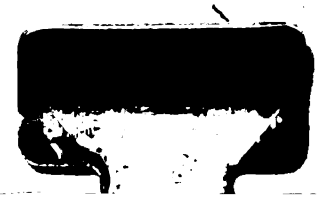
THESIS

FORMATION COMPOSITION AND USES OF MARLS OF MICHIGAN

BY

ROYAL C. FISHER.



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Formation, Composition and Uses of Marls of Michigan.

In travelling over the state of Michigan, one finds all kinds of soils, ranging from the jack-pine plains of the north to the marl and peaty swamps and marshes. Intervening between these two, we find all kinds of soils.

Michigan is noted for its numerous lakes and marshy swamps. A large number of these lakes and marshes have marl-beds for a bottom. There are but few counties in the Lower Peninsula that have not one or more extensive marl-beds. In the same county we will find large tracts of land which are in need of the elements of plant growth.

The farmer cannot afford to buy a fertilizer, and he is ignorant of the fact that the marl which is so cheap and easily procured, contains all the essential elements of plant growth. By giving these lands a good coating of marl, they could be made very productive.

In referring to the statistics of Michigan, I find that in 1890 the farmers of Michigan lost $10,000,000.00 in the production of three crops, viz., corn, oats, and wheat. Too much money is paid out for fertilizer when a good material can be obtained at a very small cost.

The question arises, "Why dont the farmers use marl as a fertilizer if it is so valuable"? This question is comparatively easily answered. Michigan is comparatively a newly settled country, and the land is and has been very cheap.

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As soon as one section of the country became settled, the more active and speculative classes moved farther back into the forests. Hence the poorer lands have not come into any use to any extent until of late.The lands are comparatively new, and it is but lately that commercial fertilizers have been used to any extent.On the other hand,we find in many of the older settled countries that the farmers use marl as a fertilizer to a large extent. Marl is used extensively as a fertilizer in Europe,parts of Asia and Africa.

In Egypt,they call the marl,'morog'. Here it is very extensive ly used as a fertilizer.These marls are foliated marls,containing nitrogen,potassium,phosphorous,lime,magnesium,oxide of iron,chloride and sulphate of soda. It has a depth of from fifty to one hundred meters.These marls are found along the hills bordering the Nile Valley in Upper Egypt. When exposed to the air, the marl crumbles to a powder which renders the material available.

We find,along the shores of Lake Michigan,especially north of Muskegon, beds of marl deposited during the Drift Age.This marl contains large amounts of vegetable and animal matter and therefore is rich in nitrogen,carbonate of lime and humus. It also contains large amounts of Potassium,phosphorous and oxide of iron. This marl was the most valuable marl of any I have analyses.I obtained it from the vicinity of Traverse City.

We also have marls from swamps that contain large amounts of humus.These marls are made up mostly of mineral matter and humus and are very valuable for fertilizers.

Our white marls or lime marls are formed in the bottom of

lakes; in river beds or in marshes. These marls are made up mostly of carbonate of lime, ranging from 40 to 90 %. Besides this we find Nitrogen, phosphorous, potassium, magnesium, manganese, iron and aluminum; some contain soda.

The mechanical condition of the marl determines its value as a fertilizer. If the lumps of marl will crumble down to a soft pulp by the action of water, it will make a good fertilizer. While on the other hand if it will not be acted on by water, it usually contains too much clay to be valuable, for fertilizer.

We find the three kinds of elements in marls as well as in most soils.

First-- The mechanical or inert material;

Second- Reserve materials-those that will be made available by other elements.

Third-- Active food for plant growth.

If it were not for the active properties of the different elements of the soil, all the salts would be washed out by drainage water.

The elements of the different marls besides acting directly as plant food, have three important properties. By mixing with the soil, it acts as a mechanical filter. Secondly;-Certain elements of the marl act upon the elements of the soil and change them from an insoluble condition to a soluble condition used by the plant. Thirdly;- Many of the most valuable salts of the soil are in a soluble condition. Certain elements of the marl act upon these salts by means of a chemical action, changing them from soluble to insoluble condition. These salts are then insoluble in

water, still they are capable of being used by the plant.

Formation of marl-beds.

