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EXTRACTS

From the Report of the Geologist, appointed by the State of Maryland to make a complete and minute geological survey of the State.

Talbot County.—Nearly the whole of this county is underlaid by marl; but it presents itself under a variety of circumstances of unequal facilities for extraction, and is, as elsewhere, of very variable qualities.

On the Talbot side of the Tuckahoe branch of the Choptank, it occurs in the high banks of the river from six to ten feet below the surface; but is exposed to view in the ravines that make down to the river. As every where else, it is undulating on the surface, occurring in a distinct stratum, from three to five feet in thickness, the inferior level of which, is six feet above high water mark; it is frequently covered by a crust of indurated marl mixed with sand, evidently caused by the action of the waters, which filtering through the lose soil above, on reaching the marl bed, have facilitated its decomposition, removing a portion of its calcareous constituents and depositing in their stead, silicious particles. The most remarkable deposite of this kind, is about three miles south of Hillsborough, on the farm of Thomas O. Martin, Esq.; a more interesting one, in every respect, can scarcely be pointed out in any other part of the county. In this place, the banks are elevated from thirty to forty feet above the river, and the deep ravines that descend to it, greatly facilitate the extraction of the material at all seasons of the year. This place may be mentioned as the only spot at which the bottom of the marl deposite is known to have been reached; unfortunately, the excavation was not sufficiently extensive to allow a satisfactory examination of its substratum; it appeared to consist in a stiff blue clay. The analysis of the marl from this locality, is given at No. 23 of the table.

Descending the Tuckahoe into the Choptank, a little below Kingston, we reach the mouth of King's creek. The high banks on the inlet of this creek exhibit thick beds of good marl, (No. 24,) the shells of which are imbedded in a stiff clay. The bed at one locality,—on the farm of Mr. William Pratt—is covered by a thick stratum of a very plastic chocolate-colored clay, which itself might serve as a useful amendment to the thin soils of the surrounding country.

But perhaps the most valuable beds of shell-marl in this part of Talbot county, inasmuch as they may be made extensively available to the public demands for the article, are those which were fully described in the preceding report.—They occur three miles below Dover bridge, forming the high bank from fifteen to twenty feet above tide, being one compact mass of fossil shells, and extending nearly a mile along the river, on the farms of the late Col. Smyth and Mr. Atkinson. These beds are in contiguous strata, apparently successive, and consist of vast accumulations, principally, in the ascending order, of oyster shells, succeeded by clam shells intermixed with other marine shells, scallop, clam and scallop, and uppermost principally of scallop. Endeavor was made to bring these beds into notice, with a view of enlisting them into the public service, by giving to their proprietors what was deemed proper directions for extracting the material, and salutary advice, as to a just estimate of its value, in order to secure a constant and permanent disposal of it. The subject is now in progress of experiment. South of these banks on the Choptank, no other deposite of marl is known to occur.

It will have been remarked, that these deposites are described as lying high above tide. It is, in fact, from this boundary of the county, that the dip from north-east to south-west in the marl deposite previously alluded to, becomes most apparent: occuring so far in Talbot county, only a small distance below the surface of the soil, it now becomes covered in the middle districts by a heavy coat of gravel and sand, extending from north to south from the head of Wye to the Choptank, and reappears again at a lower level on the banks, at the termination of the numerous inlets that so conveniently and beautifully intersect the lower portions of the county.

A reference to Map A appended to this report, will convey a better idea of the extent and numerous localities of shell marl in this section of the state, than a bare mention of them by name could do. Suffice it to say in this place, that a line drawn from the head of Skipton creek, touching the intervening creeks between this and Dividing creek, and perhaps, prolonged to the Choptank, would limit the eastern boundary of that portion of the territory which embraces the great shell-marl formation of the county; whilst another line from the mouth of Pickering creek, enclosing the western banks of Mile's river as far as the ferry; thence, by the head of Plain dealing creek to the Choptank, and uniting with the water boundary of the county, would form its western limits. Nos. 25 to 41 on the table, indicate the chemical composition of the marls from the principal localities of this great deposite.

