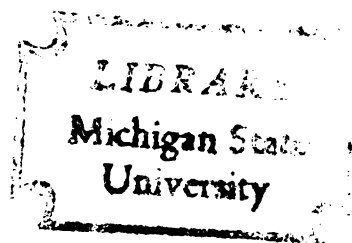


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Senior Agricultural Thesis

on

"THE ANALYSIS AND USES OF LUCK."

by

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THESIS

THE ANALYSIS AND USES OF MUCK.

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Scattered over the country, in more or less extensive tracts, are found accumulations of vegetable matter, known either as muck or peat. These deposits occur in locations where organic matter has been undergoing a slow decay for an indefinite length of time. In order that the decay may be slow, it is necessary for the deposits to be partly or entirely covered with water. If the organic matter were exposed to the air complete decomposition would take place, and no muck would be deposited. Inasmuch as the water is found in low places the deposits take place there as well as along the banks of rivers and lakes.

The materials making up these deposits may be any kind of plants, but in northern countries they are composed largely of the leaves of trees and various aquatic plants. In certain places bog moss makes up a considerable portion of the muck. The vegetation of one year's growth, being preserved from fire and decomposition by the water, falls to the ground and is buried underneath that of the following season. This process, which has been going on for ages, accounts for the great depth at which the deposits are sometimes found.

The muck consists largely of organic matter which is composed of oxygen, hydrogen, nitrogen and carbon. These

elements are burned at a red heat, leaving the ash behind, together with a variable amount of sand and clay which has been washed in from higher regions surrounding the swamp. The amount of this sand and clay depends on whether the surface of the hills near the swamp is readily washed away or not, and also on the amount carried by the winds.

Of the elements making up the organic matter carbon is the most abundant. In the form of carbon dioxide this element constitutes the chief food of growing plants. The element, however, that makes the muck of value is nitrogen, which is found in relatively large amounts. The nitrogen exists largely in the inert form, and needs to be changed to nitrates before available for plant food.

After burning away the organic matter the ash is left together with a quantity of sand and clay. Of the constituents making up this material the most valuable are the lime, potash and phosphoric acid which it contains.

Two varieties of muck have been recognized, which differ from each other in their properties. One is found at the surface, and is called "powdery muck", from the fact that it crumbles to dust when dried. It is of a dark color, and has no acid properties. The other variety is found underneath the powdery muck, and has a cheesy nature. It is usually quite acid, and will not crumble when dried, but forms a hard mass resembling coal.

The result obtained from several analyses seems to indicate that the cheesy muck contains a larger proportion of organic matter than the other, but, on the other hand, it is

deficient in such minerals as potash, lime and phosphoric acid. It, however, contains more nitrogen, as there is more organic acid present with which the nitrogen may combine.

The excess of mineral matter found in the surface muck over that found in the muck below is undoubtedly due to two reasons. First, that the plants growing at the surface send down their roots and bring up the potash, lime and phosphoric acid. Second, that the oxidation of organic matter leaves the mineral matter in relative excess. These processes, which have been going on ever since the muck began to be deposited, have resulted in robbing the lower layers of muck of a part of their mineral matter, and depositing it at the surface. As the nitrogen is in the inert state, being combined with organic matter, it is not taken up by the roots and, consequently, remains below.

There are three principal ways in which muck can be made useful:

1. By draining the swamp the muck becomes of value right where it was deposited, and in this way we get some of the most productive land under cultivation. Draining alone is often of much value, but the best results are obtained by the addition of lime and hard wood ashes. These materials supply the mineral matter in which most muck soils are deficient. If the muck is acid the lime being alkaline will destroy this property, and render the soil fit for the growth of plants. The drainage water, having a chance to run away, will also have a tendency to remove the acid. The surplus water, being removed, decomposition will take place more freely and greater quantities of carbon dioxide will be formed together with the liberation of ammonia.

2. Muck is also used as a fertilizer, and in one respect is richer than barn-yard manure. This is due to the large amount of combined nitrogen that it contains. Care should be taken to get only the part that is in the powdery form, for if the cheesy muck is applied to the land it will dry up into chunks and interfere with the cultivation of the soil. The cheesy muck can be prepared for use by allowing the frost to work on it during the winter. The effect of the frost can be readily seen by taking two thin slices of muck and placing them on two plates. One plate is allowed to dry as soon as it will, while the other is made wet and allowed to freeze. After this plate of muck has frozen and thawed out several times, it is allowed to dry up also. Both plates are examined and the one that was allowed to dry without freezing has become nearly as hard as coal, while the other is soft and friable. If the muck is coarse, and it is desirable to prepare it quickly for plant food, it may be composted with lime, ashes and barn-yard manure. The lime will aid in the process of nitrification, and the manure will supply the niter plants that are necessary in the production of nitrates.

