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ON THE FORMATION OF MANURE-HEAPS AND THE ECONOMIZING OF LIQUID MANURES.

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The free admission of the atmosphere is one of the principal causes of excess of fermentation and Boussingault, although he does not state this to be the *cause* admits that "it is of much importance that the heap be pretty solid, in order to prevent too great rise of temperature, and to rapid a fermentation, which is always injurious. At Buhelbronn, our dung-heap is so firmly trodden down in the course of its accumulation, by the feet of the workmen, that a loaded waggon drawn by four horses can be taken across it without very great difficulty." Notwithstanding what has just been stated, many able writers on this matter, have asserted that tramping down manure is injurious. It is obvious that each party is right according to circumstances. If a manure-heap is required for almost immediate use, nothing is more certain than that a free admission of the atmosphere is necessary, in order to promote free and rapid fermentation; but this is done at the expense of a considerable escape of its volatile contents. On the other hand, if intended to lie for some months (as is frequently the case), pressure and consequent absence of a great portion of atmospheric air is advantageous, fermentation being by this means retarded, and generally proceeds more equally throughout the mass.

It is a matter of considerable importance to the farmer, at some periods of the year, that he should have the means of preparing his fresh into well fermented manure. In all cases, I most strenuously advocate that moisture of every description should be kept from a manure-heap, with the exception of the drainings of the offices, which ought to be conveyed to the heap or pit by tunnels (there are tiles manufactured for the purpose,) and no water should be permitted to enter, unless to be thrown on for some special purpose by the proprietor. By restricting the admission of the air, we have a direct command over the fermentation of the manure-heap, and this can only be accomplished by placing the manure in pits. If they have a rough covering, so much the better. The usual shape of a manure-heap is that of a cube or a parallelopipedon, each being a figure of six sides, five of which are exposed to the influence of the atmosphere, the bottom only not being surrounded by it. By the use of pits we shall completely reverse this order, one side (the top) only being exposed to the atmosphere, and that also the side from the altered circumstances of the heap, by which the atmosphere will have the greatest difficulty in penetrating. In fact, from the absence of draught, fresh volumes of the atmosphere will only penetrate by means of pressure—in other words, to fill up the vacuum caused by the formation of carbonic acid and water, instead of, as according to the ordinary practice, freely permeating the whole mass, and by this means causing the disengagement of additional caloric, which reacting on the mass, a more rapid fermentation ensues, and fire-fanging is the frequent consequence.

The mode in which manure-heaps are usually formed is that exactly the best adapted to dissipate its most fertilizing contents—the soluble, but non-volatile, contents being carried away through the effects of rain, whilst a tolerably free draught of air exists throughout the mass, as the atmosphere undoubtedly penetrates it through the sides, in consequence of the slight superior pressure there, and also through the circumstance that the carbonic acid, water, &c., invariably escaping through the top, causes an ascending current unfavourable to the admission of the atmosphere at the top, but decidedly favourable to a current passing in through the sides, thus causing a draught constantly going forward from the sides through the top, or precisely that mode most favourable for the dissipation of its valuable volatile contents; whereas, if we place the manure in pits, all access of air is prevented except such as will be required by the formation of the vacuum previously described. I never carried the plan I now propose into execution having followed the usual course; but I have observed in this town (Liverpool), where, on account of the high price of land, the greatest economy of superficial space is required in forming the manure-heaps of the large horse and cattle proprietors, the general practice is to form a square pit ten or eleven feet deep, to deposit the manure in, of exactly that form which will contain the largest superficies with the smallest circumference. No form could be desired better for the purpose of containing the greatest bulk in the smallest compass, and at the same time presenting so small a surface for escape of the caloric evolved during fermentation; yet an instance of fire-fanging is never known *in these pits*. It sometimes, however, happens that, from the absence of a demand for manure, or other causes, these pits become filled above the top, sometimes to the height of 8 or 10 feet. On such occasions I have ascertained that it is sometimes requisite to obtain an immediate removal of the upper portion, or turn it over at considerable trouble, in order to prevent firing. It is worthy of particular observation also, that where the manure is heaped up above the level of the pits, and consequently one or more sides are exposed to the influence of the atmosphere; in such cases, the manure so accumulated never has the same appearance as old fermented manure. This cannot be owing to the shorter period that has elapsed from the formation of the superior portion exposed to the atmosphere, as I have been careful to observe and mark the time requisite to produce the certain appearance of well-fermented manure placed in pits, and such as are raised above them, and more subject to the influence of the atmosphere.

