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

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Several papers touching this most important topic have appeared in the last two numbers of "The Farmer's Magazine:" I allude to the translation, by Mr. G. Law, from Boussingault's "Rurale Economie" (*subjects*—"The Ammoniacal Combinations in Urines, Excrements, and Manures," and "On the Management of the Dungheap and the Manufacture of Farm-yard Manure"); "The water contained in Manures," by Cuthbert W. Johnston, E-q., F. R. S; and, lastly, "On the Management of Stable-dung Manure, especially as regards Exposure to Rain;" by Dr. John Davy. *En passant*, I may remark that the two articles of Boussingault do not convey any new theory or practical suggestions of note; Mr. Johnson's paper is a very useful one, Dr. John Davy's is, however, of, a most important nature, so much so, that I shall extract the paper at length, as it appeared copied from "The Edinburgh Philosophical Journal" into "The Farmer's Magazine" for the month of May. In order to justify myself for so doing, I may state that the general observations by the learned doctor are precisely similar to those I had made some time previous to the appearance of his paper,, which will be found to be the case on reference to a paper of mine on the subject of lime, which appeared in "The Journal of Agriculture" for October, 1844; in addition to which, Dr. Davy has made some analytical investigations, which I have not, under present circumstances, a convenient opportunity of entering into. As, however, his paper perfectly coincides with the oppinions I have formerly held on the subject, and the analytical investigations being in their results agreeable to what I have long suspected, is the reason I now incorporate his paper with this in such a wholesale manner. I have thus copiously alluded to the papers above named, as I shall have more or less occasion to recur to them hereafter. The remedies which I intend to propose for some of the evils complained of with respect to the general management of manure-heaps, I am sorry to say, are not as yet of so satisfactory a nature as I could wish. I have no doubt, however, but the difficulties which I shall point out are not of an insurmountable nature. Dr. Davy states—

"The farm-steadings here (Westmorland) are commonly on declivities; the dung-heap is usually placed on a declivity, often by the road-side, and, in consequence, after every shower of rain, the water that runs off, precolating through the manure, robs it of some of its most valuable ingredients, especially its soluble salts and soluble animal and vegetable matter, tending to starve the fields and polute the roads. I have had the curiosity to collect portions of such drainage, and subject them to examination; and I now propose to give the results, as they show in a very marked manner the injurious effect, and how great is the loss to the farmer in consequence. The first portion collected was from a heap of stable dung, fresh from the stable, just before a heavy fall of rain, the accompaniment of a thunder-storm, nearly an inch falling in three hours. The water which ran from the dung-heap was of the colour of a weak infusion of coffee, of specific gravity 1002 to pure water, or 1000. With the peculiar smell of stable dung, it had just a perceptible smell of ammonia, which was rendered more distinct by the addition of lime. Under the microscope, it was found to contain, besides a fine granular matter, and many minute fibres and scales, particles resembling grains of pollen, and two or three different kinds of animalcules. Evaporated to dryness, it yielded 2.6 per 1000 of brown matter, which deliquesced on exposure to a moist atmosphere; emitted a very faint smell of ammonia when mixed with lime, indicating that, in the process of evaporation, most of the ammoniacal salt had been expelled, and was therefore carbonate of ammonia; and, when incinerated, afforded as much as 51 6 per cent. of grey ash—48.4 per cent. of the extract having been destroyed by the fire, which may be considered as animal and vegetable matter. The ash was found to contain the sulphuric, phosphoric, and carbonic acids, and chlorine, with potash, soda, lime, and magnesia, chiefly in the form, it may be inferred, of carbonate of potash, phosphate of lime, sulphate of lime, sulphate of magnesia, and common salt.

"The proportion of the sulphate of lime was large, as was also that of the fixed alkaline salts, whilst that of the phosphate of lime and the magnesian salt was small. The next specimen examined was from a much larger and older dung-heap, after a fall of 1-12 inches of rain in about twelve hours. The fluid was of a darker brown than the preceding, very similar in its appearance under the microscope, of higher specific gravity, viz., 1008, and yet less rich in ammoniacal salt; for, when mixed with lime gave only a very faint smell of ammonia; and its extract obtained by evaporation, when mixed with lime, had no smell, of the volatile alkali.