SEC. III. *Nature of the materials contained in the shell marl deposites of the Eastern Shore of Maryland.*

It is important to become acquainted with the precise nature of the materials contained in these deposites; because upon this knowledge in a great measure depends the judicious application to be made of them. It is more especially to furnish such information that the table which has been so frequently referred to was made out. Some general remarks under the present head seem, however, to be necessary.

Perhaps the true nature of these deposites is this. They are vast accumulations of the exuviæ of testacious animals, formed at a time when the portion of dry land where they are now observed, was the bottom of an ocean. There is no evidence that their present elevated position is owing, to any upheaving of strata from below—the favorite geological notion of the day—nor to a simple retreat of the water from above them.—They are generally overlaid by a thick covering of water-worn materials, such as gravel and sand, occasionally enveloping boulders of rocks belonging to the oldest geological formations; sometimes they are covered by a heavy stratum of clay; occasionally by alternate strata of clay, sand and gravel. In no instance, save when they form the bottom of an inlet or creek, or when they occur in the bed of a stream, has their surface been observed to be denuded. Some cataclysm contemporaneous with the cause of the retreat of the ocean, or subsequent to this retreat, has no doubt, occasioned the formation of these superincumbent strata. It is not worth while however speculating about this, at present; although it may be useful to know that the material by which the marl is covered is not contemporaneous with the marl itself.

It is useful to know this, for two reasons. First, to become satisfied that the nature of the superincumbent soil cannot in any case be expected to partake of that of the underlaying stratum of marl; hence it is never found to contain calcareous particles. Secondly, to understand the cause of the variety in the ingredients with which the marl is associated; thus we find the shells sometimes enveloped in clay, at other times in sand, and then again in a mixture of sand and clay, these two ingredients being in very variable proportions.

Now, although the marl does not influence the nature of the soil lying over it, the latter frequently greatly modifies the quality of the marl beneath it. The cause of this is apparent. The superincumbent earth (understanding thereby the whole mass of materials covering the marl) consists either of clay, gravel or sand, or a mixture of all these; & having, it is presumed, been deposited upon the marl subsequent to its formation, it will, from a variety of causes, have become mixed with it. It is, however, more especially by infiltration that the marl becomes modified in consequence of the condition of the soil above it. If the latter contain fine particles of sand, as is very commonly the case, these will be taken up by the waters that traverse the soil, and so charged, will penetrate more or less deeply into the marl bed. Should the shells there be loosely scattered in their mineral envelope, which is also frequently sand, the whole of their calcarious particles may be desolved and become replaced by a silicous deposite. The bed of fossils will in this case, at least in its upper portions, exhibit an accumulation of indurated *cast* alone of shells. Such is the case in many places on Chew's island, in some of the fossil deposites of Skipton creek, and in several places on the Wye. It is evident that then the material cannot be used as marl. When again, the superincumbent soil is ferruginous, it very generally happens that the shells are bound together by an argillo-ferruginous cement extremely hard, which unfits them for use not only in this respect, but also by substituting for the calcareous ingredient which they originally contained a predominating constituent of oxide of iron, which cannot be beneficial to the soil.

It must be borne in mind, however, that this sort of disnaturing of the shell marl is most generally confined to the upper portions of the deposite. Hence, if in the search after marl, those silicious or ferruginous incrustations are met with, they should always be removed to ascertain the nature of the material beneath. There is a very remarkable example of a thick coat of silicious incrustations covering very excellent marl, on the estate of William Carmichael, Esq. on Back Wye, Queen Ann's county.

