U. S. DEPARTMENT OF AGRICULTURE,

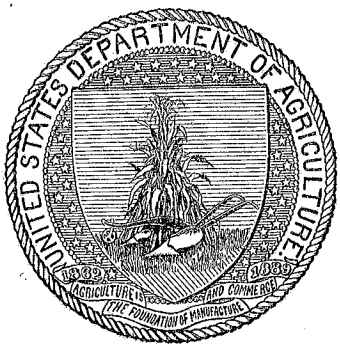
BUREAU OF SOILS—MILTON WHITNEY, Chief.

# SOIL SURVEY OF RHODE ISLAND.

BY

F. E. BONSTEEL AND E. P. CARR.

[Advance Sheets—Field Operations of the Bureau of Soils, 1904.]




WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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# SOIL SURVEY OF RHODE ISLAND.

By F. E. BONSTEEL and E. P. CARR.

## LOCATION AND BOUNDARIES OF THE AREA.

The State of Rhode Island is included between the parallels of 41° 20′ and 42° north latitude and the meridians of 71° 10′ and 71° 50′ west longitude, approximately, with the exception of Block Island, which lies about 10 miles off the coast in the Atlantic Ocean. Rhode Island is one of the thirteen original States, and the smallest in the Union, comprising a land surface of 1,085 square miles, with a coast line of 400 miles. It is bounded on the north and east by Massachusetts, on the south by the Atlantic Ocean, and on the west by Connecticut. Its greatest length is 48 miles, and its greatest width 37 miles.

The State is divided into five counties, consisting of 38 townships, and contains four cities, of which the largest is Providence, the State capital, with a population of 176,000. The other cities are Pawtucket, Woonsocket, and Newport.

## HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Rhode Island was settled in 1636 by Roger Williams, who had been banished from the orthodox Puritan colony of Massachusetts Bay on account of his ardent advocacy of liberty in religious beliefs. He settled at "Providence Plantations," near the present site of Providence, and two years later a band of Antinomians, also banished from Massachusetts Bay, settled at Portsmouth. Newport and Warwick were founded soon after, Newport by a secession from the Portsmouth colony and Warwick by still other dissenters from Puritanism. Each of these four towns was at first independent, and had radical ideas of its individual importance. Quakers and Baptists who had been persecuted and driven from Massachusetts were welcomed at these settlements, so that the earliest colonists of Rhode Island were largely religious freethinkers and dissenters from the rigor of Puritan orthodoxy.

In 1644 Roger Williams secured from Parliament a patent uniting the four towns under one government, but so pronounced was the

feeling of local independence that it was not until 1647 that a common fear of the encroachments of Massachusetts and the danger of multiplying internal revolts made the union effective. In 1663 a charter was obtained from Charles II, which served as a constitution until 1843, when the present State constitution was adopted in order to satisfy a violent public agitation for more liberal suffrage.

Rhode Island was for a long time involved in boundary disputes with Massachusetts and Connecticut, and was viewed with such suspicion by her neighbors on account of her liberal tendencies that she was not allowed to enter the federation of the United Colonies of New England. These boundary disputes were finally settled in 1862.

This State was the last to ratify the Federal Constitution, in 1790, holding aloof as an advocate of States rights, with the country towns arrayed against the maritime cities, which favored ratification.

The early prosperity of the colony was largely due to the friendly policy inaugurated by Roger Williams with the Narragansett Indians, and Indian corn and tobacco soon became prominent agricultural products. Nevertheless a conflict for supremacy between the whites and the Indians became in time inevitable, and the colony was drawn into King Philip's war after enjoying a long period of peace. In the "Great Swamp fight" of 1675 the Indians were utterly crushed in their stronghold near Kingston. There still exists a small Indian reservation in the southern part of the State.

The colonial system of farming attained a considerable development in Rhode Island, especially on the lands near Narragansett Bay. After corn and tobacco, the main crop grown was grass, and dairying was practiced extensively. Rhode Island cheese enjoyed considerable repute in the markets of the West Indies, and even in Europe. Wool was also produced in quantities, and horses were raised for export. The labor at this time was performed by African slaves and Narragansett Indians, who appear to have been quite efficient. Slavery was gradually abolished in the State after 1784. While some of the colonial estates were several miles in extent, the average size of the farms at this time was about 300 acres.

The remarkable progress of manufactures in the State from 1850 to 1900 has resulted in some decline in general farming, the general acreage having decreased 18 per cent during that time, and the acreage of improved land about twice as much. There has also been a considerable decrease in the number of sheep and swine, but significant increases in dairy cows and horses. Much attention has been given in recent years to fruit, and between 1890 and 1900 the number of peach trees increased fourfold, the majority of these being in Providence County. The cultivation of cranberries, strawberries, and other small fruits has also increased.

The most important crop in 1900 was hay, with corn, potatoes, and oats in the order named. Sweet corn and vegetables are also grown for market, and the market-gardening industry promises still further development near the larger markets. The amount of poultry raised throughout the State is exceptionally large, and may be said to constitute a characteristic feature of the system of farming.

The population of the State in 1790 was 68,825, and in 1900, 428,556. In 1729 the provincial legislature divided the province into three counties: Newport, Providence, and Kings (later changed to Washington County); in 1747 Bristol County was incorporated from lands formerly belonging to Massachusetts; and in 1786 Kent County was erected from part of the territory of Washington County.

## CLIMATE.

The following table shows the normal monthly and annual temperature and rainfall for three stations—Bristol, Kingston, and Providence—as compiled from records of the Weather Bureau. It will be noted that Kingston, which represents the south-central part of the State, shows a slightly lower temperature and considerably greater rainfall. Many local variations occur, consequent on elevation and proximity to tidewater.

*Normal monthly and annual temperature and precipitation.*

| Month. | Bristol. | | Kingston. | | Providence. | |
|---|---|---|---|---|---|---|
| | Temperature. | Precipitation. | Temperature. | Precipitation. | Temperature. | Precipitation. |
| | ° *F.* | *Inches.* | ° *F.* | *Inches.* | ° *F.* | *Inches.* |
| January | 29.0 | 4.41 | 27.7 | 5.10 | 28.1 | 4.11 |
| February | 29.7 | 3.94 | 27.9 | 5.30 | 29.1 | 3.84 |
| March | 35.3 | 4.43 | 34.3 | 5.51 | 35.1 | 4.11 |
| April | 45.1 | 3.29 | 44.8 | 4.23 | 47.0 | 3.64 |
| May | 55.6 | 3.32 | 55.0 | 4.57 | 58.2 | 3.75 |
| June | 64.8 | 2.40 | 64.5 | 2.63 | 68.2 | 3.20 |
| July | 69.8 | 3.13 | 69.2 | 3.76 | 73.0 | 3.23 |
| August | 69.3 | 3.68 | 68.6 | 4.10 | 70.8 | 4.16 |
| September | 63.7 | 3.55 | 62.4 | 3.86 | 63.8 | 3.24 |
| October | 52.3 | 4.16 | 50.8 | 5.51 | 52.2 | 3.74 |
| November | 43.8 | 3.97 | 41.1 | 5.08 | 42.6 | 4.19 |
| December | 33.6 | 3.31 | 31.7 | 3.73 | 33.2 | 3.33 |
| Year | 49.3 | 44.09 | 48.2 | 53.38 | 50.1 | 45.04 |

## PHYSIOGRAPHY AND GEOLOGY.

The topography of Rhode Island is of a generally hilly character, which tends to become more mountainous throughout its western interior, the elevations ranging from tide level up to 805 feet on Durfee Hill, the highest point in the State. The waters of Narragansett Bay extend from Long Island Sound northward through

the eastern margin of the area in the form of a rough triangle having its apex at Providence, thus forming an important commercial waterway and constituting, with the islands of the bay, a feature of scenic interest. The region is well watered by numerous small streams, but there are no rivers of any considerable size, the main streams being the Blackstone and Pawtuxet rivers, which drain southeast into the headwaters of Narragansett Bay, and the Pawcatuck River, which drains southwest and empties into Long Island Sound at the southwest corner of the State. These rivers possess no properly defined valley systems, but, as they have considerable fall, with banks abutting throughout most of their course, they are extensively utilized for water-power sites.

