and friable fine sandy loam or sandy loam containing some gritty material and angular fragments of rock. The upper part of the subsoil grades into yellowish-gray or olive-gray gravelly and gritty friable sandy loam at a depth of 16 to 20 inches.

The lower subsoil layer rests on gray or bluish-gray coarse gravelly and gritty till at a depth of 24 to 30 inches. The till varies in compactness and is composed largely of conglomerate and sandstone, together with a small quantity of granitic and other materials. The surface gravel consists of flat and angular fragments of conglomerate, sandstone, shale, and granitic rock. In places this soil has a somewhat green tinge, a characteristic of the Newport soils, in the surface soil and subsoil layers. The yellowish-brown upper subsoil layer is much better developed, however, and the influence of shale is much less pronounced in the Tiverton than in the Newport soils.

This soil has developed in several fair-sized areas in the south-central part of East Providence. It occupies fairly long, smooth slopes ranging from about 3 to 10 percent in gradient. Both surface and internal drainage are good. Because of the open and porous character of this soil, the water-holding capacity is only fair, and crops may be injured by lack of moisture during dry seasons. The more sloping areas are susceptible to erosion under clean cultivation; but with proper management, rotations, and cultural methods, the control of erosion is not a serious problem.

Tiverton gravelly fine sandy loam is practically free of surface stone. Probably 85 percent of the land is under cultivation, and the rest is in residential building sites. Corn for silage, hay, sweet corn, vegetables, and potatoes are the main crops. Alfalfa and red clover occupy small acreages. Commercial fertilizers, lime, and manure are used extensively. Fair to good yields of general crops are obtained, although this soil is not inherently so productive as some of the heavier textured soils of the county.

Corn for silage yields 8 to 12 tons an acre, hay 1 to 2 tons, alfalfa 2½ to 3½ tons, sweet corn 600 to 900 dozen ears, and potatoes 150 to 250 bushels.

Tiverton gravelly fine sandy loam, level phase.—The level phase of Tiverton gravelly fine sandy loam differs from the typical soil mainly in slope. This soil occupies nearly level to gently sloping areas in close association with the typical soil. Because of the smooth surface, it is subject to little or no erosion. Surface run-off is less rapid and the water-holding capacity is slightly higher than those features of the typical gravelly fine sandy loam.

The total acreage is very small. About the same proportion is under cultivation and about the same crops are grown as on the typical soil. Fertilizer treatments and management practices are similar, and yields of crops average slightly higher.

Attleboro gravelly loam.—Attleboro gravelly loam occurs in scattered areas in the northeast part of Cumberland and in a few small areas north of Valley Falls in the same town. This soil has developed from glacial till derived from conglomerate sandstone, shale, schist, and granitic material. In the soil survey of Norfolk County, Mass.,[11] this soil along the Massachusetts and Rhode Island State line was included in the Coloma series. The areas are practically free of surface stone, but the soil is uniformly gravelly and shallow. The surface layer ranges from medium gravelly to very gravelly, and the subsoil layers are coarse, very gravelly, and gritty.

[11] LATIMER, W. J., MAXON, E. T., SMITH, HOWARD C., MALLORY, A. S., and ROBERTS, OTIS H. SOIL SURVEY OF NORFOLK, BRISTOL, AND BARNSTABLE COUNTIES, MASSACHUSETTS. U. S. Dept. Agr., Bur. Soils Field Oper. 1920, Rpt. 22: [1033]–1120, illus. 1925.

The surface soil consists of dark-brown or dark grayish-brown gravelly and gritty loam 4 to 6 inches thick. The subsoil is pale yellowish-brown, grayish-brown, or grayish-yellow very gravelly and gritty friable loam. At a depth of 18 to 20 inches the subsoil grades into coarse gritty and fairly compact partly weathered till of loamy texture. The till ranges in color from grayish yellow to yellowish gray and is mottled or streaked with red, rust brown, or yellow. It contains more coarse material and becomes less modified in the deeper part.

This soil occurs in nearly level, gently sloping or sloping areas. Surface drainage is good. Internal drainage also is good but rather slow, especially in the smooth areas, owing to the fairly compact till.

The total acreage of Attleboro gravelly loam is small, and practically all of it is either under cultivation or in pasture. Hay, corn for silage, and vegetables are the principal crops, but small acreages are devoted to alfalfa, oats for forage, and potatoes. Several apple orchards are located on this soil, and the owners report fair to good yields.

The water-holding capacity of this soil is comparatively high, but, owing to the gravelly surface soil and subsoil, it is not so easily managed as the other cultivated soils. Hay, forage crops, and corn yield well with fertilization. Yields of vegetable crops and potatoes are fair to good, depending on the season and management. Hay yields 1 to 2½ tons an acre, corn for silage 8 to 12 tons, and oats for forage 3 tons.

STONY WELL-DRAINED SOILS FROM TILL

The stony well-drained soils from till include the stony soils of the Gloucester, Narragansett, Charlton, Hollis, Newport, Tiverton, Attleboro, and Cheshire series. The stony Gloucester soils are by far the most extensive; the Narragansett, Charlton, and Hollis soils are fairly extensive; and the other soils of the group are limited to small areas.

These soils are largely in second- or third-growth forest or have been cut-over recently. Many of the trees are small and of little value for timber. Some of these soils are cleared of trees and are used for hay, pasture, patch farming, and orchard fruits. Scattered areas that at one time were cleared of trees have been abandoned and are now reverting to forest.

The land ranges from nearly level or gently rolling to rolling and steep, and from moderately stony to very stony and rough. A large proportion of it, however, is gently rolling to rolling and only moderately stony. If cleared of stone and trees, these soils would have about the same agricultural value for grasses, orchard fruits, and cultivated crops as the nonstony soils of the same series having similar relief. The cost of clearing this land of stones and trees would range from $100 to $300 an acre, and under present economic conditions this cost largely prohibits the use of the land for agricultural purposes other than for forestry or grazing.

Gloucester stony fine sandy loam.—This is the most extensive soil in the county. It occurs in all parts, except in East Providence, in areas ranging in size from 10 to more than 700 acres. Most of the large areas are in the north-central and south-central parts. This soil occurs in gently rolling or rolling areas having a 4- to 15-percent gradient. For the most part, the slopes are fairly long and smooth.

Natural drainage is good and, in places, excessive. Probably 85 to 90 percent of this soil is in second- or third-growth forest or cut-over land. The forest cover consists mainly of white, scrub, scarlet, black, and chestnut oaks, pitch pine, largetooth aspen (locally called largetooth poplar), gray birch, white pine, and chestnut sprouts. The underbrush consists mainly of blueberry, sumac, bull brier, bracken, sweetfern, mountain-laurel, and sheep laurel. Mountain-laurel is most common in the northwestern part of the county. Most of the trees are small and are of little value except for cordwood. The rest of this soil has been cleared of trees and is used largely for hay, field corn, vegetables for the home, and pasture, or is abandoned. Part of the stone has been removed from some areas, but the stones are still present in sufficient quantities to interfere with cultivation and to prohibit the efficient use of improved farm machinery. Hay yields ½ to 1½ tons an acre and field corn 15 to 30 bushels. Pasture is poor to fair, depending on the season and the amount of rainfall. The abandoned areas support a cover consisting mainly of broomsedge, poverty oatgrass, wild-indigo, sweetfern, dewberry, blueberry, sumac, and scattered gray birch and pitch pine trees.

In forested areas that have not been disturbed recently there is a thin layer of leafmold about 1 inch thick over a very thin layer of partly decomposed organic matter. In some places this layer is underlain by a layer of highly leached gray loamy fine sand ranging from a mere film to half an inch in thickness. The surface soil proper is light grayish-brown or light-brown light and fluffy fine sandy loam. The subsoil is yellow or light yellowish-brown mellow and friable fine sandy loam, and at a depth of 14 to 18 inches it grades into grayish-yellow loose and gritty fine sandy loam or sandy loam. This material overlies light-gray or yellowish-gray loose gravelly sandy till at a depth of 24 to 28 inches. The till shows very little or no compaction and is derived largely from granitic materials. Numerous stones and boulders of granite and gneiss are scattered over the surface and throughout the soil mass. Bedrock lies from a few feet to more than 10 feet below the surface. Small rock outcrops occur in places, some of which are shown by symbols on the soil map. This soil is acid in reaction throughout. The surface layers are only slightly less acid than the subsoil layers.

Included with Gloucester stony fine sandy loam are a number of areas of Gloucester stony very fine sandy loam in Smithfield, North Smithfield, Cranston, and the northern part of Scituate. Because of the finer texture, this inclusion is slightly more retentive of moisture than the stony fine sandy loam and therefore is better suited to forestry and pasture. A few small areas of Gloucester stony sandy loam occur in Glocester and Burrillville. The total area of this second inclusion is very small, and its value for the production of timber is essentially the same as that of the stony fine sandy loam.

Gloucester stony fine sandy loam, level phase.—The level phase of Gloucester stony fine sandy loam differs from typical Gloucester stony fine sandy loam chiefly in that it occupies nearly level or very gently sloping areas. Most of the areas are comparatively small and are closely associated with those of the typical stony fine sandy loam throughout most of the county, generally on the crests of the hills.

Because of the smooth surface, run-off is not so rapid on this soil as on the typical soil; therefore this soil may be slightly superior

for the growth of trees or farm crops. About the same proportion is in forest as of the typical soil, and the rest of the land is used for hay, pasture, and home gardens or is abandoned.

Small scattered areas of stony very fine sandy loam in Cranston and the northern part of Scituate are included with this soil.

Gloucester stony fine sandy loam, steep phase.—The steep phase of Gloucester stony fine sandy loam occurs in fairly large, scattered bodies on steep single slopes or steeply rolling land throughout the county, except in East Providence. The gradient ranges from about 15 to 35 percent. Some of the slopes are short and choppy; others are moderately long and smoothly sloping. Natural drainage is good to excessive.

The profile characteristics of this soil are similar to those of Gloucester stony fine sandy loam where it is well developed. Owing to the steep and sometimes broken relief, this soil is variable in texture, depth, and degree of development. Numerous stones and boulders are scattered over the surface, and small rock outcrops are common. In general, this soil is more stony than the soils of smoother areas. In some places there is only a thin covering of soil over bedrock, whereas in others bedrock is 10 feet or more below the surface and a typical Gloucester profile has developed. The soil has developed largely from granitic glacial material and to a less extent from residual material of the underlying granite and gneiss. The best possible use for this soil is forestry or grazing. Probably 5 percent of the land has been cleared of trees and is used for pasture or is lying idle. These areas support a cover consisting mainly of broomsedge, poverty oatgrass, wild-indigo, sweetfern, sheep fescue, dewberry, sumac, scrub oak, and pitch pine. The rest is in second- or third-growth forest consisting principally of white, scrub, scarlet, and red oaks, gray birch, pitch pine, hickory, chestnut sprouts, dogwood, and largetooth aspen. The underbrush consists mainly of blueberry, sumac, bull brier, bracken, and sweetfern. Most of the trees are small and of little value except for cordwood.

Small areas of very stony fine sandy loam are included with this soil in scattered areas throughout the county, except in the southeastern part. Like the rest of this soil, the very stony inclusion is limited to forestry. Small areas of stony very fine sandy loam texture are included also.

Narragansett stony loam.—Narragansett stony loam is closely associated with the nonstony Narragansett loam. It occurs in scattered areas in all parts of the county except in Cumberland, Woonsocket, and East Providence.

In wooded areas there is a layer of leafmold and partly decomposed organic matter about 2 inches thick. A thin layer of gray sand has formed just beneath this leaf mat in places. The surface soil is dark grayish-brown mellow friable loam containing a small quantity of gritty material and small rock fragments. It is about 6 inches thick, and the upper part contains more organic matter than the lower part. The upper part of the subsoil is yellowish-brown mellow friable loam containing a small quantity of gritty material and small rock fragments. This material grades into grayish-yellow fairly loose friable loam or fine sandy loam at a depth of 14 to 18 inches. The color and texture become lighter and the gritty material and rock fragments

more abundant with depth. The material in this layer overlies gray or dark-gray compact till at a depth ranging from 24 to 28 inches. The till is composed largely of granitic material, together with a small quantity of schist in places. Although compact, it is easily broken under pressure. It restricts the downward movement of water and is locally known as a hardpan, but it does not have the true characteristics of a hardpan. Rust-brown, yellow, and gray mottlings are common in the lower part of the subsoil, and the till is mottled or streaked with the same colors in places. All layers of this soil are acid.

Stones and boulders, mostly granite and gneiss, are scattered over the surface and embedded in the subsoil. In places some of the stones have been removed from the surface and used for fences (pl. 2, *B*), but on these areas they are still present in sufficient quantities to interfere with cultivation.

Narragansett stony loam is nearly level to gently sloping. Drainage is good but not rapid, owing to the smooth relief and compact substratum. The water-absorbing capacity and water-holding capacity are high, and trees or crops are seldom injured by lack of moisture.

The total area of Narragansett stony loam is comparatively small. Probably 30 to 40 percent of this land has been cleared of trees and is used mainly for pasture, hay, corn, apple orchards, and vegetables; the rest has a forest cover. Pasture occupies the largest acreage of the open land, and the other crops follow in the order named. Most of the pasture areas support a cover consisting principally of alder, hardhack, highbush blueberry, bayberry, sheep laurel, Kentucky bluegrass, Rhode Island bentgrass, and sweet vernalgrass. This is one of the best pasture soils in the county if brush and weeds are kept out. Seeding and harvesting hay and cultivating such crops as corn and vegetables are done with some difficulty because of the stones. Apple trees do well with care, and the yields average about the same as on Narragansett loam.

In forested areas the principal trees are red maple, red oak, scarlet oak, gray birch, white oak, white pine, and sassafras, together with a thick undergrowth of huckleberry, highbush blueberry, sweet pepperbrush, bull brier, cinnamon fern, and royal fern. This is one of the best forest soils in the county. If cleared of stone and trees it would have the same value for cultivated crops as Narragansett loam.

Narragansett stony loam, slope phase.—The slope phase of Narragansett stony loam is essentially the same as Narragansett stony loam except in relief. This soil is mapped on slopes ranging from gently sloping to sloping, the slope ranging from 4 to about 10 percent. Owing to the sloping relief, surface run-off is more rapid than on Narragansett stony loam, and drainage is slightly better.

This soil occupies a much smaller acreage than typical Narragansett stony loam. It occurs in widely scattered areas in Burrillville, Glocester, Foster, Cranston, and Johnston. A very small part of the land has been cleared of trees and is used for pasture, hay, or cultivated crops. The cultivated areas are in small patches, and the stones make seeding and tillage operations somewhat difficult. This soil has about the same value as Narragansett stony loam for the growth of trees, grasses, and cultivated crops. If cleared of stones

and trees it would have about the same agricultural value as Narragansett loam, slope phase.

Narragansett stony fine sandy loam.—This is the most extensive Narragansett soil, although the total acreage is not large when compared with that of Gloucester stony fine sandy loam. The largest areas are in Cranston, Foster, Glocester, Burrillville, North Smithfield, and Lincoln. The surface ranges from gently rolling or gently sloping to rolling or sloping, having a gradient of 4 to 15 percent. Both surface and subsurface drainage are good. Internal drainage is retarded to some extent by the fairly compact till.

Narragansett stony fine sandy loam differs from Gloucester stony fine sandy loam in having a darker and thicker surface soil, less coarse material in the subsoil, and a more compact substratum. An organic mat about 2 inches thick has accumulated in undisturbed wooded areas. The surface soil is brown to grayish-brown mellow and friable fine sandy loam 4 to 6 inches thick. The upper part of the subsoil is yellowish-brown friable fine sandy loam containing a small quantity of gritty material and small fragments of rock. It grades into grayish-yellow or yellowish-gray gritty and friable fine sandy loam or sandy loam at a depth of 14 to 20 inches. Gritty material and rock fragments become more abundant with depth, and gray or dark-gray fairly compact till lies 24 to 30 inches below the surface. Brown, yellow, and gray mottlings are common in the lower part of this layer, but they are not so pronounced as in the loam types and phases. The till under the stony fine sandy loam is not so uniformly compact as the till under Narragansett loam.