As to the fossil constituents of the shell marl deposites on the Eastern Shore of Maryland they are very various. Some are principally composed of oyster shells, others principally of scallop, some again principally of clam, and in others nearly the whole bed consists of *perna*, commonly known by the name of pearl shell. These last furnished decidedly the best marl. The perna is a broad, thick shell, somewhat in the shape of a large oyster, of a white pearly appearance, peeling off in thin laminæ that are very soft and friable. When exposed to the atmosphere for a short time it falls into an almost impalpable dust, consisting essentially of carbonate of lime—This shell occurs in most of the marl beds of the Eastern Shore, but more especially in those of Talbot county, and as already stated, at the head of Reed's creek, in Queen Ann's county.

The quality of the marl is also greatly influenced by the nature of the shells that composed it. It was stated in the former report, and may be repeated here, in illustration of what has to be said under the present head, 'that those beds which consist principally of *clam shells*, usually associated with numerous varieties of other smaller bivalve & univalve shells, containing at the same time very little admixture of foreign ingredients, yield a marl which exhibits its beneficial effects upon the soil in a very short time, because the calcareous particles are derived from shells which are very prone to disintegrate when exposed to the atmosphere. Marl beds, composed entirely or principally of *oyster shells*, are much less valuable, because of the slow disintegration and decomposition of this species of shell *scallop shells* resist such decompositon still more obstinately than do oyster shells, and when they occur, as they have been observed to do, in extensive beds firmly agglutinated by an argillo ferruginous cement, they are useless in all soils, and may be positively injurious to some.'

It follows then, that the nature of the material in the shell-marl deposites must be ascertained first in reference to the species of shells which it encloses, and their admixture with foreign ingredients, as clay, sand, gravel, &c. This can be done by a simple inspection aided by such experience & knowledge as can be acquired without any difficulty. But a more important consideration relates to the *composition* of the marl, and especially to the relative proportions of its three principal constituents, namely, carbonate of lime, alumine and silex. To ascertain this, recourse must be had to a chemical analysis. The proportion of calcareous particles is doubtless generally the most important fact to be determined; but it sometimes becomes equally important to ascertain the proportions of aluminous and silicious particles; for, one of the advantages, and not an inconsiderable one, in the application of marl is its use in ameliorating the mechanical condition of the soil, and these ingredients are eminently serviceable in this way.

From what has already been said, it will readily be perceived that great variety must also necessarily present itself in the chemical composition of the marl in its different localities. So far as experiments have been conducted it has been found that the proportion of calcareous particles varies from 20 to 60 per cent.; that of aluminous from 10 to 20 per cent.; that of silicious ingredients from 30 to 50 per cent.

It is doubtful whether any directions could be given which would enable those unpractised in chemical operations and manipulations to ascertain with any degree of accuracy the relative proportions of these constituents of the marl—This is a subject which must be submitted to some analytic chemist; and it is the duty of the Geologist to satisfy inquiries of that sort whenever called upon for that purpose. On the proposed geological map of the state, it is contemplated to express the composition of the marl in the principal localities that will be laid down, and by extending the table exhibiting the chemical analyses of these marls, to all such as can be conveniently procured, a mass of information will be collected that will in some measure supersede the necessity of any further experiments.

SEC. IV. *Mode of extracting the Marl—its use and its application.*

The first use of marl on the Eastern Shore of Maryland, was made about thirty years ago, by Mr. Singleton, a gentleman whose name should ever be remembered by the people of Talbot county. The great improvement which he thus effected in the productiveness of the soil to which it was applied, soon became evident to those around. His example was, after awhile, imitated; so that, at this time there is scarcely an intelligent farmer having a supply of marl at his command, who is not aware of its value, and who has not employed it extensively and beneficially. Its use is pretty well understood in Talbot and the lower portions of Queen Ann's counties. Some errors have, however, been committed, against the recurrence of which it is proper to guard. It may be necessary also, for the benefit of those who have not yet employed the material to give some directions, not only as regards the best manner of applying it according to its own qualities and the qualities of the soil, but likewise as to the most advantageous mode of extracting it.