3. Peat has a certain value as fuel, but in this country it is unable to compete with coal. It is probable that peat has played an important part in the formation of coal. Our present peat beds are those that have been formed in comparatively recent times, while those formed in earlier times have been changed to coal by pressure and heat.

In order to get an idea of the composition of muck soils I collected a number and analyzed them. An effort was made

to secure a variety of samples, in order that they might be compared. The samples in some cases were taken at the surface and also at a depth of eighteen inches. In other cases the surface soil alone was obtained. The samples were dried and pulverized in order to get a fair sample of each. In all cases the air-dried muck was taken as the basis for computing the per cent of each constituent.

Results of Analyses of Muck.

The nitrogen of ammonia is included in the organic matter

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Sample No. 1 was taken from a swamp, at a depth of eighteen inches. The growth is mostly tamarack, ash and coarse marsh-grass. It appears to be deficient only in phosphoric acid. It is fairly well supplied with lime and potash, while the supply of nitrogen is abundant.

Sand and silicates	2.170
Alumina	2.130
Oxide of iron	.500
Lime	4.530
Magnesia	.025
Potash	.212
Sulphuric acid	1.126
Phosphoric acid	.083
Carbonic acid	1.125
Organic matter and water	<u>86.610</u>
Total	98.511
Ammonia	2.040

No. 2 was taken from the surface directly over No. 1. It contains more lime, potash and phosphoric acid, but less organic matter. Although the nitrogen content is less than No. 1, it is still sufficient to render the land valuable for agricultural purposes.

Sand and silicates	2.720
Alumina	3.780
Oxide of iron	.240
Lime	5.310
Magnesia	.013
Potash	.460
Sulphuric acid	.738
Phosphoric acid	.127
Carbonic acid	2.120
Organic matter and water	<u>84.090</u>
Total	99.588
Ammonia	1.666

Sample No. 3 was taken from land somewhat higher than that from which No. 2 was obtained. It is surface soil, and the growth is maple, beech and elm. Considerable sand is present, and the supply of phosphoric acid is abundant. The potash, lime and organic matter, however, are not so plentiful.

Sand and silicates	16.170
Alumina	4.310
Oxide of iron	.386
Lime	3.680
Magnesia	.190
Potash	.144
Sulphuric acid	.789
Phosphoric acid	.409
Carbonic acid	2.702
Organic matter and water	<u>71.000</u>
Total	99.780
Ammonia	2.040

Sample No. 4 is what may be called a marly muck, as it consists of about equal parts of marl and muck. The quantity of insoluble matter is comparatively small, while lime is abundant. The organic matter consists of only about one-half the entire weight of the sample. A large quantity of alumina is present, as well as carbonic acid. While potash is present in a considerable quantity, the sample is deficient in phosphoric acid.

Sand and silicates	1.780
Alumina	7.952
Oxide of iron	.463
Lime	20.440
Magnesia	.010
Potash	.196
Sulphuric acid	.766
Phosphoric acid	.076
Carbonic acid	15.750
Organic matter and water	<u>50.650</u>
Total	93.093
Ammonia	1.173

Sample No. 5 was taken from the surface of a swamp where the growth is principally spruce, poplar and huckleberry bushes. A noticeable feature of this sample is the large amount of organic matter and the small amount of mineral matter that it contains. The nitrogen content is the greatest of any sample in the lot. A part of this swamp has been cleared and drained, but seems to grow little of anything but sorrel.

Sand and silicates	2.110
Alumina	.770
Oxide of iron	.080
Lime	.051
Magnesia	trace
Potash	trace
Sulphuric acid	trace
Phosphoric acid	.080
Carbonic acid	.041
Organic matter and water	<u>95.300</u>
Total	98.432
Ammonia	2.865

Sample No. 6 came from Chandler's Swamp, and contained the least organic matter and nitrogen of any sample analyzed. It is fairly well supplied with phosphoric acid and insoluble matter.