Narragansett stony fine sandy loam is superior to the stony Gloucester soils for the growth of trees, grasses, and cultivated crops, but it is less productive than the Narragansett loams. Probably 65 to 70 percent of this soil is in second- or third-growth forest. The rest has been cleared of trees and is used for pasture, hay, orchards, corn, potatoes, and home vegetables, or is lying idle. Small areas of this soil have been cleared of stones that lay on the surface, and part of the stones have been removed from the larger areas. The stone-free areas are too small to show on the map, however, and the stones remaining on the larger areas interfere appreciably with cultural operations. Where this soil is cleared of brush, it affords fair grazing during late spring and summer. Hay yields 1 to 2 tons an acre. Cultivated crops, such as corn, vegetables, and potatoes, are generally grown in small patches, largely for home use. Fertilizers are not used extensively, and yields of the cultivated crops vary. If the land were cleared of stones the agricultural value of the open areas would be the same as that of Narragansett fine sandy loam. In forested areas the principal trees are scarlet, red, chestnut, and white oaks, red maple, gray birch, sassafras, hickory, and white pine. There are some chestnut sprouts. The underbrush consists mainly of sumac, highbush blueberry, bull brier, sweet pepperbush, and dangleberry.

Narragansett stony fine sandy loam, level phase.—This soil is nearly level or gently sloping, and for this reason surface drainage is not so rapid as on Narragansett stony fine sandy loam. The level soil has a darker surface soil and a more mottled lower subsoil layer than typical Narragansett stony fine sandy loam. In most places

just beneath the surface there is a 2- or 3-inch rust-brown layer, which is not uniformly characteristic of the typical soil. Otherwise, the profile characteristics of the two soils are essentially the same.

Narragansett stony fine sandy loam, level phase, occupies scattered areas in all parts of the county except Cumberland, Woonsocket, and East Providence. It is most common in Foster, Glocester, and Burrillville. The total acreage of this soil is considerably less than that of Narragansett stony fine sandy loam.

Probably 90 to 95 percent of this soil is in forest or has been cut-over recently. The trees are of the same kinds as those on Narragansett stony fine sandy loam, but the proportion of red maple, white pine, and gray birch is larger. The underbrush consists mainly of a very thick growth of sweet pepperbush, sumac, cinnamon fern, and royal fern. This soil is superior to the typical fine sandy loam for the growth of forests. From 5 to 10 percent of the land has been cleared of trees. Part of it supports a shrub and herb cover, is lying idle, or is used for pasture; the rest is used for the production of hay, orchard fruits, and cultivated crops in small scattered patches. Because of the numerous stones on the surface, seeding and cultural operations are difficult. If cleared of stone, this soil would have about the same agricultural value as Narragansett fine sandy loam, level phase.

Charlton stony loam.—Charlton stony loam occupies comparatively small scattered bodies closely associated with the nonstony Charlton soils, especially in Cumberland, Lincoln, Woonsocket, North Smithfield, and Smithfield. A few areas are in North Providence, Johnston, Glocester, and Burrillville. The relief is gently rolling to rolling, and the slope ranges from 4 to 15 percent. Both surface and subsurface drainage are good.

In wooded areas a thin layer of leafmold and partly decomposed organic matter has developed on the surface. The surface soil is rich-brown or dark-brown very mellow and friable loam about 6 inches thick. The upper few inches of the subsoil is brown loam underlain by yellowish-brown loam, which grades into grayish-brown or grayish-yellow gritty and friable loam or fine sandy loam at a depth of 14 to 18 inches. In places the lower part of the subsoil contains considerable gritty material and many small fragments of rock, and it is very loose and friable. It overlies gray or greenish-gray partly weathered till from 24 to 30 inches below the surface. The till is of loamy texture. In some places the till is only slightly compact; in other places it is fairly compact but friable. Numerous stones and boulders are scattered over the surface, and in places small outcrops occur. A small quantity of fragments of schist and other rocks are scattered over the surface and throughout the soil. All layers are acid in reaction.

Charlton stony loam ranges from light loam or very fine sandy loam to loam. Where it occurs in association with the Gloucester soils, the two soils grade into each other and the boundaries are arbitrary in places.

The agricultural value of this soil would be practically the same as that of Charlton loam if the land were cleared of stones and trees. Probably 30 to 35 percent of it has been cleared of trees and is either lying idle or is used for pasture, hay, orchard fruits, vege-

tables, corn, and potatoes. The rest is in forest or has been cut-over. The idle areas and those used for pasture support a cover consisting mainly of low juniper, sumac, redcedar, blueberry, poison-ivy, poverty oatgrass, sheep fescue, Rhode Island bentgrass, and some broomsedge. These areas furnish good grazing if the shrubs and brush are not too thick. Hay is the most important crop and yields 1 to 2½ tons an acre. A few small apple orchards are situated on this soil, and with care and fertilizer the yields average about the same as on Charlton loam. Cultivated crops, such as vegetables, corn, and potatoes, are usually grown in small patches, largely for home use. The yields vary, depending on fertilization and care.

In forested areas the principal trees are red, scarlet, and white oaks, hickory, beech, redcedar, gray birch, and red maple. There is a thick undergrowth of shrubs and herbs. This soil compares favorably with the best soils in the county for the growth of trees.

Charlton stony loam, level phase.—The level phase of Charlton stony loam is similar in profile characteristics to Charlton stony loam. The surface soil is uniformly loam or heavy loam, and the underlying till is more compact than the till under the typical soil. Owing to the level to gently sloping relief and more compact substratum, drainage is less rapid and the water-holding capacity is higher in this soil than in the typical soil. Except for the stones on the surface, this soil is similar in all respects to Charlton loam, level phase. If cleared of stones and trees, its value for the production of general crops and for pasture would be the same.

Charlton stony loam, level phase, occurs in a few very small scattered bodies, mainly in Cumberland and Lincoln. The total acreage is small. Probably 40 to 50 percent of this land has been cleared of trees, and the rest is in forest. Of the land that has been cleared, about 60 percent supports a shrub and herb cover and is lying idle or is used as pasture. These areas afford good grazing if the shrubs and brush are not too thick. Hay, apples, vegetables, corn, and potatoes are produced in small scattered areas. Hay occupies the largest acreage and yields from 1½ to 3 tons an acre. Apples do well with care and fertilization. Vegetables, corn, and potatoes are grown mainly for home use.

The cover on forested areas is about the same as that on Charlton stony loam. This ranks as one of the best soils in the county for the growth of trees.

Hollis stony loam.—Hollis stony loam occurs on steep slopes closely associated with the Charlton soils. Fairly large areas are scattered over Cumberland, Lincoln, Woonsocket, North Smithfield, Smithfield, Burrillville, and Johnston. The gradient ranges from 15 to 35 percent or more, and the slopes range from short and choppy to fairly long and uniform. Natural drainage is good to excessive. In general, this soil is very stony and ledgy and variable in depth and degree of development. It is partly glacial and partly residual in origin.

The surface soil is rich-brown or dark-brown mellow and friable loam 4 to 6 inches thick. The upper few inches of the subsoil is reddish-brown loam, which grades into yellowish-brown friable and gritty loam. The subsoil becomes lighter in color and texture with depth, and the depth to the underlying dark-gray or greenish-gray

coarse gritty and friable till or bedrock is variable. The till is composed mainly of schist, slate, and granitic materials. Numerous rock outcrops and ledges occur in this soil, and loose stones and boulders are strewn over the surface. In some places between the exposed bedrock only a few inches of soil is developed over the bedrock, whereas in other places the soil is 14 to 24 inches deep. Slabs of schist and shale and fragments of other rocks are scattered over the surface and throughout the soil. All layers are acid in reaction. The pH values of the different layers are about the same as in the Charlton soils.

Owing to steepness and stoniness of this soil, the best use for it is either forestry or grazing. Probably 50 percent of the land has been cleared of trees at one time or another, and most of it is now used for pasture. The vegetation on these areas consists of a scattered growth of redcedar, in addition to sumac, blueberry, low juniper, sweetfern, poison-ivy, poverty oatgrass, Rhode Island bentgrass, sheep fescue, and Kentucky bluegrass. Grazing is fair to good, depending on the amount of rainfall and the amount of brush and weeds.

A few very small areas on the smoother slopes are used for hay, vegetables, or corn. The rest is in forest, consisting of about the same kinds of trees as those on the stony Charlton soils. Most of the trees are rather small and are valuable mainly for cordwood.

Hollis stony loam, rolling phase.—The rolling phase of Hollis stony loam occurs in small scattered areas closely associated with typical Hollis stony loam. The total acreage is small. About 40 percent of the land is cleared of trees and used largely for pasture, and a few areas are in mowing. The rest is in forest.

This soil occupies gently rolling or rolling areas, differing in this respect from the typical stony loam. In general, it is very stony and ledgy, and the soil is variable in depth to bedrock or till. Drainage is good but not so rapid as on the typical soil. Owing to the smoother relief, it is slightly more valuable for grazing purposes.

Newport stony loam.—Newport stony loam, which covers a very small total area, is closely associated with the nonstony Newport soils in the vicinity of the State hospital in Cranston. Most of this land is in forest, consisting principally of red, scarlet, and white oaks, hickory, sassafras, gray birch, red maple, redcedar, and chestnut sprouts. The shrub and herb undercover consists mainly of sumac, shadbush, bull brier, blueberry, bayberry, and dewberry. Probably 10 percent of the land has been cleared of trees and is now lying idle or is used as pasture.

On areas that have not been disturbed recently, a covering of leafmold 1 to 2 inches thick has accumulated on the surface. The surface is rich-brown or brown mellow loam about 6 inches thick. The upper subsoil layer is pale yellowish-brown or dingy-brown friable loam grading into olive-gray gritty and friable loam or fine sandy loam at a depth of 16 to 18 inches. The lower subsoil layer overlies olive-gray or bluish-gray gravelly and gritty firm till of a loamy texture at a depth of 24 to 30 inches. A small quantity of angular and flat fragments of rock are scattered over the surface and throughout the solum. The surface soil also contains some gritty material, and this, together with the small fragments of rock, becomes more

abundant with depth. Scattered over the surface are moderate-sized stones consisting of granite, gneiss, shales, and sandstone. In general, this soil is not so stony as the Gloucester and Narragansett soils, and the cost of clearing it for agricultural purposes would not be so high.

Newport stony loam has a relief ranging from nearly level to sloping. Natural drainage is good but not excessive. If cleared of stones and trees, this soil would be just as valuable as Newport loam for agricultural purposes.

Tiverton stony gravelly fine sandy loam.—In wooded areas that have not been disturbed, a layer of leafmold 1 to 2 inches thick has developed on the surface. The surface soil is brown or grayish-brown mellow and friable gravelly fine sandy loam 4 to 6 inches thick. The upper part of the subsoil is yellowish-brown mellow and friable fine sandy loam or sandy loam, which grades into yellowish-gray gravelly and gritty sandy loam at a depth of 16 to 18 inches. This overlies dark-gray or bluish-gray coarse gritty till at a depth of 24 to 28 inches. The till ranges from slightly to moderately compact, but it is everywhere friable. Conglomerate, sandstone, and granitic stones and boulders are scattered over the surface. In addition, flat and angular fragments of shale, conglomerate, sandstone, and other rock are scattered over the surface and throughout the soil mass.

Tiverton stony gravelly fine sandy loam is not extensive. It is associated with the nonstony Tiverton soils in East Providence. Probably about 50 percent of the total acreage is in forest, and the rest has been cleared of trees and is lying idle or is used for pasture. The forested and abandoned lands support about the same cover as Gloucester stony fine sandy loam. The agricultural value of this soil would be the same as that of the nonstony soils if the soil were cleared of trees and stone.

Most of the areas are gently sloping or sloping, the gradient ranging from 3 to about 10 percent. The slopes in general are long and smooth. A few small areas having a gradient of more than 10 percent and a few that are nearly level are included.

Attleboro stony gravelly loam.—Attleboro stony gravelly loam is associated with Attleboro gravelly loam in the extreme northeastern part of Cumberland and north of Valley Falls in the same town. The total area is small, and practically all of the land is in second- or third-growth forest. A few very small areas have been cleared of trees and are used as pasture. The predominating tree growth in the forested areas includes white, black, and scarlet oaks, gray birch, pitch pine, redcedar, hickory, and beech, together with a thick underbrush of shrubs and herbs.

Where the soil has not been disturbed for some time, a layer of leafmold and partly decomposed organic matter has accumulated on the surface. The surface soil is dark-brown or grayish-brown gravelly friable loam 4 to 6 inches thick. The subsoil is pale yellowish-brown or grayish-brown very gravelly loam. Gravelly and gritty materials become more abundant with depth, and at a depth of 18 to 20 inches the subsoil grades into gravelly and gritty coarse partly weathered till. This till is grayish yellow or yellowish gray mottled or streaked with brown, yellow, or red and is firm in place but friable. The material is less modified and moderately compact at a

depth of 2 to 2½ feet. The surface soil is moderately to very gravelly, and the subsurface layers are uniformly very gravelly. Numerous stones and boulders are strewn over the surface and embedded in the subsoil. Rock outcrops are very common. The predominating rocks are conglomerate with smaller amounts of sandstone, schist, and granite.

Most of the areas range from nearly level to sloping or rolling. A few areas are included that have a slope of 15 to 25 percent. Natural drainage is good but not very rapid, and the water-holding capacity is comparatively high. Because of stoniness, shallowness, and the gravelly character of this soil, the best possible use for it is forestry or grazing. Where the land is cleared of trees and weeds it affords fair pasture.

Cheshire stony loam.—Cheshire stony loam occurs in the east-central part of Cumberland, closely associated with Cheshire loam. The total area is small. About 80 percent of the area is in forest, and the rest is cleared of trees and is used for pasture or is lying idle. The forest cover consists of about the same species of trees as grow on Attleboro stony gravelly loam. On the areas used for pasture the vegetation is principally sumac, highbush blueberry, hardhack, sweetfern, sheep laurel, Rhode Island bentgrass, sheep fescue, poverty oatgrass, and Kentucky bluegrass. These areas afford fair grazing if weeds and brush are kept out.

In wooded areas that have not been disturbed recently, a thin layer of leafmold and partly decomposed organic matter has developed on the surface. The surface soil is rich-brown mellow and friable loam about 6 inches thick, and it contains a small quantity of gritty material and small angular fragments of rock. The subsoil is yellowish-brown or reddish-brown friable loam, which with depth becomes lighter in color and texture and contains an increasing quantity of gritty material and small fragments of rock. The subsoil overlies reddish-gray or pinkish-red fairly compact partly weathered till at a depth of 24 to 30 inches. The till contains many fragments of pink sandstone, granite, gneiss, and shale, and it becomes coarser with depth. The influence of the pink or red sandstone in the development of this soil is reflected in the somewhat red tinge of the subsoil and in the reddish-gray or pinkish-red color of the substrata. All layers are acid. Scattered over the surface are stones and boulders of granite, gneiss, sandstone, and conglomerate, but in general this soil is not so stony as the stony Gloucester soils. Included with Cheshire stony loam are a few small areas of fine sandy loam or sandy loam texture. These areas are not extensive enough to separate on the map. Cheshire stony loam occurs in gently sloping or sloping areas, the slope ranging from 4 to about 15 percent. Natural drainage is good but not excessive, because of the favorable structure and fairly compact till; and the water-holding capacity is good. This soil compares well with the other stony loam soils of the county. If the land were cleared of trees and stones its value for the production of cultivated crops would be the same as that of Cheshire loam.

