

SOIL SURVEY OF MERRIMACK COUNTY, NEW HAMPSHIRE.

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DESCRIPTION OF THE AREA.

Merrimack County is situated in the south-central part of the State of New Hampshire. It is somewhat oblong in shape, extending in a northwest and southeast direction. The most southern point of the county, the southeast corner, extends to within a half mile of the parallel of 43° north latitude; while the most northern point, the northwest corner, reaches to about $43^{\circ} 35'$ north. East and west the county extends from approximately $71^{\circ} 15'$ longitude west from Greenwich to $72^{\circ} 5'$, or $10'$ less than 1° of longitude. The land area of the county comprises 590,464 acres or about 922 square miles, being approximately one-tenth of the area of the State. All but three of the nine other counties of the State touch Merrimack County, it being bounded on the north by Grafton and Belknap counties, on the east by Belknap, Strafford, and Rockingham, on the south by Hillsboro, and on the west by Sullivan.

Topographically Merrimack County may be divided into two parts, one the hilly to mountainous upland and the other the wide troughlike valleys of the Merrimac River and its main tributaries. The Merrimac is bordered by an especially marked series of terraces that rise one after another to elevations between 100 and 200 feet above the river, merging finally into the upland slopes.

The Merrimac Valley passes through the east-central part of the county in a southeasterly direction. The width of this valley varies. At Franklin, near the northern boundary, it is about 1 mile wide,

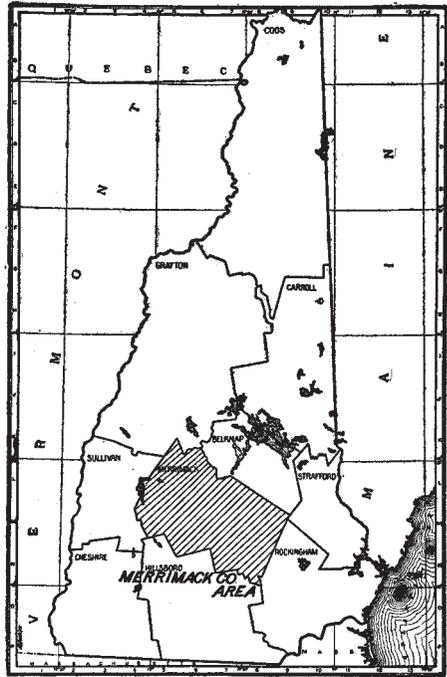


FIG. 1.—Sketch map showing location of the Merrimack area, New Hampshire.

but below this point it gradually broadens, becoming much wider at the mouth of the Contoocook River, where a broad depression extends up that river. At West Concord the valley narrows, but at Concord widens again, reaching its greatest breadth—4 or more miles—by the coalescing of the valleys of the Soucook and Turkey rivers. From the mouth of the Soucook the valley narrows down to about a mile and continues so throughout the rest of its course in the county. Along most of the course of the Merrimac occur more or less extensive bottoms, locally called “intervalles.” These reach their greatest development in the vicinity of Penacook and Concord. Above the first bottoms rises a series of terraces, on both sides of the river, one above another, varying greatly in breadth and usually flat, but sometimes of rolling surface or sloping toward the river. Along the smaller rivers and streams these terraces do not occur, their places usually being taken by small hills of gravel with occasional low, flat sand plains. The elevation of the Merrimac at Franklin is about 275 feet and, where the river leaves the area, about 175 feet above sea level.

The uplands consist of a series of hills and mountains whose general direction is parallel to the Merrimac Valley. On each side of the Merrimac and all the larger valleys the hills rise gently, the first series rising some 300 to 500 feet above the river. Farther away on the eastern border of the county they increase in height, culminating in a number of small mountains 1,200 to 1,500 feet in elevation. On the west side, which is the more irregular and broken, the elevations are higher and the surface more mountainous, being over 2,900 feet on Mount Kearsarge, while the Ragged Mountains and Mount Sunapee are 300 and 400 feet lower, respectively. Although the uplands are hilly to mountainous, with a range of about 2,500 feet in elevation, they can not be considered rugged, except in limited areas, for they have been subjected to glaciation, and the result has been to give them a rounded outline, a fact which is most obvious when they are viewed from an elevation. Large quantities of erratic boulders have been strewn on the surface by the glacial ice.

Another feature of the landscape contributing in no small degree to the attractiveness of the region is the large number of ponds and lakes, which are also due to glacial action, generally being the result of obstructed drainage. There are nearly one hundred of these ponds or lakes within the county or touching its borders, and they vary in size from a few acres to several square miles, as in the case of Lake Sunapee, which, however, is not entirely in the county.

With the exception of a small part of the western section of the county, which drains into the Sunapee lakes and finally into the Connecticut River, the county is drained by the Merrimac River and its tributaries. The Merrimac is formed just within the northern boundary of the county by the confluence of the Pemigewasset and

Winnepesaukee rivers. The former rises in the western spurs of the White Mountains, some distance north of this area, and flows in a southerly direction; the latter forms the outlet of Lake Winnepesaukee and the smaller lakes associated with it. From the junction of the two rivers the Merrimac flows a little east of south through the county. On the east it has two main tributaries, the Soucook and Suncook rivers, both of which flow in a southerly direction, draining all the eastern part of the county. On the west the only important tributary is the Contoocook, which rises in the counties to the west and southwest. Numerous streams enter it, the most important being Blackwater and Warner rivers, both small but swift-flowing streams.

The settlement of the region now included with the limits of Merrimack County was begun in 1727 by some families from Haverhill, Mass., at what is now Concord, but at that time called Pennycook. These people were of the early Puritan stock. A few years later came some Scotch-Irish, also from Massachusetts, and afterwards others from Great Britain, who settled the town of Dunbarton and took part in other settlements in the county. Besides those already mentioned there were some Irish settlers direct from Ireland. All of these early immigrants belonged to a hardy, industrious class, capable of withstanding the hardships of pioneer life incident to the rigorous climate of New England. Settlements gradually increased and extended, until by the close of the century practically all parts of the area of the present county were more or less occupied.

In 1823 Merrimack County was organized from parts of surrounding counties. In 1830 the population of the county had reached 34,614, and since 1830 there has been a gradual increase for each decade, until now the county is made up of 26 towns (townships), with a total population in 1900 of 52,430. Although there has been a steady but comparatively small increase in the county as a whole since 1830, there has been a decrease in several towns, amounting to nearly one-half in some cases. This has been brought about by the fact that the people in the more remote and rougher sections of the county either moved to the towns and engaged in the manufacturing industries or, leaving the county entirely, as many did, have gone West, where the opening of new lands offered them better returns. But while some of the native population has been moving away, its place has been more than taken by the influx in recent years of foreigners. These consist principally of French Canadians, Norwegians and Swedes, Danes, and Poles. The French Canadians generally prefer to work in the factories, forming a large proportion of the employees, both male and female. The other classes mentioned are employed on public works or as laborers on farms. Many of them, however, by their economy and thrift soon become land owners, making a success-

ful class of farmers. There is now, too, a tendency on the part of many who went elsewhere and earned a competence to return to their former home to spend their remaining days and buy back the old homestead and improve it. There is also quite a large transient population, this section, as well as most sections of New England, being a resort for summer tourists.

The streams within the county afford a large amount of water power. The Merrimac River has a fall of about 100 feet within the county, while on the smaller streams the fall is much greater. At the points where the fall is sufficient, dams have been built and manufacturing towns have been established. Concord, the county seat and capital of the State, ranks third in the State in population, with approximately 20,000 people. The next important in size is Franklin, a leading manufacturing town, in the northern part of the county, at the junction of the Pemigewasset and Winnepesaukee rivers, with more than 5,000 inhabitants. Other important towns are Hookset in the southern part of the county on the Merrimac River, Pittsfield and Suncook in the eastern part on the Suncook River, and Penacook, Contocook, and Henniker in the western part on the Contocook River.

The transportation facilities of the county are exceptionally good, and railroads reach nearly every portion that can be so reached. The railroads have been built to follow the important valleys. The Boston and Maine system owns all railroads in this section. The main line from Boston passes up the Merrimac Valley, and at Concord, which is one of the most important railroad centers of the State, several branch lines are extended to different points. Besides the main line are the White Mountain division, reaching the White Mountains and affording direct communication with Montreal and other Canadian points; the Claremont division, which reaches the important summer resort section around Lake Sunapee and extends into Vermont and also farther north to Canadian points, and the Peterboro and Hillsboro branch, reaching points directly west. At Franklin a branch line continues up the valley of Pemigewasset River to Hill and Bristol, and another connects Franklin and Tilton. At Hookset, below Concord, a branch line runs up the Suncook Valley, reaching the important manufacturing towns of Suncook and Pittsfield. Besides the steam roads there is an electric line connecting Concord and Manchester, the latter being 17 miles south of Concord. From Concord this line also extends 6 miles north to the village of Penacook.

The roads throughout the county are numerous and long established and, in general, are kept in good repair. Very little advantage has been taken of topography in locating these roads, as they go up and down hills that could often be avoided. They have been located,

however, for the convenience of settlers, and as the tops of hills were the least stony and afforded the best location for farms the roads have been made to reach these places. As the roads do not wash badly, they are fairly easy to keep in repair. There are many good roads in the county as the result of former turnpikes, which were an important factor in early days, as affording the only means of communication. These roads were wide and well built, were located with reference to easy grades, and at the same time connected the important villages.

