THESIS

SOIL SURVEY OF THE BARRON FARM IN THE TOWN OF MOUNT MORRIS, LIVINGSTON COUNTY, NEW YORK.

JOHN H. BARRON, '06

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BY

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Location.

The Barron farm is situated in Livingston county, New York, in the southern part of the town of Mount Morris. The farm lies about four miles east of the middle part of the Genesee River gorge, and is just west of the Keshequa Creek. It is located on a north and south road known as the Creek Road, about four miles north of the village of Nunda and seven miles south of the village of Mount Morris, and one and one half miles west of the station of Tuscarora. The farm contains two hundred and seventy five acres.

LOCAL HISTORY.

Long before North America was discovered Western New York was inhabited. In Western and Central New York existed the great Iroquois Indian confederacy composed of the following tribes, Oneidas, Onadagas, Mohawks, Cayugas, Senecas, and later the Tuscaroras. The Senecas roamed from Seneca Lake Westward to the Niagara River. Consequently the territory now under discussion was under their control. The tribe was very large and strong. They had many villages and a large portion of these were in the Genesee county. In the dense forests of the uplands they pursued the game that gave them a large part of their sustenance and in the lower, more fertile, less forested, and open lowlands along the streams near which their towns were located, they practiced Agriculture. Apples flourished, as also did corn, potatoes, and beans. The Seneca Indians did not live by themselves alone, but they were an active and strong force in the councils of the Iroquois nation. When war was declared, they went to the front, and their enimies trembled not only because of their great number, but also because of their sagacity, fearlessness, and blood thirstiness.

The county of the Senecas early became known to the Europeans. At first French Missionaries came to the Indians to instruct them in the Gospel. But soon the acquaintance of the French with the Iroquois was to be of an entirely different nature. In 1609 Champlain, near the lake that bears

his name, with a party of Frenchmen and Canadian Indians attacked a small body of Iroquois. By this act he secured for the French interests the undying hatred of this great confederacy, and as it later proved this was an important factor in putting an end to the ambitions of France in the Western Hemisphere. The English on the other hand secured the friendship of the Iroquois. They furnished them with arms and ammunition, and so won their friendship that during the long series of French and Indian wars they always had powerful allies in the Iroquois, against the attacks of France.

Being encouraged by his first victory over the Iroquois Champlain in 1615 again marched into their territory this time directing his attention to the Onondaga strongholds. At first he was successful, but as the advance was continued the Indians gathered together in a great fort, and finally repulsed the French Army. The exact location of the fort and battle ground is a matter of controversy, Some historians claim that it is in the vicinity of Canandaigua Lake, in Ontario county, while others in trying to make Champlains' description fit a locality and for other reasons say that it is further East, probably in what is now Madison county. Suffice it here to say that this action further incensed the Indians, and fanned into flame the hatred of the Iroquois for the French and their allies. So great was this hatred, that any one who was the enemy of the French was the friend of the Iroquois.

For the next seventy five years there was an almost constant warfare between the Iroquois and the French. The Indians made raids into Canada, killed the settlers, destroyed the crops, and more than once brought the Colonists to the verge of famine. At one time the French became so disconsolate that they called upon the Massacheusetts colony for aid. But the English having nothing to gain and all to lose by such a compact would not enter into a combat with a friendly Indian nation, who as friends were faithful, but who, as enemies, were almost irresistable.

In 1684 a party of Senecas pillaged seven hundred French canoes, and took several prisoners. M. de la Barre, who was then governor of Canada made preparations to punish the Senecas for their insolence. Just as soon as he reached the Seneca country he received the report that the Governor of New York had promised aid to the Indians in case of an attack. On account of his alarm, and the great amount of sickness in his army he returned to Canada, without having done anything.

The next year Denonville superseded M. de la Barre, After looking over the situation carefully he came to the conclusion that the Indians must be punished severely if the French were to keep any prestige. He estimated that the Seneca nation could muster 1200 warriors, He said that they were the strongest and the most insolent of the five nations, and that the French could never subjugate them except they surprise them.

In the summer of 1687 he fitted up a great expedition consisting of two thousand French and Indians, whose prime object was to punish and avenge the Senecas. Denonville arrived at Irondequoit Bay early in July, and began great destruction. Great devastation continued for a period of ten days after which Denonville withdrew to the Niagara River region. Indian towns were destroyed, the old men, women and children who had been left in the deserted villages were cruelly butchered and crops were devasted. The expedition covered a large stretch of territory, and great havoc was wrought among the Indians in Northern Livingston county. Aside from large quantities of beans, Denonville estimated that the army destroyed about 400,000 minots of corn.

During the following years until the Revolutionary war there were many attacks by the Iroquois upon the French, and vice versa. Missionaries were at all times among the Indians. All these circumstances resulted in the lands of Western New York becoming known more or less to Europeans, but very little progress was made toward their settlement because of the insecurity of the times.

During the Revolution, the Iroquois were for the most part, the allies of the British, and a source of danger to the colonists. Many an unprotected household on the frontier suffered severely from the attacks of these savage marauders. In 1779 after being earnestly exhorted by the frontier colonists

and after a long list of Indian atrocities in the border settlements of New York and Pennsylvania, including the bloody affairs at Wyoming valley, Cherry valley, and Minnisink, congress determined to punish the Indians. The expedition was fitted and the command given to General Sullivan. The objects were the destruction and total devastation of the Indians and their settlements, as well as those of their adherents and associates, and the capture of as many prisoners of either sex as possible. The expedition was directed especially against the country of the Senecas in Central and Western New York where the tories and their allies made a place of rendevous and from which issued forth many a band of steathily prowling savages and no less blood thirsty tories to visit death upon the defenseless forms of the colonists on the frontier.

During July the army assembled at Wyoming, Pennsylvania and on the thirty first of the month set out its long march. Sullivan, with his thirty five hundred men marched up the Susquehanna valley, and at length he arrived at Tioga Point. Several days were spent in the Chemung valley, during which several skirmishes were fought, and no inconsiderable damage done to the Indians. On August twenty sixth the army moved upon Newtown, (Elmira). A body of Indians and tories under Butler of the British army was here encountered. The ensuing battle lasted for two hours, and , finally was won by the American army. Sullivan encamped for a few days, destroying the town and crops.