Cheshire stony loam, level phase.—The level phase of Cheshire stony loam is in the east-central part of Cumberland, closely associated with the nonstony Cheshire soils. It differs from Cheshire stony

loam mainly in relief. This soil occupies nearly level or gently sloping areas. Drainage is good but not so rapid as on the soil of more sloping areas.

The total acreage of this soil is very small. Probably 60 percent of the land is in forest; the rest has been cleared of trees and is used for pasture or is lying idle.

WELL-DRAINED SOILS OF THE OUTWASH PLAINS

The well-drained soils of the outwash plains are represented by members of the Merrimac and Warwick series. The Merrimac soils have developed in widely scattered areas throughout most of the county from rather coarse water-laid materials consisting mainly of granite, gneiss, and quartz; whereas the Warwick soils have developed from water-laid materials containing a large proportion of shale, slate, sandstone, and schist. These soils are not extensive and occur only in the southeastern part of the county. All the soils of the group are acid in all layers, the Warwick soils being slightly less acid in the subsoil layers than the Merrimac soils.

This land is free of stones and nearly level to gently undulating. Drainage is good to excessive, depending on the texture and structure of the soil. The inherent productivity of the different soil types is closely related to texture and thickness. In general, the soils of the outwash plains are leached to a greater extent and are lower in plant nutrients than the soils developed from till. This is especially true of the lighter textured members of the group.

These soils warm early in the spring, are easily tilled, and are responsive to fertilization. They are especially adapted to early vegetables, but with heavy applications of fertilizers fair to good yields of general crops are obtained. Often the moisture supply is the limiting factor on the lighter textured soils.

Merrimac very fine sandy loam.—This is the most productive soil of the outwash plains and one of the best general-purpose soils. It occurs principally in the vicinity of Knightsville and Thornton in Cranston, and near Greenville in Smithfield. The total acreage is not very large. Nearly half of it is in residential building sites; the rest is under cultivation.

In cultivated fields the surface soil is grayish-brown to brown mellow and friable very fine sandy loam 6 to 8 inches thick. The upper part of the subsoil is yellowish-brown or pale yellowish-brown mellow and friable very fine sandy loam or loam. It grades into yellowish-gray light very fine sandy loam at a depth of 16 to 20 inches. The lower part of the subsoil becomes lighter in color and texture with depth and overlies gray or yellowish-gray stratified sand and gravel at a depth of 30 to 36 inches. The subsoil layers have a weak, platy structure in places. Just above the stratified sand and gravel, rust-brown, brown, or yellow mottlings are common. The surface soil and subsoil layers contain very little or no gravel.

Merrimac very fine sandy loam has nearly level to gently undulating relief. Natural drainage is good, but, owing to favorable texture and depth to gravel, the water-holding capacity is comparatively high. Crops are seldom injured by lack of moisture during normal seasons. This soil is easily managed, responds to fertilization and care, and is fairly retentive of applied plant nutrients.

Market-garden crops, corn for silage, and sweet corn are the principal crops grown. Smaller acreages are devoted to hay, potatoes, clover, and grapes. Commercial fertilizers and lime are used extensively. For market-garden crops, potatoes, and sweet corn 1,500 to 2,000 pounds of fertilizer to the acre is applied each year and lime every 3 or 4 years. When corn is grown for silage, the land receives a heavy application of stable manure and usually 200 to 300 pounds of commercial fertilizer to the acre. Tomatoes yield 300 to 500 bushels an acre, string beans 250 to 350 bushels, cabbage 250 to 350 bushels, carrots 500 to 600 bushels, beets 400 to 500 bushels, sweet corn 600 to 1,200 dozen ears, potatoes 250 to 350 bushels, silage corn 10 to 14 tons, and hay 1 to 2½ tons. Grapes for home use and market are grown around Knightsville and Thornton.

Merrimac fine sandy loam.—Merrimac fine sandy loam is the most extensive soil of the outwash plains. It is more loose and friable throughout, the depth to gravel is about 6 inches less, and the water-holding capacity is lower than in Merrimac very fine sandy loam.

In cultivated fields the surface soil is brown or grayish-brown mellow and friable fine sandy loam about 6 inches thick. In wooded areas a thin layer of leafmold covers a brown fine sandy loam. The upper subsoil layer is light yellowish-brown firm fine sandy loam, which grades into grayish-yellow loose friable and gritty sandy loam at a depth of 18 to 20 inches. The lower subsoil layer overlies gray or yellowish-gray incoherent coarse sand and gravel at a depth of 24 to 30 inches. The surface soil contains some gravel and gritty material. The upper subsoil layer contains a small quantity of gravel and gritty materials in places, and the lower subsoil layer generally contains a large quantity of this material. Nowhere is there sufficient gravel in the surface soil to interfere with cultivation.

Comparatively small bodies of this soil are scattered throughout the county. Some of the largest are in the southern part of East Providence and in the vicinities of Lonsdale in Lincoln and Diamond Hill in Cumberland. The relief is level to gently undulating, and natural drainage is good. At one time most of this land was cleared of trees and cultivated. Probably 30 percent of the total acreage is now lying idle or is used for pasture, and the rest is under cultivation.

Areas that have been abandoned for some time support a scattered growth of pitch pine, scrub oak, and gray birch and an undercover of broomsedge, poverty oatgrass, sheep fescue, blueberry, dewberry, goldenrod, and hairy-cap moss. Areas that have not been abandoned very long support the same vegetation except the pitch pine, scrub oak and gray birch.

This soil warms early in the spring, is easy to work, and responds to fertilization. It is especially adapted to early vegetables, but with heavy applications of fertilizer and manure fair to good yields of general crops are obtained. Crops are damaged by lack of moisture in extremely dry seasons. Market-garden crops, sweet corn, and hay are the principal crops, and small acreages are devoted to corn for silage, alfalfa, potatoes, and orchard fruits. Fertilizers and lime are used extensively in the eastern part of the county. Yields of the several crops vary, depending on fertilization, care, and moisture supply. Sweet corn yields 500 to 800 dozen ears to the acre, tomatoes

275 to 350 bushels, string beans 200 to 250 bushels, carrots 300 to 400 bushels, and beets 200 to 300 bushels. Hay yields 1 to 1½ tons, corn 8 to 10 tons of silage, alfalfa 2 to 2½ tons, and potatoes 150 to 250 bushels. Orchard fruits do only fairly well. The yield of apples ranges from 50 to 200 bushels an acre.

Average yields may be increased and stabilized if the land is irrigated. None of this soil is irrigated, and it is questionable whether the returns would justify the cost.

Merrimac fine sandy loam, shallow phase.—The shallow phase of Merrimac fine sandy loam is neither extensive nor important agriculturally. It occurs in small, widely scattered areas associated with Merrimac fine sandy loam. The largest body is near Diamond Hill in Cumberland. Probably 40 percent of the total acreage is used for hay and cultivated crops, and the rest is abandoned land or is used for pasture. Yields of crops average somewhat lower than on Merrimac fine sandy loam because of the slight depth to gravel and the droughtiness of the soil.

Merrimac fine sandy loam, shallow phase, contains more gravel in the surface soil and subsoil, and the depth to beds of sand and gravel is less than in the typical soil. The 4- to 6-inch surface soil is brown or grayish-brown gravelly fine sandy loam. It overlies a light yellowish-brown gravelly fine sandy loam subsoil, which becomes lighter textured and more gravelly with depth. This material rests on stratified sand and gravel at a depth of 12 to 18 inches. The land is level to gently undulating, and natural drainage is good to excessive.

Merrimac sandy loam.—Merrimac sandy loam is not very extensive or very important agriculturally. It occurs in scattered bodies closely associated with the other Merrimac soils and the sandy Hinckley soils. These areas are most common in Cumberland and in the southern part of East Providence. A fairly large area is south of Providence.

Merrimac sandy loam is characterized by a brown or grayish-brown loose or friable sandy loam surface soil about 6 inches thick. In wooded areas a thin covering of leafmold has accumulated on the surface. The upper subsoil layer is light yellowish-brown friable sandy loam containing a small quantity of rounded gravel and coarse sand. Below a depth of 16 or 18 inches this material grades into grayish-yellow coarse and gritty sandy loam or loamy sand, which continues to a depth of 24 to 30 inches. The substratum consists of gray or yellowish-gray coarse gritty incoherent sand or sand and gravel.

Because of the open and porous character of the soil and the loose, gravelly substratum, drainage tends to be excessive and the moisture-holding capacity is low. Fertilizer, lime, and manure are rapidly leached from this soil. Crop yields are somewhat uncertain, owing to drought; in general they average lower than those obtained on Merrimac fine sandy loam. The soil is better adapted to vegetables, sweet corn, and potatoes than to such crops as hay, corn, and small grains. Fair yields of vegetables are obtained with heavy applications of commercial fertilizer and manure when the moisture supply is sufficient.

Probably 40 percent of this soil is under cultivation, and the rest is idle, in pasture, in forest, or in residential building sites. Market-garden crops, sweet corn, and hay are the main crops. Corn for silage,

alfalfa, potatoes, and apple orchards occupy small acreages. Yields of the different crops vary considerably, depending on the moisture supply, fertilization, and care; but the average is low. In many places the moisture supply is the limiting factor, and average yields could be greatly increased with irrigation. None of this soil is irrigated in Providence County, but in other parts of Rhode Island and in Massachusetts Merrimac sandy loam produces fairly high yields of market-garden crops under irrigation and with heavy applications of fertilizer and lime. The treatment most commonly used on these irrigated farms is 1,500 to 2,000 pounds of a 5–8–7 fertilizer and lime when needed. Under such conditions sweet corn yields 800 to 1,000 dozen ears to the acre, tomatoes 300 to 500 bushels, carrots 400 to 600 bushels, beets 300 to 500 bushels, lettuce 500 to 700 crates, peppers 600 bushels, and spinach 600 to 800 bushels. In general, apple trees are off-color and the growth is not vigorous. Yields of apples vary, depending on fertilization and care, but are generally low.

The vegetation on the abandoned fields consists mainly of broomsedge, poverty oatgrass, cinquefoil, sheep sorrel, sheep fescue, and Rhode Island bentgrass.

Merrimac loamy sand.—Merrimac loamy sand has essentially the same profile characteristics as Merrimac sandy loam, except in texture. It is coarser textured, looser, and more incoherent throughout. The surface soil and subsoil contain very little or no gravel, and in places the substratum consists of beds of coarse sand with little or no gravel. Because of the loose, open structure of both the surface soil and the subsoil, drainage is excessive, and water passes rapidly to lower depths. The soil is highly leached of plant nutrients and organic matter; and applied nutrients, in the form of commercial fertilizer, lime, or manure, are rapidly leached out.

Merrimac loamy sand is of very small extent and of little importance agriculturally. A few bodies are mapped in the southern part of East Providence and in the western part of North Smithfield. Practically all of this land is in abandoned fields or in forest consisting mainly of pitch pine, white oak, scrub oak, and gray birch, with an undergrowth of blueberry.

If this soil were cultivated, the yields would be low and uncertain, except under irrigation, owing to low inherent fertility and droughtiness. The returns from this soil would not justify the cost of providing irrigation.

Warwick fine sandy loam.—Warwick fine sandy loam occurs in small scattered areas in East Providence and in the vicinity of the Reform School in Cranston. The total acreage is small. Practically all of this land is cleared, and most of it is under cultivation. A small part is lying idle or is used for pasture. The principal crops grown are market-garden crops, sweet corn, hay, and corn for silage. The agricultural value of this soil is about the same as that of Merrimac fine sandy loam, and crop yields average about the same on the two soils. Warwick fine sandy loam occupies level to gently undulating areas. Natural drainage is good, and the moisture-holding capacity is fairly high. This soil is easy to cultivate and responds to fertilization and care. Crops are injured by lack of moisture during extremely dry seasons.

The 4- to 6-inch surface soil is grayish-brown or brown mellow and friable fine sandy loam. A few flat fragments of shale and sandstone

are scattered over the surface and in the surface soil. The upper part of the subsoil is light yellowish-brown mellow fine sandy loam, which grades into olive-gray light fine sandy loam at a depth of 18 to 20 inches. With depth the lower part of the subsoil becomes lighter textured and contains an increasing quantity of gravel and gritty material. It rests on dark-colored stratified sand and gravel at a depth of 24 to 28 inches. The surface soil and subsoil are open and porous, and roots penetrate them readily.

Included with Warwick fine sandy loam in the northeastern corner of East Providence are several areas of dark-colored Warwick loam. This inclusion has an 8- to 10-inch surface soil of very dark-brown gritty loam, and a subsoil of brown or yellowish-brown coarse and gritty loam or sandy loam, which extends to a depth of 18 to 22 inches. This rests on stratified sand and gravel composed largely of shale, schist, slate, or sandstone material. On the surface and throughout the soil are many flat or semirounded smooth fragments of shale and slate. This soil was included with Warwick fine sandy loam because it covers a very small area and is unimportant in the agriculture of this county. A very small part of it is used for home gardens; the rest is lying idle or is in residential building sites.

Warwick sandy loam.—Warwick sandy loam occurs in several fair-sized bodies in the northern part of East Providence and in the vicinity of the State prison in Cranston. The surface is level to gently undulating, and natural drainage is good to excessive. Only a small part of this inextensive soil is under cultivation. The rest is in abandoned fields, in scrubby forest, or in building sites. Most of the land under cultivation is in the vicinity of the State prison. Vegetables, sweet corn, and potatoes are the principal crops; and for these crops the land is heavily fertilized. Like Merrimac sandy loam, this soil is inclined to be excessively drained, has a low water-holding capacity, and is soon leached of organic matter and applied plant nutrients. The soil is better adapted to vegetables, sweet corn, and potatoes than to such crops as hay and corn. With heavy applications of fertilizer and manure fair to good yields of vegetables are obtained if the moisture supply is sufficient. Crop yields are somewhat uncertain because of droughts, and they average lower than on Warwick fine sandy loam. The agricultural value of Warwick sandy loam is essentially the same as that of Merrimac sandy loam, and crop yields on the two soils average about the same. Under irrigation the yields could be increased considerably. The vegetation on the abandoned areas consists largely of broomsedge, poverty oatgrass, hairy-cap moss, and cinquefoil, with a scattered growth of pitch pine and scrub oak. In wooded areas the principal trees are scrub oak, white oak, pitch pine, and gray birch.

In cultivated fields the surface soil is grayish-brown loose and friable sandy loam 4 to 6 inches thick, containing a small quantity of shale and quartz gravel. The upper subsoil layer is light yellowish-brown sandy loam or light sandy loam, grading into yellowish-gray sandy loam or loamy sand at a depth of 16 to 18 inches. The lower subsoil layer becomes lighter in color and texture with depth, contains a small quantity of flat and rounded gravel, and overlies loose, incoherent, coarse sand and gravel at a depth of 24 to 30 inches. This

sand and gravel is composed largely of shale, schist, and sandstone, together with a small quantity of granitic material.

Included with this soil are a few bodies of loamy sand, in the extreme northeastern part of East Providence, that are too small to separate on the map. In places the surface soil contains more gravel and the depth to beds of sand and gravel is less than is typical of Warwick sandy loam.

SOILS OF THE KAMES

The soils of the kames have developed from outwash materials deposited largely by rapidly moving water. These soils are closely associated with the soils of the outwash plains on hummocky, uneven, or sloping relief.

The members of the Hinckley series have developed from stratified sand and gravel deposits consisting of granite, gneiss, and other crystalline rock materials and are associated with the Merrimac soils. Quonset gravelly sandy loam, developed from materials consisting largely of shale, sandstone, schist, and conglomerate, is associated with the Warwick soils. The total acreage of Quonset gravelly sandy loam is very small, but the Hinckley soils are rather extensive. Because of the unfavorable relief, shallowness, and droughtiness of these soils, the principal use for them is forestry and grazing. All the soils of the group are acid throughout.

