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OLD SERIES] *Nec aranearum sane textus ideo melior, quia ex se fila gignunt, nec noster vilior quia ex alienis libamus ut apes.* [COMPRISED 13 VOLUMES

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### REPORT OF THE COMMITTEE ON MANURES.

It was formerly thought that most of the constituents of plants were produced within themselves, by some supposed mysterious, inherent power, but it is now well established that their chemical elements are derived exclusively from materials existing in the earth, the air, or the water which surround them: such "from the beginning" has been the harmony and relation between their respective composition that, weight for weight, the materials found in the soil or the atmosphere are convertible into the roots, stems, leaves, flowers and seeds of our cultivated crops, and these again into the blood, flesh and bones of men and animals.

That which thus nourishes is what is commonly called *food*, and neither crops, nor colts, nor calves, nor childen can be made to grow and flourish in any other way than by the plentiful administration of such food.

But the food of these differs respectively, and that which is required for different kinds of crops differs also to a certain extent, still it is perfectly certain that for the luxuriant growth of any crops we must administer in proper proportion all the materials which the Chemist finds on analysis to be the uniform constituents of such crops.

When plants are freely acted upon by heat *the great bulk* of their substance become gaseous, inflames and disappears; this bulky combustible portion consists chiefly of four substances which have been termed respectively Carbon or Charcoal, Hydrogen, Oxygen, and Nitrogen: with the exception of the last, these are in general readily accessible in the atmosphere or in the soil, or *through* the soil to plants growing under ordinary circumstances.

The Ash or Mineral part which, seldom exceeds 5 per cent of the whole, consists of about nine different elements, which also with a few but important exceptions are generally to be found in soils. Here then, as in most other cases, Nature does a great deal of the work for us, that is, the chief portion of the required elements are presented by the hand of Nature, while a certain and a necessary proportion must be supplied by the skill and labor of the husbandmen: these are most generally the *Salts of Ammonia* and the *Earthy Phosphates*: from the former the flesh, and from the latter the bones of animals are afterwards chiefly to be constructed. If the Farmer refuses to do his part he will starve his crops: if he starves them, they will starve him and his cattle, but if he feeds them they will feed him and his most bountifully.

Since plants are thus greatly nourished or fed by materials derived from the soil, the fundamental principle will ever be to return to the land an eqivalent in manure for the materials contained in the crops which have been removed, or else it will soon become barren or incapable of nourishing crops at all; if from twelve or thirteen different substances originally present in a fertile soil we remove two every year for six years, the land must necessarily thus become exhausted, or even, if in one year, we remove one or two of primary importance, their absence will be the cause of a special barrenness or exhaustion of the soil; when, therefore, a farmer has for a series of years been selling off his hay and oats and cattle, without making the necessary returns in lieu thereof, his land thereby becomes either generally or specially exhausted, and he must cast about and consider upon what principle he may at the cheapest rate replace the old materials, and restore the necessary elements of productiveness to the soil.

*Manures* are substances capable of replacing either directly or indirectly the lost elements, and of feeding or sustaining the growth of crops: without them the farmer can do nothing with them almost everything; they are the basis and life-blood of all successful husbandry: by them we may increase the production and diminish the cost of food, they are in fact the material out of which the food is to be formed, and they ought to be economised and husbanded as so much coin, ever remembering that in no part of the farm work is labor better invested than in their collection and preservation.

Throughout this Province generally there seems to have prevailed much ignorance or neglect of these principles; it would not be very difficult, we apprehend, for most farmers to make or save at least one-half more manure than they do, and it would be easy by care and composting to increase the quantity of manure actually made three or four fold; it is wrong, therefore, to ascribe to the country or the climate what has been in too many instances due to the ignorance, idleness or reckless improvidence of the settlers themselves. It will be our endeavor in the remainder of this paper to indicate certain of the points and principles, by attention to which, some of the evils of the old method may be more or less effectually repaired.

