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# THE NEW-BRUNSWICK AGRICULTURIST.

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MANURES.

(Continued from page 32.)

Lime.—Lime is one of our most valuable manures, and its use constitutes one of the principal improvements in modern agriculture—we shall therefore devote a large proportion of the present number to the consideration of it. Our Provinces abound with it, and with soils that would be greatly enriched by the application of it. The cold clay lands, the unproductive moors, the moss-covered pastures and meadows, and the stunted growths upon many of our cultivated fields, prove that our farmers are either not aware of the value of this important fossil within their reach; or if aware of it, that they are culpably negligent in the use of it. The common lime stone of this Province is lime in combination with carbonic acid, forming a carbonate of lime. The plaister of paris, or *gypsum* as it is called, is lime in combination with sulphuric acid, forming a sulphate of lime. Lime may be used for agricultural purposes either by crushing the unburnt lime stone to a powder, or by burning it. But burning is the process generally preferred and adopted; because it gives immediate activity to its influence, renders it lighter to remove from place to place, and more easily reduced to powder, in which state it can be scattered more evenly over the soil, and more thoroughly incorporated with it. When carbonate of lime or common rock lime is exposed to a strong heat, the carbonic acid is expelled from it, the stone becomes lighter in weight although not apparently reduced in size, it forms a brittle mass easily pulverised, either by the addition of water, or long exposure to the air. The lime when thus burnt is in many places called *lime shells* or *shell lime*, or simply *shells*. The expulsion of the carbonic acid is the only change which is effected upon the constituent principles of lime stone. The *setting* of lime in common mortar depends upon its again attracting carbonic acid from the atmosphere through the porous mass composed of lime and sand; when lime or mortar has been kept for a long time exposed to the air before it is used for building, it is said to be *spent*, as it has already become charged with carbonic acid, and cannot be set, or, act so well as a cement. Lime when burnt, and previously to its being slaked, is termed *quick lime*, which is caustic to the tongue, and speedily effects the decomposition of animal and vegetable substances. In this state either in powder or dissolved in water it is injurious to plants, but when it is reduced to powder with water, or by exposure to the air, it again attracts carbonic acid, loses its caustic properties, becomes mild, forms a valuable ingredient in soils, and prevents the too rapid decomposition of substances already dissolved.

When quick lime is mixed with any moist fibrous vegetable matter, there is a strong action between the lime and the vegetable matter, and they form a kind of compost together, of which a part is usually soluble in water; by this kind of operation it renders matters, which were before comparatively inert, nutritious, and as charcoal and oxygen abound in all vegetable matters, it becomes again converted into a mild carbonate of lime, and in becoming so, it prepares soluble out of insoluble matters.

When lime is *slaked*, the following

phenomena take place: the lime has a powerful attraction for water and absorbs it with avidity, the absorption is attended with a hissing noise, the lime heats, swells, and falls into a powder. The *water* uniting with the lime becomes *solid*, and therefore evolves its latent caloric, the heat generated dissipates part in vapour, and by its expansive power separates the particles of the lime into a powder. If the process be conducted in the dark light is emitted; and if the quantity slaked be great, the heat generated is sufficient to cause ignition, and instances have occurred in which leaky ships loaded with lime have been set on fire. In preparing the burnt lime for agricultural uses, some farmers lay the shells upon a fallow in small hillocks of about a bushel and a half in each, which they cover up immediately with some fresh soil made very fine and laid on moderately thick, clapping it down with the spade so as to exclude rain or air; it remains a few days in this state, when it will be found that the moisture of the earth will have completely slaked it; this favours the thorough reduction to powder, and prevents the crusts and cakes which exposure to rain for slaking generally occasions. When thus fitted for use, it should be scattered over the field, and well mixed with the soil immediately, with shallow ploughing and thorough harrowing. 200 bushels may be applied to the acre from such heaps placed six yards from centre, to centre. The quantities of lime per acre will be governed by circumstances and the quality and condition of the soil. Other farmers again lay the lime down in a long heap or mound on one side of the field upon which it is to be applied, two labourers are then employed to turn the mound, and a third waters it, when the whole has been thus gone over, it is allowed to remain for four or five days, when it is again turned to discover any unslaked portions, which are then reduced with water. When it is duly prepared, it is then spread over the field and ploughed in, or prepared by combination with earth in the manner which we shall presently describe.

The principal advantage derived from the burning of lime in fitting it for a manure is the facility with which it can be reduced to powder: the prevailing idea, that calcination (or burning) is requisite for other purposes is incorrect.

Experience has established the utility of Lime as a manure, although some of its peculiar actions are not satisfactorily understood.

From what has been already stated respecting the properties of quick lime, and mild or slaked lime, it will be obvious that their respective operations depend upon principles entirely different; and the solution of the question, whether quick-lime ought to be applied to a soil, depends upon the quantity of *inert*, vegetable matter that it contains, as quick-lime renders such inert matter nutritive; and the solution of the question whether mild lime, marls, or powdered lime-stone, or calcareous shells, should be applied, depends upon the quantity of calcareous matter already in the soil. All soils, which do not effervesce with acids are improved by mild lime —and ultimately by quick-lime, which in process of time becomes mild lime. We may here observe that the effervescence of a soil when mixed with an acid implies the presence of a carbonate in them, which is decomposed by the additional acid. The carbonic acid is disengaged in air bubbles, which will be either few or copious according to the quantity of the carbonate and acid: the boiling or bubbling of the mixture is termed its effervescence.

When the circumstances of the soil require the application of quick-lime —the lime should be applied whilst in its powdered and caustic state, so that it might come in immediate contact with the minute particles of the soil—a less quantity at this time would be required, and it would act most powerfully upon the original matter lying undecomposed in the soil, viz.

the fibres and roots of noxious plants—the seeds of weeds and insects, all which it dissolves and transforms into mould. It is impossible to state with accuracy, any positive quantity of lime per acre, which land may require, as this varies according to the heaviness or lightness, depth or shallowness of the soil, and the quantity of calcareous matter which it may already contain. It is a curious fact however, that the *farther* the land is situated from the vicinity of lime kilns, the *less* it requires to produce fertility—thus in Yarrow, which is 20 or 30 miles from the lime districts 80 Winchelsea bushels are found equal to from 160 to 200 in Mid Lothian, where the lime is burnt. The soil in Yarrow is light—in Mid Lothian it is clay and moss.

The application of quick lime to soils containing much *soluble* vegetable manure is improper. It is also injurious to animal manures; owing to the chemical action which it exerts upon their various constituents.—Lime should never be applied to animal manures, unless they are too rich, or for the purpose of destroying noxious effluvia.—It is hurtful to common dung.—But in cases, where fermentation is useful to produce nutriment from vegetable substances, lime is useful, as for instance with Tanners Bark.

Judgment is requisite in the employment of lime, for although a certain quantity may promote the putrefaction of vegetable matter, yet, when too much is applied, it may have a contrary effect.