Lakes and marshes serve as basins in which chemical deposits may take place. Along with this they furnish an abode for lucrustine fauna and flora, receive the remains of the plants and animals swashed down from the surrounding country and entomb these organisms in the growing deposits. We find layers of silt, sand, mud, vegetable matter and calcareous substances, formed from the accumulation of lacrustine shells etc.

In the lakes and marshes that receive much sediment, little or no marl can be found; but we get depositions of silt in lakes and humus and peaty soils in marshes.

On the other hand when there is but little sediment, or where it only comes occasionally at intervals of floods, beds of marl formed of organic remains and mineral matter may gather on the bottom to a great depth.

We have examples of this from the Eocene Age in Wyoming, where many square miles are covered, obtaining a thickness of hundreds of feet.

We find some marls richly loaded with compounds of iron. The formation of these beds is due to the agency of vegetable life. In marshy flats where stagnant water receives a supply of the organic acids from decomposing plants, the salts of iron are dissolved. Exposure to the air leads to the oxidation of ~~the iron in the form of hydrated ferric oxide~~ these solitions and the consequent precipitation of the iron in the form of hydrated ferric-

oxidewhich mixed with other combinations of magnesia, silica, phosphorous acid, lime, manganese, alumina and vegetable matter forms one kind of marl.

Animal formations of marl are chiefly composed of the remains of the lower grades of the animal kingdom, especially of molusca, Actinozoa and Foraminiferae.

Lime chiefly in the form of a carbonate, is the mineral substance of which the solid parts of these animals are built up. Hence the marls made up mostly of accumulations of animal remains are calcareaceous. In fresh water they are represented by some of the white marls of our lakes, rivers and marshes; consisting of the mouldering remains of mollusca, entomostraca and partly of fresh water Algae. On the sea bottom in shallow water, the marls are made up of shells and the accumulations of the excrement of fishes.

Marl is used for a great many things and the principal uses are the following; Marl is used as a fertilizer, to preserve the value of manures, for the preservation of moisture in the soil, to mix with paris-green for killing potato bugs, for making road beds, for the manufacture of certain paints, in making of a polish as covering for pipes and boilers and in some parts of the country it is burned for lime to be used for mason work.

Marl makes a good fertilizer for light sandy soils containing a fair supply of vegetable matter, and when decomposition is slow. It is very benificial to soils that tend to run to wild grasses. To get the best results, from the use of marl, it must be on the surface. It should also be pulverized and mixed with the surface soil. Frost is the best agent to pulverize the marl, so draw out

the marl in the fall and leave it to be acted upon by our cold winters.In the spring the marl will be in a mellow condition.Adding a bushel or so of salt to a ton of marl is very benificial. For grain crops it is found best to apply it in the spring of the year.

In proving the value of marls, I will set forth the value of the principal elements that go to make up our marls.

We find that from 40 to 85% of our marls are made up of carbonate of lime. Lime is essential to plant growth. It rapidly promotes nutrification and increases the capacity of the soils to hold other basis. The different salts of the soil being combined with some acid,by mixing lime with the soil,the acid will unite withsome of the lime and may pass away,and the valuable salts will form a double silicate which is insoluble.

The capillary power of the soil is greatly increased by the application of lime, hence soil will hold more moisture for a long er perdd if treated with lime in the marl. It will keep clay from puddling. Soils must be either neutral or alkaline, and lime changes the acid soils to either of three conditions according to the amount used. It decomposes many of the silicates and makes them available for plant growth.It acts the same on crude vegetable fibre. The conservation of the moisture in the soils is greatly increased.It not only affects the soil with respect to the evaporation of moisture,but it affects the plants by causing them to become richer in salts and therefore less subject to loss of moisture by transposition.In connection with nutrification,it has

an indirect action in promoting the assimiability of potash.

Potassium is one of the essential elements of plant growth Besides this use the potash salts absorb the moisture of the air and add to the soil.This same property is possessed in a similar degree by sulphate and carbonate of magnesium. The latter material also assists in fixing the other valuable salts of the soil.

Aluminum is the materia that the different salts unite with to form an insoluble double silicate which will only be acted upon by the action of plant growth.

Iron is also essential to plant growth.It is the iron that aids the formation of Chloraphyl.It holds ammonia firmly in the soils and must be present in all fertile soils.