The principal market for this section, as well as all northern New England, is Boston. The chief income of the farms is derived from the sale of dairy and poultry products, mostly milk and eggs, which meet with a ready sale. There are also good local markets in the factory towns, and in the summer season the resort hotels and boarding houses cause an increased demand for these and other products of the farm.

CLIMATE.

The accompanying tables, compiled from the records of the Weather Bureau stations located at Concord and Grafton, show the mean monthly and annual temperature and precipitation and the dates of the last killing frosts in spring and first in fall. Concord is located within the county some distance southeast of the geographical center and in the Merrimac Valley, the elevation of the station being about 350 feet above sea level. Grafton is situated a few miles outside the county in the adjoining county of Grafton on the north and is distant about 50 miles northwest from Concord. The elevation of the station at this place is about 860 feet, or about 500 feet higher than the one at Concord. That its latitude and elevation influence the temperature is shown by the fact that the mean annual temperature of Grafton is nearly 4° lower than that of Concord. The data for the Grafton station, however, probably represent the average climatic conditions in the northern and higher parts of the county.

By referring to the table it will be seen that the mean annual temperature at Concord is 46° F. and at Grafton 42.6° F. The climate, as in most temperate regions, is marked by extremes of temperature. The highest temperature recorded since observations have been taken is 103° F. at Concord and the lowest -37° F., giving an extreme range of 140° F. The winters are long and cold, the mean temperature for four months in winter averaging below the freezing point. Generally the winters are accompanied by snow, affording several weeks of sleighing. The summers are comparatively short and cool, although marked by brief periods of extreme heat, with humidity. Maximum temperatures of over 100° rarely occur and the mercury seldom rises above 98° F. The average mean temperature for the summer months is about 67° F.

As shown by the table the average date of the last killing frost in spring at Concord is May 15, and at Grafton twenty days later, or June 4. The average date of the first killing frost is September 12 at Grafton and September 24 at Concord. Thus the growing season for tender crops is about four months in the vicinity of Concord and about three weeks less in the section around Grafton.

The precipitation, as shown by the table, is fairly well distributed throughout the year, yet there do sometimes occur during the summer months periods of drought in which crops suffer. The mean annual precipitation for the county will probably average 40 inches. The total annual snowfall ranges from 3 to 10 feet.

Another feature in the climate is the prevalence of heavy fogs, particularly in the spring and fall. The prevailing winds are generally northwesterly. Easterly winds from the coast, which is only about 25 miles distant, generally bring rain. The general climatic conditions are healthful and during the summers many people from distant places are attracted to this general region.

Normal monthly and annual temperature and precipitation.

Month.	Concord.		Grafton.		Month.	Concord.		Grafton.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	Inches.	°F.	Inches.		°F.	Inches.	°F.	Inches.
January	20.7	3.23	16.8	2.61	August.....	67.7	3.68	64.7	4.27
February	23.7	3.01	18.2	4.33	September ..	60.6	3.27	56.9	3.04
March	31.0	3.40	27.5	3.01	October	49.5	3.79	46.7	3.04
April	44.4	2.73	41.3	2.29	November ...	37.1	3.69	34.2	3.62
May	56.8	3.24	53.3	3.22	December...	25.9	2.94	21.8	2.31
June	65.3	3.13	62.2	3.20	Year ..	46.1	40.13	42.6	38.75
July	70.0	4.02	67.8	3.81					

Dates of first and last killing frosts.

Year.	Concord.		Grafton.	
	Last in spring.	First in fall.	Last in spring.	First in fall.
1897	May 8	Sept. 22	May 23	Sept. 18
1898	May 10	Oct. 10
1899	May 16	Sept. 14	June 11	Sept. 5
1900	May 29	Sept. 19	May 30	Sept. 19
1902	May 14	Sept. 6	June 11	Sept. 6
1903	May 24	Sept. 30	June 5	Sept. 8
1905	May 5	Oct. 7	June 4	Sept. 15
Average.....	May 15	Sept. 24	June 4	Sept. 12

AGRICULTURE.

Merrimack County at the time of settlement was covered by a primeval forest composed of evergreen and deciduous trees. Of the former the white pine then, as now, was predominant, but there were also considerable pitch pine, hemlock, spruce, and tamarack. Of the deciduous trees, most of the families of the temperate region were represented. There were several varieties of oak, maple, elm, and birch, with chestnut and many others less prominent. It is said that these different species of trees were found together on all kinds of land. It is probable that the pines were, as now, more numerous on the more sandy situations of the upland soils and on the sand plains.

The Indians who occupied the region had made occasional clearings, especially on the intervalles, or first bottoms, along the rivers, particularly the Merrimac, and the squaws practiced a rude system of agriculture. Some of the cleared areas when not cultivated were covered by a growth of coarse grasses, and these were considered as feeding places to attract deer and other game, so that they could be hunted more easily.

The squaws, it is said, planted maize, beans, pumpkins, and some tobacco on the cultivated patches. They cultivated the same land continuously, and when the yields deteriorated to any extent they cleared new areas. It is said, too, that they practiced fertilization to some extent, following the methods seemingly known to all the Indians of New England, namely, the dropping of a fish in the hill where the seed, especially corn, was to be sown. At that time fish were very plentiful and easily obtained in the rivers.

It was the wide, apparently fertile bottom land, together with the cleared areas of the Indians, that attracted the first settlers to this region, and they took advantage of these Indian clearings and the areas of meadow, for the year following settlement cattle and horses were introduced, and probably hogs and sheep a few years later.

When the settlers obtained the grant of the lands where Concord is now situated from the general court of the province of Massachusetts Bay (by whom most of the grants were made) conditions were imposed, as in all their grants, that the intended settlers should be of "substance and character;" that they must put up a dwelling house and clear a certain number of acres (about 3) in a specified time (three to five years) and have it under cultivation; and that they pay the sum of £5 for it. They naturally preferred the valley lands, as these were not stony and were more fertile. Accordingly in the settlement of Concord, or as then called Pennycook, the lands were surveyed, those on the first "intervale" into lots of 6 acres more or

less, according to quality, and known as "home lots," which were to be cultivated, while on a higher adjoining terrace the land was divided into parcels of $1\frac{1}{2}$ acres each on which the residences were to be built. These parcels were then drawn by lot. When all conditions were fulfilled then the owners were to be granted proprietary rights. Accordingly the first settlement was incorporated in 1733 under the name of Rumford and finally in 1765 changed to Concord.

The first settlers began immediately to clear the lands, to build dwellings and fences, and to plant crops. Besides the crops which the Indians had cultivated they soon introduced the cereals. Wheat was grown in small quantities, also some barley. It seems, however, that rye was the most important of the cereals and more extensively grown.

To the Scotch-Irish who settled the town of Dunbarton soon after 1750 is said to be due the introduction of the potato and the culture and manufacture of flax. It seems that potatoes were not grown in large quantities in the early days, not being considered a necessary article of food. Linen and tow made from flax were common, as also woolen cloths spun and woven from the wool produced on the farms. Apples were introduced and generally grown at an early date, but they were mostly made into cider. In this connection it may be said that one of the most valuable and popular varieties of apple, the Baldwin, was developed and became prominent in the Merrimac Valley.

For more than one hundred years from the date of settlement everything of necessity, from food to clothing, was produced and manufactured on the farms. It was not until about 1820 that cotton mills with power looms run by water power were built, but by 1839 cotton cloth had decreased in price to one-third what it had been before.

In the early days there were no markets for the farm products; hence agriculture became stagnant, as has been the case in all new countries or communities where transportation facilities are lacking. With the growth of towns by the development of manufacturing industries, however, markets were found and the lack of transportation facilities in part remedied by the construction of turnpike roads, connecting the main villages with the older and larger towns of Massachusetts, including those of the coast and Boston in particular. The laying out of turnpikes began about 1795 and a number of them were built within this county. This gave some impetus to agriculture and afforded an outlet for the surplus products. In fact the turnpikes wrought a revolution in public travel relatively as great as that brought about by the railroads between 1840 and 1850. Further relief was sought in water transportation down the Merrimac River. This

was accomplished by digging canals around the rapids, and in 1814 this route was opened, and from 1,000 to 1,500 tons of freight annually were transported in this manner. This mode of transportation became of great importance and continued so until the construction and operation of the railroad from Boston to Concord. This water route was down the Merrimac River to a point near Lowell, Mass., and thence by the Middlesex canal to Boston, the whole distance being 85 miles and requiring seven to ten days for the round trip. Cordwood was a leading item of freight, and as early as 1819 granite became an important shipment. It is interesting to note that among the shipments up from Boston were flour, corn, butter, and cheese.