Quick-lime added in sufficient quantity to fermenting stable dung has set it on fire, when the whole mass has been destroyed. It should therefore never be mixed with farm-yard manure, unless a small quantity is considered absolutely requisite for the destruction of seed weeds or the decomposition of roots. It consumes growing herbage, but if it is prudently used it does not extend to their roots, as a fresh verdure soon after appears, and seeds which had laid dormant, are excited to vegetation. If quick-lime be put too copiously upon sandy land, and its application be followed with much rain, it does mischief, and forms hard compact matter similar to mortar, and although the caustic action of the quick-lime is soon corrected by the moisture of the soil and the absorption of carbonic acid from the air, still the mischievous effects of its caustic nature are powerful, even in a short time, when it is injudiciously applied.

As the dust of quick-lime is injurious to health, the labourer should work to the windward of it, and the horse or oxen should be protected from its influence; it should be ploughed in at a dry time, immediately after the spreading of it, and although the dry powder does not injure, yet when this is moistened, it has been known to occasion serious mischief to a horse; therefore the animal, while working through it, should not be allowed to go through wet places, and the lime dust should be thoroughly rubbed from him, when he is stabled; but if either a man or an animal should have been *scalded* with the lime, the part should be immediately washed with vinegar or sour milk, to prevent irritation. When slaked lime has lost its causticity, it is said in chemical language, to be "*effete*;" this state occurs in about a week, so that horses may work in it then without risk; but if it has been allowed to run into clods, these will retain the acrid quality for several days, so that it has been recommended to postpone the ploughing in for another week.

Quick-lime deprived of its causticity is eventually converted into a mild carbonate of lime, when it does not act upon animal and vegetable matter with its former violence, nor has it any tendency to form a mortar-like matter with the sand or poor clays.

Lime, however, whether *quick* or *slaked*, when *used by itself* is not possessed of any vegetative quality. Seeds placed in a pot with powdered carbonate of lime, regularly watered, vegetated feebly, and died without coming to perfection—others again in a pot partly filled with garden mould and covered with 1½ inches of carbonate of lime, sent their radicles straight through the lime which ramify until they came to the soil. In a mixture where the lime was only one fifth, the plants were poor and sickly—quick lime with the aid of water immediately destroyed the plants.

Experience has proved that lime has different effects upon different soils, rapidly improving some, producing less benefit on others, and on others again retarding vegetation; this depends upon various unascertained properties in the soil, or upon differences in the qualities of the lime arising from its mixture with other earths.

Calcareous earth is found in the ashes of all vegetables—it abounds in wheat, clover and other plants, whose growth is promoted by calcareous manures. Some plants will not ripen in soils wanting this matter.—Experience has established the utility of lime as a manure, but science has yet to discover many important facts connected with the use of it.

Application of Lime.—When moorish or waste soils are infested greatly with the roots of rushes, and other weeds, which resist the harrow and putrefy slowly, the ground should be tilled, and allowed to lie in this state one or two years before the lime is applied to it. It should then be applied in the autumn, and immediately ploughed in, or thoroughly harrowed, so that the decomposing power of the quick lime may be applied to all the vegetable matters. "After these operations, the land may be sown two successive years with oats, without any other fallowing; along with the second crop of oats it may be sown with grass-seeds for pasture. Some farmers, after the first and second crop of oats, give the land a summer fallow for one season, and a green crop, with manure. On the following season another crop of oats is taken, along with which grass seeds are sown, and in this state it is committed to pasture."

Lime is the only known alterative, which upon poor, weak, and wet clays, has power to heal the soil. It is also known to impart peculiar vigour to certain plants, thus the roots of *sainfoin* grass penetrate far into the interstices of chalk, and grow luxuriantly, although only covered by a slight coat of inferior soil.

The *alternate* breaking up of pasture lands for oats, and again laying it down for pasture, *without manure*, is destructive eventually to the soil, "which is thus reduced to a substance almost incapable of producing vegetation. The application of lime is essentially necessary in breaking up ground from pasturage. Oats, barley, and grass, after the second application of *lime* upon land reclaimed from waste, prove its value. Lands which have been well laid down with a good coating of putrescent manures, and kept a considerable time in pasture, are greatly enriched by lime; but when manures have been neglected, or sparingly applied to a turnip crop before the land has been laid down to pasture, the lime is not so efficacious." "The additional crops of all kinds in the rotation, will amply repay its expence." "Some farmers take a crop of oats from the lea (or field,) without lime, and apply the lime after the oats for the benefit of the turnip crops, and those which are to follow. This is done either by scattering the lime on the stubble, and tilling it in with the winter furrow, or after the furrow is made, the lime may be applied and harrowed in. The land lies in this state until May, when it gets its final preparation for dung and sowing the turnip seed. Others apply the lime in the spring, when it is ploughed in shallow, and well harrowed. Others, again, scatter the lime in drills, immediately before applying the dung, without any other operation." Each mode has its advocate; but Jackson says, "There can be no doubt that the best plan is to scatter the lime, when the land is in grass, before tillage for oats." The operation of lime is gradual, therefore, "the sooner it is put into the land, the sooner will its effects be felt."

Lime, when mixed with animal manures, "has a tendency to destroy, to a certain degree, their efficacy." But when it is thus used by some farmers in turnip drills, it is said that it checks the ravages of the turnip-fly. In all arable lands, impoverished either by nature or bad management, a first dressing of lime occasions a sensible improvement in the soil—a second-dressing does some good, but unless that and every succeeding repetition be accompanied with a liberal supply of farm yard or putrescent manure to supply the loss occasioned by exhaustion of vegetable power, every future crop will be diminished until the land eventually becomes fruitless.

Lime not only benefits sheep and dairy pasturage, but grains, which belong to the tribe of grasses, grow luxuriantly under its influence, and it is found in conjunction with putrescent manures and good drainage to correct the tendency of moorish and wet lands to swell with the frost, and throw out the plants during the winter. "The usual rotations on well managed dairy farms are, 1. Potatoes or turnips with dung. 2. Oats or barley. 3. Grass cut for hay, or, in pasture. 4. Continued pasture for four or more years, according to the extent of arable land, which the farm contains. By this mode, if the lime is always applied when the pasture is broken up, or when sown out, the application will be once in eight, or, more years. On light soils, or moorish mossy grounds, this is supposed to be rather frequent, unless the lime be compounded with earth. In this state it is always found valuable, when applied in quantities corresponding with the nature of the soil. The longer the land continues in pasture, the application of lime becomes the more efficacious, as it must have a greater quantity of vegetable matter to act upon. On turnip soils, this way of applying lime, is the best that can be adopted for dairy husbandry.