Many salt ponds are to be found along the shoreline, while in the interior are scattered small fresh-water lakes characteristic of a glaciated region. There is a limited area of salt-water swamp, while the "Great Swamp," near Kingston, may be cited as an instance of the type of fresh-water swamp which occurs to a noticeable extent in the interior. Sand beaches along the coast have been formed, but only to a small extent.

The State may be divided into two distinct physiographic provinces—the eastern or Narragansett basin area, and the western and more mountainous area of hill remnants from one of the ancient east Appalachian mountain ranges. The Narragansett basin area comprises a field of low hills and glacial plains, which follows, at a distance nowhere greater than 3 miles, the western shoreline of the bay, and including the islands lying therein. It then extends northward from the head of the bay across the northern boundary of the State, and, including the islands and the waters of the bay, comprises about the eastern one-third of the State. The topography consists of smoothly rounded hills of easy slope, not exceeding 250 feet in height, and of level or gently rolling glacial plains, which are especially prominent near the head of the bay.

This province comprises decidedly the best farm lands of the State. The low hills are made up largely of shales, sandstones, and schists, which have been overlain by glacial till, oftentimes of coarser material. The soils, however, show the influence of the underlying finer-grained rocks, and these hills, while frequently stony, give a fairly heavy silty soil, which is the best upland soil for hay and general farming. The level or gently rolling plains of this province are made up of gravel, sands, and loams, which are of glacial deposition and which have been but little affected by river action. Where these glacial plains have a sufficiently loamy texture they afford the main truck soils of the State. Occasional areas of coarse gravel and rounded bowlders in these plains would indicate the action of strong glacial or subglacial currents and the transportation of the materials

for some distance from the interior granitic ridges. The more loamy portions of the plains, free from bowlders, point to easier glacial currents and to the fact that the neighboring hills of shale and sandstone have contributed much of their material.

The bed rocks of this Narragansett basin area consist mostly of stratified conglomerates, sandstones, shales, and coals of Carboniferous deposition. The geological evidence indicates that this basin was an ancient erosion trough formed before the Carboniferous age, in which the Carboniferous deposits accumulated during a period of subsidence and were compressed and tilted by later mountain-building forces. A detailed account of the geology of this area may be found in volume 33 of the monographs of the United States Geological Survey, "The Geology of the Narragansett Basin," by Shaler, Woodworth and Foerste.

The characteristic upland soil type of the basin area is the Miami stony loam, while the Miami silt loam may be called the distinctive plain soil. The Warwick sandy loam is particularly prominent near the head of the bay, and occurs in larger distribution than the Miami silt loam, but it is not confined to the basin area, and is also to be met in the more level portions of the western uplands.

An abrupt escarpment along the western edge of the Narragansett basin separates it from the second or western physiographic province, comprising the more hilly western uplands. While this distinct geological demarcation does not afford, on account of the uniform glaciation to which the entire State was subjected in later times, any absolute boundary in the distribution of the soil types, it will nevertheless be seen to have affected their distribution in a pronounced degree.

This inland or more mountainous area embraces about the western two-thirds of the State. The region consists of rough and stony hills which vary in height from 100 to 800 feet, but which, despite their moderate elevation, frequently present a decidedly mountainous appearance. This series of hills represents at the present time the remnants of an ancient prominent mountain range, which has been subject to long-continued erosion and to repeated glacial attacks. The slopes are generally steep, and in such localities the usual glacial covering is frequently missing, and the igneous bed rock outcrops prominently. Such bare outcrops seem to indicate a local process of glacial abrasion instead of deposition, and distinct bowlder trains are often to be traced from these localities. These slopes and bowlder trains give in consequence very poor agricultural soils. Another feature of these upland hills is the general absence of sharp ridges or summits. After ascending steep slopes it is a common experience to find, instead of a ridge, a level summit plain where the soil covering has been less subject to erosion and has consequently a more

loamy texture. This flattening or leveling of the summits would appear to be an obvious result of the grinding and shaving work of glaciers, and it is by such destructive action that much of the material deposited at lower levels as moraines and eskers has doubtless been obtained. There are no considerable glacial plains in this section, and such as do exist are generally composed of coarser materials than are found in the plains near the bay. The river valleys here, as throughout the State, have no distinctive fluvial character, but appear to have been quite remodified by serving as channels for glacial streams. Instead of alluvial soils, there are to be found along these courses coarse deposits of sand and gravel laid up in abrupt walls or terraces, with but occasional stretches of finer texture. Many small lakes abound in this region, and are generally bordered by the coarser types of soil, such as the Alton stony loam and Norfolk coarse sand, which are characteristic of the more prominent channels of glacial activity. In this section are to be found some considerable areas of fresh-water swamp, which are more prominent in this higher-lying region than in the lower area around the basin. Their existence at such relatively high elevations would seem to point to glacial interference with the natural drainage, analogous to glacial work in the formation of lakes. These swamp areas sometimes border the small glacial lakes, and may be regarded in many cases as incompleted lakes whose depressions serve as catch-basins for the surrounding land drainage. It is noticeable that the largest areas of these swamps occur just behind or to the north of the well-defined terminal moraine near the southern boundary of the State, where the glacial action was strongly marked.

The rocks of this section consist of granite, gneiss, mica, and hornblende schists and sandstones, with some crystalline limestone. They are mostly of great geological age—Archæan, Algonkian, and Cambrian, down to the Carboniferous—and include a complicated variety of igneous intrusions of varying age.

The characteristic upland soil of these western hills is the Gloucester stony loam, which is by far the most widely distributed type in the State. There are also some few areas of Miami stony loam in localities where the extent of weathering or the character of the glacial overlay has produced soils of more loamy texture than the general coarse texture of the Gloucester stony loam. The soil of the terminal moraine along the southern coast also consists largely of Gloucester stony loam, where these same granitic materials have been confusedly heaped along the front of the melting glacier.

It will thus be seen that the entire State has been subject to glacial agencies, and that probably for repeated periods. The till or bowlder-clay covering is not so thick here as in more central regions of glacial activity, being less than 10 feet. These till materials also

contain less than the usual amount of clay, for the reason that this was a marginal district of glacial action, and that therefore the materials composing the till consist here largely of esker and other washed sands and gravels that had already been worked by the ice and had lost their clay content. The trough of the Narragansett basin was a natural point of discharge for these heterogeneous materials. The value of the soils for tillage is therefore uniformly less than in those glacial areas where the ice action has only proceeded so far as to liberate and deposit a sheet of true bowlder clay and where the clay covering so deposited has not again been lost by the repeated wash of glacial currents. The uniformly clayless character of the glacial till has served in this manner to make the soils also rather uniform, except where differences in the underlying bed rock have affected the surface soil.