He then took up his march and, soon came to Catherinstown at the head of Seneca Lake. The town containing about thirty houses was burned, the orchards and the growing crops of beans, corn and other vegetables destroyed. Detachments were sent out in all directions to extend the devastation which was most thorough. The army now slowly moved north along the east side of Seneca Lake. Arrived at the northern end of this body of water they found several towns, among them Appletown, which contained some apple trees, the remains of some of which may be seen to-day. All the towns and the outlying cultivated fields were destroyed and laid waste. The army now turned westward, and in a short time came upon the present site of the village of Canandaigua. A village containing several large houses, and large cornfields ~~which were~~ laid waste. The General then marched on to what is now Honeoye. This was a small village. Here he left a small part of his army, taking the remainder with him in serch of Chenussio, the great town of the Senecas which was near the present Geneseo. The army moved up the east side of Conesus Lake, near its head the enemy under Butler were encountered. Here a small detachment of the army was separated, and destroyed, the prisoners taken, being moved to a nearby Indian town and tortued to death. At last Sullivan had reached his goal and great was the

havoc that he wrought. Two great towns near the Genesee river were destroyed , and the fields laid waste. His work finished Sullivan now quickly withdrew, rejoined his detachment previously left behind, and returned to Wyoming by the way of Cayuga lake and Ithaca.

The results of the campaign were satisfactory. A great army had entered the Seneca country, and forever broken the power of that great tribe. But there was also an important local effect. The men in Sullivan's army who had seen the Genesee country were pleased with it and wished, after the war, to return to it to settle. They were impressed with the productiveness of the country. At the great Seneca town alone 15,000 bushels of corn were destroyed, in addition to apple trees, beans, and other crops. The troops had never before seen such corn, some of the ears being reported as having a length of twenty two inches. In addition to this there were open glades along the river flats which gave proof of great fertility. Not only were they covered with herbage, which was very large, luxuriant, and excellent for the animals but the cultivated areas gave proof of great productiveness.

As soon as the war was over there was a demand for western lands. But New York and Massacheusetts were in dispute over these very fertile districts, The disputes were finally settled by giving to New York, soverignty over the

lands which comprised all that part of New York west of a line extending due north from the eighty second mile stone on the Pennsylvania border west from the north east corner of that state, and by giving to Massacheusetts the right to preempt the soil included here in from the native Indians.

In 1788 Phelps and Gorham purchased this preemption right thus acquiring about 8,000,000 acres. They were, however, unable to fulfill all the requirements, and later in 1790 about half of the purchase reverted to Massacheusetts. Phelps and Gorham retained the eastern part of the lands originally purchased. The western boundary being a north line 44.78 miles west of the eastern boundary, to the confluence of the Canas ER aga Creek and Genesee River, thence following the river to two miles north of Cana W agus, thence west twelve miles and thence north twenty four degrees east to Lake Ontario. The purchase then did not include the town of Mount Morris, it being situated to the west of it. Through Robert Morris most of this tract was sold to a company of London capitalists who opened the whole for settlement. The Wadsworths' procured a large portion of the remainder of the purchase directly from Phelps and Gorham.

In 1791 Robert Morris Procured the reverted portion of the Phelps and Gorham purchase, and in 1793 he sold the western portion consisting of seven eights of the

whole to the Holland Land Company. Between the purchase of the Holland Land Company and the Phelps and Gorham purchase was a tract of twelve miles wide known as the Morris reserve, Among other towns it embraced Nunda, and Mount Morris. It was sold out in large tracts to purchasers who in turn sold it out in small parcels. Among these purchasers were the Carrolls who purchased a large parcel of the land owned by the London Capitalists, and also a large portion of the Morris reserve.

When at last about 1800 the territory was opened for settlement, emigrants began pouring in, in large numbers. About 1805 the price of the best unimproved lands varied from one to four dollars according to location. Until 1812 settlers came to Livingston county in large numbers, but the war then put a temporary stop to all new sales of land. The sturdy settlers furnished their quota for the United States army; and took part in many of the important battles on the then western frontier.

After the war the tide of emigration again set in for the Genesee valley and from then until 1825 the increase in population was very large, most of the settlers coming from the New England States. From this period up to 1850 the population gradually increased. From 1350 to 1870 it decreased some what but increased up to 1880 since which time there has been a decrease.

The following table shows the population of the county at different periods.

In	1810	13,390
	1820	21,305
	1830	27,729
	1840	35,140
	1850	40,373
	1860	39,546
	1870	38,308
	1880	39,261
	1890	37,201
	1900	37,059

Although there has been a slight loss in population lately generally a steady and healthy growth has always been maintained. Livingston county is almost purely agricultural as she cannot to-day, nor never could point to any gigantic commercial or manufacturing enterprises. The only industries of this character undertaken are salt production, the manufacture of small amounts of machinery in some of the larger villages, and a very limited production of oil and natural gas. Although Livingston county cannot point to great enterprises she possesses evidences of wealth in the prosperity and contentment of her tillers of the soil. Her citizens have made a beautiful county more beautiful, and have transformed it from a wilderness

to productive and attractive farms, which adorn its valleys and hillsides.

The early settlers who came to this county brought their claims from the agents of the particular company in whose domain they wished to settle. They built rude log huts, chinking the spaces to keep out the cold. At first they gained their living chiefly by hunting and fishing. But soon these primitive industries gave way to the operation of plowing; saw mills and grist mills were built, and frame houses were built in place of the poor log shanties. As fast as the land was cleared of its timber it was put under cultivation. The principal crop was wheat.

Before 1850 the production of wheat was close to 1,500,000 bushels annually. About 1854 the wheat midge began to cause great damage, and in 1860 the production of wheat had decreased very markedly, about 200,000 bushels being produced annually. Other crops, oats and corn particularly began to be produced in increasing amounts. Beans and potatoes also began to become important and to-day Livingston county produces very large crops of beans. Wheat has by no means passed out, for the last census reports a production of 730,000 bushels. Hay and forage crops are increasing in importance. Animals are becoming more numerous, especially dairy cows. Cheese factories and creameries are increasing very rapidly. There is also a small but

steady increase in the production of fruit.