"It yielded, on evaporation, 10.4 per 1000 solid matter, similar generally to that obtained from the first portion in its qualities—abounding, in like manner, in salts, and those of the same description. The third specimen collected for examination was from the same dung-heap, after a fall of 2.79 inches of rain in twenty-four hours. It differed, so little from the preceding, that it is not necessary to describe it particularly. As might have been expected, it was more dilute, its specific gravity being 1004. The last specimen I shall notice was one procured from the same dung-heap after four days of dry weather following the heavy rain last mentioned. It was oozing out slowly in small quantity—was of a dark brown hue, nearly transparent, and almost destitute of smell. Under the microscope it exhibited a few particles and fibres, a very few minute crystals, without any animalcules. I had expected to have found it a concentrated infusion of the dung heap, and, as such, of high specific gravity. But it was otherwise. It specific gravity exceeded very little that of the preceding, and was less than that of the second portion, being only 1005, leading to the conclusion that the manure was nearly exhausted of its solubie matter. The weather during the four days, without rain, was comparatively cold for the season (it was September) with a northerly wind, the thermometer, even by day, below 58 degrees, and at night once or twice approaching the freezing point. This low temperature must have checked or put a stop to fermentation, which, in its turn, might have prevented the further formation of soluble matter. The infusion mixed with lime indicated the presence of ammoniacle salts; it emitted a pretty strong smell of ammonia and, judging from the effects of other reagents, its composition was very similar to that of the preceding portions. It probably contained a larger proportion of vegetable matter, humus and humic acids, than the earlier drainings; it gave a very copious precipitate with the acetate of lead. The bearing and application of these results hardly require to be pointed out. As the drainage of the dung-heap exposed to the rain contains some of the best, the chief ingredients of active manure (excepting always the insoluble phosphates), it followes that the more the dung is exposed—the more it is subjected to the washing and percolation of rain-water—the greater must be its loss, the poorer and more exhausted it must become; and that shelter from rain is essential as a preventive—such a shelter as only can be well secured by a shed."

The rational objects to be obtained in preparing manures in a proper manner are, in the first place, to preserve and collect all matters containing either the organic or inorganic constituents of the crops which we are about to raise; and, 2ndly, if the matters so collected are in such a state as not to be immediately available as food for plants, to render them so by artificial means. The course usually pursued for the first object is to collect all the excreta (usually mixed with straw) voided by the animals in the cattle-sheds, sties, stables, and straw-yards, throwing the whole in a heap, and leaving it in that state until carted into the field. Generally speaking, little care is taken to preserve the urine voided by the cattle, &c., except that which is absorbed by the straw. Much has been written with respect to the second object, such as turning over the heaps periodically, in order to promote a greater and more equal fermentation. This plan has had both strenuous advocates and adversaries. Amongst the latter is Boussingault, who states—"From what has now been said, it will be understood how destructive to good manure is the custom which obtains in certain countries of turning dung-heaps frequently—of airing them, as it were, in order to hasten their decomposition. Treated in this way, stable litter, &c., does, in fact, decompose much more rapidly; but it does so, and I own I do not myself clearly perceive the object proposed by it, at the expense of the quality; for it is very evident that the volatile principals must be dissipated and lost in the same proportion as their points of contact with the air are multipled." I am inclined to doubt that so serious a dissipation of the volatile principles (ammonia) of manure takes place in consequence of the turning over of manure-heaps as is here described, and am more inclined to agree with the advocates of old fermented manure, that the loss sustained mainly consists of carbonic acid and water; in fact, Boussingault admits on the authority of Thaer, that air, collected from a dung-heap undergoing moderate fermentation, does not contain much more carbonic acid than that which is taken from the mass of the atmosphere. Neither does a vessel containing nitric acid, when placed upon the fermenting mass, produce those dense white vapours which are a certain indication of the presence of ammonia. The decay of vegetable fibre in preparing manure is of great consequence, for two reasons, viz., it prepares the straw, so that it can be easily broken by the fork or cut by the spade, and is easier to work into the ground by the plough, whilst at the same time the inorganic constituents of the straw, &c., are set free. The due fermentation, therefore, of the whole mass constituting a dung-heap is of primary importance. In accomplishing this, some circumspection is required; for it allowed to acquire too high a temperature, the mass becomes what is commonly termed fire-fanged, or sometimes even catches fire; in either case, only the inorganic constituents remain. I may here remark that this circumstance of fire-fanging is conclusive evidence against the truth of the theory, that we have *only* to place upon our fields the inorganic constituent of the crop which we draw from them, in order to produce perpetual fertility; otherwise firefanging our dung-heap would be a benefit rather than an injury; but all practical farmers know that the contrary is the case. The opposite circumstance, the non-production of sufficient heat, is attended with the disadvantage of leaving the straw in a tough state, so as not to be easily workable.