The best mode of applying lime frequently to the soil—is an important subject of inquiry. In applying it we must remember that *quick*-lime favours the decomposition of hard vegetable substances in the soil, fitting them as food for plants—that it improves a soil destitute of calcareous matter, and becomes one of its earthy ingredients—that it *separates* the particles of cohesive or close soils, and that it gives firmness and cohesion to light soils.—Lime, when applied to land abounding in vegetable matter, should be in a hot and powdery state. Its effects in this state continue long after its stimulating qualities have ceased to operate, and it thus converts new into the character of old and well cultivated lands. But when lime is re-applied in a quick caustic state to land almost constantly in tillage, without being subjected to pasturage, it has no vegetable matter to act upon, and therefore can have no other effect than to make the soil expand, and become one of its earthy ingredients. The *re-application* of lime to most sorts of ground acts as a *manure*, and not, as a stimulant. As a manure, it gives luxuriance to the crop, and is a powerful auxiliary in husbandry. It is to be regretted that chemical writers have not sufficiently devoted their inquiries to improve the *qualities of lime as a manure*, by incorporating it with *given quantities* of earth. Mr. Nasmyth, of Hamilton, in his essay on manures, observes—"Lime mixed with other substances, to separate part of the earthy and to rot the organized, may be successfully applied to land, when by *itself alone* it would have no effect; and one half of the lime, which would require to have been given to the land by itself, is sufficient for the mixture to make it an efficient manure." There is reason to believe that the lime exercises some other power beside that of merely separating the earthy parts, and hastening the decay of the vegetable or animal substances in the compost. Mr. Nasmyth says "that the lime and sand communicate some degree of friability to clay when separately applied; their united effect is much more powerful, and nothing has been found to improve the condition of hard, thin soils, more than the old mortar of ruined buildings."

The term *Friability* implies the reduction of calcareous, and bony substances to small particles.

In China the plaster of old kitchens is greatly prized as a manure, so much so, that the Chinese husbandmen will frequently put new plaster on a kitchen for the sake of obtaining the old for agricultural purposes. "This might be imitated" says Mr. Nasmyth, "by slaking the lime with foul putrid water, or the juice of a dung hill, and mixing it with six or seven times the bulk of sand or friable earth, and keeping the mixture for some months sheltered from the sun and rain." Jackson admits the efficacy of the putrid water, but thinks "there must be something in the compound itself approaching the nature of animal and vegetable manure, to give it the effect it has been known to produce." The late Sir John Sinclair observes "compounds of all kinds are valuable; they so act upon one another in the mass, that the chemical properties of the whole are changed, so as to render it an efficient manure. Earth and lime make good compost; and when the lime is applied in the ordinary quantity in addition to the earth, its effects are truly astonishing."

In China, the kitchens have no fireplace; the smoke escapes through an opening in the top—the old mortar must be consequently filled with the various properties of the smoke; add to this the carbon, which escapes from the human body during respiration, and the various exhalations in a kitchen, and in this manner we may account for the preference of old mortar as a manure.

Various experiments in Scotland have established the superiority of lime in a compound as a manure, over the lime in a hot and powdery state, and used alone.

In the compound state it promotes the friability and expansion of the soil, and increases the luxuriance of vegetation. The fertility of a soil dressed with the compound is much greater than that, which is dressed with quick-lime, followed by a liberal manuring from a compost without lime in it.

The good effects of the compound are alike valuable upon all the crops of the rotation, and especially upon wheat, to which it is generally applied after a naked summer fallow. The compound is applied every second course without dung upon naked summer fallow for wheat, and all the crops in the rotation, wheat, barley, oats, grass, and at times peas, and then oats, are all as good, if not superior to those in the preceding crop with putrescent dung.—The compound is not exhausted the first season of its application, for it assists the following dung course in fertilizing the soil.

The quantity of lime applied in compound is from 40 to 60 bolls of 4 Winchester bushels with about three times that quantity of earth. The earth used was from the top ridges of fields, the scouring of ditches, the scraping of roads, &c.

In another experiment, one proportion of a field was dressed with the compound, at the proportion of 50 bolls of shells per Scotch acre, incorporated with three times the bulk of ridge earth; another proportion of land was dressed with quick lime by itself, at the rate of 60 bolls of shells per acre; a third proportion was manured with barn yard dung thirty loads to the acre; and there ridges were left without dressing. The whole was sown with oats and grass. The part manured with the compound was most luxuriant; that with the barn yard manure was good, but inferior to the former; the quick limed portion gave a poor crop, and the remaining three ridges were not worth the cutting. Hence we see, that the lime itself had some fertilizing influence—that the dung was superior to the lime alone, but neither would bear comparison with the compound as manure; for four years afterwards, the part of the field dressed with the compound yielded a superior crop.

We may conclude from these experiments, "that when quick lime has ceased to promote fertility, if compounded with earth, its effects as a manure become highly valuable"—"almost any kind of soil is suitable for making this compound, but soil similar to that to which it is to be applied is preferable. Many of the subsoils make good compounds with lime. Sand and lime should be mixed for a clay soil, and subsoil clay and lime for sandy land, gravels, free loams, and moss lands in particular. No farmer need complain of want of materials, since every sort of land can be used for this purpose. These compounds produce immediate fertility, and correct the constitutional defects of the soil."

Farmers should study the nature of their soils, and the lime should be proportioned to the lightness or heaviness, the coldness or warmth of them, as experience has proved that light soils have been injured by too free and frequent use of lime. The farmer must ascertain by careful experiment and observation the quantity of lime that his soil may require.

One part of lime compounded with six to ten parts of earth, answers for light soil, and one of lime to two, three, or more of earth will answer for heavy lands.

The failure of lime by itself upon land long under tillage has been proved, particularly in the neighbourhood of Edinburgh; but it is not doubted, that if the same quantity of lime had been applied in a compound state, it would have fertilized the soil, and produced the best effects.

Quick lime may be applied with advantage on deep loams, but the compounded lime will be much better.

Lime is well adapted for marsh lands, which contain a large quantity of matter, capable of being stimulated by it. It may also be applied on rich, deep, dry and loamy soils, which frequently require the stimulus of quick lime. Clay lands combine well with lime, and bear the repetition of it better than light soils; grain growing on such limed soils preserves its healthy appearance in wet weather, whilst that upon a similar soil not limed is yellow and sickly. Upon sandy land, which seldom abounds with much vegetable matter, lime exerts a mechanical influence, it combines with finer particles, gives consistence, and attracts moisture from the atmosphere. Such lands however may be injured by the too frequent, long continued, and inconsiderate use of lime. A state is thereby induced which requires the aid of putrescent manures.

The advantages of lime are most conspicuous in the *breaking up of fresh and coarse lands*, upon which it acts more powerfully than upon land which has been long cultivated; the first application of it upon such lands should be abundant; upon grass-lands the quantity required is less; it is best to apply it upon these in a compost with earth, except when the soil consists of clay; upon such lands lime is found to be a great corrector of acidity, and pastures which without lime bore nothing but sour grass which cattle would not eat, have by the application of lime yielded the sweetest and most abundant herbage. In Derbyshire the farmers have found that by spreading lime in considerable quantities upon the surface of their heathy moors, after a few times, the heath disappears, and the whole surface becomes covered with a fine pile of grass, consisting of white clover, and the other valuable sorts of pasture grasses.