On account of its geographic isolation, Block Island is given a separate discussion. This island, some 15 square miles in extent, is made up entirely of morainic material, presenting in a typical manner the rough, rolling, irregular topography, and interspersed with numerous miniature fresh-water lakes. The soils on the island, however, are somewhat heavier than those found in the morainic section of the State, north of Long Island Sound, and instead of the Gloucester stony loam the types found are the Alton stony loam and the Miami stony loam. Although many granitic bowlders and other glacial erratics occur, it is possible that the coarser morainic materials have been in this case mixed with, or modified by, the Tertiary coastal-plain deposits of clay and sand which underlie the island at no great depth.

## SOILS.

Eleven soil types were recognized in the soil survey of Rhode Island. The actual and relative extent of each type is shown in the following table:

*Areas of different soils.*

| Soil. | Providence sheet. | Newport sheet. | Total. | Per cent. |
|---|---|---|---|---|
| | *Acres.* | *Acres.* | *Acres.* | |
| Gloucester stony loam | 186,880 | 138,240 | 325,120 | 46.8 |
| Miami stony loam | 58,688 | 91,264 | 149,952 | 21.6 |
| Warwick sandy loam | 61,568 | 21,248 | 82,816 | 11.8 |
| Alton stony loam | 18,496 | 51,456 | 69,952 | 10.1 |
| Swamp | 8,128 | 18,880 | 27,008 | 3.9 |
| Norfolk coarse sand | 22,848 | 3,456 | 26,304 | 3.8 |
| Miami silt loam | ..... | 4,928 | 4,928 | .7 |
| Galveston sandy loam | 512 | 3,712 | 4,224 | .6 |
| Galveston fine sand | ..... | 2,048 | 2,048 | .3 |
| Meadow | 1,280 | 640 | 1,920 | .3 |
| Dunesand | ..... | 128 | 128 | .0 |
| Total | 358,400 | 336,000 | 694,400 | ..... |

MIAMI STONY LOAM.

The soil of the Miami stony loam consists of a mellow brown loam having an average depth of 10 inches, but varying in depth from 8 to 14 inches. The surface is strewn with erratic glacial bowlders, and frequent outcrops of bed rock occur, with a varying amount of gravel and rock fragments through the type. The subsoil is a reddish or yellowish silty and fine sandy loam or loam extending to 3 feet or more in depth, or underlain by bed rock at a less depth than 3 feet. In the cultivated fields the bowlders and as much of the bed rock as possible have been removed and built into massive stone fences. The angular character of the stones in the fences on this type, and the prevalence of rounded stones in the fences on the Alton stony loam, form a noticeable distinction between these two soils. The materials forming the Miami stony loam have no marked structure, but present a mass of fine earth, through which gravel and bowlders are irregularly distributed. At the foot of slopes a deeper and less stony covering has accumulated, while many of the steep slopes are unsuited to tillage because of the thinness of soil covering and the prevalence of rocks. Such areas, wherever practicable, have been indicated on the map by the rock symbol.

The smooth, rolling hills in the Narragansett basin are uniformly covered with this type of soil, and it there reaches its best development of texture and depth. Bordering the basin on the west the underlying rocks are of fine-grained and metamorphosed varieties for a width of from 1 to several miles throughout the length of the State, and the deposits of glacial till over these have given rise to the Miami stony loam. The coarser-grained granites lying outside the basin have so altered the thin covering of glacial till as to produce the inferior Gloucester stony loam type.

The Miami stony loam occurs as smooth rolling hills and tablelands, ranging in elevation from tide level to 500 feet, and presenting diversified topographic features, but as a rule it is less rough and broken than the higher lying Gloucester stony loam, with smoother contours and greater depth of soil covering. The soil is a firm, compact loam, maintaining a sufficient moisture supply during the entire growing season, and with the exception of a few small depressions is adequately drained. Although elevated and rolling it does not appear to suffer to any extent from washing. No large streams originate in this type, but it is crossed by several. Little erosion, however, has taken place since the close of the Glacial epoch.

The Miami stony loam is derived from a deposit of glacial till or ground moraine over the fine-grained rocks of the area, the character of the rock influencing the texture in no small degree. Thus, in the Carboniferous area the subsoil is somewhat heavier than where

quartzite and fine-grained granites form the bed rock. The mineral constituents have undergone considerable mechanical disintegration, but no great amount of chemical decomposition, yet they are in a condition readily subject to chemical disorganization and have been modified by the accumulation and admixture of organic matter from vegetation.

The Miami stony loam is a typical glacial soil, naturally classed as a "general farming" or grass and grain soil, and in this section such is its general use, grass and corn forming the chief crop interests. In the southeastern part of the State potatoes and onions form an important addition to the crops already mentioned. Oak, chestnut, hickory, and ash form the principal timber growth at present, and the largest standing trees are found on this type. Apples and pears do well upon it.

Grass is the principal crop, and the yields average about 1½ tons per acre, while 4 tons is not an uncommon yield for a well-tilled field. Corn is next in importance, and yields an average of about 45 bushels per acre in a fair season. Much higher yields can be produced with careful tillage. Potatoes do well, and are carefully cultivated, giving a high average yield—over 150 bushels per acre—some fields yielding as much as 300 bushels per acre. Onions are an important crop on this type, giving an average yield of 400 bushels per acre. This crop also receives careful attention.

The Miami stony loam is the strongest general soil of the State, and is approached in natural productiveness only by the Miami silt loam. Its stony character and the difficulties of cultivation are the only drawbacks to its more general culture and improvement.

The following table gives mechanical analyses of typical samples of the fine earth of soil and subsoil of the Miami stony loam:

*Mechanical analyses of Miami stony loam.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11688 | Portsmouth | Brown loam, 0 to 11 inches. | 1.9 | 4.4 | 2.7 | 12.5 | 24.1 | 41.3 | 12.6 |
| 11690 | Fox Hill | Brown loam, 0 to 10 inches. | 1.2 | 3.4 | 2.8 | 14.0 | 19.0 | 46.1 | 13.6 |
| 11691 | Subsoil of 11690 | Yellow loam, 10 to 36 inches. | 3.6 | 8.8 | 5.6 | 16.5 | 18.6 | 37.4 | 9.0 |
| 11689 | Subsoil of 11688 | Yellow loam, 11 to 36 inches. | 4.3 | 8.3 | 5.5 | 15.8 | 17.7 | 34.6 | 13.8 |

GLOUCESTER STONY LOAM.