Having now made a hasty review of local history, let us come directly to the point and take up the history of the farm in question. The Barron farm lies in the old Morris reserve. Robert Morris sold a large portion of this land to the Carrolls, who in turn opened it up for settlement. The farm was sold by them in 1824 to Johnathan Barron. A log shanty was built near the site of the present house, the location being chosen largely because of the presence of numerous springs of soft water which flow from the bases of the hills toward the east through small swales, and clearings soon made. The first timber cut was about the present farm buildings on the Volusia Loam. At first commercial agriculture was not attempted, time being ~~given~~ given only to the clearing of the land and to the growth of sufficient material for the support of the family. In a few years the log shanty was displaced by a frame house which stands to-day in good condition. Barns were built. Wheat was then grown in quite large quantities.. The grain was drawn to market at Geneseo, about fifteen miles distant, whence it was floated down the Genesee River to Rochester, the Flour city.

About 1834 the farm was sold to Moses Barron. At first he gave a considerable amount of attention to grain growing. He was a Vermonter, therefore a stockman, and consequently he introduced animals. For many years he maintained upon

the farm a large flock of excellent sheep, 150 to 200 animals being kept. On this account a diversified agriculture was practiced and the soil kept in a good state of fertility, for rotations had to be practiced in order to maintain the animals. Wheat growing was an important part of the farm economy, but it was not the sole aim of the management. Oats, corn and hay were grown in considerable quantities. About 1850 in addition to sheep, cattle were brought in. Shorthorns were procured, not only for dairy production, but also for the production of beef. Several excellent bulls were introduced which not only built up a good herd for the owner, but also they had a marked influence upon the local cattle. These were the first pure bred cattle which were brought to the neighborhood, and for many years the effect of their blood was noticeable upon all the cattle of the neighborhood. Moses Barron died in 1862. His flocks were allowed to deteriorate and thereafter less attention ~~less attention~~ was given to the stock breeding.

From 1862 to 1873 the farm was not managed with anything particular in view. A promiscus agriculture was practiced, grain being the chief product and a few animals of all classes being kept. In 1873 Milton Barron, the present owner, came into possession of the farm. From that time until 1880 he grew grain and hay for sale, and in addition

maintained a large flock of sheep.

From 1880 to 1885 the farm was rented. During this period only the necessary animals were kept, grain only being grown. Large crops of wheat, barley and oats were grown annually, and sold.

Since 1885 the owner has maintained a general farm. Wheat is grown every year, for a nurse crop for seeding, and also as a source of profit. Hay has been sold in large quantities. Corn and oats are grown for feed for the horses and cows, and for pigs a considerable number of which are annually turned off. Beans have become a crop of considerable importance. A flock of from 50 to 100 sheep has been maintained. Cows have always been kept and during the past eight years an increasing number, milk lately being sold to the local cheese factory. A small orchard and vineyard are also maintained.

CLIMATE.

The climate, like that of Western New York in general, is very varied. But on the average it is mild enough for all the crops which are commonly grown. Peaches cannot be considered a safe crop, not only because of winter killing but also because of frosts at blooming time. In general climate does not adversely affect other crops. Ocassional droughts come in summer and cause much inconvenience and loss by reducing pasturage, and the yields of corn and beans.

The following figures furnished by the Weather Bureau Station of Rochester, New York give a summary of the weather conditions. These figures cannot be applied to the locality in question in all respects, however, because Rochester is in close proximity to Lake Ontario, and the farm is far from any such influence.

The average date of the last killing frost in spring is May 1st. The average date of the first killing frost in autumn is October 19th.

AVERAGE MONTHLY AND ANNUAL TEMPERATURE AND PRECIPITATION.

Month	Temperature.	Precipitation.	Month	Temperature.	Precipitation.
	°F.	Inches.		°F	Inches.
January	24.0	3.30	August	69.0	2.75
February	22.7	3.10	September	63.0	2.31
March	34.0	3.40	October	52.2	2.28
April	45.7	2.24	November	39.4	2.21
May	57.9	2.12	December	28.0	3.01
June	65.9	2.99	Annual	47.8	33.38
July	71.9	3.70			

Annual Maximum and Minimum Temperature.

	Maximum	Minimum.
1896	92^0	-10^0
1897	99^0	1^0
1898	95^0	-2^0
1899	94^0	-7^0
1900	96^0	-1^0
1901	96^0	-3^0
1902	91^0	2^0
1903	92^0	-3^0
1904	91^0	-14^0
1905	92^0	-6^0

Note: The figures in the above tables are averages for ten years.

PHYSIOGROPHY.

The rocks of the region belong to the upper Devonion series and to the Portage group. They are all of a shaly character, but some are sufficiently hard to allow of quarrying. About five miles south of the farm there is an abrupt rise in the land, constituting the northern limit of the plateau of the southern counties of New York State. The farm itself extending from the Keshequa creek on the east, westward into the hills is located in a broad preglacial valley. Many geologists maintain that this valley was formerly occupied by the Genesee river. At Portage ten miles south that river has been diverted from its course, to the present gorge. About six miles north down the Keshequa valley there is at present a large amount of drift. Taking this into account and also taking into account the fact that the ice sheet retreated toward the north it is evident that during glacial times and for a considerable time thereafter the Keshequa valley was occupied by a lake. Gradually the dam at its northern end has been cut down and now no lake remains. The creek to-day flows through the old river course and joins the river near Mount Morris.

The farm has a slope from west to east. The lands on the lower portion which are very close to the creek are flat. Just to the west of them is a steep slope, beyond

which is a stretch of level land about one half mile in width. This land rises gently toward the west, but is cut up to some extent by streams. Following this level stretch is a steep slope which beyond the limits of the farm ends in a broad and level upland plain.

All the streams crossing the farm are small and all have an easterly direction. The streams which cross the tract all originate in the uplands to the west. They are rapid during rainy weather, but quite or almost dry for the greater part of the year. In addition to the streams properly so called there are small swales extending across some of the fields. These are in low places and are caused by the water following along hard layers until it comes near the surface, where abundant and never failing springs originate. The swales are the courses followed by water from these springs. They are very wet, and in summer covered with a very dense growth of flags.

Soils.