Railroad transportation was an important advance and superseded all the other modes of traffic. In the early thirties railroad building was agitated and companies incorporated. The Boston and Lowell Railroad was in operation by 1835, and in 1842 this line extended to Concord. Within the next twenty years railroad building was pushed rapidly. The main line or northern division was extended, the Claremont Division was built and put in operation, and the Concord and Montreal Railroad, or what is now known as the White Mountain Division, was constructed, as was also the Suncook Valley branch. These increased transportation facilities were a great factor, if not the controlling influence, in bringing about a change of conditions in New England generally. The first three decades of the last century were marked by a general improvement in all lines of agriculture throughout the then settled sections of New England. Increased transportation facilities afforded by turnpike roads and water routes marked the beginning of this improvement in conditions. More attention was given to live stock, particularly to sheep, and a better quality of wool was introduced during this time by the importation of Spanish Merinos. Horses, cattle, and hogs also received increased attention, as did also the field crops, improved varieties being introduced.

By 1830 the rural population of Merrimack County had reached its greatest number, for, as noted elsewhere, there was a gradual decrease in population in several towns of the county after that date. At that time, too, agricultural production was probably at its highest point, for it is shown by the census of 1840, the earliest report giving agricultural statistics, that the production of the staple crops was higher than reported by any census since that time, wheat, rye, oats, buckwheat, and potatoes being at their maximum production, and the total yield of corn and hay but little less than now. The figures show also that the number of farms was practically the same as some decades later, there being in fact but little change in the number of farms to this day. Moreover, the total area in farms in 1850 was but little less than in 1900, but in the earlier census the unim-

proved land was but 30 per cent of the total area in farms, while in 1900 it had risen to about 73 per cent.

This change, however, has been most marked since 1880, as prior to that it proceeded gradually. There has thus been a decline in agricultural production, and areas formerly cultivated have been allowed to grow up in forest, for with the abandonment of the cereal crops no new crops were introduced to take their place. The loss in rural population has been occasioned by large numbers moving to manufacturing centers or going West to take up new lands. These conditions were due to the operation of several factors, among which may be mentioned cheap railroad facilities, opening up of western lands, and the nonadaptability of the soils of New England to cereal crops, which, together with the stringency of labor and its high cost, made it impracticable for the local farmers to compete with the West in cereal production.

The growing of cultivated crops, particularly the cereals, in New England was more or less difficult because of the hilly and stony character of the lands, and with the small yields obtained farming was not remunerative; hence when the western lands were opened up there was practically a rush of the New England people to this new country, where farming was more promising. This emigration began in the seventies and continued up to a few years ago, when practically all the better western lands were taken. Another thing that has worked to discourage farming has been the inducements offered to labor in the various manufacturing industries developed in New England. This began at an early date. The development of manufacturing and the building of railroads were coincident, the former being fostered by the latter. The swift-flowing streams of New England afforded practically unlimited water power, and consequently manufacturing developed rapidly, assisted by the ever increasing railroad facilities. One of the first cotton mills in New England was built on the Merrimac River and put in operation in 1819, and since that time mills and factories for various purposes have increased steadily in number. By 1840, when railroad construction was well begun, the manufacturing industries were also well established.

General farming, in which dairying and stock raising in one form or another occupied an important part, was the common practice for a considerable time, but when the growing of cereal crops was abandoned dairying became still more important. To-day the practice may be considered one of specialized farming, though not strictly so, with milk production as the object, while prior to 1890 the dairy product was disposed of in the form of butter and cheese made in the home dairies. There was a decided increase in butter

production from 1880 to 1890, due probably to the installation of creameries, but with the increasing demand for milk in the cities and the good transportation facilities milk in large quantities is now shipped daily, while butter production has correspondingly decreased. The importance of this industry is shown by the last census, which reports the milk production of Merrimack County as over 8,000,000 gallons in 1899, and the output of butter as more than 800,000 pounds. Since then it can be safely said that butter production has decreased considerably and the quantity of milk sold increased greatly. The most of it is shipped to Boston, and the price is low, varying from 2 to 4 cents a quart, but at the lowest price it is claimed that a small profit can be made. The difficulty connected with dairying in this region is the cost of wintering the herds. As the growing season is short the stock must be fed the greater part of the year, and since the grain is not produced on the farms it must be brought in at the ruling high prices. The soils, though not heavy, seed readily to grass. A large proportion of the area is suitable for rough pastures and on every farm a part can be mowed for hay. The corn grown is largely of the silage varieties and silos are common wherever any number of dairy cattle are kept, for the silo proves the most economical way of preparing feed for the stock. The herds are largely grades, with preference for the Holstein blood, although pure bloods of this breed as well as of other dairy breeds are common. Some beef cattle are raised, but on the whole they are not as profitable as dairying. In 1900 there were about 15,000 milch cows in Merrimack County and about 18,000 other cattle.

Oxen are still quite common in the county and are used for draft purposes. The number of horses in the county has varied but little since 1840. The number of swine was about 1,200 in 1840, the highest number reported, but in the next two decades swine decreased to about one-half that number and have since varied little in numbers. In 1840 wool was an important source of income to the farmers, there being reported in that census year a little over 80,000 sheep, but their number has decreased, owing to the decrease in price of wool and to the loss and annoyance caused by dogs, until the number in 1900 was only one-tenth the earlier maximum. The income now derived from sheep is in the form of mutton instead of wool, and there has accordingly been a change from the wool to the mutton breeds. Sheep should still prove a source of profit, as much of the land is suitable to sheep grazing. The increase in the area of unimproved land may be attributed largely to the decrease of sheep on the farms. A reason commonly expressed for not keeping sheep is that the stone walls around the fields are not sufficient to hold them within the inclosure,

but this could be remedied by the use of wire for fences. Loss of sheep by dogs could be reduced to a minimum by keeping the sheep at night in dog-proof folds and corrals, as the damage is done chiefly at night.

The most important crop is hay, there being devoted to this crop in 1899 about 80,000 acres, producing on the average a little less than 1 ton per acre. On some areas, where the land is fertilized, yields as high as 2 or 3 tons per acre are secured. There has been an increase in acreage in mowings since 1840, because areas that were formerly used in growing grain have been put in grass and because, requiring less labor than the tillage of crops, hay at present prices is much more profitable. Timothy and redtop are the principal grasses used for hay, but millet and Hungarian grass and some clover are also grown. In recent years it is said to be difficult to get stands of clover, as it freezes out during the winter. Otherwise it is a good yielding crop and has the advantage of the other hay crops grown in that it improves the soil. It seems that greater effort should be put forth to produce this crop. Wild grasses are also cut for hay, and the meadow areas that are not too wet are held in high esteem for hay production. A volunteer grass, known as quitch grass (*Agropyron repens*), is troublesome in cultivated fields. It is cut for hay, but the yields are usually light, rarely reaching a ton per acre.

Corn is the principal cultivated field crop, with an annual yield ranging between 150,000 and 200,000 bushels. The larger part of this crop, however, is cut for silage. The fields devoted to corn are usually small, but they are given practically intensive cultivation, being highly fertilized and well cultivated, the average yield per acre being nearly 40 bushels. The eight-rowed flint varieties are most commonly grown. The acreage in potatoes is about one-half that of corn, yielding on an average about 100 bushels per acre. In 1840 potatoes were a leading crop, the production being three times what it was in 1900. The cause of the decline can not be stated, and it seems that it would be profitable to increase the acreage.

Of the cereal crops, wheat and rye are not grown at all. These were important crops in the early days, and before competition with the West began they were grown on every farm. The yields are said to have been fair. Oats, barley, and buckwheat are still produced in small quantities. There is a tendency to increase the acreage of the first two, particularly of oats. The oat crop is largely cut green for fodder. The light soils ought to produce buckwheat, and it seems that the acreage in this cereal should be increased. Beans are grown to some extent, but not so much as formerly. These succeed well on the light sandy soils, yielding about 10 bushels per acre, and at the present high prices it seems that this crop should be a remunerative one. Other crops, not produced at present, but grown in 1840, are

flax, hemp, and hops. Hops were once an important crop, but their production decreased steadily until at the present time only small garden patches are to be seen. Tobacco in small patches is grown for home consumption. On soils similar to those forming the terraces of the Merrimac River has been developed the important tobacco industry of the Connecticut Valley, but whether tobacco would succeed commercially in this section is questionable.

Apples are grown on every farm, though as a rule no very extensive orchards exist. There are, however, a number of growers, particularly in the central and western parts of the county, who gather several thousand barrels from their orchards. Apples succeed well on practically all the soils, particularly on the heavier phases of the upland soils and where there are northerly or northeasterly exposures. A large proportion of the land in the county is suitable for apple orcharding, the stony character of the soil not being objectionable and areas too stony to cultivate often being most desirable for apple growing. The variety most in favor is the Baldwin. It colors beautifully, has a superior flavor, and its keeping quality is excellent. Another variety is the Northern Spy, which meets with a ready sale. Many other varieties also succeed, but are not so well known. The prices received are not the best, for the growers sell to brokers instead of seeking the markets themselves. With an effort on the part of the growers and the formation of a growers' association, markets could be found, and when the excellence of the product became more widely known the industry should prove a most profitable one. As a rule little care is given the trees. They are simply planted and left to take care of themselves, and it is surprising to see even then how well they do and what a fine quality of fruit is produced. No spraying is done, as it is thought to be unnecessary and too costly. In this a mistake is made, for spraying would increase and improve the yields, more than counterbalancing the cost. The other tree fruits do not succeed so well as the apple, the climate being too severe. The value of orchard products in 1899 was \$102,000.