The soil of the Gloucester stony loam is a light-brown sandy loam, usually containing a varying amount of fine gravel up to 5 or 10 per cent, and having an average depth of about 10 inches, underlain by a more sandy and gravelly subsoil of gray color. The subsoil is uniformly a mass of rock fragments, or may be entirely lacking, the thin surface soil resting on bed rock. From 20 to 80 per cent of bowlders and projecting bed rock is present on the surface and through the type, these rocks being for the most part angular and of coarsely crystalline structure, though a few rounded glacial erratics occur. A better phase of this type is sometimes developed in level areas and at the foot of slopes where the soil has accumulated to a greater depth and is more silty and loamy in character. In some small areas where the glacial covering is deeper it becomes quite heavy and approaches the Miami stony loam in character; otherwise it is very uniform throughout its large extent. It is covered with a stunted growth of chestnut, oak, white birch, and undergrowth. Not over 5 per cent is cleared, and but little is under cultivation.

This is the most extensive and widely distributed type of the area, occurring principally in the western half of the State and extending into Connecticut and Massachusetts. Another large area is found in the southeastern part, below Fall River.

In elevation the type ranges from tide level on the southern boundary to nearly 800 feet above at the northwestern limits of the survey, and presents a rough, broken topography, almost mountainous in character, although evidently much subdued by the glacial action so noticeable in the truncated tops and lenticular forms of the hills and narrow, groovelike valleys. From its steep position and the loose, open character of the subsoil the type is thoroughly drained, and the pastures are likely to suffer from drought in dry seasons.

The Gloucester stony loam is derived mainly from the immediately underlying rock, and only to a slight extent from glacial deposit. Over a large part of the area these rocks are of coarsely crystalline structure, and have broken down by mechanical processes of weathering, with little chemical decomposition, furnishing the source of the fine gravel so characteristic of the type, as well as of the finer materials. The overriding of this area by the ice in Glacial time must have removed a large amount of material, but little of the débris was left behind, and the present soil is loose, porous, and unproductive. This type is in part residual and in part glacial in origin, but its materials have in no case been transported any great distance, and the soil bears a distinct relation to the underlying or adjacent rock from which it has been mechanically derived.

So little of the type is cleared and under cultivation that it is difficult to form an idea of its productive capacity. The cleared

fields are used largely for pasture and furnish rather uncertain grazing, being easily affected by drought. A very small acreage is planted to corn and potatoes, of which only light yields are obtained. The heavier phase of the type at the foot of some slopes is well suited to general farming, being only slightly less productive than the Miami stony loam.

Fully nine-tenths of the Gloucester stony loam is too rough and rocky for profitable tillage and seems to be best suited to forestry, or, in some places, to orcharding. The firewood obtained from the scant growth of chestnut, oak, and white birch furnishes the sole source of profit from large tracts of this soil. Under an intelligent system of cutting and thinning these woodlots would afford a continued and increasing source of profit. A few small peach and apple orchards were observed, which gave indication that both these fruits might be successfully grown in favorable situations. Poultry raising can be profitably carried on within reasonable distances to market or shipping point, and sheep raising would be feasible on many pastures not so well suited to cattle. Berries should do well, but none were observed under cultivation. Blackberries and huckleberries grow wild in profusion.

The following table gives mechanical analyses of fine earth of typical samples of the Gloucester stony loam:

*Mechanical analyses of Gloucester stony loam.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11684 | Pascoag | Brown loam, 0 to 10 inches. | 3.8 | 6.1 | 4.2 | 20.2 | 18.7 | 41.7 | 4.8 |
| 11679 | Bliss Corners | Red loam, 0 to 9 inches | 4.6 | 6.4 | 3.9 | 19.5 | 23.0 | 36.3 | 5.9 |
| 11677 | 3½ miles SE. of Niantic. | Medium sandy loam, 0 to 10 inches. | 7.1 | 15.5 | 8.0 | 25.8 | 16.4 | 19.8 | 6.9 |
| 11685 | Subsoil of 11684 | Sand and gravel, 10 to 36 inches. | 7.9 | 10.2 | 5.5 | 22.0 | 17.6 | 34.6 | 1.7 |
| 11678 | Subsoil of 11677 | Coarse sandy loam, 10 to 36 inches. | 11.5 | 19.3 | 10.7 | 26.7 | 15.8 | 13.8 | 2.6 |
| 11680 | Subsoil of 11679 | Sand and fine gravel, 9 to 36 inches. | 4.8 | 8.6 | 5.1 | 21.7 | 22.2 | 35.2 | 2.1 |

## MIAMI SILT LOAM.

The soil of the Miami silt loam, to an average depth of 10 inches, is a brown silty loam containing a relatively small quantity of fine and very fine sand, which render it mellow and friable. The surface

compacts when wet, but does not bake on drying. The subsoil, to an average depth of 32 inches, is a uniform plastic yellow silt loam, becoming more sandy in the last few inches, and resting on a substratum of coarse sand and gravel below 32 inches. The whole type is free from stones and gravel except for a few glacial erratics and rounded bowlders scattered on the surface. Most of these have been picked off the fields and built into fences or crushed for road material.

This type is found principally in the Kingston plain, where it presents a level surface, and near Peacedale, where it occurs as gently undulating hillocks and as a level table-land. Its range in elevation is slight, and the type as a whole is best described as level and unbroken.

Underdrainage is generally good, from the coarse and porous nature of the materials underlying the subsoil at no great depth, but the surface is usually so level and the soil so compact that water stands on the surface after heavy rains, and remains late in the spring after the melting of the snow. Areas sufficiently inclined to permit drainage, of course, do not suffer from standing water. The texture and structure of the soil and subsoil are such that they are capable of maintaining a sufficient moisture supply for the entire growing season; yet they are not so impervious as to impede the capillary movement of soil moisture, as do the heavy clays. The type therefore falls within the lighter class of desirable grass and grain producing soils, and is also adapted to a wide range of heavy truck and canning crops.

The Miami silt loam is derived from reworked glacial material laid down as a sediment from quiet water under uniform conditions. These sediments form a superficial layer rarely more than 3 feet in depth over the coarser water-deposited materials of the plain. The predominance of silt in such a localized area in only one of the plains would point to the Miami stony loam, which occupies large surrounding areas, as the probable source of the materials. The pale color of the subsoil indicates the low state of oxidation of the iron salts, while the brown color and mellow texture of the soil indicate that it has been derived from the subsoil by direct weathering and the incorporation of organic remains.

It is rather strange that such an easily tilled and responsive soil should not be more completely under cultivation, but many acres of this desirable land are allowed to grow up in brush and rank weeds. The experimental fields of the State experiment station are located on this type, and the results of its admirable work are therefore more directly applicable to this soil than to any of the others represented in the State. The yields of hay from these fields have averaged in recent years fully 4 tons per acre, and occasional yields have

amounted to 6¼ tons per acre, showing the possibilities of this soil for this crop. The latter yield consisted of timothy, clover, and redtop, but the average yield quoted refers to timothy associated with some redtop. The yield per acre of shelled corn ranges from 60 to 75 bushels on the experiment farm, and an occasional yield has gone above 90 bushels, while the yield of Indian corn stover ranges from a little less than 3 tons to nearly 3½ tons per acre. Of the other important crops, potatoes have yielded from 250 to 380 bushels per acre, while the onion crop this season (1904) amounted to 423 bushels per acre. Under intelligent cultivation a wide variety of vegetables can be grown with profit on this type. It is well suited to apples and other fruits, and with the Miami stony loam ranks as one of the best general-purpose soils of the State.