I shall only at present briefly notice what appear to be the general opinion—it is borne out by the authority of the most able writers, and which perfectly agrees with my own experience—viz., that in the preparation of the manure-heap, too great care cannot be taken to most intimately mix together the produce of stables, cattle-sheds, sties, &c., as this mixture is always found to produce that slow but perfect fermentation most advantageous to the object of the farmer. This might well be expected, as horse manure is well known to be prone, especially in hot wether, to become exceedingly hot, and frequently, if particular care is not taken, fire-fanged; whilst the dung from the cattle-sheds, on the contrary, is noted as being *cold*; in other words, not prone to ferment. I strongly suspect that the reason of this difference arises from the circumstance that the fluid and solid excrements of the horse contain a much larger amount of nitrogenous compounds than those of horned cattle, and from their more complex composition. Although the volatile alkali (ammonia) abounds more in the excrements of the horse, the mineral and vegetable alkalies (soda and potash) are found in greater abundance in those of horned cattle. I wish this circumstance to be remembered, as it is of some importnce to the consideration of the subject. I quite agree with Dr. Davy that sheds are indispensable for the due preparation of farm-yard manure, as they would be the means of keeping off the intense heats of summer and the rains of all parts of the year. It cannot be a matter of slight consequence that the surface of a dung-heap should be kept at 90° in the shade, or a 120° in the sun for days together; and, with respect to rain, I think I shall clearly shew that every drop which falls, and afterwards exudes from a dung-heap, robs it of some of its fertilizing ingredients. Experiments made by myself shew clearly that the first oozing from a dung-heap contain the largest amount of its inorganic constituents and the greatest quantity of ammonia. I allude to the liquid running from a heap in its fresh an unfermented state. I may, however, remark that a considerable portion of the salts appear always in this state to be in the state of carbonates, as, on the introduction of a little acid, a tolerably copious disengagement of gas takes place, which I have no doubt, though I did not test it for the purpose, is the carbonic acid gas. The same liquid allowed to stand a few days ceased to effervesce, and sulphuretted hydrogen was evolved pretty freely, evincing that the decomposition of the sulphates was taking place. Lime-water and the salts of lime only slightly discoloured it, precipitating a small amount of dirty coloured sediment. The drainings from a manure-heap, especially if it consists wholly or principally of horse dung, when fermented for a few days, and collected after a shower of rain, possess a dark brown appearance, similar to that described by Dr. Davy, and if allowed some time to settle, will become tolerably and sometimes perfectly clear; when such is the case, and it takes place in the *course* of the fermentation of *all* manure-heaps, it is an indication that, in the process of decay, humic acid has been formed, which, combining with the ammonia or fixed alkalies, exude in the state of brown-coloured humates. I may venture to affirm that one third of the value of our manure-heaps is lost in this manner. If we investigate the phenomenon attendant on the fermentation of a manure-heap, we will find that humic acid must be produced during the decay of woody fibre, with the simultaneous formation of carbonic acid and water, and the disengagement of the mineral alkalies, which immediately combine with the humic acid, forming humates. The latter, being exceedingly soluble, are carried off by the first shower of rain that falls. As this process is being continually repeated, it follows, as a matter of course, that the greater portion of the most valuable parts of the manure-heap is entirely lost to the farmer. It may be said, if such is the case, a manure-heap so exposed to the weather must, during the course of a winter's rain be robbed of the whole of its most valuable contents. Such would undoubtedly be the fact were it not for one counteracting circumstance, viz., the insoluble humates; and some combinations of carbon with hydrogen and oxygen, which do not combine with alkalies to form soluble salts, have the property of retaining a greater portion of other salts and various gases. Were it not for this circumstance, our manure heaps, as ordinarily prepared, would become destitute of all their fertilizing ingredients, with the exception of the almost insoluble phosphates of lime, magnesia, and the sulphate of lime. It is quite true that the fermentation of manure-heaps cannot proceed without the aid of moisture, but ordinary formed farm-yard manure con-