The best formed manure, in the shortest period, that I ever witnessed, was that of the pit belonging to an extensive cart proprietor. In the stable I now allude to there were usually about thirty horses; the pit was formed in the yard, and covered over by thick planks, part of which was covered with earth, and paved; only a few boards remaining loose for the convenience of removing the manure, with a trap for the purpose of putting the manure into the pit: the yard was roofed in, so that no extraneous moisture could be admitted. So circumstanced, I ascertained that, in summer, the whole of this mass, accumulations of the last few days, was converted into a well-fermented workable state in the course of ten days to a fortnight; in the winter it took about three weeks to accomplish the same. It might be supposed from the above description, that serious annoyance would be felt at the escape of ammonia, and that a most extraordinary heat would be generated; but such was not the case. I have been present when a pit so circumstanced was being removed, but the heat was not near so intense as that which is frequently observed in ordinary farm-yard dung heaps; but, unlike the latter, it was not entirely confined to the centre whilst the sides were comparatively cool, but it pervaded the whole mass in an equal degree; no perceptible smell of ammonia was perceived, but a very copious amount of aqueous vapour was evolved in the course of its removal so much so, that you could not, at times see the workmen in the pit who were in the act of removing the manure. These facts are strongly confirmatory of the correctness of my opinion that the mismanagement of the fermentation of our manure-heaps arises from the unlimited access of the atmosphere, and strikingly illustrate the advantages to be derived by casting the exuvia, &c., of farm offices into pits, instead of throwing it into heaps in the ordinary manner. Another advantage to be derived by using pits is, that, in winter, the caloric arising from the fermentation of the heap would not be dissipated so speedily as it is under the present system, when surrounded by a cold, perhaps frosty atmosphere. It is so well known that manure-heaps formed in winter do no ferment equally, or scarcely at all, that it has given rise to the axiom that one load of manure formed in summer is worth two formed in winter. I need not enter into any details as to the mode of forming such pits; every sensible farmer, if convinced of the correctness of the theory, will easy select the fittest place, and invent the best mode, under his own peculiar circumstances, for constructing them. As a general rule, they ought to be impervious; if the soil will permit it, so much the better; if not, they ought to be made so. A rough covering would be an improvement, for the reasons previously stated. Pits formed in the manner described would convert the average mixture of horse and cattle manure into excellent fermented manure in the course of three weeks or a month in summer, and in winter in the course of six or eight weeks—advantages which must be most palpable to every scientific farmer; and this will be accomplished without any loss worth mentioning of its volatile fertilizing contents.