Hinckley gravelly sandy loam.—This soil, the most extensive of the Hinckley series, occurs along the drainageways in all parts of the county except in East Providence. The largest bodies are in Cumberland along the Blackstone River and in Burrillville and Glocester.

The 3- to 6-inch surface soil is brown or grayish-brown loose or friable gravelly sandy loam. In wooded areas a 1-inch layer of leafmold and partly decayed organic matter has accumulated on the surface. The upper subsoil layer is brown or yellowish-brown loose and friable gravelly sandy loam, becoming lighter colored, lighter textured, and more gravelly with depth. This overlies beds of stratified sand and gravel at a varying depth, generally 10 to 18 inches. The substratum consists mainly of granitic materials, although in places there is a noticeable quantity of shale and schist. In places where this soil is associated with the Charlton and Hollis soils, the proportion of schist is higher in the beds of sand and gravel and the color of the surface soil is browner than in places where it is associated with the Gloucester and Narragansett soils.

Included with Hinckley gravelly sandy loam is a small area of Manchester sandy loam in the northeastern part of the county east of Arnold Mills. This soil is associated with Cheshire stony loam along the Rhode Island-Massachusetts State line. Hinckley gravelly sandy loam is somewhat variable in texture, in the quantity of gravel on the surface, and in depth to gravel. In places the texture is coarse gravelly sandy loam or loamy sand, whereas in a few small scattered areas the texture is gravelly fine sandy loam. Beds of gravel lie very near the surface in places, and here and there they lie at a depth of 2 to 2½ feet. Along the Blackstone River small rock outcrops are common on the steeper slopes. At one time outwash material probably covered these intrusions, but it has been removed by continuous erosion.

This soil is excessively drained, owing to the open and gravelly structure of the surface soil and subsoil and to the gravelly substratum.

It is severely leached of plant nutrients, and applied nutrients are rapidly leached out. A considerable acreage was cleared and cultivated at one time, but most of the once-cleared land is now abandoned or is used as pasture, which affords only poor to fair grazing. A few scattered areas on the smoother slopes are devoted to hay and vegetables for home use, and the rest of the land is in abandoned fields or in forest. Some of the abandoned areas support a scattered growth of pitch pine, gray birch, scrub oak, and quaking aspen trees, together with sweetfern, wild-indigo, blueberry, broomsedge, poverty oatgrass, sheep fescue, hairy-cap moss, and lichen. In the more densely wooded areas, pitch pine, scrub oak, white oak, quaking aspen, and gray birch are the principal trees and there is very little underbrush.

Numerous gravel pits have been dug in this soil, and the gravel in the substratum is used extensively for concrete work and for road building. In general this land is more valuable as a source of road-building material than for agriculture. The best agricultural use is for grazing or for forestry.

In places in the western part of the county rounded granitic and gneiss cobbles and boulders are scattered over the surface and embedded in the soil. These stony areas are of less value for cultivated crops than the typical soil. They are largely in forest. A few small areas are lying idle or are in pasture. Most of the stony areas are in the vicinity of Chepachet and the northeast part of Scituate.

Hinckley loamy coarse sand.—Hinckley loamy coarse sand is characterized by a 3- or 4-inch gray or grayish-brown coarse loamy sand surface soil. The upper subsoil layer is brown loamy coarse sand, ranging from 4 to 6 inches in thickness, which grades into yellow or brownish-yellow coarse sand or medium sand. This material becomes lighter in color with depth and rests at a depth of 18 to 24 inches on gray or yellowish-gray coarse sand containing a small quantity of gravel. In places the substratum is practically free of gravel to a depth of several feet. Where this soil has not been disturbed, a thin gray layer is common just beneath the forest duff.

Hinckley loamy coarse sand covers a small total area, principally south of Slatersville in North Smithfield, southwest of Pascoag in Burrillville, and south of Arnold Mills in Cumberland. The relief is rolling to hummocky, and drainage is excessive. Practically the entire acreage has a scant forest cover consisting mainly of pitch pine, scrub oak, and white oak, together with very little underbrush. The value of this soil is very low, either for the growth of trees or for grazing.

Hinckley gravelly fine sandy loam.—Hinckley gravelly fine sandy loam is slightly superior to Hinckley gravelly sandy loam for forest or grazing purposes or for cultivated crops. The relief, in general, is smoother, and drainage is not quite so rapid.

In wooded areas a thin layer of leafmold and organic matter has accumulated over the surface soil, which is brown or grayish-brown gravelly fine sandy loam about 4 inches thick. The upper part of the subsoil is brown or yellowish-brown gravelly fine sandy loam, in which the color becomes lighter and the gritty material more abundant with depth. Beds of sand and gravel generally lie from 10 to 18 inches below the surface. Areas mapped as this soil include many variations in texture, quantity of gravel on the surface, and depth to beds of gravel. Scattered areas of gravelly sandy loam are in-

cluded, and also a few areas of very fine sandy loam, associated with Merrimac very fine sandy loam in Cranston. In places where this soil is associated with Charlton or Hollis soils, the surface soil is browner and the substratum contains a larger proportion of schist than is characteristic of the typical soil.

This soil has a hummocky, uneven, or sloping relief. Drainage is excessive but not quite so rapid as on the gravelly sandy loam and loamy coarse sand types. Hinckley gravelly fine sandy loam, though fairly extensive, does not cover so large an area as the gravelly sandy loam. By far the largest bodies of this soil are in Burrillville, and scattered areas are in the other towns except East Providence.

Probably 5 to 10 percent of the land is under cultivation to vegetables, sweet corn, and hay. Yields are usually very low unless the soil is heavily fertilized, and crops are often damaged by lack of moisture. The rest of the land is in abandoned fields, used for pasture, or in forest. Areas that were once cleared and are now abandoned support a cover of shrubs and herbs consisting mainly of sweetfern, blueberry, wild-indigo, broomsedge, poverty oatgrass, sheep fescue, hairy-cap moss, and scattered pitch pine, quaking aspen, and gray birch trees. In forested areas the principal trees are pitch pine, white oak, scrub oak, gray birch, and quaking aspen, together with an undergrowth of blueberry.

In some areas of Hinckley gravelly fine sandy loam a few rounded stones are scattered over the surface and embedded in the soil, but the total acreage of this variation is small. An area of about 1 square mile, indicated on the map by stone symbols, is in the vicinity of Foster Center in Foster, and the rest is in small widely scattered areas associated with typical Hinckley gravelly fine sandy loam. About one-half of this land has been cleared of trees and is now lying idle or is used for pasture; the rest is in forest. The stony areas have the same value for the growth of trees and for pasture as the typical soil.

Quonset gravelly sandy loam.—Quonset gravelly sandy loam is associated with the Warwick soils in the extreme eastern part of East Providence and in the south-central part of Cranston. It occurs in small bodies, and the total acreage is small. A small part of the land is cleared and used for grazing; the rest supports a shrub and herb vegetation or a scrubby forest cover of pitch pine, scrub oak, white oak, and gray birch. The agricultural value of this soil is about the same as that of Hinckley gravelly sandy loam. The relief is hummocky or sloping, drainage is excessive, and the water-holding capacity is very low. Like Hinckley gravelly sandy loam, this soil is more valuable as a source of gravel for concrete work or road building than for agriculture.

The surface soil is grayish-brown friable gravelly sandy loam 4 to 6 inches thick. The subsoil is pale yellowish-brown loose friable and gravelly light sandy loam, becoming lighter in texture and color with depth. This material overlies beds of incoherent, stratified sand and gravel at a depth of 12 to 18 inches. The deposits of sand and gravel contain a large proportion of shale, schist, and sandstone. This soil is variable in depth to gravel and in the quantity of gravel in the surface layer. In some places beds of gravel and sand are very near the surface. All layers are acid, the subsoil layers being slightly less acid in some places than those of the Hinckley soils.

IMPERFECTLY AND POORLY DRAINED SOILS OF THE BOTTOM LANDS

The imperfectly and poorly drained soils of the bottom lands are classified either as Podunk silt loam or as alluvial soils, undifferentiated. The Podunk soils are imperfectly drained and are fairly uniform in texture and degree of development; whereas the alluvial soils, undifferentiated, are variable in texture and degree of development and are predominantly poorly drained. The Podunk soils are less subject to overflow than are the alluvial soils, undifferentiated, and are much more valuable for agriculture.

Podunk silt loam.—Podunk silt loam occupies the first bottoms, mainly along the Pawtuxet River in Cranston and the Blackstone River in Cumberland. Several fair-sized bodies occur in Cranston and Johnston and one just north of Graniteville in Burrillville. These areas lie above normal overflow but are subject to inundation in times of high water.

Podunk silt loam is characterized by a dark-brown or brown friable silt loam or loam surface soil from 8 to 12 inches thick. The upper part of the subsoil is yellowish-brown or grayish-brown silt loam, slightly mottled with rust brown and gray, grading into yellowish-gray or gray mottled loam or fine sandy loam. The lower part of the subsoil becomes lighter in texture and more mottled with depth and overlies saturated sand or sand and gravel at a varying depth but in most places at 24 to 26 inches below the surface. As mapped, this soil includes some variations in texture, drainage, and color of both the surface soil and the subsoil, but the areas as a whole are fairly uniform. The texture of the surface soil near the streams in places is fine sandy loam or very fine sandy loam; and on small areas adjoining the uplands a brown loam or sandy loam covering several inches thick has washed in from the higher land. This soil is free of stones and is easily managed. Drainage is well established, but the water table is sufficiently near the surface to provide growing crops with moisture even during dry seasons.

The total acreage of Podunk silt loam is small. Most of the land is cleared and used for the production of hay, corn, and oats, or for pasture. Crops are somewhat uncertain, owing to the hazard of overflow. Hay occupies a large part of this land and yields from 1½ to 2½ tons an acre in normal years. Corn for silage yields 10 to 15 tons and oats 2½ to 3 tons, if the crop is not destroyed by high water. Heavy applications of fertilizer are usually made for these crops. This is one of the best pasture soils in the county.

Alluvial soils, undifferentiated.—Areas of alluvial soils, undifferentiated, represent overflow land that is variable in texture, color, and stoniness, and generally is poorly drained. For the most part it occurs in narrow strips along fairly rapid flowing streams and is subject to frequent overflows. The surface soil is dark-brown or almost black sandy loam, fine sandy loam, or loam, 6 to 8 inches thick. The subsoil is dark gray, mottled with rust brown, brown, yellow, and drab, becoming more highly mottled with depth. Below a depth of 20 to 24 inches the material consists of gray or dark-gray medium and coarse sand containing a varying quantity of gravel or fragments of rock. In places the surface soil consists of gray, dark-gray, and brown layers of recent alluvium. Some areas have a few stones scattered over the surface, but most of the soil is nearly stone free.

Although fairly extensive, these soils are unimportant agriculturally. They occur in narrow strips along the larger drainageways in all parts of the county. Because of poor drainage and frequent overflows, practically none of the land is used for cultivated crops. A very small proportion has been cleared of trees and is used for pasture. The rest is in forest consisting mainly of gray birch, red maple, alder, and elm, with an undergrowth of bull brier and blueberry.

Some areas could be artificially drained at a comparatively low cost, and if drained they would be adapted to such crops as hay, corn, and certain vegetables.

IMPERFECTLY AND POORLY DRAINED SOILS OF THE UPLANDS AND OUTWASH PLAINS

The imperfectly and poorly drained soils of the uplands and outwash plains are associated with soils of the glaciated uplands and the well-drained soils on the outwash plains. Because of topographic position or because of some other characteristic of the soil, surface drainage, subsurface drainage, or both, have been greatly restricted. This restriction has had a marked influence on the production of crops and on use of the land. The imperfectly drained soils belong to the Scituate series, and the poorly drained soils belong to the Whitman, Mansfield, and Scarboro series.

A very small proportion of the imperfectly drained soils has been cleared of stones and trees and is used for hay or pasture. Otherwise, nearly the entire acreage is in forest or pasture. The imperfectly drained soils occupy nearly level areas or slight depressions within areas of the well-drained uplands or occur in narrow strips between the well-drained and the poorly drained soils. Subsurface drainage is so restricted that the subsoils are mottled and waterlogged during wet seasons. The poorly drained soils occur in depressions along small streams and drainageways and around springs. The surface soils are dark, and they overlie waterlogged mottled subsoils.

The Mansfield soils are associated with the Newport, Charlton, Hollis, Attleboro, and Tiverton soils and are less acid than the soils of the Whitman or Scarboro series. The Whitman soils are associated with the Gloucester and Narragansett soils in granitic areas, and Scarboro loam is associated with the soils of the outwash plains.

Scituate stony loam.—Scituate stony loam occurs in level or very gently sloping areas. Surface drainage is only fair, and subdrainage is imperfect. The comparatively small areas are closely associated with the well-drained Narragansett soils. Bodies of this soil are most numerous in the northwestern part of Scituate, in Foster, in Glocester, and in Burrillville. They occupy slight depressions within areas of the well-drained soils or narrow strips between the well-drained and poorly drained areas.

The 6- to 8-inch surface soil consists of dark-brown or dark grayish-brown heavy loam containing a considerable amount of organic matter. The upper subsoil layer is yellowish-brown firm but friable loam. At a depth of 12 to 14 inches it grades into olive-gray or yellowish-gray loam or sandy loam mottled with brown, yellow, and gray and becoming lighter in color and in texture and more highly mottled with depth. This material overlies gray or dark-gray com-

pact till mottled or streaked with reddish yellow or yellow at a depth of about 2 feet. Although compact, the till is friable and breaks down easily when crushed. The material in all layers is acid. Numerous stones and boulders are scattered over the surface and embedded in the soil.

Where this soil has not been disturbed, a layer of leafmold and partly decayed organic matter has accumulated on the surface, and in places this is underlain by a thin highly leached gray layer.

A small proportion of the land has been cleared of trees and is used for pasture or is lying idle. The rest is in second- or third-growth forest. The principal vegetation on the open areas consists of hardhack, meadowsweet, highbush blueberry, blackberry, thistle, dandelion, Rhode Island bentgrass, and Kentucky bluegrass. In forested areas the tree growth consists mainly of red maple, swamp white oak, yellow birch, gray birch, elm, ash, and alder, and there is a thick undergrowth of shrubs.

Because of stoniness and imperfect drainage, probably the best use for this soil is grazing or forestry. It is well adapted to native grasses, and when cleared of trees and weeds it affords good grazing.

Scituate loam.—Scituate loam is essentially the same as Scituate stony loam except that the surface has been cleared of stones. This soil comprises a very small area. Several small bodies are mapped in the southern part of Cranston.

Because of the high moisture supply, this soil is well adapted to grasses and forage crops. Practically the entire acreage is used for hay or is in good pasture. Hay yields 1½ to 2½ tons an acre.

Whitman stony loam.—Whitman stony loam is the most extensive of the poorly drained soils. It occurs throughout the areas of the Narragansett and Gloucester soils in basinlike areas, narrow bands around areas of muck, and narrow strips along drainageways. Natural drainage is poor, and water stands on the surface in wet seasons and after heavy rains.

The surface soil of Whitman stony loam is very dark grayish-brown to nearly black medium plastic loam 6 to 8 inches thick. It contains a considerable amount of organic matter. The subsoil is gray or yellowish-gray mottled loam that becomes lighter in texture with depth. The lower part of the subsoil is highly mottled with rust brown and yellow, and at a depth of 24 to 30 inches it rests on gray or dark-gray coarse and gritty fairly compact till, which is composed largely of granite, gneiss, and other crystalline rock materials. All layers of this soil are acid. Numerous stones are scattered over the surface and throughout the soil mass. The soil ranges from moderately stony to very stony.