In reference to its extraction—suppose a farmer to be about to commence the opening of a marl pit. His first care must be to select a situation from which it may be hauled with the gratest convenience and facility, at all seasons of the year. In those parts of the country where the marl lies high, this is easily done; but in the lower portions of Talbot county where the country is flat and but a few feet above the level of tide, more attention to this circumstance than has hitherto been paid, should be observed. Farmers have seemed more solicitous about the presumed quality of the material, than its facilities for extraction relying upon its soft and plastic character as a criterion of its richness. A little reflection should satisfy us that its wet condition cannot improve its quality, and by rendering it much more heavy will increase the labor of transportation; besides it must have been observed that when hauled out in its moist state, and exposed to the desicating effects of the sun and wind, it is apt to cake and harden, so as to require to be subsequently broken up before it can be incorporated with the soil. It is always necessary, therefore, to select a situation, such as the head of a branch, where facilties exist for draining the pit; and the removal of the marl should always be commenced at top, even should it appear of much inferior quality. The saving of time and labour in raising and hauling will amply compensate for the additional quantity which it may, in consequence, be found requisite to apply.

Mr. Edmund Ruffin, of Virginia, in his valuable 'Essay on Calcareous Manures,' has given the following practical directions for the working of marl pits, which will be found to suit many localities on the Eastern Shore of Maryland. In working a pit of wet marl,' he says, 'no pains should be spared to drain it as effectually as possible. Very few beds are penetrated by veins of running water, which would deserve the name of springs—but water oozes very slowly through every part of wet marl, and bold springs often burst out immediately over its surface. After the form of the pit, and situation of the road are determined, a ditch to receive and draw off all the water, should be commenced down the valley, as low as the bottom of the pit is expected to be, and opened up to the work, deepening as it extends, so as to keep the bottom of the ditch on the same level with the bottom of the marl. It may be cheaper, and will serve as well, to deepen the ditch as the deepening of the pit proceeds. After the marl is uncovered the full size intended for the pit (which ought to be large enough for carts to turn about on) a little drain of four or five inches wide, and as many deep, of the size made by the grubbing hoe used to cut it, should be carried all around to intercept the surface or spring water, and conduct it to the main drain. The marl will now be dry enough for the carts to be brought on and loaded. But as the digging proceeds, oozing water will collect slowly, and aided by the wheels of loaded carts, the surface of the firmest marl would soon be rendered a puddle, and then a quagmire. This may easily be prevented by the inclination of the surface. The first course dug off, should be much the deepest near the surface drain, (leaving a margin of a few inches of finer marl, as a bank to keep in the stream) so that the digging shall be the lowest around the outside, and gradually rise to the middle of the area. Whatever water may find its way within the work, whether from oozing, rain or accidental burstings of the little surface drain, will run to the outside the dip of which should lead to the lower main drain. After this form its given to the surface of the area, very little attention is required to preserve it—for if the successive courses are dug of equal depth from side to side, the previous dip will not be altered.—The sides or walls of the pit should be cut something without the perpendicular, so that the pit is made one or two feet wider at bottom than at top. The usual firm texture will prevent any danger from this overhanging shape, and several advantages will be gained from it. It gives more space for work—prevents the wheels running on the lowest and wettest parts—allows more earth to be disposed of, in opening for the next pit—& prevents the earth tumbling into the next digging when the separating wall of marl is cut away. The upper drain of the pit, which takes the surface of water, will hang over the one below, kept for the oozing water. The first remains unaltered throughout the job, and may still convey the stream when six feet above the heads of the laborers in the pit. The lower drain of course sinks with the digging. Should the pit be dug deeper than the level of the receiving ditch can be sunk, a wall should be left between, & the remainder of the oozing water must be conducted to a little basin near the wall, & thence baled or pumped into the receiving ditch. The passage for the carts to ascend from the pit should be kept on a suitable slope—and the marl forming that slope may be cut out in small pits, after the balance has been completed.'

'If the marl is so situated that carts cannot be driven as low as the bottom, than the area must be cut out in small pits beginning at the back part, & extending as they proceed, towards the road leading out of the pit."