There were mapped on the farm eight types of soil. While in their distribution they follow general laws, their distribution is rather intricate and in some cases rather hard to account for. The Dunkirk Clay and the Volusia loam are the chief and important types.

Miami Loam.

The Miami Loam is a brown or black silty loam soil, six to ten inches deep. Small amounts of sand are present, and in small areas sand predominates in the soil. Only very small amounts of gravel are present. The subsoil to a depth of three feet is a chocolate brown to brownish yellow in color, and slightly mottled. It is silty in texture becoming more clayey as the depth increases.

This soil occurs along the old flood plain of the Keshequa Creek. It consists of glacial material worked over and deposited by the creek as it has cut its way down through the material filling the old valley. As the creek has swung from side to side of the valley it has left this material as a terrace. The source of this soil is very evident when it is noticed that its western and upper boundary is plainly the limit of the meanders of the creek. This soil is level. On account of the fact that it lies low, and on the account of the shallowness or the small

ditches which cross it, it is likely to be overflown in the spring.

It is very fertile and strong soil. On account of its distance from the barns it has never to the knowledge of the writer received stable manure. It is rich in humus, and usually produces good crops without the addition of fertilizers. Light applications of commercial fertilizers are occasionly given when it is seeded to wheat. Wheat, oats and grass do well on this type, and it also affords excellent pasturage. Twenty bushels of wheat, thirty five of oats, and two and one half tons of hay are the usual yields. Beans may also do well but their culture on this soil is risky as it is likely to be too wet. The yields given above are obtainable when too much moisture is not present, and they are frequently exceeded in favorable seasons. In seasons particularly suited to vegetative growth, wheat and oats become very tall and are very likely to lodge.

This soil is easy to work and quickly responds to efforts expended upon it. While as great care in handling it is not required as is necessary in some cases, it will bake if worked when too wet. This is due in part to its silty nature and in part to the clayey material which it has received as wash from the surrounding clay hills.

MECHANICAL ANALYSIS OF MIAMI LOAM.

	Soil %	Subsoil %
Fine gravel	2.68	1.64
Coarse sand	1.44	tr
Medium sand	8.52	3.47
Fine sand	9.14	9.56
Very fine sand	19.86	12.74
Silt	35.75	43.10
Clay	24.08	30.36

DUNKIRK CLAY.

The Dunkirk Clay lies just west of the Miami loam. Its eastern boundary is irregular, as it was formed by creek meanders. It rises abruptly from the Miami loam to a height of about sixty feet. This abrupt rise is due to the fact that since glacial times the Dunkirk clay material has been deeply cut into by the creek east of the farm. The creek during its cutting has formed the Miami loam at the foot of the clay slopes. From the top of the slope of the present creek valley the Dunkirk clay rises gradually to the westward. Its surface is fairly level, except that deep cuts have been made in it by the small streams which cross it.

The Dunkirk Clay is a gray to dark brown clay or clay loam six to ten inches in depth, underlain by a mottled or dark brown subsoil, which at the depth of three to six feet is underlain by boulder clay. This type is the heaviest soil on the farm. Gravel is absent or only very occasional pebbles and small boulders may occur. The soil is in an exceedingly fine state of division. On this account when situated on hill sides it is subject to washing. Also it is inadvisable to work it in wet weather on account of liability of puddling. On drying this soil cracks, and breaks up into hard lumps. In many places on account of

the impervious nature of the subsoil this type is likely to be poorly drained.

The soil is composed of offshore deposits laid down in the glacial lakes which originally covered this region. For this reason it is very uniform in texture and appearance. The few boulders and small bits of gravel scattered through it were probably dropped from floating bits of ice as they slowly melted.

This soil is especially well adapted to wheat, oats, rye, barley, buckwheat, grass and pasture. Blue grass seems to be at home on it. Usually fields which are left for a time, seed themselves to it and dutch clover, even though the common meadow mixtures have previously been sown. The meadow mixtures thrive for two or three years when they begin to deteriorate, and become replaced by blue grass and dutch clover. This type is not used for any of the cultivated crops, as corn, beans, and potatoes. It responds well to application of nitrogenous fertilizer, green manure crops and stable manure. In fact many very poor spots have in the past few years been entirely reclaimed by the application of stable manure alone.

When well handled this type gives good yields of all kinds of grain, with the exception of corn, affords abundant hay crops, and excellent pasturage. On account of its

peculiar nature it is not a sure soil. Winter killing of wheat and hay mixyures, especially clover, often results, not on account of the cold, but by heaving which breaks the roots of the plants.

MECHANICAL ANALYSIS OF DUNKIRK CLAY.

	Soil %	Subsoil %
Fine gravel	.700	.407
Coarse sand	.638	.260
Medium sand	1.212	.537
Fine sand	5.160	1.996
Very fine sand	20.484	18.855
Silt	34.314	30.055
Clay	35.792	48.189

MANURIAL REQUIREMENTS OF DUNKIRK CLAY.

Fifty years ago in Livingston county Dunkirk clay was an important wheat soil. At that time cereals were the principal crop of this county, and under the systems of management many soils deteriorated. Especially was this true of Dunkirk clay. Most of the other types have partially or wholly recovered, but the Dunkirk clay on account of its peculiar nature is not so susceptible to ameliorating influences, and to-day is not utilized in the best manner.

By continued cropping in cereals this soil gradually lost a large part of its humus, and is now in a rather poor state of cultivation. The loss of humus has tended to make this soil more compact, and to make its drainage poor. This loss is due in part at least to the original condition of the soil. Humus was never plenty if the condition of the soil in the woods to-day indicates anything. The predominating timber was pine among which were a few deciduous trees, and under which a small herbage grew. On this account this soil was easily reduced in its nitrogen and humus content, when, as was the case, no attempts were made to put anything back on the soil, but every endeavor was to get as much out of it as possible.

On account of its various peculiar properties this

soil is to-day looked upon with some disregard by farmers, but experience has shown that it responds quickly to good treatment. It is handled as little as possible being commonly kept in pastures in which there is often a scant herbage, and usually when the land is cropped it does not give as large returns as it should.

In handling this soil care must be taken to have it in good physical condition. Dunkirk clay must not be worked wet, Also underdrainage is in many cases essential to success.