Manures we have said are such substances as are capable of supplying directly or indirectly one or more of the elements of our cultivated crops; accordingly it must be obvious that plants themselves or the parts of animals fed upon plants, must be the basis of all common manures—that whatever has been part of a living plant or animal may by proper treatment be made to yield the materials out of which living plants and animals are again to be constructed; practically, however, it must be our endeavor to procure the cheapest or waste forms of these, and also to make use of such materials as are accessible and contain one or more of the same constituents as plants, even although they may not hitherto have formed part of any living plant or animal.

In this point of view the sources of manure will appear to increase and multiply: the barn yard, the hog pen, the sheep fold, the hen roost, and the pigeon house, the privy, the ash bin, the wash tub, the slaughter house, and the tan yard, peat bogs, muck holes and gullies, road sides, roads and ditches, the forest, the sea beach, the sewers, the lime kiln, the plaster bed, the shell and marl bed—these are a few, but not all of the sources from which the intelligent farmer may procure materials for his manure heaps; by a patient industry in collecting materials from the above sources, and by a rigid economy in saving them, much more land may be profitably brought into tillage than has ever heretofore been the case; it is not intended, however, by the above remarks to induce the farmer to forego other profitable labor, but it is intended to show how a farmer who is properly aware of the sources of manure need never himself be idle, nor his cttle in want of a useful occupation.

When plants or animals die, their elements spontaneously separate by degress again, and became viewless: some of them become gases, (*carbonic acid, ammonia, and watery vapor*) and mingle with the atmosphere, some of them (*alkaline salts*) are dissolved in water and washed away, while the remainder (*earthy salts*) are hidden in the soil and become incorporated with it; these changes, which really differ but little from those which are effected by combustion, are called *decompositions*, because the living substance is thus gradually brought back to simpler and simpler forms; at ordinary temperatures the decomposition or "fermentation" of vegetable substances which abound in woody fibre, proceeds very slowly, while under the same circumstances the decomposition or "putrefaction" of animal substances, if not too dry, proceeds very rapidly; this great difference is by Chemists ascribed to the comparative abundance of Nitrogen, (an element which has naturally but little tendency to unite with others,) in the latter. Now when animal matters are mixed with vegetable the tendency to rapid decomposition which the former naturally possess is, by contact—as fire kindles fire—or leaven leaveneth the lump—communicated to the latter and the whole is changed together: like fire also, or like leaven a little of the one may also transform a great mass of the other; the time required for these decompositions and the temperature which both conduce to them and characterise them, varies according to certain conditions, of which the most influential are the proportions in which the materials are present, the openness and moisture of the mass, and the temperature of the surrounding atmosphere: in a general way it may be said that the more animal matter there is in proportion to the vegetable, and hotter the external air while at the same time the heap is moderate-compact and moist, the more rapidly will decomposition proceed, and the greater will be the heat devoloped in the heap.

"Blood heat," or say 100° of Fahrenheit's Thermometer is the most favorable temperature at which the decomposition of manure heaps ought to proceed, and this can generally be maintained pretty evenly by opening or closing up the fermenting heap; covering it with water is found not to be so good in practice.

To secure the greatest effect of the fermented material, the process ought to be stopped and the manure applied before the whole has become a mere soft black earthy mass without trace of straw or vegetable structure, or before the temperature has become lowered wholly down again.

If the fermentation of a mixture of straw, &c., with cow dung, &c. be allowed thus proceed unheeded it will be gradually losing weight and value; recent manure, it has been proved, weighs more than twice the dry food and litter consumed, when half rotten it loses one fourth of its weight, and when quite rotten one half; that is—its elements have disappeared as gases in the air or as liquids in the soil. Now since putrefaction cannot proceed without the formation of such gases and liquids the true secret of economising manures (at this stage of the business) will be to try to fix or absorb the gases, (ammonia, carbonic acid &c.) and to retain the liquids by some appropriate means.

