COURSE
OF
LECTURES ON ORGANIC CHEMISTRY
AS APPLIED TO
MANUFACTURES AND AGRICULTURE.

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LECTURE IV.

Preservation of Manure—Desiccation—Blood—Flemish Manure—Manure Cellars—Price—Comparative Results—Commerce of Manure—Importation—Exportation—Marl—Animal Black—Guano—Importation into England—Pigeon's Dung—Adulteration of Manure—Rational Use—Analysis applied to the Quantity required by the Nature of the Soil—Cultivation.

GENTLEMEN,—From what I told you in my former lecture, it appears that nitrogen is the essential basis of all manure; and hence it follows that the agriculturist should employ, for the purpose of enriching his land, such substances as contain the greatest quantity of nitrogen in the least bulk. On the other hand, while we lay due stress on the value of nitrogen, we must not forget the important influence exercised on vegetation by non-azotised organic matter and by certain inorganic substances, as silica, lime, &c. We have already seen that humus is essentially composed of carbon; when mixed with a certain proportion of animal matter, and submitted to the action of heat and moisture, this carbon decomposes slowly and gives out carbonic acid, which latter saturates a portion of the ammonia furnished by the decomposition of the azotised matter. Any excess of carbonic acid is dissolved by the water contained in the soil, or, rising into the air, is taken in by the respiratory surfaces of the plant. Some mineral substances—as lime, alumina, silica, &c.—are carried along by the sap-fluids of vegetables, and appear to be necessarily connected with the existence of a great many plants.*

We shall now turn to the preservation of manure; and this is a highly important subject, for when well understood it teaches the agriculturist how to import manure from distant countries and keep it as long as may be requisite without the danger of fermentation, which always destroys a portion of its fertilising principle.

We have already seen that we obtain an exceedingly rich manure by drying the blood which is procured in such quantities from the slaughter-houses. The same process of desiccation may be applied with advantage to the dung produced on farms; it is less simple than the process of drying blood, but the waste is very little; about 2 per cent. of the value of the

* Some vegetables have a peculiar tendency to absorb the mineral salts contained in the soil. The genus *rhubarb* shows this tendency in a very high degree; the oxalate of lime or potass, found in the roots or stems, arises from the absorption of an alkaline basis and its saturation by oxalic acid which exists, *a priori*, in the plant. Oxalic acid is very abundant in the vegetable kingdom, and this is easily understood when we remember its composition ($\text{C}^2 \text{O}^3$, $\text{H O} = \text{C}^2 \text{O}^2$, $+ \text{O h}$) and with what facility and under how many circumstances it may be produced. Oxalic acid in combination with potass exists in several roots, particularly those of *rhubarb*, *tormentilla*, *gentian*, *saponaria*, &c., as an oxalate of lime it abounds in many lichens.

material is lost; but as 100 parts are reduced to 33 in drying, the expense of cartage is reduced about two-thirds. M. Dailly, a celebrated agriculturist, arranges his stable manure* in small heaps, or cocks, for the purpose of drying it. The cocks are constructed and thatched exactly like those of hay, oats, &c., to protect them from the rain; the moist and solid portions should be well mixed up with the straw, so as to give free access to the air. Besides this the agriculturist will take care to construct his heaps of manure as close as may be convenient to the ground on which it is to be spread. The expense of laying out manure, when thus dried, is much less than that of moist material. It is unnecessary to add, that dried manure is chiefly suited for argylaceous soils, and that it should be used shortly before the rainy season.

In Belgium and Flanders, where the cultivation of land is carried to a high degree of perfection, the manure (*Flemish*) is kept in subterranean cellars, removed from all atmospheric influence which might develop fermentation. The Flemish manure is composed exclusively of night-soil, to which a certain quantity of water is generally added, so as to render it fluid. The night-soil is carried in casks to the place of deposit; the casks emptied through their bung-holes, and the fluid conducted along a gutter into the hole; this latter has two openings—one to receive the gutter, the other, which usually faces the north, to give exit to the gases produced during the slow fermentation of the manure. When the hole is full, the first opening is carefully closed to prevent the access of air, which would render too active the slight degree of fermentation that takes place. When the season for manuring arrives a number of large tubs are placed round the manure holes, and the fluid is carried from them in hods, or in water-carts, exactly like those employed for watering the streets. The use of this fluid manure in irrigation produces the most wonderful effects; it is equivalent to more than three times the quantity of our stable manure, which contains 4 per 1000 of nitrogen; still they employ in Flanders two and a half times more of their rich manure than we do, but the produce amply repays the expense.

Manure now forms a very considerable branch of commerce, which has been wonderfully extended within the last few years, for the methods of desiccation and preservation now in use are comparatively of modern date. Manure is a matter of import and export; we send immense quantities of it to our colonies, and the importation from foreign countries is increasing every day. Each county is engaged in the commerce of manure according to its situation, riches, &c. Normandy and Brittany employ and export very large quantities of a peculiar substance called *merl*, a corruption of the English word *marl*. It is an animal production exactly like common sand in appearance, but containing much more nitrogen (5 per 1000) than farm manure. It is composed of carbonate and phosphate of lime and organic matter derived from the animals which have produced it. This substance is highly esteemed in Brittany.