Granting that the physical condition is important, and that attention to it will be profitable, the author believes that something else is lacking. In many cases where the physical conditions are nearly perfect, entirely satisfactory results are not obtained. Accordingly an attempt has been made to find what manures give beneficial results.

In this work the wire basket method of the United States Bureau of Soils was employed. Soil was procured from the worst and most compact places on the Barron farm. The tests were carefully carried on during a period of three months in the winter of 1905 - 1906. in the greenhouses at Cornell University. It is generally supposed by farmers that this soil is acid, and thus they account for non success. Tests of the samples were conducted by Mr. G. W. Tailby, several different methods being used. As a result

it was shown that this soil is not acid.

The first series of the tests consisted in merely adding the commercial fertilizers to the soil at the time of planting, the soil being well mixed to distribute the fertilizers. The experiment was repeated three times, the results of each run corresponding quite uniformly with those of the other runs. The results here presented are those obtained in the third trial. Only these are used because they show, just as well as more tables would, what results were obtained, and further they are more to be relied upon because they were obtained under better growing conditions and because the author by this time was able to manipulate with greater accuracy. In these tests as in all the others transpiration and green weight are the factors taken to indicate the growth.

TREATMENT.	Total transpiration of each treatment consisting of five baskets for 25 days.	Total green material grown on each treatment during 25 days.
	Grams.	Grams.
1. Check.	370.0	4.5
2. 320 lbs. $NaNO_3$ per acre.	463.5	6.5
3. 320 lbs. $Ca_3(PO_4)_2$ " "	350.6	4.0
4. 250 lbs. K_2SO_4 " "	345.0	3.8
5. $Ca_3(PO_4)_2$ - $NaNO_3$ #	368.3	4.3
6. $NaNO_3$ - K_2SO_4	359.9	4.3
7. $Ca_3(PO_4)_2$ - K_2SO_4	318.9	3.5
8. K_2SO_4 - $Ca_3(PO_4)_2$ - $NaNO_3$	378.8	4.7
9. 10 tons Stable Manure per A	382.2	5.0
10. 10 T. Green Manure(clover)"	394.7	5.0
11. 1 ton lime per acre	388.0	4.7
12. 1 ton chalk per acre	357.4	4.25
13. 1 ton gypsum per acre	362.1	4.00

The same amounts of each constituent were used in the mixtures as were used when each constituent was employed by itself.

AS measured by transpiration and green weight sodium nitrate, a complete fertilizer, stable manure, green manure, and lime had a beneficial effect. Tricalcium phosphate and potassium sulphate each depressed the growth, the potash salt being the more injurious. When either one of these two salts was combined with sodium nitrate there was only a very slight retardation of growth. Apparently the sodium nitrate which, when applied by itself, gave far better results than any of the other applications, exerted a beneficial influence, but such benefits were not sufficient to quite overcome the mischief wrought by the other two salts. When the phosphate salt and the potash salt were applied in combination the poorest results were obtained. In a complete fertilizer application the nitrate was able to over come the bad effects of the other two salts, and give a slight increase as is shown by comparing the results obtained with those of the check. Stable manure and green manure were equally beneficial, and in efficiency stand next to sodium nitrate, which however far surpassed them. Lime was as effective as a complete fertilizer using green weight as a factor for comparison, but when transpirations are compared, lime had a slight advantage. Chalk and gypsum were not beneficial.

It is a matter of common field experience that lime has beneficial results on this soil. As by the previous

test it did not prove markedly beneficial another experiment was devised to test its efficiency. Lime was added to a considerable volume of soil at the rate of one ton to the acre. This soil was allowed to stand four weeks it being stirred occassionally, and moisture enough was added to keep it in good physical condition. At the end of four weeks this soil was put into baskets, various fertilizers were added to it, and it was compared to soil not so treated in regard to lime. Another comparison was made by adding lime, sodium nitrate, green manure, and stable manure to the soil four weeks before it was planted, and comparing the results with the soil to which the fertilizers were added at the time of planting. During the four weeks that the soil was under treatment it was kept moist and well worked. The following table shows the results.

TREATMENT.	Transpiration per 5 baskets in 25 days.	Green weight per 5 baskets.
(a) Soil taken just as it came from the field, well worked, put into good condition, and fertilizers added at the time of planting.		
1. Check.	450.5	5.5
2. 320 lbs. $NaNO_3$ per acre	564.4	7.8
3. 10 tons stable manure per acre	493.8	6.0
4. 10 tons green manure per acre	504.0	6.2
5. 1 ton lime per acre.	486.8	5.8
(b) Soil treated with lime four weeks before planting, during the interval being kept in good condition. All fertilizers except lime added at the time of planting.		
6. 1 ton lime per acre	507.8	6.3
7. 1 T. lime - 320 lbs $NaNO_3$ per acre	595.3	8.1
8. 1 T. lime - 10 T. Stable manure "	524.7	7.2
9. 1 T. lime - 10 T. green manure "	538.2	7.6
(c) Soil treated with lime and other fertilizers four weeks before planting. During the interval it was kept in good condition.		

10. 1 ton lime - 320 lbs $NaNO_3$ per acre		603.4	8.3
11. 1 ton lime - 10 tons Stable manure "		592.6	8.1
12. 1 ton lime - 10 T. Green manure per A.		610.5	8.4

The above experiments show that lime, sodium nitrate, stable and green manure all have beneficial effects. The results of A verify the results shown in table 1. Sodium nitrate was very beneficial while the other fertilizers were less so, but showed a slight increase. B shows that lime as time goes on increases in its beneficial influence. In B the application of lime alone was attended with an increase over the test in A in which lime alone was applied. Applying lime a time before planting and then applying the other fertilizers at the time of planting increased slightly the efficiency of sodium nitrate, and greatly increased the efficiency of green manure and stable manure. When, as in C, the fertilizers together with lime are added a time before planting peculiar results present themselves. Sodium nitrate is increased but slightly in efficiency and green manure and stable manure have their efficiency greatly increased, green manure being even more efficient than sodium nitrate.

