which animals take for their nourishment, diminishes or increases in the same proportion as it contains more or less of the substances containing nitrogen. A horse may be kept alive by feeding it with potatoes, which contain a very small quantity of nitrogen; but life thus supported is a gradual starvation; the animal increases neither in size nor strength, and sinks under every exertion. The quantity of rice which an Indian eats astonishes the European; but the fact that rice contains less nitrogen than any other kind of grain at once explains the circumstance.

Now, as it is evident that the nitrogen of the plants and seeds used by animals as food must be employed in the process of assimilation, it is natural to expect that the excrements of these animals will be deprived of it in proportion to the perfect digestion of the food, and can only contain it when mixed with secretions from the liver and intestines. *Under all circumstances, they must contain* less nitrogen than the food. When, therefore, a field is manured with animal excrements, a smaller quantity of matter containing nitrogen is added to it than has been taken from it in the form of grass, herbs, or seeds. By means of manure, an addition only is made to the nourishment which the air supplies.

In a scientific point of view, it should be the care of the agriculturist so to employ all the substances containing a large proportion of nitrogen which his farm affords in the form of animal excrements, that they shall serve as nutriment to his own plants. This will not be the case unless those substances are properly distributed upon his land. A heap of manure lying unemployed upon his land would serve him no more than his neighbours. The nitrogen in it would escape as carbonate of ammonia into the atmosphere, and a mere carbonaceous residue of decayed plants would, after some years, be found in its place.

All animal excrements emit carbonic acid and ammonia, as long as nitrogen exists in them. In every stage of their putrefaction an escape of ammonia from them may be induced by moistening them with a potash ley; the ammonia being apparent to the senses by a peculiar smell, and by the dense white vapour which arises when a solid body moistened with an acid is brought near it. This ammonia evolved from manure is imbibed by the soil either in solution in water, or in the gaseous form, and plants thus receive a larger supply of nitrogen than is afforded to them by the atmosphere.

But it is much less the quantity of ammonia, yielded to a soil by animal excrements, than the form in which it is presented by them, that causes their great influence on its fertility. Wild plants obtain more nitrogen from the atmosphere in the form of ammonia than they require for their growth, for the water which evaporates through their leaves and blossoms, emits, after some time, a putrid smell, a peculiarity possessed only by such bodies as contain nitrogen. Cultivated plants receive the same quantity of nitrogen from the atmosphere as trees, shurbs, and other wild plants; but this is not sufficent for the purpose of agriculture. Agriculture differs essentially from the cultivation of forests, inasmuch as its principal object consists in the production of nitrogen under any form capable of assimliation; whilst the object of forest culture is confined principally to the production of carbon. All the various means of culture are subservient to these two main purposes. A part only of the carbonate of ammonia, which is conveyed by rain to the soil is received by plants, because a certain quantity of it is volatilised with the vapour of water; only that portion of it can be assimilated which sinks deeply into the soil, or which is conveyed directly to the leaves by dew, or is absorbed from the air along with the carbonic acid.

Liquid animal excrements, such as the urine with which the solid excrements are impregnated, contain the greatest part of their ammonia in the state of salts, in a form, therefore, in which it has completely lost its volatility; when presented in this condition, not the smallest portion of the ammonia is lost to the plants; it is all dissolved by water, and imbibed by their roots. The evident influence of gypsum upon the growth of grasses—the striking fertility and luxuriance of a meadow upon which it is strewed—depends only upon its fixing in the soil the ammonia of the atmosphere, which would otherwise be volatilised, with the water which evaporates. The carbonate of ammonia contained in rainwater is decomposed by gypsum, in precisely the same manner as in the manufacture of sal-ammoniac. Soluble sulphate of ammonia and carbonate of lime are formed: and this salt of ammonia possessing no volatility is consequently retained in the soil. All the gypsum gradually disappears, but its action upon the carbonate of ammonia continues as long as a trace of it exists.