In the best cultivated counties in Scotland lime is most generally laid on finely pulverised land, while under a fallow, or, immediately after being sown with turnips. In the latter case, the lime is uniformly mild: in the former, quick lime, as pernicious (in a certain extent) to vegetation, may be beneficial in destroying weeds, and the turnip fly. Sometimes mild lime is applied in the spring to lands and harrowed in with grass-seeds, instead of being covered with the plough: this has been particularly beneficial upon hill pastures. In some places lime is spread on grass lands a year or more before it is ploughed, with decided benefit to the pasture and to the subsequent crop. But in whatever manner this powerful stimulant is applied, the soil should never be afterwards exhausted by a succession of grain bearing crops, a justly exploded practice, which has reduced some naturally fertiie tracts to a state of almost irremediable sterility.

We shall conclude this important subject in our next number with a few remarks upon the quality and some further observations upon the quantity of lime. We may here observe that we have condensed the preceding remarks from Reid's practical chemistry, from Fife's and Ure's chemistry, from the volume "British husbandry in the library of useful knowledge," and from Jackson, so that our readers have the latest and best authorities upon this subject, which we particularly urge upon the attention of our farmers, for we are convinced that too many of them are unacquainted with the value of lime, as one of the most useful and powerful agents in agriculture.

AGRICULTURAL CHEMISTRY.

(Continued from page 41.)

THE reciprocity between the animal and vegetable kingdoms in contributing to preserve a healthy state of the atmosphere, is one among the unnumbered instances of omnipotent intelligence. The study of it must interest, and the contemplation of it excite our admiration. The untutored Indian "sees God in winds and hears him in the clouds;" the mighty tempest and the rolling thunder proclaim the power of Deity; but the natural philosopher recognises equally the Omnipotence and the Omniscience of the Creator in the economy of nature—in that wonderful arrangement, which produces an astonishing variety out of a few constituent principles, and manifests Supreme wisdom in the harmony that characterises them. There is a reciprocal dependence between man, and the grass to which he is compared. The one wants oxygen, and the other requires carbonic acid, the former throws out carbonic acid, and the latter, in return, furnishes oxygen for the former.

From the experiments of physiologists, it appears that about 40 cubic inches of air enter the lungs of a man at each ordinary inspiration in a healthy person, and allowing 20 inspirations a minute, 1,152,000 cubic inches, or 666½ cubic feet are inspired daily. The ordinary inspirations and expirations of health are about 18 a minute, and generally once for every four pulsations of the heart, making the standard pulse about 72. The entire quantity of air contained in the lungs, when filled by inspiration, is not expelled by every expiration; a portion remains in the minute air vesicles. It is supposed that not less than 280 cubic inches remain in the lungs at each expiration, and that about one eighth part of air contained in the lungs is changed by each respiratory act. The change produced on the blood by respiration is the conversion of venous into arterial blood. The change upon the respired air is a loss of bulk, the loss of oxygen, and the formation of a greater or less quantity of carbonic acid, or, the absorption of oxygen and the evolution of carbon. The azote of the atmospheric air appears but little altered in quantity. The proportion of carbonic acid formed varies from 3 to 10 per cent. The average quantity formed by the respiration of an ordinary sized man in 24 hours is 40,000 cubic inches, which weigh about 3 lbs., and contain about 11 ounces of carbon. Respiration occasions also an exhalation of water, and the quantity thus exhaled in 24 hours has been estimated from 19 to 24 ounces a day. The quantity of carbonic acid thrown off from the lungs, varies according to circumstances. It is most at mid-day, and least at night. It is greater in old age than in youth; and it is diminished by fatigue and debilitating causes. The inference from the numerous and interesting experiments upon this subject is, that in animal respiration, the volume of oxygen consumed is greater than the carbonic acid that is formed, that the carbonic acid is exhaled ready formed, and that the oxygen, which disappears, is absorbed into the blood to fit it for its uses in the animal economy. If pure oxygen is breathed sufficiently long to arterialize the blood, it acts like a poison, showing that a certain degree of dilution of oxygen in the air by azote or nitrogen, is requisite to render it subservient to its intended purposes in animals. If the chemical properties of the atmosphere are thus altered, and its purity vitiated by respiration, how is this impurity corrected, so as to enable the atmosphere to continue its important action in the animal system? By the respiration of vegetables:—leaves are the lungs of vegetables, and perform an office in them, similar to that performed by the lungs in animals, with this exception, that vegetable respiration occasions a chemical change in the air, directly opposite to that caused by the breathing of animals. Animals consume oxygen, and throw out carbon; vegetables consume carbon, and throw out oxygen. The sap of the plant, absorbed by the roots is conveyed to the upper surface of the leaf, where it is acted upon, partly by the solar ray, but principally by light independently of warmth. When the sap is thus digested it is transmitted to the under surface of the leaf, where it undergoes a change analagous to that produced by respiration in the animal system. Dr. Smith in his remarks upon the philosophy of health, observes, "This operation, which is strictly analagous to that of respiration in animals, in which carbonic acid is always generated, and expired, is carried on chiefly in the night. In this manner, under the influence of the solar ray, the leaf decomposes carbonic acid; retains the carbon, and returns the greater part of the oxygen to the air in a gaseous form; at night, in the absence of the solar ray, the leaf absorbs oxygen, combines this oxygen with the materials of the sap to produce carbonic acid, which as soon as formed, is evolved into the surrounding air, the carbonic acid gas, exhaled during the night, *is re-absorbed* during the day, and oxygen is evolved; and this alternate action goes on without ceasing; whence the plant deteriorates the air by night, by the abstraction of its oxygen, and exhalation of carbonic acid, and purifies it by day, by the evolution of oxygen and the abstraction of carbonic acid." "The experiments of De Suassure have proved that the upper strata of the air contains more carbonic acid than the lower, which are in contact with plants, and that the quantity is greater by night than the day, when it undergoes decomposition." Some physiologists have considered the absorption of oxygen by the leaves of plants, and the evolution of carbonic acid at night from them, as an *exact* analogy with animal respiration: This is incorrect: Leibig observes, "The carbonic acid which has been absorbed by the leaves and by the roots together with water ceases to be *decomposed* on the departure of day-light. It is *dissolved* in the juices, which pervade all parts of the plant, and escapes every moment thro' the leaves, in quantity corresponding to that of the water which evaporates."

Carbonic acid is always present in

moist fertile soils, and in rain and well waters; the roots of plants during their life absorb moisture, air, and carbonic acid. Light by its chemical action fixes the carbon of the carbonic acid in the plant; when the light ceases to act during night, the carbonic acid absorbed with the water by the roots passes from the plant *unchanged;* hence plants growing in humus exhale more carbonic acid than those which grow in dry situations, and they throw out more in rainy than in dry weather. The cause of this has just been explained. Many experiments have proved that plants yield much more oxygen to the air, than they extract from it. The evolution of oxygen from the leaves and twigs of plants is observable in those which grow in the bottom of pools and ditche.. . hen the surface of this water is frozen with clear ice, small bubbles of air can be seen rising from the bottom and floating beneath the ice. These are pure oxygen, disengaged from the carbonic acid dissolved in the water, which is absorbed by the plants: the water receives a fresh supply of carbonic acid from the decaying vegetable matter in the soil. The oxygen thus evolved is not again absorbed by the plant; shewing that it must receive its supply from some other source.