From the results obtained it may be argued that this soil is deficient in nitrogen. For use by young plants, this element may be furnished by sodium nitrate applied at the time of seeding. No appreciable increase in efficiency is obtained by making the application previous to that time, for nitrogen in this form is quickly available and in field

conditions if the salt were applied a considerable time before planting a large part of it might be lost by leaching as it is very soluble. Also nitrogen,(or the same effect may be procured as is given by sodium nitrate) may be applied in green manure and stable manure, but for best results these materials should be applied some time before planting to allow them to decay some what, and thus liberate some of the stored up plant food. Also lime should be applied. In this case it apparently aids nitrification, for when applied with sodium nitrate it does not produce any marked increase, but when applied with green manure and stable manure the good effects of these fertilizers are greatly enhanced. Lime also probably has other actions for when applied by itself it produces beneficial results.

Practically then directions may be given as follows: Apply lime sometime before planting; apply sodium nitrate at the time of planting as a source of nitrogen, or with the same object in view, apply stable manure or green manure some time before planting.

From what the writer knows of this soil it seems, that if good physical condition is secured, good cultivation given, humus increased, and lime applied, the Dunkirk Clay will improve, give good crops, and as time goes on so improve in texture that it will be no very hard task to handle it.

DUNKIRK BLACK CLAY LOAM.

The Dunkirk black clay loam is a minor type being confined to a very small area. It is a black clay loam of rather light texture underlain at depths of six to ten inches by a yellow to dark brown clay subsoil which may be mottled. This soil has been formed largely by small ponds in the surface of the Dunkirk clay becoming filled with organic matter. This is an early soil and produces large crops of all kinds. Corn grows excellently. In dry seasons it dries out rather quickly, and for this reason it does not hold sod well. It is very rich and if no crop is present produces a luxuriant growth of weeds.

MECHANICAL ANALYSIS OF DUNKIRK BLACK CLAY LOAM.

	Soil %	Subsoil %
Fine gravel	.800	.98
Coarse sand	2.541	.194
Medium sand	3.260	.643
Fine sand	4.375	2.431
Very fine sand	19.878	18.754
Silt	32.134	31.072
Clay	37.684	45,872

DUNKIRK GRAVELLY CLAY LOAM.

The Dunkirk gravelly clay loam is a small type, and occurs typically developed near the western border of the Dunkirk clay. This soil was formed under lake influence. It is a yellow to a light brown loam, four to six inches in depth, underlain by a yellow loam changing to silt and mottled clay, below which is boulder clay. From fifteen to thirty five per cent of gravel is present. The fine earth of this soil consists of silt and clay into which is mixed a considerable portion of sand and gravel. It owes its origin to a set of peculiar conditions in that at the same time that clay was being deposited, sand and gravel were also brought in and deposited. Boulders are rare in this type, the stony material being all rather fine, not more than two or three inches in diameter, and well worn both by glacial action and by water.

In color this type is not very unlike the Dunkirk clay, but its texture is very different. The soil is rather loose, and well drained except in places where the subsoil comes very close to the surface. In adaptation it is similar to the Dunkirk clay. Of course it is easier to handle, and in its cultivation so much attention does not have to be given to determine if it be in right condition. When very wet this soil becomes quite like quick sand. On side

hills it washes badly, and great care must be taken to prevent this. A wagon wheel rut down a hill side occupied by this soil is dangerous, because after a few rains it will develop into a yawning chasm.

MECHANICAL ANALYSIS OF DUNKIRK GRAVELLY CLAY LOAM.

	Soil %	Subsoil %
Fine gravel	4.290	6.6
Coarse sand	3.145	3.86
Medium sand	8.615	10.46
Fine sand	11.960	12.905
Very fine sand	15.260	11.205
Silt	39.967	33.716
Clay	16.763	21.476

VOLUSIA LOAM.

The Volusia loam is a very important type not only because of its extent on the farm, but also because of its many excellent qualities. It occurs to the west of the Dunkirk series, and occupies a slightly higher level than this series. It extends to the western limit of the farm, and still further up the hill to the west. Westward from the foot of the hill near the western limit of the farm, it occupies only the little valleys. The surface of this soil is gently sloping. It was formed largely by the deposition of the till sheet by the glacier. Since glacial times it has received additional material from the high hills to the west. Originally this soil probably did not extend much further east than the heads of springs which now occur on the farm. Apparently the springs mark the limit of a lake which stood for a long time at one level. Since the disappearance of the lake the soil has been washed out over the lake deposits to a considerable extent.

The soil is a brown or black loam having a depth of six to twelve inches. It rests upon a silty loam of a yellow color, which at a depth of three feet or more is underlain by gravel. Near its eastern border the subsoil of this type is underlain by clay, and as it gradually passes over into the Dunkirk clay, the subsoil becomes more and more dense. Along its western boundary as mapped

upon the farm this type is underlain by shale rock at a depth of about six feet. This is accounted for by the fact that as we go west we are climbing the old valley wall, and by the fact that the material here is thinner than out toward the middle of the old valley which is occupied chiefly by the Dunkirk clay. In the area mapped the Volusia loam is typically developed upon the uplands, but extends well down to the forelands of the old glacial lake.

The surface of the soil is strewn with shale fragments, and erratic boulders are not uncommon. Fine shale fragments form a large part of the soil.

The material of which the soil is made is of glacial origin, and consists mainly of moranic material of heterogenous composition.

The Volusia loam is usually well drained, and a fairly easy soil to work. It does not require as much skill in its management as the clays and by farmers is considered much more satisfactory. This type is usually considered a strong soil and when well treated gives excellent yields. It is adapted to all kinds of crops which are commonly grown in the region. Cereal crops give large yields. Many times on the farm under consideration this type has given an average yield of thirty five bushels and more per acre of wheat. Such a yield is not based upon good spots in a field, but the whole field gave this

average. Excellent crops of hay are obtained, three and four tons per acre not being uncommon. Aside from these crops Volusia loam is better suited than any of the other types to intertilled crops, corn and beans give excellent yields, and potatoes do very well. This soil seems well adapted to apples. In 1826 an orchard was planted on the farm surveyed. But a few of the trees have yet gone out. In general this orchard has not received any care, but it yields fruit of good quality with a good degree of regularity and the trees are exceedingly large. A few years ago a young apple orchard was set out and up to date has done remarkably well. A peach and plum orchard alsohave grown good trees and have yielded several good crops. A vineyard of Niagara grapes did excellently for twelve years, and yielded large crops. The peach orchard and vineyard on the farm have not been entirely successful. This is not do to poor soil conditions but to a bad location which has several times resulted in injury by frost.