Among the *fixers* or absorbents which are readily accessible we may mention good black earth, peat or bog mould, plaster, saw dust, charcoal dust, leaf mould, pond mud, chip rubbish, turf, road scrapings &c., the liquids, again, may either be drained off into proper reservoirs and re-applied to the heap or they may be soaked up by a thick coating of black earth or peat muck spread beneath the heap. This decomposition or fermentation of manures is necessary to bring the materials into that form which suits them to become the food of plants and it ought always to be continued uniformly and steadily until it is completed. When it is an object to prevent the fermentation of manure it ought to be piled up in close masses on the shady side of the barn and kept as dry and cool as possible: if we have the materials, and if we can induce them to ferment we can at all times find the means for nourishing a luxuriant crop on our land.

By a full understanding of these simple principles a great deal more manure may be saved in the country than ever has been done heretofore. The same close apprehension of the principle must govern our practice wherever manures are concerned; in the yards much is lost by evaporation and by the winds which might readily be saved; then also, the melting snow and rain are two often allowed to drench the putrefying mass; much of this loss might be prevented by freely spreading bog earth in the cattle yards in early spring; in the fields also there is often great loss by evaporation or by leaching—a cover or crust of clay or peat or earth will be necessary here as well, and to economize the wash, probably the best way is to lay the heaps on a bottom of clay, peat or marl, and to place them on a high instead of a low part of the field. But besides saving the elements of crops, as indicated above, we may, by composting or mixing various materials, themselves useless with the animal manure or *ferment*, increase our available manure to a very great extent. This is a point to which we cannot give too much importance—the old upland farms of this country cannot be again brought back to fertility except by a much more general attention to mixed manures or composts. The materials for these are sufficiently abundant and accessible to all: by making proper use of them we may at least treble our manure and thereby bring three times as much land into profitable tillage. Their preparation may go on either in the barn yard or in the field, or by the road sides, and we will again recur to them in a more particlar manner.

Having got our manure how are we apply it? as a general rule, it ought to be *short* or well rotted before it is used, and as a general rule also, ploughing it under immediately after being delivered and equally spread over the field is more advantageous than using it as top dressing; on the average twenty waggon loads are a dose for an acre of tilled land, and it is better economy by far to apply twenty loads to one acre than ten loads each to two acres; if the land has been ploughed to the depth of say ten inches, it will be sufficient to cover over the manure to the depth of about three or four; all that is required is merely earth enough to cover and absorb the fertilising materials—after the manure has been thus added to the land, decomposition still goes on, warming the land and yielding those nutritious elements under their proper forms which are required for the luxuriant growth of the crops: but, as formerly observed, heat, air, and moisture to a certain extent being required for fermentation, we must take care not wholly to deprive the manure while in the ground of its chance of access to these important influences. The previous clearing of the soil from weeds, and its preparation by drainage will greatly conduce to the economy of manure—a cold watery soil, will not only arrest putrefaction, but it will run away with the materials which constitute the chief virtue of the manure. Another point of great importance to the farmer who complains of having but a small supply of manure, is that he should apply that which he has got to that crop, and in that part of his rotation that the greatest benefit shall be derived from that which he actually can command. The principle which ought to guide the farmer in determining the rotation or succession of crops is sufficiently simple; all crops remove certain of the elements of the soil, that is, they exhaust the land more or less, but they do it unequally; grain crops, which grow till their seeds are ripe, remove the greatest number of the fertilising elements of soil; the English grasses which also ripen their seeds are next in the order of exhaustive power, then the fallow or root crops, while land laid down to pasture rather improves than otherwise. Hence it is obvious that crops of the same kind ought not immediately to succeed each other, but to alternate with others, and the same principle holds good, not only for the different classes of crops, but for the different species of the same class, as each class comes round in the general rotation. Thus they will exercise upon the land actions alternately opposed, and therefore to a certain extent compensatory while each particular element of fertility in the soil is made to go as far as possible.