These directions, of which doubtless avail may be taken on many places in Maryland, are the result of the experience of a gentleman well known to have devoted much time and attention to the subject. There are other circumstances, however, that should be attended to in preparing a pit from which marl is to be drawn. In the preceding section, it was stated that the upper portion of a marl deposite sometimes consists of a thick incrustation, occasioned by causes then explained. This, as a matter of course, should be removed. It has also been stated, that the species of shells occuring in a deposite, vary. In some localities that have been examined, they are disposed in strata, each stratum containing a predominance of one kind of fossils. Thus, some strata contain nearly all scallops, some nearly all oyster, or nearly all clam, &c. There is an advantage in possessing a choice in this respect; but it should be directed by the knowledge which we have acquired, that some more readily disintegrate than others when exposed to the air. If the upper stratum in a marl bed should, for example, be found to consist principally of scallop shells, it would be advisable to remove this, so as to reach at once the second stratum, which will commonly be found to consist of clam shells. The former must not, however, be thrown away. They should be piled up around the pit; where, by the influence of the atmosphere agents, they will after awhile become so disintegrated as to constitute marl of very good quality.

Some marl deposites consist of broken shells so cemented together, that their contents cannot be extracted but in large masses, or hard lumps. In this condition, the material cannot be readily incorporated with the soil. It might be burnt as an impure limestone; but generally speaking, it will be found sufficient to suffer it to remain exposed for one season, which will bring it into a proper state to be hauled out.

In the lower parts of Talbot county where the marl lies deep, occasionally not more than a foot above high water mark, its extraction is inconvenient & laborious. Still, its benefits must not be resigned. Advantage should be taken of low tides to raise it upon the banks, from which it may be hauled at convenient oppertunities.

The value of marl is now so generally acknowledged, and its property of improving a soil, and even restoring one totally impoverished, so universally recognised, that no farmer should hesitate to make the hauling of it a regular occupation. Marling to be carried on with advantage, or even with economy, should be carried on throughout the year, or at least during a specified portion of it, by a force expressly set aside for that purpose and none other. "If only a single horse," says Mr. Ruffin, "were employed in drawing marl throughout the year, at the moderate allowance of two hundred working days, and one hundred bushels carried out for each, his year's work would amount to twenty thousand bushels, or enough for more than sixty acres. This alone, would be a great object effected. But besides, this plan would allow the profitable employment of additional labor. When at any time, other teams and laborers could be spared to assist, though for only a few days, every thing is ready for them to go immediately to work. The pit is drained, the road is firm, and the field marked off for the loads. In this way, much labor may be obtained in the course of the year, from teams that would otherwise be idle, and from laborers whose other employments would be of but little importance. The spreading of marl on the field, is a job that will always be ready to employ any spare labor; and throwing off the covering earth from an intended digging of marl, may be done when rain, snow, or severe cold, have rendered the earth unfit for almost every other kind of labor."

As to the mode of applying marl, it consists simply in disposing of it in heaps over the field; then spreading it in the manner that is done with other manures; and finally, turning it in with the plough. It may sometimes, be used also as a top dressing.

The next subject of consideration and the most important one, relates to the *quantity* of marl to be employed. Specific directions under this head can scarcely be expected; so much depending upon the quality of the marl, so much more upon the nature of the soil to which it is applied. It is correctly remarked by the writer quoted, that "every application of calcareous earth (marl) to soil, is a chemical operation on a great scale. Decompositions and new combinations are produced and in a manner generally conforming to the operator's expectations. But other and unknown agents may, sometimes, have a share in the process, and thus cause unlooked for results." The *general principle* which it is believed, however, may be safely laid down is, that the better the soil, the greater the quantity of calcareous manure which it will bear. A permanent *caution* which must at the same time be given *is*, to beware of *over*-marling.