Careful experiments have sufficiently proved that the *Carbon of plants is derived from the atmosphere.* Humus evolves carbonic acid, and thus makes an atmosphere of it around the roots of plants by which it is absorbed, while the leaves absorb it from the atmosphere surrounding themselves.

The functions of a plant during its life must be constantly in action, therefore the roots and other parts possessing the power of absorption are constantly absorbing water and carbonic acid, either in the shade during the day, or in the night in the absence of the solar ray: "But the assimilation (*or the digestion*) *of Carbon* and the exhalation of oxygen commence from the instant that the solar ray strikes them; thus, as soon as a young plant breaks through the surface of the ground, it begins to acquire colour from the top downward; and the true formation of woody tissue commences at the same time.

"The proper, constant and inexhaustible sources of oxygen gas are the tropics and warm climates, where a sky, seldom clouded, permits the glowing rays of the sun to shine upon an immeasurably luxuriant vegetation. The temperate and cold zones, where artificial warmth must replace deficient heat of the sun, produce on the contrary carbonic acid in abundance, which is expended in the nutrition of tropical plants. The same stream of air, which moves by the revolution of the earth from the Equator to the Poles brings to us in its passage from the Equator the oxygen generated there, and carries away the carbonic acid formed during our winter."

The various currents of air, storms, and tempests, all contribute to produce a healthy state of the air, by mingling the oxygen of purer regions with the carbonic acid of those in which the evolution of oxygen is less. "The objection has been urged," says the American Editor of Leibig, "that towards the end of autumn, and through the winter and early spring, the air in our climate must become impure from the absence of leaves, that the oxygen must diminish, and carbonic acid increase in the atmosphere. But the different parts of the atmosphere are constantly mixed together by the winds, which when strong, move at the rate from 50 to 100 miles an hour." "The air from the vast forests of tropical climates passing over the ocean arrives uncontaminated, and the constituent parts of the air are mingled by constant agitation and motion."

But even in our cold regions, if oxygen is evolved from the ends of twigs, as Leibig has observed in those under water, our forests must supply our climate with a constant supply of oxygen, independently of that which is constantly evolving from evergreens, which is another among the wonderful provisions of Providence for the continuance of purity in the air during the absence of those leaves which die in the autumn.

(To be continued.)

CULTIVATION OF TURNIPS.

We think we are sufficiently acquainted with rural proceedings in these Provinces to venture the assertion, that the cultivation of the turnip crop has been too generally neglected; and as it is one of the departments of husbandry which has contributed greatly to the advancement of agriculture in other countries, that the adoption of it upon a larger scale, in our Provinces, would be attended with improvement to the soil and profit to the cultivator of it; for a suitable supply of turnips, independently of other important considerations, would relieve the expenditure of hay during our long winters. Hitherto the growth of turnips has been confined to a small patch of ground, prepared by the yarding of cattle upon it, or to a similar space upon newly burnt land. After mentioning the advancement which agriculture experienced in England by attention to the turnip crop, the writer in "*British Husbandry*" observes, "It was also so difficult to support the stock upon a farm throughout the winter, that the fattening of cattle for market during that season could only be effected with hay, and it was therefore customary among country families *to slaughter* a number proportionate to their wants, for the purpose of salting them down for winter consumption. This indeed saved the expense of feeding, but besides abridging the comforts of the table, it prevented the production of manure for the culture of the land, which thus became impoverished, *and it was not until the admission of turnips into our farming system*, that those inconveniences were remedied. They are now, however, universally grown for the common food of sheep and oxen, upon all soils to which they are adapted, and lands so poor as to be formerly worthless under the plough, have now been rendered productive, by the application of the dressings which they furnish." We may here notice the reduction of stock which takes place occasionally in our Provinces in consequence of the scarcity of hay in the spring. In England, the farmer calculated the length of his winter, the number of *mouths* and the quantity of hay requisite to fill them, and when there was an overplus of the former, he put the beef, when it was eatable, in his pickle barrels. But our farmers in too many instances do not trouble themselves with any such proportional calculations, they keep their stock, feed liberally in the winter, and when the spring comes, famine comes with it; the cattle are then put upon an allowance; this daily decreases with the daily decrease of flesh upon the bones of the unfortunate animals, their skeleton frames are sustained a little longer with a pittance from the potatoe cellar, oat-bin, or meal barrel, until they drop down, with nothing in them to make manure, and nothing on them to feed either the owner or the crows. We have seen these occurrences too often to doubt the propriety of making the assertion, and the spring that has just passed has verified it in many parts of both Provinces. It may be said in reply, that the spring was unusually late this season, and that all probable calculations would have failed We return for answer, that a prudent calculator would make provision for two or three weeks of extra feeding.

We shall give full extracts respecting the cultivation of turnips, to which so much importance is attached by the highest agricultural authorities in Great Britain. Our climate is favourable to the growth of them, we have soils in abundance suited to them, and if they are considered a good substitute for hay in the short and mild winters of England, they must prove equally beneficial in our long and severe ones.

Turnip Soil.—The best soil for turnips is a light, dry, friable soil, of a free nature, with some depth of fertility. Clays are unfavourable. But although the common root can be grown upon the poorest sands and gravels, yet there are some species, which require rich, free loams. They all require careful culture, with an abundant supply of manure, and a cool, temperate, moist climate.

Culture.—Turnips are considered by all farmers, as the most complete fallow crop, that can be grown; the land should be well cleansed from weeds, liberally manured, and limed, if necessary. When turnips are to be sown upon stubble land, the stubble should be ploughed to a good depth immediately after harvest, the upper drains and water furrows should be drawn and opened as soon as the ploughing is finished, and the ground laid as dry as if it were under crop. Ten-furrowed lands or five-bout ridges are considered best in strong soils, liable to wet in winter; this kind of furrowing favours the good effects from frost. Broder work may be adopted on dry soils. Let the land be in this state until the close of the oat-seeding, when it should be cross-ploughed; if leisure permitted for a previous ploughing, it would be still better; after the ploughing the land should be well harrowed with a heavy harrow, and then rolled so as to pulverize it completely; all roots of weeds and rubbish should be collected and raked together, and either burned upon the land or carried to the compost heap. If the land is clear, three earths or ploughings may be sufficient to bring it into condition, but four are more frequent—the second and third not quite so deep as the first and fourth. If the ground is very foul, a fifth ploughing is sometimes necessary, after which it is fitted for the seed.