The following table gives mechanical analyses of typical samples of this soil:

*Mechanical analyses of Miami silt loam.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11700 | 1 mile SE. of Kingston. | Brown silty loam, 0 to 10 inches. | 2.1 | 6.7 | 4.2 | 9.5 | 12.5 | 53.8 | 11.2 |
| 11698 | ½ mile E. of Slocum.. | Brown silty loam, 0 to 11 inches. | .6 | 1.9 | 1.1 | 2.2 | 13.4 | 64.9 | 15.3 |
| 11699 | Subsoil of 11698 ..... | Yellow silty loam, 11 to 36 inches. | .7 | 1.6 | .5 | 1.2 | 8.3 | 82.9 | 4.7 |
| 11701 | Subsoil of 11700 ..... | Yellow silty loam, 10 to 36 inches. | 1.5 | 5.4 | 2.9 | 6.6 | 13.7 | 62.6 | 7.3 |

ALTON STONY LOAM.

The soil of the Alton stony loam, to an average depth of 8 inches, is a brown or gray loose sandy loam, containing widely varying amounts of gravel and rounded bowlders up to 1 foot in diameter. Small local areas are free from bowlders on the surface and in the soil. The subsoil, to a depth of more than 3 feet, is a gray or yellow, sometimes slightly loamy sand and gravel, containing as much as 70 per cent of rounded, roughly stratified bowlders and large gravel, forming a very thoroughly drained and unretentive stratum, which is often underlain at about 10 feet by cross-bedded medium and fine sands of gray or yellow color extending to the bed of the formation.

Large areas of this type occur along Wood River, Big River, the upper Pawtuxet River and its tributaries, the Chepachet River, along

the Blackstone River, around Woonsocket, and bordering many of the upland ponds. But little is found east of Narragansett Bay.

The topography of the type exhibits terrace remnants along the walls of the larger stream valleys, presenting flat tops and abrupt slopes from which the soil covering has been eroded; also rounded hillocks and broken ridges characteristically marked by glacial kettle-holes. This latter class of surface features is more general in the areas surrounding upland ponds, and there also the soil covering is usually thinner and the slopes often devoid of vegetation. In elevation it ranges from tide level to nearly the highest points, being exceeded only by the Gloucester stony loam and the Miami stony loam of the upland soils, but the range of elevation in any one location is slight, particularly where it occurs as a terrace remnant. The physical texture and structure of the whole type naturally favor rapid percolation of meteoric waters, and the subsoil is incapable of maintaining a sufficient amount of soil moisture to meet the needs of most crops. The level terrace areas and depressions in the rough areas of the type receive the wash from the adjacent slopes and the drainage from higher lands, and are capable of producing a fair crop in ordinary seasons, but are quick to suffer from droughty conditions. Practically none is in need of artificial drainage. The large streams which traverse the type have eroded comparatively narrow channels, in which small areas of more recent alluvial soil occur. The hilly areas have been modified but little since their disposition by stream erosion.

The Alton stony loam has been derived from a residual weathering of coarse and roughly sorted sediments deposited by glacial lakes and streams immediately following the close of that epoch, and in part from morainic material. The rather sharp line of demarcation between soil and subsoil indicates a final subsidence of more silty material. The soil itself, if of sufficient depth and not so completely drained by the porous underlying strata, would form a naturally productive soil. The materials of this type, being largely siliceous, have undergone little change through weathering except on the surface, where the decay of vegetation has modified their texture in no small degree.

The natural growth on the Alton stony loam consists of wild grass,[a] pitch pine, cedars, white birch, and some scrub oak and chestnut, together with a dense undergrowth. It is not so generally covered with pitch pine and wild grass as the Norfolk coarse sand, but

[a] The wild or beard grass mentioned as natural growth on this type and the Norfolk coarse sand is *Andropogon scoparius* Mx, and much resembles the broomsedge so common farther south. It is considered by Professor Wheeler as a particularly characteristic indication of acid soil in this vicinity. (R. I. Agr. Exp. Sta. Rep., 1895, p. 240.)

next to that type it seems best adapted to that growth. It is perhaps best suited to truck and some canning crops, and to corn on the heavier areas, but what little is under cultivation brings poor and uncertain returns. Peaches might prove successful.

Pasturage occupies most of the cleared portions of the type, and is fairly good in the early part of the season, but soon fails from lack of moisture. Corn is grown to some extent and yields up to 30 or 40 bushels on the best fields, though few reach this yield. Potatoes do well and are said to be more than ordinarily free from disease, but few are grown. Where favorably situated in regard to markets the early garden vegetables might well be grown and the soil improved through more intensive methods.

The following table gives mechanical analyses of fine earth of typical samples of the Alton stony loam:

*Mechanical analyses of Alton stony loam.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11669 | Locustville | Sandy and gravelly loam, 0 to 8 inches. | 6.9 | 18.5 | 11.3 | 33.2 | 8.3 | 16.5 | 4.8 |
| 11671 | 2 miles S. of East Greenwich. | Sandy loam and gravel, 0 to 9 inches. | 5.5 | 13.1 | 9.9 | 25.5 | 14.2 | 23.9 | 7.6 |
| 11670 | Subsoil of 11669 | Sand and gravel, 8 to 36 inches. | 12.6 | 22.8 | 13.1 | 31.9 | 7.0 | 9.0 | 3.0 |
| 11672 | Subsoil of 11671 | Sand and gravel, 9 to 36 inches. | 13.7 | 17.9 | 7.7 | 22.6 | 13.6 | 20.1 | 4.4 |

WARWICK SANDY LOAM.

The soil of the Warwick sandy loam, to an average depth of 10 inches, is a mellow brown sandy loam, usually containing some fine gravel. The sand content is of all grades and evenly distributed through the soil mass. The soil is free from stones and large gravel, and is warm, early, and easily tilled. The subsoil, to depths greater than 3 feet, consists usually of a few inches of loose sandy loam of yellow color, quickly grading into coarse, loose sand and fine gravel similar to the materials of the Norfolk coarse sand. Occasional areas occur having a subsoil identical with that of the Alton stony loam, and the type was undoubtedly formed from a thin layer of finer sediments deposited over these earlier coarse materials, which, when exposed, give rise to the last mentioned types. Usually where the subsoil consists of the coarse materials similar to the Alton stony

loam subsoil the soil covering is thinner, ranging from 6 to 8 inches in depth, and more or less mingled with large, rounded gravel and occasional stones. This gravelly phase has been separated on the map from the more typical gravel-free areas, although little difference was observed in its crop-yielding capacity. This phase represents a transition between the conditions which gave rise to the Alton stony loam and those which formed the typical Warwick sandy loam. It occurs mainly as terrace remnants in narrow bands along the principal stream valleys, and having a higher general elevation, and because of its gravel content, ranging from 5 to 20 per cent of the soil mass, it is more thoroughly drained than the bulk of the main type, and is a slightly warmer and earlier soil, less well adapted to grass, but more favorable to the production of fruit and earlier truck crops. In other respects the general description of Warwick sandy loam applies with equal force to this phase.

Large, uniform areas of the Warwick sandy loam occur in the glacial plains of the Narragansett basin around the head of the bay, while smaller areas are widely distributed in the valleys and plains throughout the State. The surface features are level and unbroken, except by gentle undulations, and the elevation is usually low, part of the type occurring as stream bottoms, especially along the rivers and larger streams.