Vegetables and truck crops do not receive the attention they should, considering the demand for these products by the resort hotels and summer boarding places, which at present must depend on Boston markets to supply their needs. The surrounding sections should be fully able to supply this local demand. The soils of the river terraces, particularly the finer soils, as the Merrimac sand and Podunk fine sandy loam, are well drained, warm soils and adapted to truck and vegetable crops. There are many small, rather mucky areas where onions and celery would do best, and these should be utilized for such crops.

The poultry industry is an important source of income. There is a great demand for all kinds of poultry and for eggs, particularly in the summer season, and the supply is nowhere equal to the demand. Some poultry raisers are meeting with success and realizing good profits, and it seems that this could be made to hold good in general. The value of poultry products can not be given, but in 1899 nearly 1,000,000 dozen of eggs were produced and there is no question that the output at present greatly exceeds that figure. It is said to be more profitable to raise poultry for eggs than for meat.

Finally, in enumerating the principal products, those of the forest must not be neglected, as at the present time the most important asset on the farms of Merrimack County is the forest growth which covers the larger part of practically every farm, and which is from year to year becoming more valuable as the supply of timber decreases. With proper precaution for preservation, followed by a systematic plan for the removal of the marketable timber, these forests will yield most profitable returns. An idea of the value of forest products will be realized when it is stated that the last census report gave the value of these products in 1899 as approximately \$400,000. The income from this source has no doubt greatly decreased since then. The value of the forests both from an economic and a physical standpoint is being recognized and forested areas are now held in higher esteem than formerly. This is particularly the case where the growth is white pine.

Increasing interest is now being manifested in reforestation areas, particularly to white pine. The natural method of reforestation is the one followed which is effected by leaving the smaller growths and some seed trees and protecting from fire and stock. Another system of reforestation is that of transplanting the small seedlings. This has been done to some extent in the State, but as far as known not in this county.

There is no recognition of the adaptation of soils to crops, except it be in the use of grass, and this is more because of moisture conditions than because of difference in soil texture. There is so little difference in the upland soils that differences in yields are small and often depend more upon management than upon the particular soil. The same crops are grown throughout the county on all the soils. It is recognized, however, that the sandy terrace soils are not so desirable as the upland or first bottom soils.

A large part of the farms, because of the quantity of bowlders on the surface, must necessarily remain in grass, so that rotation on these parts is not feasible, but on the cultivable portions, however, some form of rotation is generally followed. This usually consists of a two or three course rotation, involving five or six years. There are

only two main crops, grass and corn, with which the rotation is to be made, with occasionally potatoes for a third crop. The acreage in grass, according to the last census, is fully fifteen times that of corn, so that the rotation is not balanced, and consequently is not adhered to closely. Two crops of corn are grown in succession; the land is then sowed to timothy or redtop, which is cut for hay two seasons, after which it is pastured a year or two. Where potatoes are grown they take the place of corn one year. Often, for various reasons, particular fields are planted continuously to corn, but in such case the land receives heavy applications of barnyard manure, together with fertilizers, so that the organic matter or humus in the soil is replenished. Where fields are kept continuously in grass, the practice of the better farmers is to plow the fields at least every five years and reseed. It would seem advisable to follow the rotation systematically and also to introduce other crops into the rotation, particularly some leguminous crop. Clover will do well. The acreage in oats and Hungarian grasses or millet could and should be greatly increased.

The general occurrence of bowlders on the upland soils does not allow of extended use of farm machinery, and the land is therefore difficult to till. It has been necessary in many cases to remove the loose and smaller bowlders, and this has been no small undertaking. The stones removed, however, are used for fences or walls around the fields and the labor is not entirely lost.

The preparation of the land for planting is in general thorough. The 2-horse turning plow is used and the work is done well, after which it is harrowed and smoothed with a birch brush drag, which in these light soils is effective, leaving the surface in good tilth. After the loose stones turned up by plowing and harrowing have been removed, the crops are carefully planted and the after cultivation is thorough and, in the case of corn, practically intensive, as the area grown is small. Corn is largely converted into silage, the varieties grown being suited to that purpose. Silos are quite common. The cows are fed largely in the stall, so that ensilage makes the best and most economical feed. For hay making the mowing machine is in common use, but the scythe must be relied upon where the surface is steep or stony.

A practice to be commended is the care taken to make as much barnyard manure as possible and to save all that is made. This can be done readily, as the barns are generally what are known as bank barns, and the manure is kept in the basement until ready to be put on the fields. Commercial fertilizers, however, are generally used, and in large quantities. The brands are of good grade and usually special mixtures for the particular crop grown. These are usually sown broadcast.

Labor on the farm is scarce, commands good wages, and is efficient. The tendency has been for the younger generation to go to the towns and cities, where the inducements are seemingly better. For laborers, the newly arrived foreigners are drawn upon. Principal among these are the Danes and Poles, who make good, steady workmen. The French Canadians also give very general satisfaction as farm laborers.

According to the last census there were nearly 4,000 farms in Merrimack County, and 90 per cent of these were operated by the owners. The renting of farms is the exception and not the rule. This is due to the comparatively low price of land and to a great extent to the enterprise of the people themselves. Another reason given is that one can not pay rent for a farm and make a living. It is necessary to get the whole product. There are, however, numbers of farms operated by managers for certain stipulated wages. These are the farms owned mostly by summer residents, the manager living on the farm throughout the year. There has been a slight decrease in the number of farms according to the census statistics, while in size the decrease has been marked. By the last census the average size of farms was 122.5 acres, which is less than one-half what it was two decades before. Various causes have operated to bring these conditions about. Principal among these has been the lack of labor.

Undoubtedly at one time too many farms of rough stony surface were cleared and put under cultivation. With change in labor conditions these became unremunerative and were abandoned or reduced in area, but in no case can the abandonment of these farms be ascribed to exhaustion of the land, which is seemingly as productive as ever.

It is difficult to state the value of cultivable lands, as there is so much rough land included in the farms. The average price is low. Some distance from the larger towns farms sell for as little as \$10 an acre, and often this price will not cover the original cost of the buildings. Nearer the towns the values are much higher, and particularly in resort sections along the lakes, where the locations are especially desirable for summer homes. In this case the agricultural value is not considered at all, or is only a minor consideration. It is remarkable that the owners have in the past been able to make the improvements they have. The houses and barns are large and well built and kept in good repair generally, and rarely are they unpainted. Then, too, modern conveniences have been and are being installed, particularly in the matter of water supply and sewage disposal. Usually where the house is on the hillside the well is located above the house and water piped into the house by gravity, and also into the barns and feed lots. Commonly the house and barn are built together, the woodhouse and carriage shed connecting

them, so that in inclement weather in winter the farmer need not go outdoors at all. Incentive for further improvement is stimulated by the summer boarder business, as at practically all farm-houses where accommodations can be given summer boarders are taken. From this source alone a considerable revenue is brought into the section and everyone profits more or less by it. To increase this business, and particularly to assist in the locating of summer homes for intending purchasers, the State authorities distribute illustrated pamphlets giving authoritative and reliable information. The result is that farm values, particularly in desirable sections, are steadily rising, with an increasing demand.

The present condition of the farmers of Merrimack County may be said to be fairly prosperous. While they do not realize large incomes from the farms alone, they make something above a living, and the larger number of farmers have something in bank. They are an industrious class as a whole and very economical. They produce nearly all their supplies on their farms, which, of course, makes the taking of summer boarders more profitable. The buildings are maintained in good repair, both houses and barns painted, and the surroundings neat.

The telephone and rural free mail delivery are available in nearly all parts of the county. The farmer has the advantage of good country roads, which are numerous and kept in repair, although, as stated before, many of the roads are not built with reference to topography and run up and down hill where this could oftentimes be avoided. The railroad facilities are also good, few farms being more than 10 miles from a station.

With all these favorable surroundings it seems that the conditions could be further improved and the incomes from the farms materially increased. This could be brought about not only by the introduction of new crops, giving a wider diversity to the rotations practiced at present, but also by increasing the production of the crops now grown and thus supplying as far as possible the local demand. As it is now only two field crops are produced, grass and corn, and no more than enough, if enough, of these to feed the dairy cattle, while the vegetables and fruits are used mainly for the immediate needs of the household. The only income is derived from the sale of the product of the dairy and from summer boarders by those who keep them. By the introduction of more crops, particularly some of the legumes, more feed would be produced and at the same time a better rotation from the standpoint of improving the soil would be afforded, thus in the end enabling the farmer to reduce the amount of nitrogenous fertilizers used. Of the leguminous crops, clover, Canadian field peas, and vetches could be employed. Hungarian grasses and millets

should be included in the rotation and another field crop cultivated, for instance, potatoes, which do well under the local soil and climatic conditions.

There are three items of expense in the management of the farm that confront the Merrimack County farmer, and for that matter New England as a whole, which reduce very materially his net income. These are the high cost of labor, of fertilizer, and of feed. As has been previously noted, the surface conditions are such that the extended use of improved machinery is precluded. Hand labor is scarce and commands wages really beyond the power of the farmer to pay. As local labor is not obtainable the only solution for the New England farmer is to obtain foreign laborers, a practice which seems to be increasing in this section. The second item of cost—fertilizers—is high, as they are in general use over the county. They are mainly the so-called high-grade mixtures and are used in generous quantities. One investigator of this subject claims that the fertilizer bill can be reduced to one-half and even to one-fourth without materially decreasing the yields; that the large amount used does not increase the yield enough to warrant the increased expense. By the introduction of more crops, including a legume, and by following a systematic rotation, the use of fertilizers could be largely curtailed. This would also be the means of reducing the third item of cost—the feed for work and dairy stock—in that with a leguminous hay a minimum of grain would have to be purchased.