Most of this soil is in forest consisting mainly of red maple, elm, alder, gray birch, and swamp white oak, together with a thick underbrush of sweet pepperbush, bull brier, and highbush blueberry. A few scattered areas have been cleared of trees and are used for pasture. These areas support a vegetation consisting of hardhack, meadowsweet, broomsedge, sensitive fern, white clover, Rhode Island bentgrass, and sweet vernalgrass.

Because of stoniness and poor drainage, the best use for this soil is either for grazing or for forestry. Where cleared of trees and brush, it affords good grazing during the summer.

Areas of stony silty clay loam texture, in the western part of Cranston and in scattered areas throughout the Gloucester and Narragansett soils, are included with this soil. This heavier textured inclusion differs little from the typical soil in value for forest or pasture. The stoniness and poor drainage limit the use of this land to forestry and grazing.

Whitman loam.—In profile characteristics Whitman loam is practically the same as Whitman stony loam. It occupies similar topographic positions and is poorly drained. It is free or nearly free of surface stone and in this respect differs from Whitman stony loam. Most of the land has been cleared of forests.

Whitman loam is closely associated with Whitman stony loam in small widely scattered bodies. The total acreage is small. Only a small part of the land is used for the production of hay, and most of the rest is used for pasture.

Whitman silty clay loam.—Whitman silty clay loam occupies a few small scattered areas where the surface is free or practically free of stones. Except for this comparative freedom from stone, it is similar to the areas of heavier textured Whitman stony loam. This soil is neither extensive nor important agriculturally. Several areas occur in the southern parts of Cranston and Lincoln, and one area is south of Woonsocket. Most of this soil is used either for pasture or for the production of hay. It affords excellent grazing even in dry seasons.

Mansfield stony silty clay loam.—This soil occurs throughout Cumberland and Lincoln, and a few areas are in parts of North Providence, Johnston, Cranston, and East Providence, associated with the Charlton, Hollis, Newport, Attleboro, and Tiverton soils. For the most part, the Mansfield soil occupies slight depressions within the well-drained uplands or narrow strips along the drainageways. The relief is level to very gently sloping. Drainage is poor, as water stands on the surface in wet seasons and after heavy rains. The subsoil is more or less permanently waterlogged.

The surface soil is dark grayish-brown or nearly black silty clay loam about 6 inches thick. In places there is a thin layer of mucky material on the surface, which is generally wet and plastic; but when dry, it cracks and becomes hard. The subsoil is gray or dark-gray silt loam, mottled or streaked with yellow and brown, and it becomes lighter in texture and contains an increasing quantity of gritty material with depth. In places a somewhat blue cast is noticeable in the subsoil, and about 24 inches below the surface it rests on bluish-gray coarse and gravelly compact till composed largely of shale, schist, conglomerate, and sandstone. All layers are acid. The pH value of the surface soil ranges from 3.5 to 5.0.

Numerous stones and rock fragments are scattered over the surface and embedded in the soil. In general, however, this soil is not so stony as Whitman stony loam.

Because of poor drainage and stoniness, this soil is used largely for grazing and for forestry. Probably 25 percent of the total acreage has been cleared of most of the trees and supports a shrub and herb vegetation consisting mainly of hardhack, broomsedge, bayberry, meadowsweet, sensitive fern, sweet vernalgrass, white clover, Kentucky bluegrass, and Rhode Island bentgrass. These areas provide fair to good grazing even in dry seasons. The trees

on the forested areas are principally red maple, sour gum, elm, alder, swamp white oak, gray birch, and redcedar, together with a thick undergrowth of hardhack, bayberry, bull brier, sensitive fern, and cinnamon fern.

Mansfield silty clay loam.—Mansfield silty clay loam differs from Mansfield stony silty clay loam only in the content of surface stones. The surface is free or practically free of stones, but it occupies similar topographic positions and is poorly drained.

Mansfield silty clay loam is closely associated with Mansfield stony silty clay loam but is much less extensive. Several fair-sized bodies occur in East Providence, Cranston, and Johnston, and smaller areas are in North Providence and northeast of Pawtucket Reservoirs in Cumberland. Practically all of this land has been cleared of forest. A very small proportion is used for the production of hay, and the rest is used for pasture or is lying idle. The vegetation on the pastured and idle areas consists of the same kinds of shrubs and herbs as grow on the open areas of Mansfield stony silty clay loam.

With artificial drainage these areas would be well adapted to grasses for hay and pasture and to certain cultivated crops.

Mansfield stony loam.—Mansfield stony loam is essentially similar to Mansfield stony silty clay loam in all respects except texture. It is characterized by a very dark-brown or nearly black loam surface soil over a mottled subsoil. Stones and rock fragments are scattered over the surface and embedded in the soil except in a few small areas where part or all of the stones have been removed.

Mansfield stony loam is neither extensive nor important agriculturally. It occurs in a few small areas, mostly in Cumberland, associated with the Charlton and Hollis soils. Like the other Mansfield and the Whitman soils, it is used largely for grazing or for forestry. The vegetation is essentially the same as that on Mansfield stony silty clay loam.

Scarboro loam.—Scarboro loam occupies poorly drained areas associated with the Merrimac, Warwick, and Hinckley soils. The land is level or gently sloping toward the drainageways. Water stands on the surface part of the time, and the subsurface layer is waterlogged during a greater part of the year.

The soil is somewhat variable in texture and color. The surface soil consists of dark grayish-brown or nearly black loam, heavy loam, or silt loam, 6 or 8 inches thick. It is medium plastic or sticky when wet. In undisturbed areas a 2- to 3-inch layer of leafmold and partly decomposed organic matter has accumulated on the surface and is underlain in places by a thin ashy-gray layer. The upper subsoil layer is rust-brown or brown slightly cemented sandy loam or fine sandy loam, which varies in thickness. In exposed cuts this layer is fairly hard, but it breaks down easily. The lower part of the subsoil generally consists of alternate layers of gray and yellowish-gray incoherent sand saturated with water. In places this layer is mottled or streaked with rust brown. At a depth of 24 to 30 inches the material is yellowish-gray stratified sand and gravel with slight cementation in places. The rust-brown slightly cemented layer just beneath the surface is missing in places, and the subsoil is gray loam or sandy loam mottled with rust brown and yellow. This soil is strongly acid in all layers.

Scarboro loam is not extensive. It occurs principally in the southern part of East Providence and in the vicinity of Chepachet in the western part of the county. Only a small part of the land has been cleared of trees, and most of this is used for pasture. The rest is in forest cover consisting of a dense growth of red maple, swamp white oak, gray birch, shadbush, sassafras, sweet pepperbush, bull brier, and highbush blueberry.

Because of the absence of stones and the loose and open structure of the subsurface layers, artificial drainage would be easier and less expensive to provide on this soil than on either the Whitman or the Mansfield soils. If cleared and drained this land would be fairly well suited to grasses and to corn. Certain vegetables may be grown successfully if the land is heavily fertilized and limed.

Muck and peat.—Muck and peat areas are composed of plant remains that have accumulated in former ponds, in depressions, and on the borders of sluggish streams. These areas differ considerably from place to place in depth, degree of decomposition, and character of the material. As mapped, muck and peat include deposits of organic matter that are fairly well decomposed on the surface, but the lower part is mostly in a raw or partly decayed condition. In general these deposits are more than 3 feet deep.

The surface soil consists of dark-brown or black fairly well decomposed organic matter 6 to 15 inches thick. This material has a slimy or sticky feel when wet. In some places there is very little evidence of the original leaf litter and woody material; in other places, partly decayed leaves, wood, or fibrous plant remains are evident. Below this layer the material is brown or dark-brown partly decomposed remains of trees and plants. This material varies in color and in degree of decomposition, depending somewhat on the character of the material. It is light in weight, spongelike in places, and generally saturated with water. It extends to a depth of 3 feet or more. Water stands on the surface in wet seasons. All layers of this soil are strongly acid.

Small to fairly large areas of muck and peat are scattered throughout the county. The total acreage is not large. A few small areas have been cleared of trees and brush and are used for the production of cranberries. The other areas of muck and peat are largely in second-growth trees or shrubs and coarse grasses and are used very little for grazing. The forest growth consists mainly of red maple, gray birch, alder, willow, sour gum, and white-cedar, together with an undergrowth of shrubs and herbs. On areas where water stands on the surface most of the time, the vegetation is mainly coarse grasses and cattails.

It is not likely that very much of this land will be drained and reclaimed for agricultural purposes in the near future. Adequate drainage would be difficult in most areas, and returns from cultivated crops probably would not justify the cost.

Muck and peat, shallow phase.—Areas of shallow muck and peat differ from typical areas of muck and peat in that the organic material is 3 feet or less thick over mineral soil and is slightly better decomposed throughout. The surface layer is dark-brown or nearly black well-decomposed organic matter containing a small

quantity of mineral soil in places. This material varies in thickness and grades into brown or dark-brown partly decomposed material consisting of leaves, woody material, and fibrous plant remains. At a depth ranging from 24 to 36 inches below the surface this, in turn, rests on a gray mineral soil mottled with yellow and brown and varying in texture from fine sand to coarse loam. All layers of the shallow muck and peat are strongly acid.

This land type occupies small depressions, narrow bands around areas of deep muck and peat, and narrow strips along drainageways. Small areas are scattered throughout the county. Like the areas of typical muck and peat, those of the shallow phase are largely covered with a growth of trees or shrubs and coarse grasses and are used very little for grazing. A few small areas are devoted to cranberries. The vegetation is essentially the same as on typical muck and peat. In general, the areas of shallow muck and peat would be less difficult to drain than the areas of deeper organic material. Under present economic conditions, however, very little of this land is likely to be drained.

MISCELLANEOUS LAND TYPES

The group of miscellaneous land types includes rough stony land (Gloucester soil material), tidal marsh, coastal beach, made land, and unclassified city land. None of these land types is of any importance for cultivated crops. Rough stony land (Gloucester soil material) and unclassified city land are extensive, whereas the other land types are of very small extent.

Rough stony land (Gloucester soil material).—This land type includes steep areas containing many outcrops of solid rock and large boulders. Because of its steepness and stoniness, this land is unsuited to cultivation and is of little value even for grazing. Its principal use is for forestry.

Rough stony land (Gloucester soil material) occurs in small to fairly large areas throughout the county except in East Providence. The soil between the rocks is largely Gloucester soil material. In the northeastern part where the rough stony land is associated with the Hollis soils the soil material is similar to Hollis stony loam.

Most of the rough stony land supports a forest growth consisting principally of white oak, red oak, black oak, and gray birch, together with some redcedar, white pine, and pitch pine. Sumac, bull brier, lowbush blueberry, sweetfern, and wild-indigo are the principal shrubs.

Tidal marsh.—Tidal marsh is very inextensive, occurring in a few small areas in the extreme southern part of East Providence. These areas consist of shallow tidal flats that are exposed to the air during low tide and covered with water at high tide. The surface layer consists of a brown fibrous mat of grass and grass roots intermixed with sand. Below this layer there is generally a dark-gray sandy layer that is fairly firm in place but loose when broken up. This layer gradually changes to coarse loose gray sand at a depth of about 2½ feet. Tidal marsh is the result of the mingling of the coastal beach sand washed or blown over the tidal flats and mixed with finer sediments and the

subsequent growth and partial decay of the coarse grasses that form the present cover. The vegetation in most places consists of thick and vigorous stands of saltgrass, eelgrass, and sedges. When cut this grass produces a coarse hay that is of little value except for bedding.

Coastal beach.—Coastal beach includes the level sandy fringe, ranging from 50 to 200 feet in width, along the shore line. This land occurs only in the vicinity of Bullock Point in the extreme southwestern part of East Providence. This sandy material was deposited by action of the waves. Most of the fine material has been removed, leaving the sand assorted to some extent. This land may be covered with water at high tide or during storms. Coastal beach supports no vegetation and is of value only for recreational purposes.

Made land.—Made land consists of areas that have been changed by man from their original form and are of no agricultural value. It includes excavations, dumps, filled-in areas, and areas that have been artificially leveled. This land occurs in small scattered areas, in the form of excavations and dumps, and is most common in Cranston and East Providence.

Unclassified city land.—A total area of 24,384 acres of land is included in metropolitan areas where the soils have been so changed or disturbed that identification was not practicable.

PRODUCTIVITY RATINGS

In table 6 the soils of Providence County are listed alphabetically according to soil series and estimated average acre yields of the principal crops are given for each soil.

The estimates in table 6 are based primarily on interviews with farmers, the county agricultural agent, members of the staffs of the Rhode Island Agricultural Experiment Station and the State College of Agriculture, and others who have had experience in the agriculture of the county. They are presented only as estimates of the average production over a period of years according to prevailing types of management, which are outlined in the last column of table 7. It is realized that these estimates may not apply directly to specific tracts of land for any particular year, as the soils as shown on the map vary somewhat, management practices differ slightly, 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.

In order to compare directly the yields obtained in Providence County with those obtained in other parts of the United States, yield figures have been converted in table 7 into indexes based on standard yields. The soils are listed in the approximate order of their general productivity under prevailing farming practices, the most productive at the head of the table.

The rating compares the productivity of each of the soils for each crop to a standard of 100. This standard index represents the approximate average acre yield 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 each respective column. It is to be noted that the standards given here for sweet corn, tomatoes, and cabbage have been used so far only in Rhode Island. It is not expected that they can be used satisfactorily in other regions, such as the Winter Garden area of Texas, etc. Soils given amendments, such as lime and commercial fertilizers, or special practices, such as irrigation, and unusually productive soils of small extent may have productivity indexes of more than 100 for some crops.

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 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. Slope, drainage, and most of the aspects of climate may be considered as characteristics of a given soil type, since the soil type, as such, occupies specific geographical areas characterized by a given range of slope and climatic conditions. Crop yields over a long period of years furnish the best available summation of the associated factors, and therefore they are used where available.

The soils are listed in table 7 in the order of their general productivity according to the prevailing practices. General productivity grade numbers are assigned in the column "General productivity grade." The general productivity grade is based on a weighted average of the indexes for the various crops, the weighting depending on the relative acreage and value of the crops. If the weighted average is between 90 and 100. the soil type is given a grade of 1; if it is between 80 and 90, a grade of 2 is given, and so on.[12] Since it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops, perhaps 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 Providence 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.

[12] Instead of following the usual procedure for weighting the indexes of the individual crops on a percentage basis, 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.