From the mellow character of the soil and the loose and porous nature of the subsoil, drainage is thorough and adequate, notwithstanding the level surface presented by the greater part of this type. It rarely suffers from drought, however, because of its low elevation and the proximity of the water table. Underdrainage is seldom required to remove surplus water, and grass and grain crops yield better than on soils of similar texture at higher elevation. Its position, therefore, as well as its texture and structure, places it among the lightest of desirable grass and grain soils.

The Warwick sandy loam is derived from a thin layer of recent sediments deposited over the coarser alluvial materials which were laid down in outwash plains and stream terraces at the close of the Glacial epoch. It has been much modified at the surface by weathering and cultivation, the rich brown color of the soil being due to the incorporation of organic matter. The subsoil gives little evidence of change since its deposition. The line of demarcation between soil and subsoil in this type is very sharp.

Crop interests are divided between grass, grain, and other general farming crops and the trucking and market-gardening interests which center around Providence. In yields of the former class it is only slightly below the two Miami types of the area, averaging nearly 1½

tons of hay per acre, with occasional yields of over 3 tons. About 40 bushels of corn per acre is the average yield of that grain. It excels the other soils of the locality in the production of heavy truck or market-garden crops, of which a great variety is grown. It is especially suited to those not required for the earliest marketing. Small fruits are well suited to it, and the more gravelly phases produce large yields of potatoes. Its level surface, freedom from large stones, ease of tillage, and ready response to the addition of fertilizing agents make it a highly esteemed, desirable soil, and much of it has been brought to a good state of cultivation, but little remaining uncleared. Heavy applications of lime are required to realize the best yields, and more attention should be given to crop rotation.

The following table gives mechanical analyses of fine earth of typical samples of this soil:

*Mechanical analyses of Warwick sandy loam.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11712 | 1 mile E. of Pawtucket. | Sandy loam, 0 to 10 inches. | 7.7 | 15.9 | 12.1 | 18.8 | 11.9 | 23.3 | 10.0 |
| 11710 | Hillsgrove | Brown sandy loam, 0 to 11 inches. | 8.3 | 13.4 | 10.2 | 19.0 | 13.5 | 22.4 | 12.9 |
| 11711 | Subsoil of 11710 | Sand and gravel, 11 to 36 inches. | 15.5 | 18.7 | 14.6 | 18.8 | 11.1 | 15.2 | 6.0 |
| 11713 | Subsoil of 11712 | Sand and gravel, 10 to 36 inches. | 12.2 | 18.3 | 13.6 | 17.0 | 11.2 | 20.8 | 6.3 |

NORFOLK COARSE SAND.

The soil of the Norfolk coarse sand is a light-brown or yellowish sand of coarse to medium texture, containing more or less fine gravel, and varying in depth from 4 to 10 inches, with an average of about 6 inches. It is loose and porous in structure, is inclined to wash on slopes, and where bare of vegetation often shifts with the wind. The cultivated areas are more loamy on the immediate surface from the incorporation of vegetable matter. The subsoil to an indefinite depth is a uniform yellow or orange sand, of coarse, medium, and fine grades, and mixed with fine gravel much like the soil, but is usually more porous and unretentive, with a more uniform gravel content. It is occasionally underlain below 3 feet by the same materials as

constitute the Alton stony loam subsoil or by cross-bedded medium and fine sands.

The principal areas of this type are found around the head of Narragansett Bay, in the vicinity of Providence; near Slatersville, in the northern part of the State; around Flat River Reservoir, and along Wood River, near Woodville. Much of the area in and around Providence has been altered by grading and filling and by intensive trucking and market-garden operations. The other areas are for the most part uncultivated.

The characteristic surface features of this type consist of level plains, long, narrow ridges, undulating hillocks, and steep valley walls, where these coarse sediments outcrop from underneath finer-textured overlying types. It occurs at different elevations from tide level to 500 feet, but most of it lies below 100 feet, and the range in each individual area is slight. From the coarse and porous nature of the materials this is naturally a thoroughly drained, dry, early soil, incapable of retaining more than a slight amount of moisture, and requiring no artificial drainage.

The Norfolk coarse sand is derived from the coarser sediments of the glacial outwash plains, and in general has been but slightly modified by subsequent weathering, being mainly siliceous and traceable in origin largely to the coarse-grained granites, the prevailing bed rock over the western half of the State.

The natural growth consists of scrubby pitch pines and wild or beard grass, which are very characteristic of the type in its untilled condition. This is a thin and naturally unproductive soil, and, though fairly well suited to some of the early truck crops in more southern latitudes, it is not so well adapted here because of climatic conditions. Peaches might do well where the water table is not too far below the surface, and melons are perhaps best adapted to this type of any of the market-garden crops. It is not suited to any of the cultivated grasses or small grains. Rhubarb, spinach, dandelions, celery, and other garden crops are grown on some of the low-lying areas near Providence, which do not part with their moisture so readily. Partial irrigation and heavy applications of coarse organic manures are used to secure good results even on the best of the type, with the result that the surface soil has been modified. Elsewhere little or none of the type is under cultivation, and no yields can be given in comparison with those of other soils of the State. Irrigation will be generally necessary to secure adequate returns, and in many cases is entirely feasible.

The following table gives the mechanical analyses of typical samples of this soil:

*Mechanical analyses of Norfolk coarse sand.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11706 | Pawtuxet | Sand and gravel, 0 to 8 inches. | 9.0 | 12.0 | 15.7 | 39.0 | 14.7 | 7.4 | 1.7 |
| 11704 | 1 mile N. of Woodville. | Sand and gravel, 0 to 8 inches. | 4.7 | 27.1 | 23.0 | 35.0 | 4.9 | 1.5 | 3.3 |
| 11705 | Subsoil of 11704 | Sand and gravel, 8 to 36 inches. | 4.8 | 32.0 | 26.7 | 31.7 | 3.1 | .3 | 1.4 |
| 11707 | Subsoil of 11706 | Sand and gravel, 8 to 36 inches. | 6.7 | 12.3 | 14.0 | 44.1 | 15.2 | 5.9 | 1.5 |

GALVESTON FINE SAND.

Galveston fine sand is the name given to the familiar beach sands of the coast. The soil, to an average depth of 12 inches, consists of loose, incoherent sand of medium to fine texture, light gray in color, and containing varying amounts of shell fragments. The subsoil, to a depth of more than 3 feet, is of the same nature as the soil, but is often darker in color, containing more moisture and a greater percentage of shell fragments. The subsoil is often marked by thin bands of dark hornblendic material, roughly stratified.

This type occupies a narrow, nearly continuous strip along the seacoast from Watch Hill to Point Judith and forms small detached areas on the shores and island coasts in the lower part of Narragansett Bay.

Within reach of the waves and tides this type presents a smooth, hard surface, inclined toward the water and saturated with salt water. Beyond the reach of tides it rises in loose, irregular hillocks to a height of 30 feet. In the former position it is saturated, but in the latter it is almost completely drained and is capable of holding only an insignificant amount of moisture.