The animal black derived from manufactories for refining sugar contains 15 per cent. of coagulated

* Dung of horses, cows, &c.

blood, and is a very valuable manure. Nantes, and the seven adjoining counties, furnish annually twenty millions of pounds of this substance. In certain parts of Peru, the soil, which is very barren, is rendered fertile by a species of manure called *guano*; this is nothing more than the excrement deposited by immense numbers of aquatic birds in some islands of the South Sea. When a small quantity of this substance is placed on a soil composed merely of white sand and potter's clay, it furnishes an abundant crop of maize. The soil thus prepared contains no other organic matter than the *guano*, which is composed of urate of ammonia, oxalate of ammonia, phosphate and carbonate of ammonia, and some earthy salts (Fourcroy, Vanquelin). It fetches a very high price in England (£2 8s. for 200 lbs); but if we can believe the reports of the English merchants, several agriculturists have found their benefit in employing it. The *guano* of Peru has been recently introduced into France under the name of *columbine*, but true *columbine* (excrement of pigeons) is even richer than *guano* in nitrogen, containing 80 to 83 per 1,000. The Flemish agriculturists esteem the true *columbine* very highly, and farm the pigeon-houses of Picardy every year for the purpose of exporting it; they employ about four pounds worth of it for every acre (French).

In proportion as the commerce of manure became a matter of importance, the various substances employed have undergone every kind of adulteration. Since the year 1824 the animal black of sugar factories has been much sought after; but now the adulteration of this substance is so general, that it is impossible to obtain it in a state of purity. Indeed, the adulteration was carried to such a pitch that the executive government was forced to interfere, and appoint persons to analyse the suspected merchandise. Little benefit, however, accrued from this measure, because the experiments were conducted in too rough a manner. A certain quantity of the substance having been weighed, was exposed to a strong heat in a platinum or earthen capsule; in this way the loss of weight was supposed to indicate the proportion of organic matter contained in the mass. But the most common adulteration—viz, the admixture of turf-dust, escaped detection by this method.

The following is the method now generally employed for the purpose of analysing different kinds of manure. The first point is to obtain a sample which represents correctly the composition of the whole mass; this is easily effected by taking about 200 pounds weight from the mass, mixing them well together, and then dividing them into ten portions, which are also carefully powdered and sifted. Then a small quantity—say ten, five, or two scruples, is taken from each. The quantity selected is then completely dried in a glass tube (one end of which is closed) plunged in oil heated to 100° or 120°; the tube communicates with another tube full of chloride of calcium, and the latter communicates, in turn, with a bell placed on the stand of a pneumatic machine. When the apparatus is thus arranged and a vacuum formed, the whole of the water contained in the sample is expelled and absorbed by the chloride of calcium; when there is no longer any trace of aqueous vapor, the solid matter is weighed, and submitted to combustion in one of Liebig's tubes, with some oxide of copper. The carbon

is thus reduced to carbonic acid by combining with the oxygen of the oxide of copper; the hydrogen unites with a portion of the same oxygen and forms water; the carbonic acid is received into a tube filled with a solution of caustic potass, which saturates the acid. The water is partly condensed in the globular portion of the tube and partly absorbed by the chloride of calcium contained in a tube fixed to the end of the former one. While this is going on, the nitrogen passes through the alkaline fluid contained in the *tube à boules*, is dried in passing through the chloride of calcium, and is received into graduated bells which indicate the exact volume of the gas. We must not forget that the sample may contain a small quantity of oxygen; to obviate this source of error, a small leaf of metallic copper is fixed in the combustion tube, and absorbs the gas as fast as it is disengaged.

The mode of analysis just described may likewise be applied to the determination of the quality of any given soil, or, in other words, of the quantity of azotised matter which it contains, for this is the measure of its fertility. In this way the condition of the soil, at the time of letting and at the period of receiving it from the tenant, might be determined in a very accurate manner.

The experiments of M. Boussingault enable us to determine precisely the quantity of azotised matter abstracted from a soil or communicated to it by any given mode of culture.

Corn, as is well known, exhausts a soil more than any other species of vegetable; but this depends not only on the action of the roots of the plant, but because every portion of it is taken away, which, if left to decay on the ground, would have restored to the earth some of the nitrogen extracted during vegetation; besides, corn is not cut until the grain is ripe, and the grain of every species of corn contains a certain proportion of azotised matter. The effects just noticed are not produced by plants, the leaves of which present an extensive surface, absorb all the nitrogen contained in the air, and economise the nutritious elements of the soil. Upon this principle we can explain the excellent results obtained by the extensive cultivation of clover, lucern, &c. Finally, the cultivation of potatoes, which generally precede a corn crop, is attended with many advantages arising from the mode in which the land is worked; while the leaves and useless weeds which remain on the ground are, in practice, considered as equivalent to a quarter part of manure.

EFFECT OF TARTAR EMETIC ON THE GENITAL ORGANS.

TO THE EDITORS OF THE PROVINCIAL MEDICAL JOURNAL.

GENTLEMEN,—In the anticipation that some of your numerous readers may have witnessed similar unpleasant results from the use of the *unguent. antim. potass. tart.* applied externally as a counter-irritant, I am induced to beg your insertion of the following two instances, which have fallen under my notice, in one of which the above ointment was ordered to be rubbed on the chest and in the other over