TABLE 6.—*Estimated average acre yields of the principal crops on each soil in Providence County, R. I., under prevailing practices* [1]

Soil (soil types, phases, and land types) [2]	Corn (grain)	Corn (silage)	Mixed hay [3]	Clover [4]	Alfalfa	Potatoes	Sweet corn	Tomatoes	Cabbage	Apples	Pasture
	Bushels	*Tons*	*Tons*	*Tons*	*Tons*	*Bushels*	*Dozen ears*	*Bushels*	*Bushels*	*Bushels*	*Cow-acre-days* [5]
Alluvial soils, undifferentiated											40
Attleboro gravelly loam	30	10	1.5	1.5	2.5	125	700	275	275	150	60
Attleboro stony gravelly loam											25
Charlton loam	45	12	2.0	2.0	3.25	250	850	350	325	200	80
Charlton loam, level phase	45	13	2.25	2.25	3.5	275	900	350	350	200	90
Charlton stony loam [6]	35		1.5			125				175	50
Charlton stony loam, level phase [6]	35	10	1.75			150				175	50
Cheshire loam	40	12	2.0	2.0	3.0	200	800	325	300	200	75
Cheshire stony loam											40
Cheshire stony loam, level phase [6]			1.5								50
Coastal beach											
Gloucester fine sandy loam	20	8	1.0	1.0	2.0	125	650	300	250	100	45
Gloucester fine sandy loam, level phase	25	8	1.25	1.0	2.25	150	650	300	250	100	50
Gloucester stony fine sandy loam [6]	20		.75							75	25
Gloucester stony fine sandy loam, level phase [6]			.75							75	25
Gloucester stony fine sandy loam, steep phase											15
Hinckley loamy coarse sand											10
Hinckley gravelly sandy loam [6]			.75								25
Hinckley gravelly fine sandy loam [6]			.75								25
Hollis stony loam											50
Hollis stony loam, rolling phase [6]			1.5								50
Made land											
Mansfield stony loam											30
Mansfield silty clay loam											40
Mansfield stony silty clay loam											30
Merrimac loamy sand	10	4	.5				300				20
Merrimac sandy loam	15	6	.75	.75	2.0	100	550	250	150	75	30
Merrimac fine sandy loam	25	8	1.0	1.0	2.75	175	700	325	250	100	50
Merrimac fine sandy loam, shallow phase	20	6	.75	.75	2.0	100	600	250	150	75	30
Merrimac very fine sandy loam	40	12	1.75	1.75	3.5	275	1,000	400	300		70
Muck and peat											10
Muck and peat, shallow phases											10
Narragansett fine sandy loam	30	10	1.25	1.25	2.5	200	700	300	275	175	65
Narragansett fine sandy loam, level phase	35	10	1.5	1.5	2.75	175	750	300	300	175	65
Narragansett stony fine sandy loam [6]	25	10	1.0			100				100	40
Narragansett stony fine sandy loam, level phase [6]	25		1.0							100	35
Narragansett loam	45	13	2.25	2.25	3.5	275	900	350	350	225	90
Narragansett loam, slope phase	45	12	2.0	2.0	3.25	250	850	350	325	200	80

Narragansett stony loam [6]	35	10	1.5							175	50
Narragansett stony loam, slope phase [6]	35		1.5							175	50
Newport loam	40	12	2.0	2.0	3.25	275	850	350	325	200	75
Newport loam, level phase	45	13	2.25	2.25	3.5	275	900	350	350	200	80
Newport stony loam											40
Podunk silt loam [7]	50	12	2.0				800				80
Quonset gravelly sandy loam [6]			.75								25
Rough stony land (Gloucester soil material)											10
Scarboro loam											35
Scituate loam	35	10	1.5						300		80
Scituate stony loam [6]			1.5								40
Tidal marsh											
Tiverton gravelly fine sandy loam	30	9	1.25	1.25	2.5	175	700	300	275	175	60
Tiverton gravelly fine sandy loam, level phase	35	10	1.5	1.5	2.75	150	750	300	275	175	65
Tiverton stony gravelly fine sandy loam											50
Warwick sandy loam	15	6	.75	.75	2.0	100	550	250	150	75	30
Warwick fine sandy loam	25	8	1.0	1.0	2.75	175	700	325	250	100	50
Whitman loam [6]			1.0								40
Whitman stony loam											30
Whitman silty clay loam											40

[1] Prevailing practices include the use of commercial fertilizers, manure, and ground limestone on most of the soil types used for crops. A greater proportion of fertilizer is used on the soils near the cities. For certain crops, the land generally receives treatment as follows:

Corn for silage—Heavy applications of manure plus 300 to 400 pounds to the acre of complete fertilizer, such as 5-8-7 or 4-8-4.
Sweet corn—About 500 pounds of 5-8-7.
Market-garden crops—Manure plus 1,000 to 2,000 pounds of complete fertilizer (5-8-7) with 1 to 2 tons of limestone about every 3 or 4 years (with rye and buckwheat used as green-manure crops).
Potatoes—1 ton of complete fertilizer (commonly 5-8-7 or 5-10-10).
Hay—1 to 2 tons of ground limestone at time of seeding, to help establish legumes. Manure applied during the rotation. Some farmers apply from 200 to 400 pounds of complete fertilizer.
Apples—½ to 1 ton of ground limestone plus complete fertilizer, although a few farmers add only nitrogen.

[2] Soils are listed alphabetically according to the series. Absence of a yield estimate indicates that the crop is not commonly grown.

[3] Mixed hay includes timothy mixed with red or alsike clover, redtop, orchard grass, or Rhode Island (Colonial) bentgrass in varying proportions. Timothy alone is grown on a very small percentage of the total area.

[4] Clover refers to red clover alone or mixed with alsike or white clover.

[5] These estimates are less satisfactory than others, as specific data are difficult to obtain. The term "cow-acre-days" is used to express the carrying capacity or grazing value of pasture. 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. 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. For example, a soil that would provide grazing for 1 cow or 1 animal unit to the acre for 100 days, or for 2 cows or 2 animal units for 50 days, would rate 100 cow-acre-days; another soil that would provide grazing for 1 cow or 1 animal unit to 4 acres for 100 days would rate 25 cow-acre-days.

[6] These soils are for the most part in forest. The yields apply to the scattered areas that are cultivated or used for hay. Stone are numerous enough on the surface to interfere significantly with seeding and cultivation.

[7] Yields are based on productivity in normal years. Crops are destroyed infrequently by high water.

TABLE 7.—*Productivity ratings of the soils of Providence County, R. I., under prevailing farming practices*

Soil (soil types, phases, complexes, and land types)[1]	Crop productivity index[2] for—											General productivity		Principal type of farming, crops, or use
	Corn (grain) (100=50 bu.)	Corn (silage) (100=12 tons)	Mixed hay[3] (100=2 tons)	Clover[4] (100=2 tons)	Alfalfa (100=4 tons)	Potatoes (100=200 bu.)	Sweet corn[5] (100=1,000 doz. ears)	Tomatoes[5] (100=400 bu.)	Cabbage[5] (100=350 bu.)	Apples (100=200 bu.)	Pasture (100=100 cow-acre-days)[6]	Grade[7]	Group[8]	
Narragansett loam	90	108	112	112	87	135	90	87	100	112	90	1	Very high	General farming.[9]
Charlton loam, level phase	90	108	112	112	87	135	90	87	100	100	90			Do.[9]
Newport loam, level phase	90	108	112	112	87	135	90	87	100	100	80			Do.[9]
Charlton loam	90	100	100	100	80	125	85	87	93	100	80			Do.[9]
Narragansett loam, slope phase	90	100	100	100	80	125	85	87	93	100	80			Do.[9]
Merrimac very fine sandy loam	80	100	87	87	87	135	100	100	85		70			Silage corn, hay, vegetables.
Newport loam	80	100	100	100	80	135	85	87	93	100	75			General farming.[9]
Cheshire loam	80	100	100	100	75	100	80	80	85	100	75	2	High	General farming.[9]
Narragansett fine sandy loam, level phase	70	83	75	75	70	87	75	75	85	87	65	3		Do.[9]
Tiverton gravelly fine sandy loam, level phase.	70	83	75	75	70	75	75	75	80	87	65			Do.[9]
Podunk silt loam[10]	100	100	100				80				80			Hay, pasture, corn, oats.
Narragansett fine sandy loam	60	83	62	62	62	100	70	75	80	87	65	4	Medium	General farming.[9]
Tiverton gravelly fine sandy loam	60	75	62	62	62	87	70	75	80	87	60			Do.[9]
Attleboro gravelly loam	60	83	75	75	62	62	70	68	80	75	60			Do.[9]
Warwick fine sandy loam	50	65	50	50	70	87	70	80	73	50	50			Vegetables, sweet corn, hay, potatoes.
Merrimac fine sandy loam	50	65	50	50	70	87	70	80	73	50	50	5		Do.
Gloucester fine sandy loam, level phase	50	65	62	50	55	75	65	75	73	50	50			General farming.[9]
Gloucester fine sandy loam	40	65	50	50	50	62	65	75	73	50	45			Do.[9]

Merrimac fine sandy loam, shallow phase	40	50	37	37	50	50	60	62	43	37	30	6	Medium to low.	Vegetables, sweet corn, hay, pasture.
Warwick sandy loam	30	50	37	37	50	50	55	62	43	37	30			Do.
Merrimac sandy loam	30	50	37	37	50	50	55	62	43	37	30			Do.
Charlton stony loam, level phase [11]	70	83	87	------	------	75	------	------	------	87	50			Forest, pasture, patch farming.
Scituate loam	70	83	75	------	------	------	------	------	85	------	80			Hay, pasture.
Narragansett stony loam [11]	70	83	75	------	------	------	------	------	------	87	50			Forest, pasture, patch farming.
Charlton stony loam [11]	70	------	75	------	------	62	------	------	------	87	50			Do.
Narragansett stony loam, slope phase [11]	70	------	75	------	------	------	------	------	------	87	50			Do.
Narragansett stony fine sandy loam [11]	50	83	50	------	------	50	------	------	------	50	40			Forest, pasture, general farming.[9]
Narragansett stony fine sandy loam, level phase. [11]	50	------	50	------	------	------	------	------	------	50	35	7		Do.[9]
Gloucester stony fine sandy loam [11]	40	------	37	------	------	------	------	------	------	37	25			Forest, pasture, vegetables, hay.
Merrimac loamy sand	20	33	25	------	------	------	30	------	------	------	20			Forest, pasture, vegetables, hay.
Cheshire stony loam, level phase [11]	------	------	75	------	------	------	------	------	------	------	50			Forest, pasture, hay.
Hollis stony loam, rolling phase [11]	------	------	75	------	------	------	------	------	------	------	50			Do.
Scituate stony loam [11]	------	------	75	------	------	------	------	------	------	------	40			Do.
Whitman loam [11]	------	------	50	------	------	------	------	------	------	------	40	8		Forest, some pasture.
Gloucester stony fine sandy loam, level phase [11]	------	------	37	------	------	------	------	------	------	------	25			Forest, pasture, hay.
Hinckley gravelly fine sandy loam [11]	------	------	37	------	------	------	------	------	------	------	25			Forest, pasture, hay, idle land.
Quonset gravelly sandy loam [11]	------	------	37	------	------	------	------	------	------	------	25			Do.
Hinckley gravelly sandy loam [11]	------	------	37	------	------	------	------	------	------	------	25		Low	Do.
Hollis stony loam	------	------	------	------	------	------	------	------	------	------	50			Forest, pasture.
Tiverton stony gravelly fine sandy loam	------	------	------	------	------	------	------	------	------	------	50			Do.
Newport stony loam	------	------	------	------	------	------	------	------	------	------	40			Do.
Cheshire stony loam	------	------	------	------	------	------	------	------	------	------	40			Do.
Alluvial soils, undifferentiated	------	------	------	------	------	------	------	------	------	------	40	9		Forest, some pasture.
Whitman silty clay loam	------	------	------	------	------	------	------	------	------	------	40			Do.
Mansfield silty clay loam	------	------	------	------	------	------	------	------	------	------	40			Do.
Scarboro loam	------	------	------	------	------	------	------	------	------	------	35			Do.

See footnotes at the end of table.

TABLE 7.—*Productivity ratings of the soils of Providence County, R. I., under prevailing farming practices*—Continued

Soil (soil types, phases, complexes, and land types) [1]	Crop productivity index [2] for—											General productivity		Principal type of farming, crops, or use
	Corn (grain) (100=50 bu.)	Corn (silage) (100=12 tons)	Mixed hay [3] (100=2 tons)	Clover [4] (100=2 tons)	Alfalfa (100=4 tons)	Potatoes (100=200 bu.)	Sweet corn [5] (100=1,000 doz. ears)	Tomatoes [5] (100=400 bu.)	Cabbage [5] (100=350 bu.)	Apples (100=200 bu.)	Pasture (100=100 cow-acre-days) [6]	Grade [7]	Group [8]	
Mansfield stony loam											30	10	Very low.	Forest, some pasture.
Whitman stony loam											30			Do.
Mansfield stony silty clay loam											30			Do.
Attleboro stony gravelly loam											25			Forest, pasture.
Gloucester stony fine sandy loam, steep phase.											15			Forest, very little pasture.
Hinckley loamy coarse sand											10			Forest, some pasture.
Muck and peat, shallow phases											10			Forest.
Muck and peat											10			Do.
Rough stony land (Gloucester soil material)											10			Forest, very little pasture.
Tidal marsh														Wasteland.
Coastal beach														Do.
Made land														Do.

[1] The soils are listed in the approximate order of their general productivity under prevailing farming practices.

[2] The soils are given indexes that indicate the approximate average production of each crop in percentage 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 of the United States in which the crop is most widely grown. The indexes are based on estimates of yields (see table 6), as specific yield data are very limited. Absence of an index indicates that the crop is not commonly grown.

[3] Mixed hay includes timothy mixed with red or alsike clover, redtop, orchard grass, or Rhode Island (Colonial) bentgrass, in varying proportions. Timothy alone comprises a very small percentage of the total area.

[4] Clover refers to red clover alone or mixed with alsike or white clover.

[5] The standards used here for these crops are selected only on the basis of yields in Rhode Island. They are not to be accepted as standards for all sections of the United States.

[6] See footnote 5, table 6.

[7] These numbers indicate the general productivity of the soils for the common crops under prevailing farming practices. Refer to the text for further explanation.

[8] This is a generalized statement of relative productivity.

[9] General farming includes the production of hay, corn, potatoes, vegetables, alfalfa, orchard fruits, and pasture.

[10] Indexes are based on productivity in normal years. Crops are destroyed infrequently by high water.

[11] These soils are for the most part in forest. The indexes apply to the scattered areas that are cultivated or used for hay. Surface stone is in sufficient quantity to interfere significantly with seeding and cultivation.

Economic considerations play no part in determining the crop productivity indexes. These indexes cannot be interpreted, therefore, into land values 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. The ease or difficulty of tillage and the 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, the presence or absence of stones, the 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 and susceptibility to erosion are characteristics that influence the ease of maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced in some degree by all these and other factors, such as the moisture-holding capacity of the soil and its permeability to roots and water. These factors, therefore, should not be considered entirely separately from productivity; on the other hand, schemes of land classification to designate the relative suitability of land for agricultural use must give some separate recognition to them.

The right-hand column of table 7 gives information regarding the principal crops grown on or the use made of each soil.

LAND USES AND AGRICULTURAL METHODS

In Providence County only a small percentage of the total acreage is cultivated or improved land. The agriculture consists principally of patch farming; that is, the areas of improved land are, in general, scattered and in small tracts. This is especially true in the western part of the county. In the eastern part, near the centers of population, a higher percentage of the land is cleared of stones and trees and is utilized for hay and cultivated crops. Dairy farming is the most important agricultural enterprise, followed by poultry farming, fruit growing, and market gardening.

Most of the well-drained soils have favorable texture and structure for deep penetration of roots, adequate drainage, and fair to good moisture-holding capacity. Stoniness is the limiting factor for the production of cultivated crops on a large percentage of the glaciated uplands.

The soils in this county are not inherently so fertile as soils in some other parts of the United States. The cultivated soils, however, respond to fertilization and care and are adapted to a great variety of crops. With the exception of some of the light sandy soils on the outwash plains, practically all of the cultivated soils are capable of being built up to and maintained in a fairly productive state. No particular soil is especially adapted to or used for any certain crop or crops. It is generally recognized, however, that the heavier textured soils developed from till are the most productive for such crops as grasses, corn, small grains, clover, and such market-garden crops as cabbage and cauliflower. The lighter textured soils are not so productive, in

general, as the heavier soils but are well suited to certain market-garden crops, such as potatoes and small fruits.

In general, the cultivated soils are used to good advantage. An effort is made by most farmers to build up and maintain the productiveness of their soils by adding barnyard manure, commercial fertilizer, and lime and by turning under green-manure crops. Most farmers also realize the need of protecting their soils from erosion.

A large percentage of the stone-free land of the better soils developed from till, such as Narragansett loam and Charlton loam, is used for hay, apple orchards, and cultivated crops.