The Volusia loam is then a general all round soil suited to many crops, especially grasses and cereals. It works easily, in most places is well drained, and gives good yields. It responds most readily to applications of sodium nitrate and green manure. It is well supplied with humus. Originally this type was covered with deciduous trees and an abundant herbage. In this way a large

amount of humus accumulated, which was not exhausted by the early term of wheat growing.

MECHANICAL ANALYSIS OF VOLUSIA LOAM.

	Soil %	Subsoil %.
Fine gravel	10.022	10.292
Coarse sand	5.800	6.424
Medium sand	9.200	10.585
Fine sand	9.482	11.086
Very fine sand	10.342	10.131
Silt	38.629	31.669
Clay	15.868	19.708

MIAMI STONY LOAM.

The Miami stony loam occupies a level higher than that occupied by any of the other soils on the farm. It occurs as ridges hung upon the hill side. It is probable due to deposit from subglacial streams.

The soil of the Miami stony loam is a dark yellow to light brown sandy loam six to ten inches in depth. The subsoil is but little lighter in color, and is of a sandy loam texture to a depth of about two and one half feet, where it changes to a silty loam. Cuttings by streams shows that the whole is underlain by shale or clay. Stones and gravel are present in large amounts, composing as they do from five to forty five per cent of the soil mass. The stones are mostly of granite, gneiss, and sand stone, usually they are not very large, but many boulders of the size of a man's head do occur. Many shale fragments are also present. This type occurs as well defined ridges extending up the hill side, the intervening spaces being occupied by the Volusia loam. The origin is glacial, and the peculiar distribution is due probably to deposit from streams under the glacier. In fact these ridges have in many respects the appearance of eskers.

The soil is well drained, underdrainage is unnecessary. It is a warm soil, and of such a nature that it can be cultivated very soon after a rain.

Most of this type is still covered with forest, only a comparatively small portion being under cultivation. On account of the steepness of the slope intertillage crops are not planted on this soil. Oats, wheat and hay are , however, planted, and exceptionally good crops are produced. Wheat often gives more than thirty bushels per acre, three tons of hay per acre are usually secured, at the first cutting, and very commonly meadows give two crops per season, the second crop of course being much lighter than the first. In regard to its ability to give two crops of hay in a season this soil closely resembles Volusia loam, and differs from Dunkirk clay, which soil rarely yields a satisfactory second crop.

MECHANICAL ANALYSIS OF MIAMI STONY LOAM.

	Soil %	Subsoil %
Fine gravel	1.842	1.742
Coarse sand	3.360	2.54
Medium sand	5.569	3.500
Fine sand	8.134	4.909
Very fine sand	19.501	12.394
Silt	46.153	54.573
Clay	15.375	20.875

MUCK.

The name muck has been applied to low lying lands which in their present state cannot be cultivated. They are present as long strips extending across the Volusia loam, and Dunkirk clay. They are caused by water following down the hard layers on the hillsides, and breaking out about midway between the eastern and western boundaries of the Volusia loam. The springs thus formed are perennial, and the water from them spreads out and flows slowly through the mucky land, which in summer supports a very rich growth of cat tails and the like.

A FINANCIAL STATEMENT.

In order to show what is being done on a farm composed of the soils discussed, managed with but little more than ordinary care, and on which the agricultural practice is by no means intensive, the following finanicial statement of the farm in question is given. In this connection it should be well to state the rotations used. About sixty acres are kept continually in pasture. Those parts of the farm on the Dunkirk clay grow oats, wheat, and hay two years. The rotation on the Volusia loam and other lighter types is corn, beans, wheat and hay two or three years. All stable manure is carefully used. Commercial fertilizers are but little employed. Meadows not standing long afford a large sod to turn under to make humus, and in addition clover is still abundant in the sod.

The farm consists of two hundred and seventy five acres, ninty two of which are in timber and waste land. The following table shows the acreage of the different crops for 1901, 1902 and 1903.

Crop.	1901	1902	1903
Corn	6	7	7
Wheat	18	27	16
Oats	10	10	8
Rye	-	2	-
Beans	17	6	17
Meadow	75	60	70
Pasture	50	60	60
Tree fruits	3	3	3
Small fruits	2	2	2
Potatoes	2	6	3/4

TABLE SHOWING TOTAL CASH RECEIPTS.

Crop	1901	1902	1903
Wheat	$ 300.00	$ 605.00	$ 213.00
Beans	510.00	248.00	655.00
Hay	400.00	350.00	295.00
Potatoes	75.00	375.00	--
Tree Fruits	260.00	195.00	10.00
Small Fruits	200.00	150.00	35.00
Horses	125.00	--	--
Cattle	50.00	150.00	60.00
Sheep and Wool	150.00	150.00	150.00
Swine	75.00	100.00	150.00
Dairy Products	275.00	300.00	500.00
Poultry and Products	25.00	50.00	30.00
Bee Products	150.00	175.00	250.00
Total	$ 2595.00	$ 2848.00	$ 2348.00

FARM EXPENDITURES.

Item	1901	1902	1903
Labor	$ 225	$ 225	$ 225
Board of Laborers	20	20	20
Feed and Seeds	100	250	50
Fertilizers	75	150	50
Machinery and repairs	150	100	125
Buildings and fences	250	100	100
Live Stock	200	50	100
Miscellaneous	150	75	175
Total	$ 1170.	$ 970.	$ 845.

During this period the capital increased from $ 17,300 to $ 18,700. The work was done by the farm owner and one man who was employed by the year. Two sons of the farm owner worked during the summer vacation only.

MARKETS.

In the early days markets were a long distance from the farm. Easily transported products had to be grown, and also products which did not easily receive damage in transportation. Wheat was advantageous from this point of view, and the first crops grown were drawn to Geneseo, a distance of fourteen miles. About 1850 the Genesee Valley Canal was built, and in fact was along the eastern boundary of the farm. Warehouses were built at Tuscarora, and this became a loading point for boats. To-day the canal is replaced by a branch of the Pennsylvania railroad extending from Rochester New York to Olean, New York. The station is Tuscarora, one and one half miles distant from the farm. By this road the Rochester markets are easy to reach, as also are those of the cities in southwestern New York and western Pennsylvania. The Erie at Dalton, and the D.L. and W. at Mount Morris are also within easy driving distance.