The Galveston fine sand consists of finely ground rock fragments of marine origin, and owes its formation to the action of waves and tides, modified by wind action at the higher elevations. These materials are of recent deposition and are still subject to frequent change. In character they are mainly siliceous, but are occasionally micaceous, depending on the character of rock from which they have been derived. This type is saturated with salt, and in its present condi-

tion is unsuited to agricultural purposes. It supports a scant growth of salt grasses and stunted shrubs, and in some cases it is desirable to extend the areas of this growth in order to bind the shifting surface and prevent the encroachment of these barren sands on more desirable adjacent soils.

The smooth beaches are of great value for recreation purposes, and command a higher price than much of the tillable land.

The following table gives mechanical analyses of typical samples of the soil and subsoil of the Galveston fine sand:

*Mechanical analyses of Galveston fine sand.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11687 | Quonochontaug Beach. | Gray fine sand, 0 to 36 inches. | 0.0 | 1.5 | 13.0 | 84.2 | 1.0 | 0.0 | 0.1 |
| 11686 | Narragansett Pier .. | .....do..... | .1 | 2.6 | 11.1 | 84.7 | 1.2 | .0 | .2 |

GALVESTON SANDY LOAM.

The surface soil of the Galveston sandy loam consists of a mass of salt-grass roots and turf mixed with sandy loam, having a depth of from 8 to 12 inches and varying in color from dark brown to black. It is underlain by a lighter colored subsoil of gravelly sandy loam.

This type represents the tide marshes of the area, and occurs adjacent to the Galveston fine sand and bordering the salt ponds inclosed by the barrier beaches. It is of small extent or importance and is confined to the southern part of the State.

The surface is level, and has a very limited range in elevation. Frequently the surface is much cut up by channels and waterways. Drainage is lacking, and can be accomplished only by diking to exclude the salt water. Although when reclaimed this type should furnish a more easily tilled soil than the Galveston clay occupying a similar position in other areas, it is doubtful if the expense would be warranted, owing to its limited occurrence in the area.

The Galveston sandy loam is the result of the mingling of the sands washed and blown over from the beaches, with the finer sediments deposited on the tidal flats, and of the subsequent growth and partial decay of the salt grasses which form the present surface. It affords a firmer surface than the Galveston clay of other areas, and

the coarse hay it produces is therefore more accessible, although the yields are much lighter, being about 1 ton to the acre on the average. No other crops are grown, and the type is of little interest or value.

The following table shows mechanical analyses of typical samples of this soil:

*Mechanical analyses of Galveston sandy loam.*

| No. | Locality. | Description. | Fine gravel, 2 to 1 mm. | Coarse sand, 1 to 0.5 mm. | Medium sand, 0.5 to 0.25 mm. | Fine sand, 0.25 to 0.1 mm. | Very fine sand, 0.1 to 0.05 mm. | Silt, 0.05 to 0.005 mm. | Clay, 0.005 to 0 mm. |
|---|---|---|---|---|---|---|---|---|---|
| | | | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* | *P. ct.* |
| 11401 | 2 miles N. of Narragansett Pier. | Dark-colored sandy loam, 0 to 12 inches. | 2.8 | 12.2 | 7.7 | 16.6 | 16.4 | 32.9 | 11.3 |
| 11402 | Subsoil of 11401 | Gray sandy loam, 12 to 28 inches. | 2.6 | 10.7 | 7.0 | 19.0 | 19.8 | 33.3 | 7.6 |

DUNESAND.

Three small areas of drifting sand occur in the State. They are of no agricultural importance and not of sufficient size to be a menace to adjacent lands. These dunes are composed of fine sand to a depth of more than 3 feet, and are so loose and unretentive of moisture that they support no vegetable growth.

MEADOW.

In this report Meadow is used to designate those low-lying, poorly drained lands along streams and in depressions. These areas are usually subject to overflow, and present a variable texture, which has less apparent influence on crop values than usual, owing to moisture conditions. The areas of Meadow are flat and narrow, partaking of the character of the surrounding types in which they occur. They are generally adapted to grass crops and pasturage, and are quite distinct from the areas of true Swamp. The slight extent of this type throughout the area renders further discussion unnecessary.

SWAMP.

Swamp has been used in this area to designate those lands totally or in greater part submerged and therefore unfit for tillage, to which no definite texture could be ascribed. A large part of the Swamp area is used to a greater or less extent as a source of water supply for mills, the surplus of rainy seasons being stored there for use in periods of drought. Until this practice is abandoned it will

not be possible to reclaim any large portion of these soils to agricultural uses. Part of the Swamp area consists of bogs which do not serve as reservoirs, and are therefore capable of improvement. In many instances these could be readily drained by means of inexpensive ditches. Around the margins there is usually a belt where organic matter has not accumulated to any great depth; and this belt, after drainage, would form tillable fields of good quality, well adapted to market gardening and a variety of special crops. Where the peaty matter has accumulated to a considerable depth it would be difficult to bring it into condition for ordinary tillage, and such areas would be best suited to cranberries, which are at present cultivated only to a limited extent in this State.

## AGRICULTURAL METHODS.

The agricultural methods employed in this section do not differ materially from the commonly accepted practices in similar latitudes, but are adapted to suit that line of general farming where corn is the main cereal and hay the chief farm product.

Plowing is carried to a good depth and is done mostly in the spring season, although fall plowing is practiced to some extent, and should become more general in connection with some cover crop as a soil improver.

There seems to be no well-arranged or well-adhered to system of crop rotation, but in a general way it may be said that grass land, after plowing, is planted first to corn, then to potatoes, or to potatoes first and then to corn, with an occasional crop of oats or rye; and then it is seeded to grass and allowed to remain in grass for an indefinite number of years. In those cases where intensive market gardening is carried on, with applications of large amounts of manure and other fertilizing agents, the rotation is of course much shorter and may embrace in one year a succession of several garden crops. These truck farms, being near the cities, are readily and cheaply supplied with manure from the city stables, in some cases even using it by whole train loads; but the use of manure in general farming throughout the State is not great, and is inadequate to maintain the land in its best yielding condition. A considerable waste of manure from negligent exposure to the weather was observed throughout the area.

The common use of menhaden fish scrap and seaweed on lands adjacent to the coast may be said to be characteristic of the section, and these fertilizers are highly esteemed for corn. The amount of seaweed that will accumulate on shore after a hard blow is often surprisingly large, and the shore rights for its use are carefully regulated.

Canadian unleached hardwood ashes are much used as a source of potash and lime, and through the persistent efforts of the State

experiment station the use of lime as a corrective of soil acidity is being made a general practice. It has been shown that nearly all soils in the State are in an acid condition.

On account of the moderate size of the farms, and especially on account of the generally stony character of the soils, the use of improved horse implements is not so general as would be the case on larger and more level farms, and considerable hand-implement culture is necessary because of the interference of stones and bowlders. The husbandry must be constantly varied to suit local irregularities and individual locations and conditions. A characteristic method is the hauling of hay on the common farm wagon, with sharpened stakes set up along the edges of the box to hold the hay in place, instead of using the broad, flat racks so common in most hay-producing sections. The reason assigned for this practice is the rough, hilly character of so many of the farms. The greater part of the hay crop is stored in stacks without shelter, large barns for storage being much less common than in most Northern States. Silos are in general use on the larger dairy farms. Most of the orchards display great lack of care.