In the application of manure, if lime be used, it will of course have been mixed with the soil during these operations, and if the seed be sown broad-cast, the dung must also be previously laid on. Some farmers advocate sowing broad-cast, others prefer "drilling;" all however agree that the broad-cast is best upon soils of a compact or cloddy nature, which would prevent the due application of the drill and horse-hoeing implements, which are generally preferred on light and loamy soils, as affording the most effectual means of cleansing the ground. Many farmers, who adopt the drill, manure the land before giving the winter furrow, which they think saves time in the hurry of turnip season, and meliorates the soil more equally for the subsequent crops. This will answer best with those farmers who have the manure to spare at the time. But as most men have to wait for the production of it in their yards during the winter, the most generally approved method of applying the muck is in drills, immediately before sowing, in the following manner: "The land being levelled by the former ploughings, is divided into straight lined ridgelets, either by the operation of the double-mould-board plough, or by the common swing plough, at distances of 27 inches; others prefer half this distance; the turnips in the former grow larger, but the actual quantity from the soil is made up by the greater number in the close ridges. The manure should be duly fermented, and pit dung of the richest kind, and put on most abundantly after the last ploughing—say from 12 to 20 tons per acre, according to the state of the land, and the quality of the turnip, as Swedes require more than any other. The loaded cart goes between the rows, so that the wheels run in each of the furrows of the two adjoining drills on each side—the drills are the wide ones; the muck is then deposited in small heaps at regular distances, and spread with forks in the hollow drills, and the ridgelets are then immediately split open by the passage of a plough through the centre of each, by which means the manure is completely covered, and a bed is formed for the reception of the seed."

In England it is customary to lay these drills off obliquely, in order that the ploughing for the following crop may incorporate the manure more thoroughly, as that crop, which is generally barley, oats, or wheat, gets only one preparatory ploughing. In some instances, wherein the manure has been very intimately mixed with the soil, the drills are drawn through the soil after it has been laid quite flat, and the seed is sown in them without any other preparation. Various manures have been used for turnip crops, as lime, dung, ashes, sea weed, but the bone dust has the preference.

Sowing the seed.—This should be done whilst the earth is fresh and moist, and as soon as possible after it has been turned up. The *drilling* has been effected in various ways; the seed is dropped either from some of the improved drill-machines, or, after it is dried, it is put into something like a pepper box, with holes in one end, the other is attached to a stick; it is then dropped by one person, who is followed by another with a rake to cover the seed; the crowns of the drills being in either case flattened down by a light roller, and the seed sown in regular rows, at the depth of about an inch and a half along the middle of the tops, directly over the manure. A common mode of sowing is also by the hand-drill, which follows the roller, to which it is attached by a rope, and the seed is sown upon *one-bout* ridges in the following manner. The roller, wide enough to cover two ridges at once, yet, on the first turn takes but one ridge with one of its ends; and in returning, while it rolls this a second time with the same end, rolls a second ridge the first time with the other; which again in returning it rolls a second time, along with a third ridge the first time. In this way it goes twice over the ground; the drill depositing the seed between the first and second rollings. The more general practice, however, is to sow two drills at a time from a drill machine constructed for the purpose.

The plants generally make their appearance in ten days or a fortnight, getting the rough leaf when they are a couple of inches high. The process of horse-hoeing now commences, by running a small single horse plough, or one of the implements constructed for the purpose, up and down the rows, as near as it can be done without injuring the crop, or at about 3 inches distant from the plants, so as to cut up weeds, and turn off a shallow portion of earth from the turnips. In 2 or 3 days afterwards the sides of the drills are *hand-hoed* with a gardener's hoe, with an 8 inch blade. With this the labourer stands opposite the rows, and with one stroke across the ridge he cuts out the plants at regular distances, leaving them standing singly, with a vacant space of at least 9 or 10 inches between each, thus thinning them and allowing sufficient space for their roots. This at first sight seems as if it would destroy the crop, but the plant soon regains its vigour, and thrives more luxuriantly.

When the turnips are intended for immediate use, the space between may be 10 or 12 inches, as this favours the greater growth of the bulb; but when they are for winter consumption the spaces may be smaller, as it is thought that the bulb having its growth somewhat checked, ripens more firmly, and resists the frost better.

The second process must be repeated within a fortnight or three weeks from the first, but with more care; the hand-hoer must turn the earth around every single plant, removing all other sprouts excepting the one; for when two grow together, they mutually injure each other; this terminates the horse and hand hoeing, as the broad leaves of the plant generally overshadow the ground and check the growth of weeds, but if, owing to moist and favouring weather, more weeds should spring, they must be carefully removed. The removal will produce effects counterbalancing the expense of it.

There are several kinds of turnips cultivated for use, as the white, the green, the purple, the red-top, the tankard, the Norfolk, the globe. But they are generally classed under the heads of the white and yellow species, and the Swedish.

The white Globe, or Norfolk Turnip, was first known and is most commonly cultivated. It is best suited to light soils, and for sheep-feeding, as it produces the heaviest crop, and ripens soonest. This turnip, however, becomes pithy after Christmas.

The Aberdeen yellow is an intermediate species between the globe and the Swede. It is hardier than the former, and of a slower growth; it should, therefore, be sown earlier, and it requires to remain longer in the ground. The crop is large, but not so abundant as the former, but equally as nutritious, although not so well relished by cattle. This turnip requires a stronger soil than the "white globe," and varies sometimes in colour, being red, approaching to purple, and various shades of green and nearly white. Some farmers mix them, as cattle are found to feed better upon the variety.

The Swedish turnip, or *Ruta-baga*, is the hardiest species known, and is of comparatively late introduction into England. It resists the weather better than the others. The true sort has yellow flesh, and is without a stem; but it is apt to degenerate into white flesh, and by the crown running up into a stem; its roots are solid, its leaves more palatable; it retains its nutritive properties later in the spring; it thus affords excellent food in that time of frequent scarcity; it requires a more abundant supply of manure, and a better soil than the others. It is four that although it does not yield s large a crop as the white, yet that an equal weight contains a greater proportion of nourishment; that a smaller quantity satisfies cattle, and that they thrive better upon them. Whereas, it is said that cattle fed exclusively on the white turnip, they will only hold their own. The Swedish turnip on an ordinary soil, even with a large allowance of manure, becomes tough and fibrous, and seldom in such soil acquires any size. The culture is the same as that which has been described, with this advantage, that the Swedish turnip bears transplanting, and, therefore, any vacancies in the drill or field, made either by accident or vermin, can be filled up, any time in June. When the turnip is transplanted, it is found that the bulb is sooner formed. This is considered a disadvantage in England, when the crop is left upon the ground, but will not apply to our Provinces.

Seed and Sowing.—The time of sowing is governed by the quality of the turnip, and the state and condition of the ground. The most nutritive require the longest period for ripening, and, therefore, should be sown early. In England the Swedes are sown first, early in April or May; if later, the crop is found to suffer in weight. The yellow are sown next, and, lastly, the white turnip, from the middle of May until the close of June. If the soil is cold and slow in producing vegetation, the seed should be sown sooner; but if it is well manured and rich, it may be sown later. But there is always an advantage from early sowing; as the soil is then moist, and the heat less intense, which forwards the plants, and subjects them to less injury from insects. Some farmers, however, are averse to early sowing, as the plants are sometimes apt to run up into flowering stems. The ground should be in a proper state of dryness—not the dryness of drought—and sufficiently moist to ensure vegetation. Many farmers in Britain sow the white turnips in successive crops, each a week or a fortnight later. This allows the hoeing to come on also in rotation, and the crop answers for consumption in a similar way.