The beneficial influence of gypsum and of many other salts has been compared to that of aromatics, which increase the activity of the human stomach and intestines, and give a tone to the whole system. But plants contain no nerves; we know of no substance capable of exciting them to intoxication and madness, or of lulling them to sleep and repose. No substance can possibly cause their leaves to appropriate a greater quantity of carbon from the atmosphere, when the other constituents which the seeds, roots, and leaves require for their growth are wanting. The favourable action of small quantities of aromatics upon man, when mixed with his food, is undeniable; but aromatics are given to plants *without food* to be digested, and still they flourish with greater luxuriance.

It is quite evident, therefore, that the common view concerning the influence of certain salts upon the growth of plants evinces only ignorance of its cause.

The action of gypsum or chloride of calcium really consists in their giving a fixed condition to the nitrogen—or ammonia which is brought into the soil, and which is indispensable for the nutrition of plants.

In order to form a conception of the effect of gypsum, it may be sufficient to remark that 110 lbs. of burned gypsum fixes as much ammonia in the soil as 6880 lbs. of horse's urine would yield to it, even on the supposition that all the nitrogen of the urea and hippuric acid were absorbed by the plants without the smallest loss, in the form of carbonate of ammonia. If we admit with Boussingault that the nitrogen in grass amounts to 1.100 of its weight, then every pound of nitrogen which we add increases the produce of the meadow 100 lbs., and this increased produce of 100 lbs. is effected by the aid of a little more than 4 lbs. of gypsum.

Water is absolutely necessary to effect the decomposition of the gypsum, on account of its difficult solubility, (one part of gypsum requires 400 parts of water for solution,) and also to assist in the absorption of the sulphate of ammonia by the plants: hence it happens, that the influence of gypsum is not observable on dry fields and meadows. In such it would be advisable to employ a salt of more easy solubility, such as chloride of calcium.

The decompositon of gypsum by carbonate of ammonia does not take place instantaneously; on the contrary, it proceeds very gradually, and this explains why the action of the gypsum lasts for several years.

The advantage of manuring fields with burned clay, and the fertility of ferruginous soils, which have been considered as facts so incomprehensible, may be explained in an equally simple manner. They have been ascribed to the great attraction for water, exerted by dry clay and ferruginous earth; but common dry arable land possesses this property in as great a degree: and besides, what influence can be ascribed to a hundred pounds of water spread over an acre of land, in a condition in which it cannot be serviceable either by the roots or leaves? The true cause is this:—

The oxides of iron and alumina are distinguished from all other metallic oxides by their power of forming solid compounds with ammonia. The precipitates obtained by the addition of ammonia to salts of alumina or iron are true salts, in which the ammonia is contained as a base. Minerals containing alumina or oxide of iron also possess, in an eminent degree, the remarkable property of attracting ammonia from the atmosphere and of retaining it. *Vauquelin*, whilst engaged in the trial of a criminal case, discovered that all rust of iron contains a certain quantity of ammonia. Chevalier afterwards found that ammonia is a constituent of all minerals containing iron; that even hematite, a mineral which is not at all porous, contains one per cent of it. Bouis showed also, that the peculiar odour observed on moistening minerals containing alumina, is partly owing to their exhaling ammonia. Indeed, gypsum and some varieties of alumina, pipe-clay for example, emit so much ammonia, when moistened with caustic potash, that even after they have been exposed for two days, reddened litmus paper held over them becomes blue. Soils, therefore, which contain oxides of iron, and burned clay, must absorb ammonia, an action which is favoured by their porous condition; they further prevent the escape of the ammonia once absorbed by their chemical properties. Such soils, in fact, act precisely as a mineral acid would do, if extensively spread over their surface; with this difference, that the acid would penetrate the ground, enter into combination with lime, alumina, and other bases, and thus lose, in a few hours, its property of absorbing ammonia from the atmosphere. The addition of burned clay to soils has also a secondary influence; it renders the soil porous, and, therefore, more permeable to air and moisture.

The ammonia absorbed by the clay or ferruginous oxides is