Sand and silicates	49.670
Alumina	7.024
Oxide of iron	.216
Lime	2.450
Magnesia	.090
Potash	.092
Sulphuric acid	.429
Phosphoric acid	.454
Carbonic acid	1.160
Organic matter and water	<u>37.200</u>
Total	98.785
Ammonia	.425

Sample No. 7 was taken from a piece of marsh where the principal growth is sage brush, marsh-grass and willows. Potash, lime and phosphoric acid seem to be present in sufficient quantities to make the soil fertile.

Sand and silicates	1.650
Alumina	3.290
Oxide of iron	.272
Lime	3.072
Magnesia	.105
Potash	.317
Sulphuric acid	1.099
Phosphoric acid	.335
Carbonic acid	1.100
Organic matter and water	<u>84.090</u>
Total	95.330
Ammonia	1.921

Sample No. 8 is much the same as No. 7, as it has the same growth upon it. The lime and phosphoric acid, however, are present in larger quantities. The nitrogen content is slightly less but still sufficient to make the soil fertile.

Sand and silicates	3.470
Alumina	1.476
Oxide of iron	.823
Lime	4.340
Magnesia	.134
Potash	.295
Sulphuric acid	1.305
Phosphoric acid	.640
Carbonic acid	2.420
Organic matter and water	<u>84.950</u>
Total	99.853
Ammonia	1.818

Sample No. 9 was taken at a depth of eighteen inches, directly underneath No. 8. It contains more organic matter and nitrogen, while the potash, lime and phosphoric acid are present in considerably reduced quantities.

Sand and silicates	1.750
Alumina	.954
Oxide of iron	.356
Lime	3.800
Magnesia	.141
Potash	.167
Sulphuric acid	1.459
Phosphoric acid	.217
Carbonic acid	2.120
Organic matter and water	<u>88.040</u>
Total	100.024
Ammonia	2.635

Sample No. 10 was taken from the surface of a piece of marsh that had been partly drained. A crop of potatoes had grown there the season before, but did not do well on account of the water. Potash, lime, phosphoric acid and nitrogen are present in sufficient quantities to render the soil fertile

Sand and silicates	6.230
Alumina	3.170
Oxide of iron	.108
Lime	5.480
Magnesia	.206
Potash	.248
Sulphuric acid	1.116
Phosphoric acid	.505
Carbonic acid	2.410
Organic matter and water	<u>80.810</u>
Total	100.283
Ammonia	2.380

Sample No. 11 was taken at a depth of eighteen inches, immediately below No. 10. Its supply of organic matter and nitrogen is greater than that in No. 10, but its mineral matter is much less.

Sand and silicates	1.050
Alumina	1.323
Oxide of iron	.077
Lime	4.450
Magnesia	.174
Potash	.171
Sulphuric acid	1.287
Phosphoric acid	.134
Carbonic acid	2.860
Organic matter and water	<u>88.680</u>
Total	100.208
Ammonia	2.701

Summary of Results of Analyses.

Sample of muck.	Organic Matter and Water	Insoluble Matter	Fe ₂ O ₃	Al ₂ O ₃	CO ₂
No. 1	86.610	2.170	.500	2.130	1.125
No. 2	84.090	2.720	.240	3.780	2.120
No. 3	71.000	16.170	.386	4.310	2.702
No. 4	50.850	1.780	.463	7.952	15.750
No. 5	95.300	2.110	.080	.770	.041
No. 6	37.200	49.670	.216	7.024	1.160
No. 7	84.090	1.650	.272	3.290	1.100
No. 8	84.950	3.470	.823	1.476	2.420
No. 9	33.040	1.750	.366	.974	2.120
No. 10	80.810	6.230	.108	3.170	2.410
No. 11	88.680	1.050	.077	1.323	2.860

Summary of Results of Analyses.

MgO	P ₂ O ₅	CaO	SO ₃	K ₂ O	NH ₃
.025	.083	4.530	1.123	.212	2.040
.013	.127	5.310	.728	.460	1.666
.190	.409	3.680	.739	.144	2.040
.010	.076	20.440	.766	.196	1.173
trace	.080	.051	trace	.000	2.865
.090	.454	2.450	.429	.092	.425
.105	.335	3.072	1.029	.317	1.921
.134	.640	4.340	1.305	.295	1.819
.141	.217	3.800	1.459	.167	2.635
.206	.505	5.480	1.116	.243	2.38
.174	.134	4.450	1.287	.171	2.701



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