A sketch of the development of this region of the Genesee valley shows that in the first place those products to which the soil was adapted, and which could be marketed under the existing conditions were grown. By this method the fertility of the land was depleted, and by pests and competition the old lines of effort were displaced. Gradually new crops have come which have not entirely displaced the

old. Animals and dairying are becoming more and more important. This is a distinct advantage, not only because the present soils are eminently adapted to growing forage, but also because animals intelligently managed will continually improve the productive power of the soil. Lastly fruit is becoming, slowly to be sure, of considerable importance. Again the soils indicate that some kinds of fruit can probably be grown to a considerable degree of perfection, especially those kinds which are hardy.

By reviewing the past it is apparent that the soils of the region in question have produced crops to which they are adapted. Taking the present as an indication of the future it seems that a change is coming in, to which the region is no less adapted than it was to that of the past. Now perishable products can profitably be grown and disposed of at markets far from home. The conditions of the past did not permit of this. The new products will be largely those which tend to make the soils better, instead of decreasing its fertility.

In conclusion it may be said that farms in the Genesee valley presenting the soil conditions of the one in question, can by careful management, by adaptation of changing conditions, by taking advantage of the new markets now opened up, by growing crops to which the soil is adapted, become more

profitable, produce good crops, become more fertile, and sustain the agricultural reputation of the Genesee Valley region -- a reputation which in early times was won by fertile soil and great wheat production, but which now is and in the future will be sustained not only by cereal production but by the production of many other crops which do not rob the soil of its fertility, but which are well suited to the existing soil and market conditions.

80° 79° 78° 77° 76° Longitude West from Greenwich. 75°

45°

44°

43°

42°

41°

• Shows approximate Location of the Farm.

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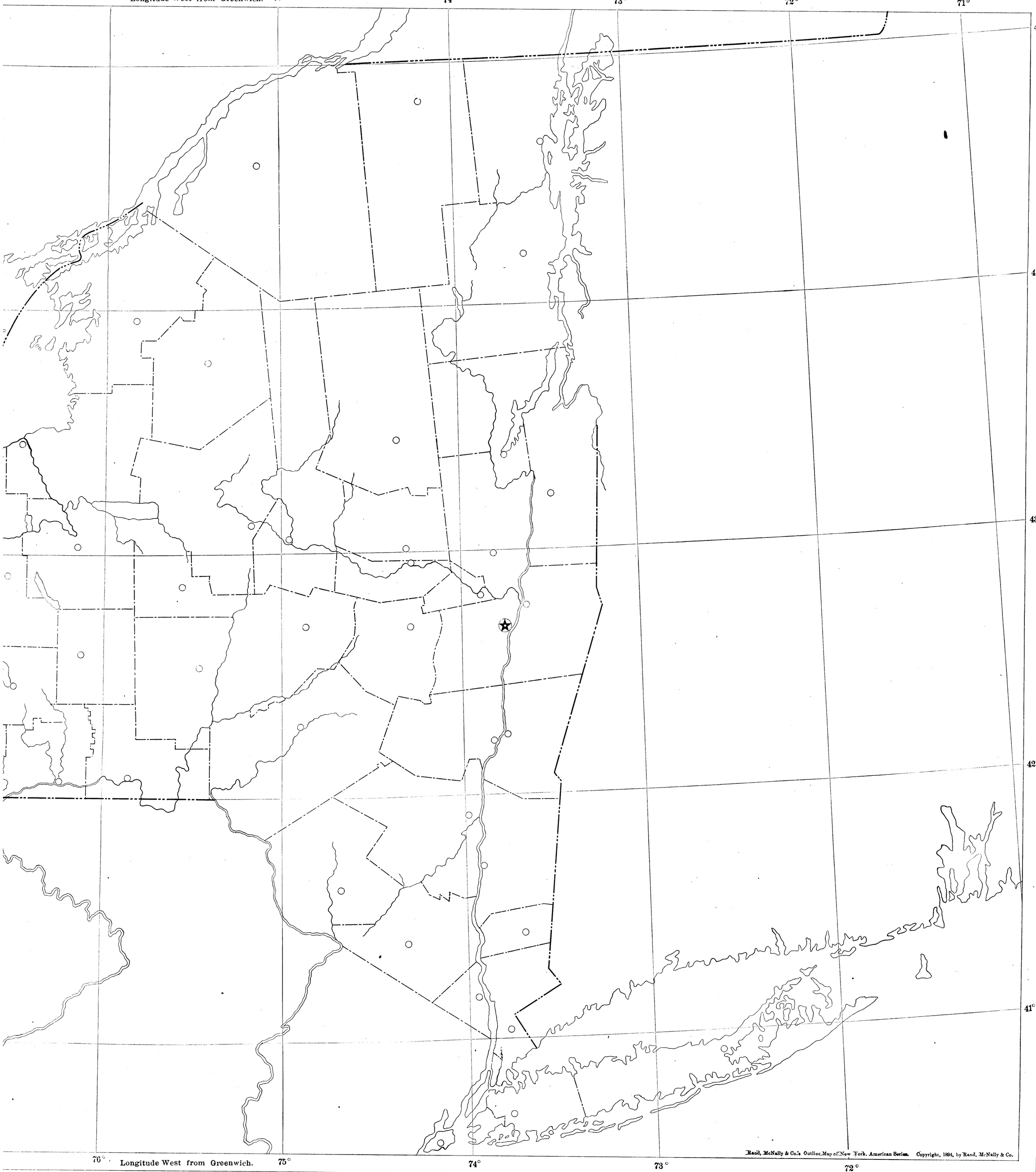
SCALE OF STATUTE MILES.

0 5 10 25 50 75

80° 79° 78° 77° 76° Longitude West. from Greenwich. 75°

76° Longitude West from Greenwich. 75° 74° 73° 72° 71°

45° 44° 43° 42° 41°



76° Longitude West from Greenwich. 75° 74° 73° 72°