SOILS.

The soils found in Merrimack County come under the class of transported soils and are of glacial origin, being derived either from the glacial débris as originally deposited or from like material more or less modified by other agencies, principally water. The soils, therefore, are not derived from the underlying rocks, although they are in a measure closely related thereto, the glacial material having been derived largely from similar rocks. The soils are granitic; that is, granites have entered very largely into their composition.

The underlying rock formations throughout the State of New Hampshire are mainly igneous and metamorphic rocks of pre-Cambrian age. They consist of a variety of granites, gneisses, and schists. The granites especially are of great economic value for building purposes, and are extensively quarried in several localities within Merrimack County, especially in the vicinity of Concord. Outcrops of these different rocks occur, and boulders of all are found indiscriminately strewn over the surface and within the soil mass or till.

In recent geological time, during that period called by geologists the Glacial epoch, all of New Hampshire, in fact, all of New England, even the highest mountains, was covered by a moving ice sheet of

great thickness. This moving mass has, by crushing and grinding the rock material, more or less smoothed or rounded off the tops of the hills and ridges and filled in valleys with transported material. As the ice melted and receded it left upon the plowed-off surface a heterogeneous or unstratified mass of coarse and fine materials. The lower stratum of this glacial débris, or that carried under the ice, is known as ground moraine or lower till. It is more or less finely pulverized, contains much clay, and is compacted as a result of the great weight of ice. Upon the lower till was dropped material carried upon and within the ice sheets, and this is known by geologists as the upper till. It is distinguished from the lower till in that the material is coarser and the bowlders more angular, not having been subjected to so much grinding or crushing by the ice. The upper till is of a lighter color than the lower till or bowlder clay, the difference being due to a difference in the degree of oxidation of the included iron compounds. The greater oxidation of the surface material has given a light yellow color, while the color of the deeper lying clay ranges from drab to light blue. Usually there is a distinct line of demarcation between the two tills. The depth of the upper till varies from a few inches to several feet, and may be absent altogether, in which case a heavier soil, derived from the ground till, results.

At the close of the Glacial epoch the land is believed by geologists to have subsided, a change also to a warmer climate taking place. During the Champlain period the Merrimac Valley, as also the other valleys, though to a lesser extent, was filled up as high as the highest terraces by materials carried by glacial streams issuing from the melting ice front. The materials were assorted by the varying velocities of the streams, and the deposits are found in more or less well-defined layers or strata. At the close of the Champlain period, or what is known as the Terrace period, there was evidently an elevation of the land, for the streams began cutting their channels, reworking and redepositing the materials and forming flood-plains or terraces. This has continued until the streams are in many places flowing over floors formed by rock in place. The last and lowest terraces or flood-plains are still in process of formation. In cutting their channels the streams, particularly the Merrimac River, have changed their courses often, so that the terraces are not always continuous on one side or the other.

The soils occurring in Merrimack County may be divided into two general groups—those derived from the unmodified drift, or the upland soils, and those originating from the modified drift, or terrace soils. These two groups of soil, because of their different mode of origin and also their different topographic position, are included in two great series of soils. In the upland region are representatives of the Gloucester series, which doubtless have a wide

distribution in the State, and on the terraces occur soils of the Merrimac and Podunk series.

Upon differences of texture the soil types within each series have been made. In the upland group only two types were found, and these are so closely related as to make their separation difficult. They are the Gloucester stony loam and the Gloucester stony sandy loam. On both these stony types there generally occur erratic glacial boulders of varying sizes, which require removal before the land can be cultivated. Where, however, the boulders are so abundant as to make their removal impracticable and where the conditions are such that the land is of no value except for pasture and forestry, the areas have been included under the name of Rough stony land. Texturally this classification includes soils that would belong in the two types just enumerated. The name Rock outcrop is applied to areas such as tops and upper slopes of the higher mountains, where the outcroppings of rock occupy the larger part of the surface, supporting at best only a sparse, stunted growth of spruce, hemlock, and pine.

In the terraces only five types were recognized, yet all grades of material except the finest occur, though in areas too small to appear separately on a map of the scale used in this survey. The soil types established, with the exception of the silt loam, which is of small extent, are all more or less sandy, ranging from a gravelly sand to a fine sandy loam.

The name and actual and relative extent of each of the several soil types are given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough stony land	319,744	54.1	Merrimac coarse sand	13,824	2.3
Gloucester stony loam.....	80,192	13.6	Podunk fine sandy loam.....	12,928	2.2
Gloucester stony sandy loam.	67,904	11.5	Rock outcrop	3,264	.6
Merrimac gravelly sandy loam.....	50,240	8.5	Podunk silt loam	960	.2
Merrimac sand	26,560	4.5	Total.....	590,464
Meadow	14,848	2.5			

GLOUCESTER STONY LOAM.

The Gloucester stony loam, to an average depth of 8 inches, consists of a dark-brown loam or heavy sandy loam of medium to fine texture, underlain by a yellow medium to fine sandy loam, which is usually somewhat coarser and stonier in the lower depths. Flakes of mica are a prominent feature, giving to the soil and also to the subsoil a soft, greasy feel. The soil and subsoil are to some extent coherent when pressed in the hand, and the type forms, with one

exception, the heaviest soil of the county. The subsoil, particularly the lower portion, is generally quite compact and is locally known as hardpan. It is not, however, hardpan in the true sense of the word, as there is no cementing material present, the compactness being due no doubt to pressure of the ice sheet at the time of deposition. Beneath the subsoil occur the drab and light-blue boulder clays.

Upon the surface and in the soil and subsoil are scattered erratic glacial boulders, ranging in size from "niggerheads" to massive fragments weighing several tons. There is also present more or less rounded glacial gravel. The boulders are usually rounded, which distinguishes them from those occurring on the Gloucester stony sandy loam. They are, however, of the same rocks, consisting of different kinds of granite, gneiss, and schist. They vary in quantity, but in general are less numerous than on the other upland type of soil. Many of the boulders have been removed from the fields and used in building walls.

The Gloucester stony loam is found in practically all the towns of the county, but usually in rather small, irregular-shaped areas. The towns in which some of the largest areas occur are Pembroke, Pittsfield, Northfield, Salisbury, Webster, and New London.

The Gloucester stony loam is an upland type, occupying as a rule the smooth, rounded, or rolling tops of the hills and extending partly down the slopes. It occupies also many of the lenticular or drum-linoid hills that abound in the county. Its position insures good surface drainage. The compactness of the subsoil and presence of the underlying boulder clay aid materially in making the soil retentive of moisture and resistant to drought. Even in dry weather the soil and subsoil contain enough water to make them feel moist.

The Gloucester stony loam is derived from the finely ground moraine, denoting severe and long-continued ice action. The interstitial material is fine and the boulders well rounded.

The deciduous trees predominate in the forest growth, and among these the sugar maple and other maples are prominent. The oak, elm, birch, and butternut are also plentiful.

The Gloucester stony loam is the most productive soil in the county and the one best adapted to the crops grown in this region. Corn produces well, yielding where fertilization is practiced 30 to 60 bushels per acre. The yield of timothy hay ranges from 1 to 3 tons per acre, the average being about 1½ tons in the two cuttings generally secured in this county. Clover is also said to grow well on this soil, provided it is not winterkilled, which in this particular case is apt to occur more through the fault of the climate than of soil. Apples do especially well, and more orchards should be planted on this type. Irish potatoes yield about 200 bushels per

acre, and beans are grown to some extent. Oats make good growth for this locality, but being cut for hay and not thrashed no yield of grain can be stated. Some fields of barley were observed, but the yields were not promising.

The cultural methods employed on this type do not differ from those given the other soils, except that possibly grass is left for a longer period. The rotation is generally corn, followed by potatoes, then possibly oats, followed by grass, several crops of hay being cut and the land then left in pasture a year or two. It would be better if the rotation was made shorter. Certain parts of the type where location is suitable should be devoted to apple growing and the stoniest areas should be allowed to revert to forest. Fertilizers are used on this as on the other soils and in like amounts. It is a fairly retentive soil and can be improved readily.

Some of the best farms are located on the Gloucester stony loam. Good dwellings and outbuildings are seen, and there is evidence in general of prosperous conditions. There are, however, abandoned farms on this type as well as on other types, though in most cases the cause is not entirely a question of the soil. The value of the Gloucester stony loam would probably average \$20 per acre, including woodland and rough pasture land.

The average results of mechanical analyses of typical samples of the Gloucester stony loam are given in the following table:

Mechanical analyses of Gloucester stony loam.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14731, 15928, 15930..	Soil	3.7	10.8	6.4	17.4	17.4	29.0	14.7
14732, 15929, 15931..	Subsoil....	4.1	11.8	6.6	18.3	19.1	27.2	12.3

GLoucester Stony Sandy Loam.