There is not the least doubt but that the benefit derived from marling, so far as its calcareous particles are concerned, will be in proportion to the putrescent matter naturally contained in the soil.—In this respect it acts chemically. But the marl as we find it, containing aluminous and silicious particles, the mechanical operation of which should by no means be overlooked. To lay down general rules, therefore, for the application of marls, it would seem necessary to classify them in reference to the predominance of each of their essential constituents. Thus, a marl very rich in *calcareous* particles—such as might be termed emphatically a *calcareous marl*—ought especially to be used where the soil contains, or may receive a considerable proportion of putrescent matter.—On a barren soil, whether a dead stiff clay, or a loose sand where no plant can live, marl of this sort would be perfectly useless. On the other hand marl with a due proportion of *aluminous* particles—such as might be called *clay marls*, would be very serviceable to sandy soils, improving their texture when used alone and rendering them fertile when used in conjunction with other manures. Again, *sandy marls*, or such as contain considerable admixture of silicious ingredients, are found to be most benificially applied to stiff clay soils. Extraordinary benefits have been derived on a soil of the latter kind, by the use of a marl having the following composition:—carbonate of lime 39, alumine 10, silicious sand and gravel 44, iron 2, water 5. This soil, previously totally unproductive yielded after the application of thirty loads to the acre, a return of ten for one. It is more than probable, that the primary good effects of the marl, were as much due to its silicious as to its calcareous constituents. This marl occurs on the estate of H. Hollyday, Esq. in the vicinity of Easton, by whom it was employed with the results just stated.

The experience of farmers on the Eastern Shore of Maryland seems to confirm the theoretical views entertained by Mr. Ruffin on the neutralizing effects of marl applied to soils denominated *acid*. In reference to the application of marl to such soils, that gentleman, has the following remarks. "When acid soils," he says, are equally poor, the increase of the first crop from marling will be greater on sandy, than on clay soils; though the latter, by heavier dressings and longer time, may ultimately become the best land. The more acid the growth of any soil is, or would be, if suffered to stand, the more increase of crop may be expected from marl; which is directly the reverse of the effects of putrescent manures. The increase of the first crop on worn acid soil, I have never known under fifty per cent. and often is as much as one hundred—and the improvement continues to increase slowly under a mild tillage. In this, and other general statements of effects, I suppose the land to bear not more than two crops in four years, and not to be subjected to grazing—and that a sufficient cover of marl has been laid on for use, and not enough to cause disease. It is true, that it is difficult, if not imposible, to fix that proper medium, varying as it may on every change of soil, of situation, and of the kind of marl. But whatever error may be made in the proportion of marl applied, let it be on the side of light dressing, (except where putrescent manures are also laid on)—and if less increase of crop is gained to the acre, the cost and labor of marling will be lessened in a greater proportion. If, after tillage has served to mix the marl well with the soil, sorrel should still show to any extent, it will sufficiently indicate that not enough marl had been applied, and that it may be added, safely and profitably.—*If the nature of the soil, its condition and treatment, and the strength of the marl, all were known, it would be easy to direct the amount of a suitable dressing*; but without knowing these circumstances, it will be safest to give two hundred and fifty, or three hundred bushels to the acre to worn acid soils, and at least twice as much to newly cleared, or well manured land. Besides avoiding danger, it is more profitable to marl lightly at first on weak lands. If a farmer can carry out only ten bushels of marl in a year, he will derive more product, and confer a greater amount of improvement, by spreading it over forty acres of land intended for his next crop, than on twenty; though the increase to the acre, would probably be greatest in the latter case. By the lighter dressing, the whole farm will be maried, and be storing up vegetable matter, in half the time that it could be marled at double the rate.'

It will be perceived, it is hoped, throughout this report, that endeavors have been made, (and they will continue to be made) to supply the desideratum implied in the underlined sentence of the preceding quotation. In the present stage of our examinations it would not be safe to give other than very general directions in this respect.

'Perhaps,' adds Mr. Ruffin, 'the greatest profit to be derived from marling, though not the most apparent, is on such soils as are full of wasting vegetable matter. Here the effect is mostly preservative, and the benefit may be great,

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