THESIS

ON

MARL OR BOG LIME IN MICHIGAN.

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THESIS

Marl

Marl is an indefinite and somewhat ambiguous term applied to a great variety of earth found in many different parts of the country. In some countries some substances are called marl that contain no lime whatever, but as popularly used, however, and which it is not at all unlikely is the correct usage, it is applied to soils of a calcareous nature found in the form of deposits under marshes or peat bogs or around many of the small lakes. It is principally a mixture of clay, and lime in the form of a carbonate; either of which may be found in widely varying quantities in the different samples.

The marl may be readily recognized by its light ashy or yellowish white color. Its location may also aid in recognizing it, for if a soil or a deposit underneath the peat or water be found about the margin or occupying the shallow and quiet portions of small lakes, it is quite likely it is marl. It may sometimes be discovered by thrusting a pole down into bogs or shallow waters of lakes and pulled up. On removing sufficient marl will adhere to be recognized.

Marl has some synonyms under which it is known in different parts of the country. Besides the name marl which has already been defined, it is known as tufa. This is marl fully as much as that found underneath the water of lakes. It has simply been elevated after its formation and is now hard, porous marl, and is known as lime-called marl, the only difference being the circumstance under which it is placed. Marls are always formed by [illegible] and are [illegible] the [illegible] of

bogs; the surrounding moisture and exclusion of air prevents the firm cohesion of particles found in tufa. This action causes it to be called bog lime.

In the Michigan Agricultural Report for 1858 pg.393, marl is said to be "an alluvial deposit from waters which have percolated soils charged with lime. On reaching the surface the water parts with a portion of its carbonic acid and becomes no longer capable of holding the lime in solution, which is then deposited in the form of a pulverulent, chalky substance in the beds of lakes and beneath peat marshes." Shells of molluscous animals contain a large proportion of CaCO3 and as the circumstances of its formation are favorable they often constitute even the main portion of the bed itself.

There are several different classes of marls the composition of which is all somewhat similar. The upper layer is known as blue marl or shell marl. These are found near the surface. They are usually mixed with an appreciable amount of sand, clay, and in some cases large amounts of organic matter. They also contain large quantities of decayed shells and bones and usually have some K and P2O5.

Chalky marls are found at greater depths and are of a lighter color consisting mainly of comminuted shells and corals witha trifle of sand and "green sand" mixed with them.

The "green sand" marls of New Jersey are much heard of and extolled but mainly for the large amounts of K and P2O5 which they are said to contain. The percentage of lime which they contain seldom reaches above 1-2%. The Maryland Experiment Station says that the potash is not in so soluble a form as some others and on the other hand equally as good

authorities say that it is more soluble than other forms. We are certain however that it is beneficial as a fertilizer for its Phosphoric acid and lime and intime the potash that it contains will become available if applied to the soil.

The marls of Maryland, or what are called marls and analyzed as such would here be called clays, sands, or marly soils, as the insoluble silicious matter is greatly in excess of all other components. Of 26 analyses recorded, none contained over 30% of carbonate of lime and that was a sample of chalky marl while many others contained not more than 15% and a very large percentage contained but 1 to 5% of $CaCO_3$.

There is scarcely a county in Michigan that has not more or less marl deposited in it around the numerous lakes or where lakes formerly existed, found so extensively distributed throughout the state. In some localities we find these deposits covering but small areas of one acre and up, while in other portions of the state we find the deposits covering areas of a thousand acres or more.

The value of these marls depends upon several things. It depends upon the use that is to be made of them, the means of access, the extent of the deposit and the quality of the marls or the amount of lime they contain. Some may be valuable to use as fertilizers, others may be more valuable to burn for lime and still others for making Portland cement and the like. In some cases we may find a marl bed covered to a depth of several feet with [illegible] or with the shallow waters of a lake that would [illegible] expensive to secure it for commercial purposes at the present time unless it was an extensive deposit and several feet in depth.

As regards the quality of the marl we find that the amount of lime it contains often determines the advisability of using it for commercial and mechanical purposes as well as for fertilizers.

The following table shows the analysis of several samples from various parts of the state.

Locality.	Insoluble siliceous matter.	Iron and alumina.	CaCO3	MgCO3	Organic matter K2O,P2O5	H2O
Indian River, Cheboygan Co.	10.205	2.25	77.088	3.1496	.2384	1.13
Bay City.	6.90	.79	88.282	1.7312	1.49176	.805
Stanton #1.	.26	.76	90.846	3.04608	5.0873	
Shelby.	.79	.61	81.4545	2.70606	4.37854	
Stanton #2.	.57	.39	90.7357	3.0769	5.5873	
Lake Odessa.	5.00	.79	88.494	3.28104	2.435	
Peachridge.	15.03	1.87	63.98175	.31	17.24	1.57
Constantine #1.	93.50			1.012		
Bronson.	1.13	1.12	88.4499	3.36	5.9401	
Constantine #2.	95.67	1.61		.68	2.04	
Constantine #3.	93.66	2.26		.70	.338	

It will be readily observed from the above table that Michigan marls have a large amount of CaCO3. The three samples analyzed from Constantine which were found to be nearly pure silica were taken from different beds in that vicinity. Not the least trace of lime was found in any of the three samples and only a very little magnesium. These are of no value whatever either for fertiliser or for mechanical purposes,

as the sand itself has round granules and has no grit to it.

The various uses to which marls are put are quite numerous. Their composition, texture, and the extent of the deposit are usually what determine their uses as much as anything else. They are used for fertilizers, paints, polishes, quick lime, Portland cement, and the like.