The soil of the Gloucester stony sandy loam consists of 8 inches of medium to fine sandy loam of light to dark-brown color, underlain to an average depth of 18 inches by medium to fine yellow sand or sometimes light sandy loam. In some locations the soil is nearly a sand or rather loamy sand, particularly in those areas occurring on the lower slopes along the Merrimac River that have been influenced by wind-blown sand from the Merrimac sand areas. The subsoil is also somewhat deeper and less stony. In the more level or gently sloping areas the soil and subsoil approach that of the Gloucester stony loam, and it is difficult to separate the two types. Small flakes of mica are generally present in both soil and subsoil.

Scattered over the surface and in the soil and subsoil and becoming more abundant at a depth of 20 inches, are glacial boulders of all

sizes, mostly angular or subangular. There is also more or less gravelly material present upon the surface and throughout the profile. In the cultivated fields the most of the small stones and bowlders have been picked up and built into walls or fences around the fields.

The Gloucester stony sandy loam is found to some extent in practically all parts of the county, but its greatest occurrence is as a broad broken belt in the central portion along both sides of the Merrimac River and extending back some distance from that stream. The town having the largest extent of this soil is Pembroke. It is also a prominent type in Concord and Boscawen. The areas as a rule are irregular and not continuous, being broken by areas of Gloucester stony loam and Rough stony land.

The Gloucester stony sandy loam is an upland type of soil occupying the slopes and tops of the hills. Usually the surface is smooth or gently rolling, as a result of glaciation, but there are many areas along valley escarpments where the surface is very uneven, consisting of hills or piles of stony and gravelly glacial material, which are evidently of morainal origin.

The Gloucester stony sandy loam is a well-drained soil, as might be expected from its topographic position and the sandy texture of the soil and subsoil. Water passes through it readily, and while it is not very drought resistant the subsoil generally is compact enough to hold water to some extent, so the type as a whole is fairly retentive of moisture, although it does not equal in this respect the Gloucester stony loam.

The Gloucester stony sandy loam is also of direct glacial origin. It appears to be derived from the material known to geologists as the upper till, which was carried upon and in the ice and not subjected to the great grinding process giving rise to the lower till. There is a more or less distinct line of demarcation between the two materials. There was no arrangement in deposition of the surface till. It consists of sands of all grades, but mostly fine, mingled with gravel, stones, and bowlders of all sizes. A distinguishing feature of this type is the more or less general angularity of the bowlders, while those of the ground moraine giving rise to the Gloucester stony loam are more rounded. The weathering that has occurred in this till since deposition has been disintegration rather than decomposition, although both forces must have operated. Weathering has not proceeded far enough, however, to produce clay, as the particles are still almost entirely of the different grades of sand. The rocks from which the glacial debris has been derived are, like those underlying the area, igneous and metamorphic, comprising different varieties of granites, gneisses, and schists. Bowlders of these different rocks are scattered indiscriminately over the areas, although in some places there may be a preponderance of any one kind.

The natural forest growth on the Gloucester stony sandy loam is that found on the uplands throughout the county. The white pine is somewhat indigenous to this soil and occurs in areas to the practical exclusion of all other trees, and a pine forest seen on the uplands generally indicates the presence of this type of soil rather than the heavier type, the Gloucester stony loam. However, the rough, stony areas where the soil is similar to that of the Gloucester stony loam also supports a considerable proportion of this pine.

All the crops of the area are grown on the Gloucester stony sandy loam. Corn yields about 50 bushels per acre where fertilizers and manures are applied, and this is rarely neglected. The soil seems to be fairly well adapted to corn, and as good crops were seen on this type as on any other in the county. Some oats are grown, as well as the grass crops. The average yield of hay is not as high as on the heavier upland type, but may be considered fair. Apples do well, and are generally grown more or less extensively on every farm. It can not be called a strong soil, its natural productiveness being low, but by the use of fertilizers and large quantities of manure good crops are produced.

The cultural methods practiced on this soil do not differ materially from those in vogue throughout the area. With the stones removed, it is an easily cultivated soil. A shorter crop rotation would no doubt be beneficial and more profitable. It should not remain in grass so long without cultivation and should be reseeded oftener, thereby getting larger and better yields. The difference in value of the two upland types is so small that the condition of the particular farm is usually the deciding factor. The price of the Gloucester stony sandy loam ranges from \$10 to \$25 or more an acre, depending on the improvements, the extent of cleared land, of pasture, and of woodland, and its general condition.

The average results of mechanical analyses of typical samples of the Gloucester stony sandy loam are given in the following table:

Mechanical analyses of Gloucester stony sandy loam.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14958, 15932, 15934..	Soil	1.3	8.5	6.9	24.9	26.8	23.0	8.5
14959, 15933, 15935..	Subsoil....	2.0	9.7	9.1	27.7	29.9	16.5	5.1

ROUGH STONY LAND.

The Rough stony land includes those areas so rough and stony as to make cultivation very difficult or impossible, yet having enough soil to support forest growth or to offer when cleared some grazing. Extremely stony areas in the upland soils have been included under Rough stony land, which thus represents a condition rather than a

textural separation. The areas range from those having a very shallow soil, consisting of nothing more than sand of yellowish color or even in some cases coarsely disintegrated rock, to others having as the interstitial material a sandy loam or loam. The capacity to support vegetation varies accordingly. Occasional areas of small extent—an acre or two—are found on which cultivation can be profitably carried on, and such areas had they been larger would have been included with one or the other of the upland types. This land is distinguished from the Rock outcrop because the latter consists entirely of outcropping ledges without sufficient soil to support tree growth or any vegetation, except, if at all, of a sparse and stunted character.

The Rough stony land occupies the larger part of the county. The largest unbroken areas are along the lower eastern boundary of the county, covering the small mountains and hills in the towns of Epsom and Allenstown. The greatest development, however, is throughout the western half, where the county is more broken and mountainous. Land of this character occupies both the tops and slopes, though often the summits of the hills are less stony and are cleared, while the slopes are too stony to justify clearing. The soil is believed to be partly residual and partly glacial in origin.

The better areas of the Rough stony land are adapted to pasturage, and some limited areas of it could be used to advantage in orcharding, as apples of fine quality could be produced. The rougher portions should be left in forest, and wherever possible a growth of white pine should be encouraged, as it makes the quickest growth and is the most profitable timber. Except where there is a good forest growth the Rough stony land is of low value, and as it is found to a greater or less extent in all sections of the county it reduces the price obtained for the average farm.

ROCK OUTCROP.

The term "Rock outcrop" is used to designate those areas consisting entirely of bed rock exposed on the surface. Such areas are incapable of supporting any save the most sparse and stunted vegetation. Areas of this description occur on the tops of Kearsarge, Ragged, and Sunapee mountains, and extend down the slopes to some extent. A little dwarf spruce, with some hemlock and pine, is scattered over the surface wherever the roots find a crevice in which to grow.

MERRIMAC GRAVELLY SANDY LOAM.

The soil of the Merrimac gravelly sandy loam ranges from a gray or light-yellowish medium-textured sand to a light-brown loamy sand or sandy loam with an average depth of 12 inches. The texture of the surface material is thus somewhat variable, becoming finer in places, though the coarser grades of sand more often predominate.

Some fine gravel is encountered in the soil and upon the surface. The soil rests upon gravelly beds composed of rounded, waterworn gravel varying in size from small pebbles to large cobblestones. The interstitial material, of which there is relatively a small quantity, consists generally of coarse, yellow sand.

The Merrimac gravelly sandy loam is found in every town in the county, occurring along most of the streams. The topography is hummocky, small hills of gravel with uneven surfaces alternating with depressions or kettle holes. The texture of the soil and of the underlying loose, porous material promotes rapid and thorough drainage and the type is leachy and droughty.

The Merrimac gravelly sandy loam belongs to the class of soils derived from modified glacial drift—glacial material reworked and deposited, as indicated by the coarseness of the materials, by swift-flowing water. This deposition took place at the close of the Glacial epoch, when the ice was melting and large volumes of water were given off.

The forest growth on the Merrimac gravelly sandy loam consists of a heavy growth of pitch and white pine, the former predominating, with a lighter growth of birch, oak, and other deciduous trees. Beard grass is another distinctive plant on this soil.

The general farm crops of the area are grown on this soil, but as a rule it is not a desirable type to cultivate, the open, leachy nature of the subsoil causing it to be subject to drought. Like all the sandy terrace soils, continued applications of fertilizers and manures are necessary in order to secure fair crop yields. But with its finer surface soil, especially when made loamy by the incorporation of organic matter, it is a much more productive soil than the Merrimac coarse sand. In some locations fairly good farms were seen on this type, especially so where the farms are in a zone of gradation between the terrace and the better upland types adjoining. In many cases this soil is better adapted to truck crops than to general farm crops, its drainage insuring warmth and earliness. Some apple trees seen on this soil seemed to be doing well. The greater part of this type should be used for forestry purposes, as pine thrives upon it. Its agricultural value is low, except in certain desirable locations near streams.

The average results of mechanical analyses of typical samples of the surface soil are given in the following table:

Mechanical analyses of Merrimac gravelly sandy loam.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
16945, 16946	Soil	<i>Per cent.</i> 9.4	<i>Per cent.</i> 24.6	<i>Per cent.</i> 9.4	<i>Per cent.</i> 16.9	<i>Per cent.</i> 14.2	<i>Per cent.</i> 18.9	<i>Per cent.</i> 6.3

MERRIMAC COARSE SAND.