## AGRICULTURAL CONDITIONS.

Generally speaking, the farming class of Rhode Island's population is divided by natural causes into two groups. A large proportion of those tilling the mellow soils of the Narragansett basin, favored both by the texture of the soils and easy access to markets, are prosperous to a high degree, comfortable buildings and well-kept fields and fences being the rule, while those less fortunately situated on the rough and stony hill lands in the western part of the State, with few exceptions give evidence of their struggle against the unfavorable conditions of rough, thin soils and difficulties of transportation, and here poorly kept fields and buildings and many abandoned farms are seen. About two-fifths of the total area of the State, or 268,248 acres, consists of unimproved and abandoned farms, many of which should be reforested, others used for orcharding, and a few, which are favorably located, for small fruits and berries.

Fully three-fourths of the farms are operated by the owners and their families, the remaining one-fourth being let to tenants for one or more years, sometimes for a money consideration, but more generally for a share of the crops produced—usually one-half.

Farms range in size from a few acres on the highly improved lands near the markets to several thousand acres in the rough and broken portions of the State, making the general average about 80 acres. The small farms are intensively cultivated to market-garden

crops, while the very large ones are mainly in woodlots, and furnish a poor quality of grazing for stock. Over 80 per cent of the farms are free from incumbrance.

Farm labor is scarce and commands high wages throughout the area. The many mills and manufacturing enterprises furnish employment to thousands of the laboring class, and few are willing to leave the excitement and assumed advantages of town life for the quiet of the country, even at a high wage. Farm labor consists almost entirely of native whites of good intelligence, except on a few large truck farms near the cities, where many Italians, Poles, and other foreigners of recent arrival are employed. Many small farms are owned and successfully operated by this latter class throughout the State.

Agriculturally Rhode Island is a hay-producing State, the acreage of tame and cultivated grasses exceeding the total acreage of all other cultivated crops of the area combined. Timothy, redtop, and clover are the principal varieties grown, and the average yield of the first two throughout the State is about 1 ton per acre, while clover yields a general average of 1½ tons.

Corn comes next in importance to hay as an agricultural product, with a total acreage of over 8,000 and an average yield of 35 bushels per acre for the area, indicating a high yield on the heavier soils best suited to its production.

Potatoes rank next to corn in importance, occupying an area of nearly 6,000 acres, with the unusually high average yield of 145 bushels per acre. This crop is largely grown on the Miami stony loam on the island of Rhode Island. Early varieties are in favor and command a fair price in the local market, making this an especially remunerative crop. The importance of the truck and market-garden crops in this area may be readily foreseen, the acreage of miscellaneous vegetables amounting annually to about 5,000 acres, and the total value of the product reaching nearly half a million dollars.

Oats have steadily decreased in importance during the last half century, until the present area of this crop is only about 1,500 acres and the production less than one-fourth that of fifty years ago. The State does not produce enough of this grain for home consumption, although the climate is favorable and some of the soils are well adapted, the average yield per acre being as high as 30 bushels.

Apples do well, and there is a great opportunity for an extension of this industry on large tracts of land which are but poorly suited to general farming. Few orchards of commercial size were noted, but each farm has a small orchard, and most of the trees are sadly in need of pruning and cultivation. The orchard products represent a yearly value of about $150,000, which could be largely and profitably increased.

Of the small fruits, such as strawberries, raspberries, and currants, the product is marked by high quality, but the industry is confined chiefly to the immediate vicinity of the local markets, the value of this class of fruits being only about $50,000 a year.

Onions are an important special crop, the production of which is confined principally to the eastern part of the State. About 300 acres are grown annually, with the remarkably high average yield of 400 bushels per acre. Large areas of swampy and poorly drained land exist in the State, which, with a little preparation, would be well suited to onion culture, as they are usually rich in organic matter and unsuited to general crops, but capable of producing heavy yields of onions. This statement applies equally well to cranberries, which are little grown at present, with light yields, averaging a little more than 20 bushels per acre.

Rye, barley, and buckwheat are relatively unimportant and the acreage decreases from year to year. Considerable grain is cut green for stock feed and sown for forage and ensilage in the dairying sections. Millet and Hungarian grass are grown to some extent. Wild and salt grasses are cut and used for hay and bedding.

An area of over 175 acres in the State is devoted to flowers, shrubs, and fancy plants, which have an annual value more than twice as great as that of the orchard products.

A large part of the population of the area is engaged in manufacturing and mercantile pursuits, while the various fisheries produce the greater part of the income in the coast townships. Rough and dressed building stone is an important item in the resources of the State.

Considering the importance of the grass crop, it is natural that cattle and horses should occupy a leading place among the live-stock interests. Herds of cattle are mostly small or medium sized, and are kept for dairy purposes, supplying milk for the near-by markets. Most of the dairy farms are located along the rail and trolley roads and near the cities. Sheep raising, which was formerly an extensive industry, has rapidly declined of late, although large areas of rough land unsuited for other purposes would furnish good sheep grazing, and it would seem that this industry might be profitably extended in such localities.

Poultry raising is an extensive and steadily increasing industry in the State, and includes ducks, geese, and turkeys. This is a branch of agriculture that can be successfully carried on in rough areas difficult of tillage. It has its center in the southeastern part of the State, although of wide distribution over the entire area. The raising of swine is a scattered and unimportant industry compared with the attention given to other varieties of live stock.

With a few exceptions, the adaptation of the different soils to particular crops has been but slightly recognized or practiced, general farming being practiced almost universally, regardless of the fitness of soil conditions, grass and grain following each other in regular rotation on the cultivated fields, while the rough and undrained fields furnish pasturage and the family supply of fuel.

Near the markets, where local demand has created the necessity for supply, and competition has been more keen, the requirements of each crop have been more fully met, and we find the melons and early truck on the lightest sands, the cabbage, potatoes, etc., on the heavier sandy loams, and the onions and celery on richly organic soils.

Rhode Island is well supplied with transportation facilities, having over 400 miles of railroad, operated chiefly by the consolidated system, while numerous trolley lines radiate from the principal towns through all the more thickly populated districts in every direction, and give frequent service. Narragansett Bay furnishes good water transportation and has many good harbors, thus adding in no small degree to the wealth of the State. Rail communication to New York and Boston is direct and frequent, while the water route furnishes cheap shipping for bulky commodities to these and other ports. Passenger and freight lines make regular sailings from the port of Providence to New York, Baltimore, Norfolk, and Savannah.

Many miles of wagon roads have been macadamized, and the dirt roads are very good, except in the sandy areas and part of the rough and broken sections of the State. An abundance of good road material is at hand, and the mileage of paved road is increasing every year, to the great advantage of the agricultural population, as well as the pleasure seeker.

Providence, with its large population of mechanics and artisans, furnishes a good market for the bulk of the agricultural products of the State. It is centrally located and easy of access. Fall River, Mass., just over the State line, affords a good market for the southeastern portion of the State, while Newport, Narragansett Pier, and the numerous smaller summer resorts give a good demand for truck, fruit, poultry, and dairy products during the season. Woonsocket furnishes a local market for the northern section, and Westerly and Stonington for the southwestern section. Some of the bulky products find their way to New York and Boston, as does a small portion of the truck and poultry. It has been stated that four-fifths of the population of the State reside within 10 miles of Providence, and the greater part of the produce naturally goes to that market.