Considerable acreages of the lighter textured Merrimac and Warwick soils that were cultivated at one time have been abandoned. With the exception of Merrimac and Warwick fine sandy loams, crop yields are generally low and uncertain without heavy fertilization and irrigation, and for these reasons much of this land is idle. Some areas of Merrimac fine sandy loam now idle could be used to advantage for cultivated crops.

As dairying is the most important agricultural enterprise in the area, more attention should be given to the improvement of both improved and unimproved pastures. On most of the unimproved pasture land the growth of brush, shrubs, and weeds is so thick that grasses do not have a fair chance. A little fertilization would be of great benefit to some of the improved pastures; in other words, hayfields that are beginning to run out and are used for pasture.

Commercial fertilizers and lime are used extensively on most of the farms in the eastern part of the county, but in the western part their use is not so general. Most of the commercial fertilizer is ready mixed, but some unmixed chemicals are used. Fertilizer mixtures most commonly used for silage corn are 5–8–7, 4–8–4, and 4–12–4; for vegetables, 5–8–7, 5–10–10, and 8–16–16; for potatoes, 5–8–7 and 5–10–10; and for sweet corn, 5–8–7. There is a general tendency to use a fertilizer with a higher percentage of phosphorus for corn and a fertilizer with a higher percentage of potash for potatoes than have been used heretofore.

Table 8 gives recommendations for the use of fertilizers for the principal farm crops of Rhode Island.

TABLE 8.—*Recommendations for the use of fertilizers for the principal farm crops of Rhode Island* [1]

Recommendations for—	Fertilizer	Acre application
		Pounds
New seedings of alfalfa, clover, and clover mixtures	4–16–20	400–500
Do	2–8–10	800–1,000
Do	Nitrogen fertilizer [2]	100–125
	16-percent superphosphate	400–500
	50-percent muriate of potash	160–200
Top-dressing alfalfa, clover, and mixtures of either	4–16–20	400–500
Do	2–8–10	800–1,000
Do	Nitrogen fertilizer [2]	100–125
	16-percent superphosphate	400–500
	50-percent muriate of potash	160–200
Top-dressing grass, hay, and pasture	8–16–16	300–500
Do	5–8–7	500–800
Do	10–16–14	300–500
Do	Nitrogen fertilizer [2]	150–250
	16-percent superphosphate	300–500
	50-percent muriate of potash	100–160

See footnotes at end of table.

TABLE 8.—*Recommendations for the use of fertilizers for the principal farm crops of Rhode Island* [1]—Continued

Recommendations for—	Fertilizer	Acre application
		Pounds
Corn and small grains	8–24–8	300–500
Do	4–12–4	600–800
Do	5–10–5	400–500
Do	Nitrogen fertilizer [2]	150–250
	16-percent superphosphate	450–800
	50-percent muriate of potash	50–100
Fall-sown small grains	8–24–8	200–300
Do	4–12–4	400–600
Do	5–10–5	300–400
Do	Nitrogen fertilizer [2]	150–250
	16-percent superphosphate	450–800
	50-percent muriate of potash	50–100
Potatoes	8–16–16	1,000
Do	4–8–8	2,000
Do	5–10–10	2,000
Do	8–16–20	1,000
Vegetables and market-garden crops	5–8–7	1,500–2,000
Do	5–10–5	1,500–2,000
Do	5–10–10	1,500–2,000
Apples	Nitrogen fertilizer [2]	150–200
Do	16-percent superphosphate	400
Do	50-percent muriate of potash	200

[1] Prepared by the Rhode Island Agricultural Experiment Station and the Extension Service of the Rhode Island State College.

[2] Nitrogen fertilizers: Nitrate of soda, cyanamid, or Cal-Nitro. (When cyanamid or Cal-Nitro is used, the given quantities may be reduced one-fifth.)

All the soils of this county are acid in reaction, ranging from extremely acid to medium acid. Most farmers recognize the need of lime as an economical method of improving the land and increasing crop yields in general. Lime is used generally, but not so extensively as it should be for optimum yields of most crops. T. E. Odland, head of the Department of Agronomy, Rhode Island State College, gives the following recommendations for the use of lime for various crops on the soils of Rhode Island.

The amount of lime needed for any farm or soil type depends largely on the present condition of the soil and on what crops are to be grown. Light-textured soils can be corrected for acidity with relatively smaller quantities of lime than can the heavier textured soils. After being brought to the right degree of acidity, however, the heavier textured soils maintain this condition longer than the light-textured ones.

For potatoes a pH value of about 5.2 to 5.4 seems to be near optimum, considering yield and freedom from scab. In less acid soils, scab is likely to be serious, and the more acid soils do not yield so well.

For optimum results, clover needs a soil so limed that it has a pH value of 6 or more, and alfalfa does best when the soil acidity is not greater than pH 6.5. Again, the method of cropping and the quantity of manure and fertilizer used have considerable influence. When stable manure is used liberally, both clover and alfalfa can stand greater soil acidity than when little or none is used.

For best results with nearly all market-garden crops, the soils need to be limed so that the reaction is about neutral.

Very few farmers practice definite crop-rotation systems over a period of years, but most farmers recognize that rotation is an essential part of good farming, and some form of rotation is practiced on the better farms. The most common rotation followed, but not strictly adhered to, are as follows: (1) Corn 1 or 2 years, followed by hay and pasture 4 to 6 years; and (2) corn 1 year, potatoes or some other cash crop 1 year, followed by hay from 3 to 6 years. On the strictly market-garden farms, crops are rotated so that the same one is not

grown on the same field too often. A cover crop of rye is usually sown in the fall on the better managed market-garden farms.

The following crop rotations are suggested by the Rhode Island Agricultural Experiment Station:

For dairy farms: (1) Corn for silage 1 or 2 years; potatoes; hay 2, 3, or 4 years; and pasture 1 to 3 years. (2) Corn for silage; hay 2 to 4 years; and pasture 1 to 3 years. Individual farm conditions will necessarily determine the number of years in hay, whether to use tillable land for pasture, and what additional crops to use in the rotation.

For potato farms: (1) Potatoes; clover and grass. (2) Potatoes 2 or 3 years; clover and grass. (3) Potatoes 2 to 5 years; green manures 1 year. The green manures are rye followed by buckwheat, soybeans, or millet, then rye again in the fall. Fall rye should be sown following potatoes every year as a cover crop, unless a meadow mixture has been seeded.

Rotations for vegetable growers are difficult to prescribe. Crops should be rotated so that the same one is not grown on the same land too often. Provision should be made to grow as many green-manure and cover crops of rye, buckwheat, millet, and soybeans as possible in the cropping system.

Rotations for poultry raisers are also difficult to suggest, as most poultry producers carry on this enterprise on comparatively small areas of land and the growing of feed is of minor importance.

Seeding mixtures for hay lands and pastures vary somewhat, depending on the texture, drainage, and acidity of the soil to be seeded. Information on the best seeding mixture for a given soil type may be obtained from the Rhode Island Agricultural Experiment Station or from the county agent.

The crop varieties commonly grown in Providence County are those generally recommended by the Rhode Island Agricultural Experiment Station and the Rhode Island Farm Bureau. Varieties of field crops, market-garden crops, or vegetables, and fruits most commonly grown are as follows:

Field crops.—Corn for grain, Rhode Island White Flint; corn for silage, West Branch Sweepstakes, Improved Leaming, and Eureka; potatoes, Green Mountain (late); Irish Cobbler (early), and Chippewa (intermediate); alfalfa, Grimm or Canadian Variegated; clover, northern-grown seed; rye, Rosen or similar winter varieties; soybeans, Manchu (for hay or silage).

Market-garden crops or vegetables.—Sweet corn, Yellow Bantam, Golden Sunshine, and Golden Cross Bantam; tomatoes, Bonny Best, Pritchard, and Marglobe; cabbage, Copenhagen Market (early), Early Jersey Wakefield, Savoy (late), and Danish Ballhead (late); carrots, Hutchinson, Tendersweet, Red Core Chantenay, and Danvers Half Long; beans, Bountiful, Burpee Stringless Green Pod, Valentine, Tendergreen, Surecrop, and Kentucky Wonder; beets, Crosby Egyptian and Detroit Dark Red; peppers, Worldbeater, Italian Sweet, and Early Giant; spinach, Long Standing and Bloomsdale; squash, Straightneck and Blue Hubbard No. 1.

Fruits.—Apples, McIntosh, Baldwin, Gravenstein, and Rhode Island Greening; peaches, Elberta and Champion; pears, Bartlett; strawberries, Howard 17, Dorsett, and Fairfax; raspberries, Latham, Newburgh, and Taylor; blueberries, Pioneer; grapes, Concord.

Because such a large percentage of the land area of Providence County is better adapted to forestry than to cultivated crops, owing to stoniness, poor drainage, unfavorable relief, low fertility, or a combination of two or more of these factors, it seems that more attention should be given to forestry. Most of this land is in second- or third-growth forest cover or has been cut over recently. Little attention has been or is given to selective cutting, fire prevention,

and control of diseases and insects. The hurricane of September 21, 1938, worked havoc with the forests, uprooting or breaking off many of the trees. This damage greatly increased the fire hazard. A little time and money spent in improving the forest lands might prove more profitable in the future than many other lines of agricultural endeavor.

Much information on crops, fertilizers, crop rotations, and crop varieties can be obtained from bulletins published by the Rhode Island Agricultural Experiment Station. These bulletins are mailed free on request.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of forces of weathering and development acting on the materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and has existed since accumulation, (3) the plant and animal life in and on the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of development have acted on the material. External climate, although important in its effects on soil development, is less so than internal soil climate, which depends not only on temperature, rainfall, and humidity, but on the physical characteristics 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.

Providence County lies within the Brown Podzolic soil region in the northeastern United States, south and east of the true Podzol area of New England. Essentially, the Brown Podzolic soils are imperfectly developed Podzols. A normal mature profile in this region, under forest cover, has an organic mat on the surface from ½ to 3 inches thick, underlain by a thin leached layer. Where present, this leached layer varies from a mere film to about 1 inch in thickness. In many places it is not noticeable; whereas it is best developed in the light-textured soils, because the higher the content of siliceous material the more susceptible the soil is to podzolization. The upper B horizon may be yellowish brown, brown, or reddish brown, becoming lighter in color and texture with depth. In places there is the beginning of a dark-brown orterde just beneath the leached layer or the surface soil. In most places the depth of the solum ranges from 24 to 30 inches.

The physiography of the county consists of a series of rounded hills with gentle to steep slopes and nearly level to gently undulating glacial plains. The elevation ranges from sea level to a maximum of 805 feet above in the western part. The average annual rainfall is about 40 inches. Drainage ranges from excessive to poor.

The soils have developed under a forest cover of mixed hardwoods and conifers consisting mainly of white, red, black, scarlet, and chestnut oaks, chestnut, white and pitch pines, redcedar, swamp white-cedar, hickory, beech, birch, maple, elm, hemlock, and walnut. All the original forest growth has been removed, and the present forest consists of second- and third-growth trees of the original species. The distribution of the trees is correlated to some extent with drainage conditions, texture, and depth of soil. Both the humid climate and

the soils over most of the area favor rapid growth of vegetation, and raw humus has accumulated to some extent on the surface of virgin land or even on land once cultivated but now abandoned and reverting to forest. The quantity of leafmold and organic matter accumulated on the surface is correlated in a general way with the degree of drainage. On the poorly drained or imperfectly drained soils, conditions are most favorable for a rapid growth of dense vegetation. and in such places the layer of leafmold is thickest. On the light sandy soils the accumulation of organic matter is small because of low fertility, droughtiness, and the consequent sparse or stunted vegetation.

Climatic conditions under which the soils developed were such that the ground was frozen or covered with snow several months during the year, thereby preventing leaching; but rainfall was sufficient during the rest of the year to accomplish some leaching. The summers are sufficiently warm to allow some disintegration and leaching of the organic matter on the surface. This is more rapid on the light sandy soils than on the heavier textured soils. Most of the cultivated soils are deficient in organic matter and could be improved both physically and chemically by the addition of organic matter in the form of barnyard manure and green-manure crops.

Providence County lies within the glaciated region of North America, and the materials from which the soils have developed through the soil-forming processes have been accumulated largely through glacial action and deposited as till by the receding glacier or as outwash material from the melting glacier. The mantle of glacial till varies in thickness, and on the rough and very stony areas the soils have been influenced to some extent by residual material of the shallow bedrock or rock outcrops. The outwash materials from which the soils on the outwash plains have developed are, in general, rather coarse and assorted. At the time of deposition the till was little altered mineralogically, whereas the outwash material was altered considerably by the loss of fine materials and minerals. Soils developed from recent alluvial materials are of small extent.

As much of the glacial material has been transported only a short distance, the underlying rock formations play an important part in the distribution of the parent material from which the soils have developed. Soils developed from glacial drift composed largely of granitic materials have given rise to the Gloucester, Narragansett, Scituate, and Whitman soils. These soils cover approximately two-thirds of the county. The Charlton and Hollis soils have developed largely from till composed of schist, granite, gneiss, and other rock materials. The Newport soils have developed largely from shales, schist, conglomerates, and sandstone, and the Cheshire soils from pink sandstone and other materials. Soils developed from glacial drift composed largely of conglomerate and sandstone have given rise to the Tiverton and Attleboro soils.

As has been stated previously, all the soils are acid. In general, the Gloucester soils are the most acid soils of the well-drained groups and the Newport soils the least acid. Of the poorly drained soils, the Mansfield soils are less acid than the Whitman or Scarboro.

Table 9 gives the pH values of a number of soils in Providence County.

TABLE 9.—*pH determinations on a number of soils from Providence County, R. I.*[1]

Soil type and sample No.	Depth	pH
Scituate loam:	*Inches*	
140401	1½- 1	4.7
140402	1 - 0	4.3
140403	0 - 1	4.0
140404	1 - 2	4.2
140405	2 - 8	4.6
140406	8 - 23	4.6
140407	23 - 48	4.9
Cheshire stony loam:		
140408	¼- 0	4.5
140409	0 - 7	4.2
140410	7 - 18	4.5
140411	18 - 28	4.8
140412	28 - 50+	5.5
Attleboro stony gravelly loam:		
140413	1 - 0	3.9
140414	0 - 6	4.5
140415	6 - 18	4.7
140416	18 - 30	5.3
140417	30 - 50+	5.4
Hinckley gravelly fine sandy loam:		
140423	1 - 0	4.0
140424	0 - 3½	3.9
140425	3½- 9	4.5
140426	9 - 15	4.7
140427	15 -120	6.0
Merrimac sandy loam:		
140428	½- 0	3.8
140429	0 - 3	3.9
140430	3 - 6	4.2
140431	6 - 17	4.0
140432	17 - 23	4.0
140433	23 - 34	4.3
140434	34 - 56	4.5
140435	56+	5.0
Gloucester stony fine sandy loam:		
140436	1 - 0	3.1
140437	0 - 1½	3.2
140438	1½- 2½	3.6
140439	2½- 19	4.2
140440	19 - 24	3.7
140441	24 - 40	5.3
Hinckley gravelly sandy loam:		
140442	1 - 0	2.9
140443	0 - 2	3.1
140444	2 - 7	3.5
140445	7 - 14	3.6
140446	14 - 27	3.9
140447	27 - 60	3.9
Charlton stony loam:		
140452	1 - 0	3.1
140453	0 - 6	3.2
140454	6 - 14	3.3
140455	14 - 27	3.5
140456	27 - 40+	3.7
Warwick sandy loam:	*Inches*	
140457	¾- 0	3.2
140458	0 - 5	3.4
140459	5 - 12	3.5
140460	12 - 24	4.2
140461	24 - 40	4.3
Merrimac very fine sandy loam:		
140462	0 - 7	4.0
140463	7 - 16	4.7
140464	16 - 31	5.0
140465	31 -120+	5.5
Podunk silt loam:		
140466	0 - 9	5.1
140467	9 - 18	5.4
140468	18 - 23	5.4
140469	23+	6.3
Narragansett stony loam:		
140475	2 - 0	3.9
140476	0 - 5	4.6
140477	5 - 17	4.8
140478	17 - 26	4.9
140479	26 - 48	5.0
Tiverton stony gravelly fine sandy loam:		
140480	1½- 0	4.2
140481	0 - 4	4.5
140482	4 - 18	4.6
140483	18 - 24	4.9
140484	24 - 46+	5.0
Narragansett stony fine sandy loam:		
140485	2 - 0	4.0
140486	0 - 4	4.6
140487	4 - 14	4.7
140488	14 - 25	4.8
140489	25 - 32	5.9
140490	32 - 48	6.4
Charlton stony loam:		
140491	½- 0	4.5
140492	0 - 7	4.8
140493	7 - 15	4.9
140494	15 - 30	4.9
140495	30 - 48	5.3
Scarboro loam:		
140496	3 - 0	4.0
140497	0 - 6	4.3
140498	6 - 15	4.7
140499	15 - 18	4.8
1404100	18 - 26	5.1
Hollis stony loam:		
140448	½- 0	4.2
140449	0 - 6	4.4
140450	6 - 17	4.9
140451	17 - 40	5.0

[1] Determinations made by E. H. Bailey, assistant soil technologist, Division of Soil Survey, by the hydrogen-electrode method.