The surface soil of the Merrimac coarse sand varies from 4 to 10 inches in depth, with an average of 8 inches, and consists of a yellowish coarse sand to dark-brown coarse loamy sand. The subsoil consists of a yellow coarse sand usually resting at an average depth of 20 inches on a stratum of generally white, waterworn quartz gravel. This gravel sometimes comes within a few inches of the surface, and again is not found within the 36 inches of the profile. Both soil and subsoil are composed largely of coarse and medium sands with very little of the finer grades, but both often contain a high percentage of fine gravel. It is a type easy to cultivate because of its coarse texture and rather loose structure.

The Merrimac coarse sand occurs on the sand plains along the Merrimac River and some of the other larger streams of the county. The most extensive area occurs as the "sand plain" across the river from Concord. Other large areas occur along the lower course of the Contoocook River and also along the Blackwater and Warner rivers. There are smaller areas, one of which is at the lower end of Webster Lake. Along the Merrimac River it occupies high, broad, flat terraces, which are in most cases 100 feet or more above the river. Along the Contoocook and other smaller streams it occupies generally broad terraces elevated but a few feet above the streams. It is not marked by any very perceptible elevations in the areas themselves, for in that case the soil would be so gravelly as to be included in another type. Its elevation, coarse texture, and rather loose structure allow the water to pass through it so readily that it is subject to conditions of extreme drought.

The Merrimac coarse sand is of glacial origin, being evidently a deposit of reworked drift in shallow water, as indicated by the extent and the coarseness of the materials. Its occurrence is always marked by the predominance of pitch pine in the forest growth, which is not, as a rule, large, and by scrubby oak bushes. Where such lands are burned over blueberries take hold. The whole appearance of the land indicates that it can support only a scant vegetation.

Very little of the land of this type is cleared, but where cultivated the general crops of the area are grown. Good yields are not secured, and only by heavy fertilization is a paying crop produced. Beans and potatoes do fairly well, and other light-truck crops could be produced by proper fertilization, as it is a warm soil and easy to till. Its value as a trucking soil, however, is much lower than the other sandy terrace soil, and only the better parts should be cultivated.

The average results of mechanical analyses of typical samples of this soil are shown in the table on page 60.

Mechanical analyses of Merrimac coarse sand.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14941, 15943.....	Soil	6.2	40.5	18.6	14.1	5.1	8.7	7.0
14942, 15944.....	Subsoil.....	9.1	41.6	18.0	13.4	5.4	6.7	5.0

MERRIMAC SAND.

The soil of the Merrimac sand consists of a gray, or, where organic matter has been added through cultivation, of a light or dark brown medium textured sand. The subsoil to depths greater than 36 inches—the limit of the profile—is a yellowish sand of very much the same texture and composition as the surface material. There is usually a noticeable proportion of fine sand in some areas occupying higher elevations, where more or less wind-blown material has accumulated, and a somewhat similar variation in texture was observed on lower terraces in areas adjoining the Podunk fine sandy loam. In some places the soil tends to the other extreme, approximating a coarse sand in texture and carrying some gravel. There are also found underlying this formation, at a depth generally several feet below the surface, where they have no influence on the soil, deposits consisting of pockets or strata of drab and blue clays. These upon examination are found to contain a large percentage of generally fine sand. The type, as a rule, is incoherent and only becomes slightly coherent where enough organic matter has been incorporated to make it loamy.

The Merrimac sand occurs along streams, ponds, and lakes. Its greatest development is along the Merrimac River, especially on the east bank from Concord to the northern boundary of the county. It forms the terraces, from the one next to the first bottom to the very highest, merging into the uplands about 200 feet or more above the river. Where terraces are distinct the areas are usually narrow. They generally have a sloping surface and are often marked by small hillocks, which are wind blown or the result of erosion. Rarely does the type occur in flat areas of any extent. Being loose and incoherent, the drainage is very rapid and its water-holding capacity is low.

The Merrimac sand is another of the types derived from modified glacial drift. The terraces, which this type forms, were the old flood plains of the streams along which the reworked glacial material was deposited. They have since been modified by wind action, particularly on the east side of the Merrimac, the wind piling the finer material high up the slopes of the uplands.

The characteristic native vegetation on the Merrimac sand is white pine and coarse grasses. Pitch pine is found to some extent, and on

the better areas some of the deciduous trees. The white pine thrives on this soil and attains a good size.

Little of this type is under cultivation, but the better areas are devoted to corn and grass. To the latter crop it is not particularly well adapted, yet fair meadows were seen upon it. Corn does fairly well, though not so well as on a more retentive and less droughty soil. Apple trees make a fair growth and yield moderately, but the type can not be considered a desirable soil for tree fruits. It is, however, well adapted to early truck crops, which should be more extensively grown than at present. The drainage is thorough, and the soil is warm and early for this locality, and on the better portions of the type light truck should be grown. The local markets, hotels, and boarding houses during the summer season secure most of their vegetables in the Boston markets, and there would seem to be an opportunity to supply this trade by utilizing the better areas of this type of soil in the production of all kinds of market-garden crops. The undesirable portions of the type should be allowed to revert to white pine, or if necessary should be planted in this tree, which is now a most valuable timber. The income from this source, although not immediate, would eventually be much greater than is the case where such areas are devoted to annual crops.

Large quantities of fertilizers and manures are used by the farmers cultivating this type of soil, and they find it necessary in order to maintain the yields to make applications of one or both before each planting. The lands where cleared are not in demand even at the low ruling prices, but where covered with a good growth of white pine they are highly prized.

The results of mechanical analyses of a sample of both soil and subsoil are given in the following table:

Mechanical analyses of Merrimac sand.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14939.....	Soil	0.6	7.8	21.4	52.6	10.5	3.2	4.1
14940.....	Subsoil.....	.4	13.3	27.9	42.4	9.9	3.2	3.1

PODUNK FINE SANDY LOAM.

The Podunk fine sandy loam consists of a dark-brown fine to very fine sandy loam, with a depth of 10 inches, underlain by a fine silty sand of yellowish color, extending to a depth of 36 inches or more. Sometimes the first few inches of the subsoil is a little lighter in color grading gradually into yellow, and in such areas its texture is, if anything, somewhat heavier than the typical profile, approxi-

inating a light fine sandy loam, but the material in all cases very quickly grades into a true fine sand. Both soil and subsoil usually contain more or less finely divided mica. While in most cases the fine sand subsoil persists to depths of 36 inches or more, an occasional bed of gravel or coarse sand is encountered within the limits of the profile. In some places the surface soil of small areas is a fine sand or loamy sand, and again, in lower situations and depressions, it becomes quite silty, approaching a silt loam. In all cases the soil is friable and easy to cultivate.

The Podunk fine sandy loam occurs practically without interruption along the entire course of the Merrimac River and in a few small, narrow strips along some of the other streams. It occupies without exception the first bottoms, locally known as the "intervalles," and occasionally the low second terraces. The area along the Merrimac, which is by far the most important occurrence, varies in width from a few rods in the narrowest places to fully a mile or more in other places, the greatest development being in the vicinity of Penacook and Concord.

The bottoms are generally flat or very slightly undulating. They probably lie from less than 10 to more than 20 feet above the river, and the drainage is generally good, the sandy texture of the soil allowing the ready passage of water. In fact, the greater part of the type is considered leachy and the best moisture conditions do not always prevail. The lower lying areas, however, are inclined to be wet and require drainage. Where areas are too wet for cultivation they have been included with the type mapped as Meadow.

The Podunk fine sandy loam is of alluvial origin and represents the most recent flood plain of the streams. At times of high water the type is subject to overflow, but this does not occur in every year. Great damage is done to these bottoms by the cutting away of the banks by the stream and also the changing of the stream channel, which has happened often in the past along the Merrimac, as old troughs and ponds now indicate.

With the exception of small areas cleared by the Indians and either cultivated or covered by a growth of coarse grasses, the bottoms when found by the white settlers were forested with oak, elm, maple, birch, and other trees, occasionally including some pine. They are now, however, entirely cleared and devoted to grass or corn. The former grown for hay is the principal crop. Timothy is the variety most largely used, but there is also a native grass, known as "quitch" grass, which flourishes on this type. The latter is not so desirable, nor does it yield so well as timothy. Although this soil gives heavier yields of hay than any of the other types in the area, yet the farmers find it necessary to fertilize and manure the fields in order to secure

the large yields. Corn is grown to some extent and where fertilized gives very good yields.

The methods of cultivation employed on this type of soil differ little from those used on other types of the area. It is, however, easier to cultivate and has a surface which allows the extended use of all farm machinery required in the cultivation and harvesting of the crops grown.

It is said that in the early days these bottoms were subject to annual overflow, and that with fresh deposits of fine sandy and silty material containing more or less organic matter the productiveness of the soil was maintained without the use of manures. But now it is claimed to be necessary to fertilize these bottoms, since they are not overflowed so often and where overflowed do not receive the same character of material they did when the land was mostly forested and virgin. Stable manure in conjunction with 200 or 300 pounds or more of chemical fertilizers per acre is now generally used to maintain good yields on these bottoms. It is said that the soil deteriorates decidedly when cultivated for four or five years without fertilization. It would seem wise to grow more corn and rotate the crops oftener. Increased yields of hay would be obtained by starting new meadows rather than trying to keep up the old ones when the grass has run out.