The quantity of seed sown in England varies from a pound and a half to two pounds, when sown broad cast, and about a pound when drilled; this allows for bad seed, the ravages of the fly, and thinning out. Mr. Malcolm, of Surry, has observed in experiments upon the successive sowings of the *tankard* turnip, a large variety of the white species, that one acre of May sown turnips were worth two acres of those sown in July. - It has been said that the fly is most destructive upon chalky lands, therefore, on such soils the seed should be sown more liberally. The same gentleman recommends the full black seed, as the best in quality; but as the buyer is subject to great imposition, he advises that the seed should be obtained a month or two beforehand, and that 12 or 24 seeds be planted in a pot placed in a shady spot, and that a similar number should be sown for 10 days in 10 different pots successively; by so doing he can count the number of good seed that vegetate, and he may safely then apportion his seed from a pint to a quart or four pints, or even more, per acre, according as he finds the seed grow. This is an infallible guide, and has ensured many a crop; but every farmer should save seed for himself.

Diseases.—Large tumours form below the bulbs, soon after the formation of the apple; these are called "*Anbury*," and when the root, instead of swelling, runs into a number of roots, the disease is called "*fingers and toes.*" Various causes have been assigned for these, but they are now found to be caused by two different insects. Another disease, called the "*black canker*," is caused by a species of slug, or caterpiller, when the plants are in rough leaf, and have partly formed their tops. These worms come out at night, and heavy rolling has been tried; it destroys many on smooth land, but has little or no effect on rough stony ground. A flock of ducks is the best remedy. In England a field of 33 acres was completely cleared in five days by a flock of 400 ducks. In these Provinces, if we may judge from the appearance of the poultry yard, our farmers would consider the remedy as bad as the disease. The most destructive enemy to turnip crops is the "*turnip fly.*" It attacks as soon as the tender seed leaves of the plant burst forth, and the swarms of them completely strip the plants; they disappear when the rough leaf is formed, which occurs in a few days, during which time they have entirely destroyed whole fields, requiring the ground to be re-sown. Top-dressing of quick lime and soot have been tried, but the result of frequent experience proved the insufficiency of it. A composition of 3 parts soot and 1 of quick lime, slaked with urine, has been serviceable. Sowing of raddish seed, mixed with the turnips, has been recommended as food for the fly. The burning of weeds and damp straw has been tried. Various steeps for the seed, as train oil, and water mixed with powdered black brimstone have also been used. Mr. Poppy, a practical farmer sowed four acres in drills with the usual quantity of Swedes intended to stand for a crop, and half a peck per acre of common turnips in alternate rows for the purpose of attracting the fly; the result was, the Swedes were but little injured, whilst the leaves of the common turnips were black with flies; after the Swedes had got into rough leaf, the rows of common turnips were ploughed up, and the field was managed in the usual way, and turned out a good crop, while all the other crops in the neighbourhood were destroyed. But after all, a good soil, abundance of well rotted dung, a full quantity of seed and careful culture to ensure rapid growth, are the most probable means of ensuring a crop.

In conclusion, notwithstanding the expense of culture and the insufficient return from an acre of turnips in the market, the advantages consist in the crop answering as a substitute for naked fallow, affording succulent food for cattle and sheep, increasing the fertility of the soil, and thus ensuring heavy crops of grain and hay; therefore, the culture of turnips is considered in Great Britain "*the main stay of all good husbandry on those soils to which it is adapted.*"

A TEST FOR SOUND SEED POTATOES.

"From the now generally diseased state of the potatoe, it appears to us that there is but one way to test the seed before planting, which, if properly attended to, will prevent those melancholy results that may be anticipated in the crop. It is this: select from the potatoes proposed for seed, a dozen or two; cut them with a sharp knife into sets, then put them on the floor of a potatoe house, or any other place free from damp, with the skin next the floor; if, upon examining them three or four days after, it should be found that the incision has dried up, and is covered with a kind of new skin, be assured that the seed is wholesome—plant it. But if, on the contrary, the wound is found to be wet, sluggish, and spotted, touch not the unclean thing, but be certain that the constitution of the potatoe is exhausted. This experiment should not be tried until vegetation has completely taken place, say about the middle of April."—*Dumbartonshire Farmer.*

CHARCOAL.

Various experiments made with charcoal to ascertain its influence upon vegetation have established its extraordinary powers; and as this substance is easily obtained in our Provinces from the slow combustion of wood, during which the air is excluded, we would earnestly recommend the employment of it. We may here observe that we have often seen grass and shrubs growing with rank luxuriance around the margin of charcoal heaps in the woods. To the Horticulturist charcoal will be found an invaluable agent as a substitute for humus in exhausted soils; and we would suggest among other experiments the trial of it upon Indian corn, viz. a few spoons-full on each hill.

Vegetable mould, or *humus*, which is the product of decaying vegetable matter, is, according to Leibig, constantly although very slowly emitting carbonic acid around the roots of plants, supplying them with this important principle in soils permeable to the air. "An atmosphere of carbonic acid surrounds every particle of decaying humus, the cultivation of land by loosening the soil causes a free and unobstructed access of air" around the roots; "an atmosphere therefore of carbonic acid is contained in every fertile soil, and is the first and most important food for the young plants, that grow in it." This will explain in part the beneficial effects of charcoal, which readily condenses carbonic acid, attracting a fresh supply as fast as it loses it from absorption by the roots of plants. In this manner it acts as an excellent substitute for humus. But its influence is not confined to the carbonic atmosphere, which it affords. Charcoal absorbs ammonical gases very largely and condenses the ammonia in its pores. These are very readily separated by water, and as carbonic acid, water and ammonia are indispensably requisite for the existence of plants, the beneficial effects of charcoal must be obvious. Rain or river water are requisite to secure the favourable influence of charcoal upon vegetation; owing to their containing some compound of nitrogen, without the assistance of which charcoal and *humus* are deprived of their powers upon vegetation; for experiment has proved that vegetation is not promoted and matured with charcoal and pure distilled water. Plants thrive in powdered charcoal, and may be brought to blossom and bear fruit, if exposed to the influence of the atmosphere and rain. The power of the charcoal is increased, if it is previously heated to redness. It has been found to promote the growth of plants on heavy and argillaceous (clayey) soils. "It is" says Leibig "the most unchangeable subtance known; it may be kept for centuries without change;" it may yield some salts, especially the silicate of potash, to plants. Some vegetable physiologists are of opinion that it is decomposed in 5 or 6 years, converted into a coaly earth, and in this manner supplies carbonic acid. Dr. Webster, of the Harvard University, mentions an instance of the decided effects of carbonic acid upon vegetation in the volcanic Island of St. Michael. The gas issued from a fissure in the base of a hill of trachyte and tuffa, from which a level field of some acres extended. This field at the time of his visit was in part covered with Indian corn. The corn at the distance of 10 or 15 yards from the fissure was nearly full grown and of the usual height, but the height regularly diminished until it dwindled to the height of a few inches. The carbonic acid from its greater specific gravity was most abundant where the corn was highest, and either deficient, excepting what was obtained from other sources in the atmospheric air, or greatly diluted with it, on those parts of the field where the corn was poorest. A mixture of two thirds of charcoal with vegetable mould produced astonishing effects upon some tropical plants with tuberous roots, it improved the size and colour of their leaves and flowers; and the roots formed more rapidly in it. A Cactus planted in a mixture of equal parts of charcoal and earth throve progressively in it, and attained double its former size in the space of a few weeks. Similar results were obtained from trials with various other plants. When charcoal was used as a substitute for sand in soils requiring it, to keep them open and porous, vegetation was always rendered stronger and more vigorous.