Humus has a wide range of affinity;it will hold and take up large amounts of water.It warms the soils several degrees and helps to bring elements of plant growth into condition for use by the plant.It is also one of the sources of nitrogen.It ~~is~~x It is however not the only source of nitrogen,but it does convert the nitrogen into nitric acid so that it can be used by the plant.

In the analysis of these marls much precaution must be taken The following process was used.Ten grams of the marl were digested in Hydrochloric Acid for several hours on a water bath;diluted to 500CC., and aliquot parts taken for analysis of the valuable elements. I made a careful analysis of three different kinds of marl and the following i s the result.

Name of place from; where marl came	Insoluble matter	Percent of different elements. Lime	Mg	Manganese	K	P	Other
Cedar, B & W	27.76	62.22	3.15	1.04	.13	.45	5.86
Branch Co.	8.	85	2.91	1.45	.025	.33	1.29
Grand Rapids W.	14.13	78.21	2.85	1.75	.02	.28	2.76

I analysed six samples for phosphoric acid and obtained the following results.

Grand Rapids	Cedar	Branch	Traverse City	Portland	AuSauble.
.28	.45	.33	.65	.18	.31

Prof. R.C. Kedzie, several years ago, made an analysis of several marls and I will take the liberty to copy his results.

Berrien County Marl.

Carbonate of Lime	79.60
Carbonate o f Magnesium	4.54
Ferrous Oxide	1.43
Insoluble matter	13.00
Organic matter	1.43

St.Joseph County Marl.

Carbonate of Calcium	56.16
Carbonate of Magnesium	6.00
Ferrous Oxide	1.05
Insoluble matter	36.79

Lenawee County Marl.

Carbonate of Calcium	90.00
Carbonate of Magnesium	2.00
Insoluble matter	5.50
Organic matter	2.50

0 Otsego County Marl.

Carbonate of Calcium	80.00
Carbonate of Magnesium	2.50
Phosphate of Lime	1.50
Insoluble matter	16.00

I also determined the amount of nitrogen in the black or humus marls from Traverse City and the white marls from Grand Rapids. In the Traverse City marls I found 1.45% of Nitrogen and in the Grand Rapids marls .68 of 1%.

By a report of Dr. R.C. Kedzie, I find that he gives the market value of certain bone fertilizers to be $39.00 per ton. I will give the valuable elements of the same value he did and compute the worth of a tons of marl as a fertilizer. For this computation I will take my best marl, which comes from Traverse City.

29# of Ammonia at 18cts. per #	$5.43
13# of Phosphoric Acid at 8cts. per #	1.04
5# of Potash at 6cts per #	.30
Total value of Nitrogen, Phosphorous & Potash	$6.77

Besides this value the marls range from 50 to 85% of lime. Land plaster is retailed at about $5.00 per ton. By atomic weights I find one ton of our best marls to amount to as much as a ton of land plaster, hence this would give the marls a value of over $10.00 per ton as a fertilizer, besides the value of the iron, aluminum, magnesium, and manganese which add much to the value of the soil.

The white marls are run through a screen, (an ordinary sand screen) after being dried and pulverized, the same as land plaster and is then

and are then mixed with paris-green and used to paris-green potatoes. The marl will adhere to the potato vines better than the land plaster, thus holding the poison longer on the plant and getting more benifit from the same.

In many places people burn these marls for lime which is then well suited for building purposes.

In many of the older countries, the people are using marl for making road-beds, which, when mixed with clay, makes a cheap and very durable road-bed.

White marl, being a very poor conductor of heat and also owing to its cheapness, is becoming very popular as a covering for steam pipes and boilers.

There is no appreciable grit to white marl and owing to this property, it is used in the manufacture of polishes. Polishes made from marl are the very best kind for polishing silver-and brass-ware and also for steel instruments.

Many firms of the United States, who manufacture Portland cement, use large quantities of these marls instead of pure lime.

Another very important use for these marls is in the manufacture of some of our floor-paints.

Some of our marls are valuable for some uses while others are not; but one can judge for himself whether these marls belong to one class of the other. I know of some large business firms in the United States that pay from $8.00 to $10.00 per ton for dried marl.

These marls are of much value. Let us use them and plenty will be brought to our homes.

Royal Clare Fisher.