All the soils are comparatively young, and there is a close correlation between the texture of the parent material and the soil. The light-textured soils in general are derived from light-textured materials. In poorly drained areas little development of a profile has taken place, whereas in the well-drained uplands the soils have reached a fair stage of maturity.

The mechanical analysis of a sample of Gloucester sandy loam from Medway, Mass., which is representative of the Gloucester soils in New England, indicates that there has been little transfer of material within the profile.[13] No significant variations in colloid

[13] BROWN, IRVIN C., and BYERS, HORACE G. CHEMICAL AND PHYSICAL PROPERTIES OF CERTAIN SOILS DEVELOPED FROM GRANITIC MATERIALS IN NEW ENGLAND AND THE PIEDMONT, AND OF THEIR COLLOIDS. U. S. Dept. Agr. Tech. Bul. 609, 56 pp. 1938.

content were observed. The chemical analysis of the same sample, however, indicates that eluviation of iron and alumina has been marked. The silica-sesquioxide ratio of the B_2 horizon is 0.64, and the silica-alumina ratio is 0.79. The Gloucester soils of Massachusetts and Rhode Island are similar, and it is believed that the analysis of a sample from Rhode Island would show the same results.

Following is a description of a profile of Gloucester stony fine sandy loam, as observed in a cut 1 mile east of Georgiaville.

1 to 0 inch, dark-brown organic material.

0 to 1½ inches, brownish-gray loose and friable fine sandy loam. This is a weakly developed Podzol layer and consists of layers of gray fine sand mixed with grayish-brown fine sandy loam.

1½ to 2½ inches, light-brown or brown fine sandy loam, firm in place but friable. This layer has a very soft crumb structure and contains some roots, worm holes, and a small quantity of gritty material and small rock fragments.

2½ to 19 inches, yellow or brownish-yellow loose and friable fine sandy loam containing some roots, worm holes, and a small quantity of small rock fragments and gritty material. Very little structure is evident.

19 to 24 inches, grayish-yellow loose and friable fine sandy loam or sandy loam containing a larger proportion of rock fragments and gritty material than the layer above.

24 to 40 inches +, light-gray or yellowish-gray gritty and gravelly till showing very little or no compaction. This till is composed largely of granitic material, becomes coarser with depth, and contains many boulders and rock fragments. The depth to bedrock varies, but the average depth is about 10 feet.

Areas of Gloucester fine sandy loam are similar in profile characteristics to Gloucester stony fine sandy loam, but most or all of the stones have been removed from the surface.

The Narragansett soils also have developed from glacial till composed largely of granitic material and have profiles somewhat similar to the Gloucester soils. In general the Narragansett soils have developed on smoother relief, the content of finer materials is higher throughout, the color of the surface soil is darker as compared with those features of the Gloucester soils, and the C horizon is compact. The content of organic matter in the surface layer is greater than in the Gloucester soils. The upper part of the B horizon is paler yellow or yellowish brown, and the lower part of the B horizon is darker grayish yellow than the corresponding horizons in the Gloucester soils. The greatest difference between the soils of these two series is in the C horizon. The C horizon of the Narragansett soils, beginning at a depth of 24 to 30 inches, consists of gray or dark-gray firm to compact till. This till varies in compactness and is more compact under the loam soils than under the fine sandy loam soils. In some places the till is uniformly compact; in others it is compact in layers intermixed with layers of loose and friable till. In either instance this layer restricts the downward movement of water to some extent. Locally it is called a hardpan, but it is not impervious to water, and it lacks the hardness and chemical characteristics of a true hardpan. Gray, yellow, and rust-brown mottlings, caused by impeded drainage, are common just above this layer. The mottlings are more pronounced in the loam soils than in the fine sandy loam soils. The relief has influenced the degree of drainage, and this is reflected in the profiles of the different soils. In the loam soils of smooth areas the surface soil is darkest, mottling is more pronounced

in the lower B horizon, and the till is more compact; whereas in the fine sandy loam soils the surface soil is not so dark, the mottlings in the lower B horizon are not so pronounced, and the till is less compact.

The Scituate soils are associated with the Narragansett soils in imperfectly drained positions.

Areas of poorly drained Whitman soils occur throughout the areas of Gloucester and Narragansett soils, in swamplike positions, along drainageways, and around springs. Because of poor drainage, these soils have not been acted on to an appreciable extent by the soil-forming processes, and they are considered young or immature. The Whitman soils have dark-brown or nearly black surface soils over mottled subsoils.

The Charlton soils have developed from glacial till composed largely of schist and to a less extent of granite, gneiss, shale, and other materials. These soils differ from the Gloucester and Narragansett soils in having a browner surface soil and a higher content of finer materials throughout.

Following is a description of Charlton stony loam, level phase, as observed in a wooded area 1 mile north of Lonsdale Station, Cumberland.

1½ to 0 inches, an organic leaf mat, the lower part being partly decomposed.
0 to 6 inches, rich-brown mellow and friable loam, well matted with small roots. The upper part is slightly darker than the lower part, owing to a higher content of organic matter.
6 to 9 inches, reddish-brown mellow and friable loam containing some small roots, worm holes, and organic stains. It has a soft-crumb structure and contains very little gritty material.
9 to 14 inches, yellowish-brown loam having about the same structure as the layer above. It contains a small quantity of small rock fragments and gritty material.
14 to 27 inches, pale yellowish-brown or grayish-brown friable and gritty loam, becoming lighter in color and texture with depth. This layer contains a few small roots, some worm holes, and a considerable quantity of small fragments of rock and gritty material.
27 to 40 inches, gray or greenish-gray loamy till mottled or streaked with brown or yellow. This till is fairly compact, but it breaks down easily when crushed between the fingers. It is composed largely of schist, blue shale, and granitic material.

Scattered over the surface are numerous stones and boulders, and slabs of schist are common on the surface and throughout the solum.

The Hollis soils have developed from the same kind of materials as the Charlton and resemble them in profile characteristics. The Hollis soils, however, are shallow over till or bedrock and are generally very stony, containing numerous rock outcrops.

The Newport, Tiverton, Attleboro, and Cheshire soils occupy small areas. Owing to the differences in the parent material from which they have developed, these soils have slightly different characteristics from those previously discussed and differ from one another in certain characteristics. The Newport soils have developed from till composed largely of shale, with some schist, conglomerate, and sandstone, and the surface and subsoil layers have a green cast in places. The Tiverton and Attleboro soils have developed largely from conglomerate and sandstone and to a less extent from granitic material, shale, and schist. These soils have gravelly surface soils, and the Attleboro soils are uniformly compact and very gravelly in the subsoil layers. The Cheshire

soils have been influenced by pink or red sandstone. This influence is reflected in the red tinge of the subsurface layers, and the underlying material is reddish-gray or pinkish-red partly weathered till.

The poorly drained soils associated with the Charlton, Hollis, Newport, Attleboro, and Tiverton soils are classified as Mansfield. The Mansfield soils are somewhat similar to the Whitman soils in degree of development and profile characteristics, but they are less acid. The surface soil is dark brown or black, mucky in places, and underlain by a mottled subsoil.

On the nearly level to gently undulating outwash plains the Merrimac and Warwick soils are developed from gravelly outwash material. Merrimac fine sandy loam is representative of the outwash soils. Following is a description of a profile of this soil, as observed in a wooded area 1 mile northeast of Sabin Point, East Providence.

1½ to 0 inches, partly decomposed organic leaf litter.
0 to ¼ inch, ashy-gray fine sand. In places the gray layer is absent or very thin.
¼ to 5 inches, rich-brown mellow and friable fine sandy loam, well matted with roots. Decomposed organic matter is fairly high in this layer.
5 to 18 inches, brownish-yellow fine sandy loam, firm in place but mellow and friable, it is slightly heavier than the material in the layer above. This layer contains a small quantity of gritty material and a few roots and root holes and gradually changes to the layer below.
18 to 26 inches, grayish-yellow loose friable and gritty sandy loam containing a small quantity of gravel in the lower part. A few roots and some root and worm holes are noticeable.
26 to 48 inches, gray or yellowish-gray fairly coarse loose and incoherent beds of sand and gravel.

The other Merrimac soils differ from Merrimac fine sandy loam mainly in texture.

Soils of the Warwick series have developed from outwash material, which is predominantly shale, schist, conglomerate, and sandstone. In this respect they differ most from the Merrimac soils. In profile characteristics the soils of the two series with the same texture are very similar. The Warwick soils are slightly darker and probably a little less acid.

Soils developed on the kames associated with the outwash soils are represented by the Hinckley and Quonset series. The Hinckley and Quonset soils are associated with the Merrimac and Warwick soils, respectively.

The Scarboro soils occupy poorly drained areas on the outwash plains. They are characterized by dark-brown surface soils over mottled brown, rust-brown, yellow, and gray subsoils.

The alluvial soils are of recent origin and are considered young. Their present status is due largely to drainage conditions, as the materials from which they have developed are similar in character. The Podunk soils are imperfectly drained, and the alluvial soils, undifferentiated, are poorly drained.

The organic soils, classified as muck and peat and muck and peat, shallow phases, vary in the degree of decomposition and depth. In general these deposits are fairly well decomposed on the surface, but the subsurface layers are mostly in a raw or partly decayed condition.

SUMMARY

Providence County is in the northern part of Rhode Island and comprises a little over one-third of the total area of the State.

Roughly rectangular in shape, it comprises a total area of 426 square miles, or 272,640 acres. The county is divided into two distinct physiographic sections—the Seaboard Lowland around the Narragansett Basin in the southeastern part, and the more hilly New England Upland covering the rest of the county. The elevation ranges from sea level bordering Narragansett Bay to a maximum of 805 feet in the western part.

Originally the vegetation consisted of a dense growth of mixed hardwood and conifer forests, with variations in the dominant species of trees corresponding to differences in drainage conditions and soil texture. The present forest growth consists of second- and third-growth trees of the original species.

The population of Providence County, according to the Federal census, was 550,296 in 1940, of which only 2.7 percent was classed as rural. Providence, with a population of 253,504 in 1940, is the largest city and the principal market for agricultural products. Transportation facilities consist of railroads, steamship lines, and an excellent system of highways.

The climate is humid, being characterized by medium-cold winters and short, warm summers. The mean annual temperature at Providence is about 50° F. The average length of the frost-free season at Providence is 188 days—from April 18 to October 23, inclusive. The average annual precipitation is about 40 inches and is well distributed over the seasons.

The early agriculture in Providence County centered around Narragansett Bay in the southeastern part of the county and gradually spread to other parts. Agriculture advanced fairly rapidly until around 1880, when manufacturing in New England became important and the more fertile and easily tilled lands of the West were opened up.

According to the Federal census of 1940, about 12 percent of the total area of the county was in improved land in 1939, including cropland and plowable pasture. The farms are scattered over most of the county, and the improved land is in comparatively small tracts. The present agriculture consists principally of dairy farming, poultry raising, fruit growing, market gardening, and potato growing, respectively, in order of importance. Less important agricultural enterprises are the growing of small fruits, nursery stock and flowers, and the raising of beef cattle and hogs. Hay and forage crops occupy the largest acreage and are produced mainly in support of dairying. Vegetables, potatoes, and field corn are grown for subsistence and cash.

Providence County lies within the glaciated region of North America, and the materials from which the soils have developed have been accumulated largely through glacial action and deposited as till by the receding glacier or as outwash material from the melting glacier. On the till soils, stoniness is often the limiting factor in their use for cultivated crops. For convenience in discussing the agricultural relationships of the soils, they are placed in seven broad groups based on agricultural use and adaptations, stoniness, physiography, and drainage. The groups are (1) nonstony well-drained soils from till, (2) stony well-drained soils from till, (3) well-drained soils of the outwash plains, (4) soils of the kames, (5) imperfectly and poorly drained soils of the bottom lands, (6) imperfectly and poorly drained

soils of the uplands and outwash plains, and (7) miscellaneous land types.

The nonstony well-drained soils developed from till include those of the Narragansett, Gloucester, Charlton, Newport, Cheshire, Tiverton, and Attleboro series that are free or practically free of surface stone. The Narragansett and Charlton soils are the most extensive, the acreage of the others being comparatively small. Practically the entire acreage of these soils is under cultivation or in orchards, and they form the most important group in the agriculture of the county. In general the relief ranges from nearly level to sloping or rolling, drainage is good but not excessive, and the soils are capable of being built up to and maintained in a fair to good state of productivity.

The stony well-drained soils developed from till include the stony soils of the same series as those in group 1 and other series. The Gloucester soils are by far the most extensive, followed in order by the Narragansett, Hollis, and Charlton soils. The soils of the Newport, Tiverton, Attleboro, and Cheshire series occupy very small acreages. A small part of this land, largely of the better soils, such as Narragansett loam and Charlton loam, has been cleared of trees and is used for hay, pasture, and cultivated crops or is lying idle. The rest is largely in second- or third-growth forests. Because of stoniness and relief, the use of the soils of this group is limited largely to grazing and forestry.

Well-drained soils of the outwash plains are represented by the Merrimac and Warwick series. These soils occur in small areas throughout the county; the relief is level to gently undulating, and drainage is good to excessive, depending on the texture. They are free of stone, easily tilled, and responsive to fertilization. If heavily fertilized, the heavier textured members of the group are productive for general crops, especially vegetables. The lighter textured soils are adapted to vegetables if heavily fertilized and if the moisture supply is sufficient.

The soils of the kames have developed on hummocky, uneven, or sloping land closely associated with the Merrimac and Warwick soils. They are shallow, gravelly, and droughty, and are used largely for grazing or for forestry.

Imperfectly and poorly drained soils of the bottom are classified as Podunk silt loam and alluvial soils, undifferentiated. The Podunk soil is imperfectly drained, and nearly all of it is cleared and used for the production of hay and forage crops or for pasture. Alluvial soils, undifferentiated, are poorly drained and are mostly in forest.

Imperfectly and poorly drained soils of the uplands and outwash plains are largely in forest. A small acreage has been cleared of trees and is used for pasture. When cleared of trees, brush, and weeds, these soils make good grazing lands.

Miscellaneous land types include rough stony land (Gloucester soil material), tidal marsh, coastal beach, made land, and unclassified city land. Rough stony land is adapted to forestry, but the other land types have no agricultural use.

All the soils of the county vary from extremely acid in the surface layers to strongly acid or slightly acid in the subsoil layers.

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