Agriculturally, the Podunk fine sandy loam is an important and valuable soil and none of it is on the market.

The average results of mechanical analyses of this soil are given in the following table:

Mechanical analyses of Podunk fine sandy loam.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14978, 15937, 15939..	Soil	0.1	0.7	0.6	15.0	35.7	41.4	6.5
14979, 15938, 15940..	Subsoil....	.0	.3	.5	26.5	38.5	30.1	3.8

PODUNK SILT LOAM.

The Podunk silt loam consists of about 12 inches of dark-brown silt loam or heavy loam, underlain by lighter colored silt loam grading into drab and yellow mottled silt loam, which in turn at an average depth of 20 inches rests upon a very compact fine sand of a drab color. Throughout the soil and subsoil is found finely divided mica, which makes the material feel slightly greasy.

There are only two small areas of this type. These occur, in the immediate vicinity of Concord, as level depressed areas on the river terraces next the higher lands, the smaller one being on the lower terrace or high first bottom and the other on a still higher terrace.

The impervious nature of the material underlying this soil prevents the percolation of water, and in consequence the areas are wet a large part of the year. Drainage is necessary and is accomplished both by open ditches and covered drains.

The Podunk silt loam is an alluvial soil, the silt and fine sand composing the type being laid down in still water. This material is probably of comparatively recent deposition, since it overlies the fine sand of the terraces deposited probably at the close of the Glacial epoch.

All of the type is now cleared and under cultivation, but it was probably covered originally by a heavy forest growth. Being a wet soil it is naturally best adapted to grass crops, and it gives large yields of hay. Hungarian grass observed in one field made an extra large yield. Where moisture conditions are good large crops of ensilage are produced. On one of the areas is located a truck garden, producing especially large crops of onions and celery. More of this land should be devoted to truck crops, as good returns would be realized.

Fertilizers are used as on all the other soils in order to produce the best yields.

The farms on this type of soil indicate prosperous conditions, the land being desirable not only because of its crop-producing value, but because of its proximity to the city of Concord.

A mechanical analysis of a typical sample of the Podunk silt loam is given in the following table:

Mechanical analyses of Podunk silt loam.

No.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14980.....	Soil	0.5	2.1	1.3	6.4	20.4	51.4	17.7
14981.....	Subsoil.....	.1	.5	.3	2.8	27.1	58.3	10.5

MEADOW.

The wet areas in depressions and along streams and ponds, supporting a growth of coarse grasses and in some places bush and tree growth, have been mapped as Meadow. Nearly all these areas could be drained and used for the production of hay, large yields of which are secured where drainage, either surface or underdrainage, has been undertaken.

The soil is variable, but in general consists of gray or drab sand of medium to fine texture, grading into true sand, usually of compact structure, medium texture, and lighter color, often white. Often there is sufficient organic matter in the first few inches of soil to make it loamy, or in some instances mucky, but these mucky as well as swampy portions of the type are too small in extent, generally

being not more than a fraction of an acre, to be mapped as a separate soil type.

Meadow is found both in the uplands in depressions and in the valleys as narrow strips along the smaller streams and around ponds. It is not an extensive or important type in this area. It is the result of lack or obstruction of drainage. The drier portions produce large hay crops, and the more mucky areas, if drained, would be desirable for the growing of onions and celery, though of very little value in their present condition.

SUMMARY.

Merrimack County lies in the south-central part of the State and embraces an area of 590,464 acres, or about 922 square miles. The county was organized in 1823, and, according to the census of 1900, its population numbered 52,430.

Concord, the county seat, as well as the capital of the State, has a population of 20,000. Other important towns of the county are Franklin, Hookset, Pittsfield, Suncook, Penacook, Contoocook, and Henniker.

The surface features of the county consist of the hilly and mountainous uplands and the troughlike valleys of the Merrimac River and its tributaries. Along the Merrimac occurs a series of terraces. A large number of lakes and ponds are found within the limits of the county. The area is drained for the most part by the Merrimac River and its tributaries. The streams afford much fine water power, a good deal of which has been developed.

The climate is marked by extremes of temperature. The winters are long and cold, the mean temperature for four months in winter averaging below the freezing point. The summers are short and cool, though marked by brief periods of extreme heat. The average mean temperature for the summer months is about 67° F. The average for the year at Concord is 46.1° F., and at Grafton, which is situated a few miles to the north outside of the county, is 42.6° F. The average precipitation is about 40 inches. The average growing season for the tenderest crops is about four months.

Settlement of the area now included within Merrimack County was begun by some of the early Puritan stock in 1727, at what is now Concord, but then called Pennycook. Other settlements were made a little later by the Scotch-Irish and others from Great Britain. In recent years many French Canadians, Norwegians and Swedes, Danes, and Poles have settled in the county.

The production of the staple crops was higher in 1840 than has been reported by any census since that time. Wheat, rye, oats, buckwheat, and potatoes were at their maximum production and the total yield of hay and corn but little less than now.

The decline in agricultural production has been most marked since 1880, and areas formerly cultivated have been allowed to grow up in forest. With the abandonment of the cereal crops, no new crops were introduced to take their place. Owing to the hilly and stony character of the land, the growing of the cereals was always more or less difficult, and these crops were not sufficiently remunerative to justify their continued production when brought in competition with the new West. Another discouragement was the inducement offered to labor by the various manufacturing industries.

General farming, together with dairying and stock raising, was the usual practice for a considerable time, but when the cereal crops were abandoned dairying became still more important. Prior to 1890 the dairy product was put on the market in the form of cheese and butter made in the home dairies, but with good transportation facilities and the increasing demand for milk in the cities milk in large quantities is sold daily, while the butter product has decreased.

The largest crop produced is hay. Timothy and redtop are the principal grasses, but millet and Hungarian grass and some clover are grown. Wild grasses are also cut for hay. Corn is the principal cultivated field crop, the annual yield ranging from 150,000 to 200,000 bushels, but the larger part of this crop is cut for silage. The acreage in potatoes is about one-half that of corn. Oats, barley, and buckwheat are still grown to a small extent.

As a rule no extensive orchards exist, though apples are grown practically on every farm. The variety in highest favor is the Baldwin, which originated in the lower Merrimac Valley. A large proportion of the land is suitable for apple orcharding, but other tree fruits do not do well, the climate being too severe.

Some of the soils of the area are specially adapted to vegetables and truck crops, but these are not grown in sufficient quantities even to supply the local markets. The chief income from the farms is from the sale of dairy and poultry products, mostly milk and eggs. Boston is the principal market, though good local markets are afforded by the factory towns, and in the summer months by the resort hotels and boarding houses.

The adaptation of soils to crops is not recognized, nor is a crop rotation systematically followed, although the general intention is to rotate the two main crops, corn and grass, growing two crops of the former followed by two or three years of grass for hay and then for pasturage.

Exclusive of Rock outcrop, Rough stony land, and Meadow areas, seven distinct types of soil were recognized and mapped. These are all derived from glacial drift. They may be divided into two groups, depending upon whether derived from unmodified or modified drift.

The upland soils are those derived from the weathering of the drift as laid down and are more or less stony.

Rock outcrop and Rough stony land cover a large part of the county, and their names truly describe their character. The former is of no agricultural value whatever, while the latter, though too rough and stony to cultivate, is of value for forestry and when cleared for pasturage and fruit growing.

The two upland types of soil—Gloucester stony loam and Gloucester stony sandy loam—represent the areas where the bowlders were less abundant and have been wholly or partly removed so that cultivation is practicable. They are light-textured soils, and the last-mentioned type, the stony sandy loam, is in part a modification of the former, due to the influence of sand blown from contiguous sandy areas in the valley. These soils constitute the farming lands of the county. They are of moderate fertility, and their productiveness has been increased and maintained by the use of barnyard manure and commercial fertilizer. They are particularly well adapted to grasses for hay and pasturage and to fruit, especially apples.

Occupying the valley terraces are the modified drift soils, varying from coarse gravelly sands down to silt loam, five types being recognized. The two finer textured types, Podunk fine sandy loam and Podunk silt loam, are of recent alluvium and form the most productive and highest priced lands of the area. They are particularly well adapted to grasses and corn. The coarser soils of the Merrimac series are generally not as desirable, but where cultivated are made to produce the same crops as the heavier and better adapted uplands. They are especially well adapted to truck crops. The natural forest growth is white and pitch pines.

The farmers in general are in a fairly prosperous condition. They have good dwellings and well-built, warm barns for live stock. They have, however, three items of expense in the management of their farms that materially decrease their net income. These are high cost of labor, the cost of fertilizer, and the cost of feed brought into the county. Farm labor is scarce and commands high wages. Foreigners are employed as much as possible. The fertilizer bill should be reduced by making smaller applications, and this item and the cost of feed can be met partly by the introduction of new crops, particularly a legume. Forestry, orcharding, poultry and sheep raising should receive more attention. Besides these, garden products, which are in demand at good prices, should be produced more extensively and efforts made to supply the home demands as far as practicable. The prospects are, however, encouraging, and the farmers of this county have plenty of opportunity to better their condition.

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