For fertilizers, marl should be taken from the swamp in the fall of the year and applied to the soil, where it is allowed to remain on the surface during the winter. The frost or freezing and thawing of winter will crumble it in such a manner that it may readily be plowed and harrowed into the soil in the spring. These marls may be applied to any soils in various amounts, but usually from one to three tons or more per acre. The soils most benefited by application of marl are muck beds rich in humus and containing little mineral matter, and acid soils of any kind, as the marl is alkaline and in its neutralizing action may reclaim much land that would be otherwise waste and useless. It is also found very beneficial to clay soils and sands. In the former it flocculates the particles of clay and makes it more porous and more easily worked, thus causing a tendency to do away with some of the immense rock-like clods found on clay fields if plowed when damp. On sands the action is different. It increases the number of small particles in the soil by being applied in large quantities, thus increasing the capillary action which is so much desired in sandy soils. It is also said to have a tendency to prevent leaching of soils as it forms a base with which other useful elements of plant growth may unite, as potash, sulphur, and phosphorus. When easily obtained it is the cheapest form of lime

to use on any soil. It has a milder action on the soil than the pure caustic lime (CaO) and at the same time exerts all its beneficial influences. Plants are found to require a certain amount of lime but the best results have been obtained from applying an amount far in excess of the amount needed by the plants. It is found to [illegible] the $FeSO_4$ x found in some soils and to produce the necessary alkalinity for nitrification and preparation of other plant food. Some years ago it was held in fairly high esteem as an agent for keeping [illegible] borers from young trees, but is used very little for [illegible] purpose now.

In [illegible] as it is found so beneficial [illegible] soils, [illegible] [illegible] [illegible] [illegible].

[illegible] humus [illegible] [illegible] [illegible] [illegible].

Owing to the very fine texture of marls and the extremely small amount of grit and silicious matter found in some marls it is used quite extensively by some manufacturers in making barn paints and the like and adulterating some of the better paints. Owing to these same properties it is used very much as a polishing material. In some places it is prepared into a polishing paste or powder and sold as a fine grade

of polish for nickel, silver and gold ware. These two uses are however, not very extensive at present. This material is used by some manufacturers for packing steam pipes and the like as it is inexpensive, not very heavy, and a fairly good nonconductor of heat. It is also sometimes used with asbestos and MgCO3 for the same purpose.

In some parts of the state and at different times marl has been dug and burned for the purpose of making quick lime. This was done more in early times perhaps than now, and in sections destitute of lime stone. It has been applied to nearly all the uses of the best rock lime, but as that is now found in such large quantities and is so easily obtained both in this and other states that its use as quick lime is not so extensive now as it was some years ago. It is somewhat inferior in strength, yet it is nevertheless a valuable and useful product. Its real value is frequently under rated from its not being sufficiently burned. Marl is supposed by some to require less heat than limestone, but this has been found erroneous. Gypsum or $CaSO_4$ and marl have both the same base, but the former is a sulphate and the latter a carbonate. Both are used as fertilizers, but with not very widely differing results. The gypsum while it is perhaps a trifle more soluble in water has not as lasting a benefit to the soil where applied, as marl.

As compared with quick lime from limestone burned in Ohio and Kentucky we can notice but little difference except in the amount of magnesium and the absence of iron in white lime. The following table will give an idea of the similarity of the composition of rock lime and some of the best marls analyzed.

Locality.	SiO_2.	Fe and Al.	$CaCO_3$.	$MgCO_3$	Organic Matter.
Marl from Stanton #1.	.26	.76	90.247	3.047	5.87
Marl from Shelby	.79	.61	91.45	2.77	4.378
White lime.	.57		91.000	3.097	
Gray lime.	.23	[illegible]	[illegible]8.836	10.153	
Marl from [illegible].	1.13	1.12	8[illegible].45	3.30	5.9401
Marl from Stanton #2.	.57	.39	[illegible]0.7357	3.0768	5.587

There has recently been organized in the state an industry which bids fair to be the largest institution of its kind in the United States if not in the world. This is a factory for the manufacture of Portland cement on an extensive scale. The factory which was a small one for a few years past has been located at Union City a few miles from where the large plant is being erected. The large factory that is now being built is located upon a piece of upland in the center of a large swamp [illegible] miles from [illegible] in [illegible] township, Branch county. The beds of marl are situated on all sides of the factory. The main bed [illegible] acres, [illegible] miles long and 1/2 [illegible] 1 1/2 miles wide. [illegible] [illegible] [illegible] [illegible] [illegible]

cement. This bed also lies next to the [illegible] and is found to cover a considerable area. The depth of these beds is not exactly known but they are of sufficient depth to prove very valuable. In many places [illegible]

[illegible]. The proportions of these two, marl and clay, used in Portland cement are 5 to 1. These are mix d and heated with a blast until vitrified, when it is cooled and ground and is then ready for use in the form of Portland cement.

The following table will show the comparative analysis of the components of Portland cement and the cement itself as manufactured by a Cleveland firm.

Sample.	SiO2	Fe & Al.	CaCO3	MgCO3	Organic matter.
Diamond Portland Cem.	19.83	20.04	58.6936	1.4364	
German Portland Cem.	24.05	12.04	61.81	2.1	
Marl from Bronson.	1.13	1.12	88.4409	3.36	5.9401
Clay from Bronson.	82.37	6.90	2.43	2.28	5.43

The sample of clay was a typical sample , but the marl contained more organic matter than it would otherwise, as it was taken from near the surface for the reason that the marl beds had not been opened up.

From the few investigations and analyses that have been made, and from the experiments already tries, we can readily see that the white, chalky material underneath the peat bogs of our marshes, instead of

being worthless inert matter as many once supposed, may be advantageously and profitably utilized in many ways.