The careful farmer will always be mindful that every matter which can be collected about his farm, such as weeds, twitch, or squitch, &c., are collected and added to his manure-heap. Such will find that the mode proposed has decided advantages over the ordinary method; whilst on this subject, I may remark that, a few years ago, whilst fallowing a field overrun with weeds, twitch, &c., I had the weeds, after being well harrowed, carted to the yard, and placed between two layers of fresh horse manure. As it was my intention to apply the whole as manure to potatoes, I thought it would be advantageous to throw a little nitrate of soda on the weeds, &c. This was done, and a strong fermentation took place, and the whole of the weeds were converted, within ten days into a rich black mass. All of the work people attributed this to the saltpetre, as they called it, being used. I am inclined to think that the heat generated by the horse manure caused the weeds rapidly to decompose; and as matters in a state of decay have the property of absorbing oxygen from all other matters with which they come in contact, it is probable that a portion of the nitric acid of the nitrate of soda was decomposed. A very heavy shower of rain fell between the time of mixing the weeds, &c., and the period of removing them to the fields, and I never remarked such a quantity of deep-coloured fluid to exude from so small a mass of manure, evincing that a great quantity of humic acid was formed, which was probably combined with the soda of the nitrate and ammonia of the decomposed horse manure, and not improbably ammonia formed by the decomposition of the nitric acid. I now merely state the facts as I observed them, and shall be happy if they can in any way be serviceable to others; this much is quite certain, the weeds were speedily converted into an apparently good manure, the value of which I did not attempt to determine at the time, and I have not since repeated the experiment. On a large farm, in some years, no inconsiderable amount of dead animals are inconsiderately thrown aside or given to the dogs, which, if cut into pieces, and placed in pits such as described would form a valuable addition to our manure-heaps; and, from observation, I am convinced that, if so placed, would occasion much less annoyance than is felt by their putrefying in the open air. However we may cause the manure of our farms to be prepared, under all circumstances a large amount of humic acid will be formed. I will not now enter into a disquisition as to the reason how the humic acid—which forms a soluble salt with several of the alkalies—becomes, in the course of a lengthened fermentation, converted into a black substance, insoluble in either alkalies or acids. The result of my observations amount to this, that in heaps as usually formed, with free access of the atmosphere, a larger amount of humic acid soluble in alkalies is formed, than when the manure is placed in pits, and access of the atmosphere is limited. In the latter case, some humic acid is formed; in both cases the humic acid is in the same state as that which is found in barren peat mosses, as I have determined by repeated experiments. As I have shewn in my article on lime, humic acid has a strong affinity to conbine with the alkalies, potash, soda, and ammonia, which combination in manure-heaps forms the brown coloured solution which is observed running from them after rain. It is perfectly obvious, therefore, that every drop of this brown-coloured liquid which oozes from a manure-heap contains in combination one or other of the above named alkalies, two of which—potash and ammonia—are of such importance as fertilizers. The mode I have suggested—viz., placing the manure in pits—may be said to remedy this evil, as, at all events, it will prevent the liquid from running away. It is of no importance, however, preserving the liquid of manure-heaps in the state described, as I have repeatedly found that no beneficial effects are derived from the use of it. Lime and its salts, however, have the property of combining the former with humic acid, and setting the previously combined alkali free; the latter, by double decomposition, forms insoluble humate of lime, and the soluble muriate or sulphate of the alkali, as the case may be. Lime-water, or milk of lime, if poured on a fermenting heap of manure, will combine with the humic acid; but there are two circumstances which prevent this operation being so perfectly beneficial to the farmer as it might be supposed: in the first place, the lime is apt to conbine with the carbonic acid gas evolved during the fermentation of the heap, and form the carbonate which is insoluble, and only slightly so where an excess of carbonic acid is present. This condition is found in fermenting manure; but as it is so sparingly so—viz., one part of bicarbonate of lime in 2,500 parts of water—its beneficial action in neutralizing the injurious action of humic aid is much deteriorated. Were, however, the power of lime-water to destroy the obnoxious effects of free humic acid in dung-heaps as complete as though no carbonic acid was present to retard its influence, another cause operates to prevent the remedy being so desirable as it other-wise might be; when humic acid, combined with ammonia, is decomposed by lime, ammonia is immediately set free, which is speedily converted into the carbonate. Both of these being volatile substances, there is danger of this important nitrogenous matter being dissipated by evaporation. In experiments made with humate of ammonia decomposed by lime-water, I have not discovered the well-known smell of ammonia; which I attribute to the fact that humate of lime has the power of absorbing ammonia in a remarkable degree.

I state these circumstances now by way of caution. It occurred to me that dissolved bones in muriatic acid would be the fittest mode of conteracting the injurious effects arising from the presence of free humic acid, or the soluble humates which exist *in all* manure-heaps. I found, however, one counteracting circumstance, viz., that the mixture was extremely apt to gelatinize. If, therefore an economical mode could be discovered (and I see no difficulty in the way) of exacting the fat and gelatine from bones previously to mixing them with muriatic acid, and also converting the gelantile to a profitable use, this would be the best mode of fixing ammonia and rendering humic acid innoxious.

Experiments made with special manures seem to prove that the sulphate of ammonia has greater fertilizing qualities than the muriate; and gypsum might be deemed for this service more economical and serviceable; but gypsum is very insoluble, and when placed in contact with a soluble humate, becomes immediately surrounded with a thin circumference of humate of lime, which prevents all further action. I therefore recommend on all occasions to use the muriate of lime, or bones dissolved in muriatic acid. Whenever we wish to neutralize acid,