The best results were also obtained from charcoal when used without any addition of soil to it. Cuts of plants took root in it well and quickly. "Leaves and pieces of leaves and even pedunculi, or petioles (flower stalks, and leaf stalks,) took, root and in part budded in pure charcoal. The leaves of various plants took root in it, as did also pieces of a leaf of the Agave Americana, and tufts of the Pinus, &c. and all without the aid of a previously formed bud."

Pure charcoal is an excellent remedy in curing unhealthy plants. A Dorianthes Excelsa, which had been drooping for three years, was restored to health and vigour in a very short time by it. An Orange tree, which had turned yellow from disease, acquired within four weeks a healthy green colour, when the upper surface of the earth was removed from the pot, containing it, and a ring of charcoal of an inch in thickness strewed in its place.

The charcoal used in the foregoing experiments was obtained from Firs and Pines, which was considered preferable to all others, principally on account of its greater porosity. It was powdered previously to using it, and it was found to be more effectual after it was exposed for a winter to the action of the air.

Wherever charcoal is employed the plants should be plentifully supplied with water, as the experiment without it would fail, owing to the porosity of the charcoal admitting the free access of air to the root, which would thus, without water, soon become dried.

ROTATION OF CROPS.

(*Continued from page 52.*)

Every constituent of the body of man and animals is derived from plants when used as food. The vital principle does not generate a single element, therefore says Leibig, all the inorganic constituents, viz. salts and earths which remain after the process of putrefaction, must be considered in some respect as manure; when putrefaction takes place nitrogen and carbon escape into the atmosphere as ammonia and carbonic acid, until at last nothing remains excepting the phosphate of lime and other salts in their bones. The excrement of a dog conveys a tolerably correct idea of the chemical nature of animal excrements, "when a dog is fed with flesh and bones, both of which consist in great part of organic substances containing nitrogen, a moist white excrement is produced, which crumbles gradually to a dry powder in the air; this excrement consists of the phosphate of lime of the bones, and contains scarcely 1-100 parts of its weight of foreign organic substances." "The whole process of nutrition in an animal consists in the progressive extraction of all the nitrogen from the food, so that the quantity of this element found in the excrements must always be less than that contained in the nutriments," which however do contain a small proportion of it. "Now this earthy residue of the putrefaction of animals," continues Leibig "must be considered in a rational system of agriculture as a powerful manure for plants, because that which has been abstracted from a soil for a series of years must be restored to it if the land is to be kept in a permanent condition of fertility." The chemical analysis of fertile soils has detected the presence of certain salts and earths in them, which have been also discovered by analysis in the constitution of plants; the abstraction of these substances from the soil deprives it of its fertility, and the restoration of fertility must depend upon the restoration of these salts and earths to the soil. This is effected by the various manures all of which are found to contain greater or less proportions of them. The dung from a horse is found to consist of

Water,	357 0 parts.
Vegetable fibre and animal matter,	135 0
Silica,	3 2
Phosphate of lime,	0 4
Carbonate of lime,	1 5
Phosphate of magnesia and soda	2 9
	500 0

The excrements of cows, black cattle and sheep contain phosphate of lime, common salt, and silicate of lime, and when fresh about 90 per cent. of water. Human excrements contain besides ¾ of their weight of water, nitrogen in variable quantities from 1½ to 5 per cent: 100 parts when dried and exposed to heat, gave 15 parts of ashes, which were principally composed of the phosphate of lime and magnesia.

The vegetable constituents of excrements are not without their influence upon vegetation, for as they decay, they furnish carbonic acid to the young plants, but this influence is not very great, since a good soil needs manure only once in 6 or 7 years, or once every 11 or 12 years, when esparsette or lucerne have been raised upon it; during which time however the quantity of carbon thus given to the land corresponds only to 5. 8 per cent. of what is removed in the form of herbs, straw and grain.

"The peculiar action then of the solid excrements is limited to their *inorganic* constituents, which thus restore to the soil, that which is removed in the form of corn, roots, or grain." The manures of cows and sheep restore silicate of potash and some salts of phosphoric acid to the soil; human fæces give it the phosphates of lime and magnesia, and the dung of the horse gives it phosphate of magnesia and silicate of potash. The straw of litter adds a further quantity of the silicate of potash and phosphate, which if the straw be putrified are in exactly their original condition. It is therefore evident that the soil of a field will alter but little, if we collect and distribute the dung over it; but as a certain quantity of the phosphates must be lost every year by the removal and sale of corn and cattle, which collects in the neighbourhood of towns, this loss must be remedied, which is effected in good farming, by allowing the fields to lie in grass in a system of rotation.

Fields might be kept in a state of constant fertility by replacing every year, as much as is removed from them in the form of produce, but an increase of fertility and consequent increase of crop can only be effected by adding more than we take from the soil.

Substances containing the essential constituents of animal excrements may be substituted for them as manures. In Flanders the ashes of wood or bones have been employed as such a substitute, as they contain a large proportion of the phosphates of lime and magnesia. They have also been found very beneficial in the light siliceous soils of Long Island, Connecticut, and other parts of United States, and of course would be equally beneficial upon similar soils in our Provinces. Ashes contain also silicate of potash exactly in the same proportions as in straw. The value of ashes depends upon the tree from which it is obtained; those from the oak wood are the least, and those from the beech are the most serviceable. 100 lbs. of lixiviated ashes of the beech spread over the soil, furnishes as much phosphates as 460 lbs. of human excrements. Lixiviation is the process of dissolving by water the soluble parts of the ashes; the ley of ashes is an instance of it; and every 100lbs. of ashes from the beech supply a field with phosphoric acid sufficient for the production of 3,820 lbs. of straw or 15lbs. and some fractionals of corn.

Bone manure possesses a still greater importance in this respect. The primary sources from which the bones of animals are derived are the hay, straw, and other substances, which they take as food. From analysis, it follows, that 8 lbs. of bones contain as much phosphate of lime as 1,000 lbs. of hay or wheat straw, and 2 lbs. of it as much as 1,000 lbs. of the grain of wheat or oats. "These numbers express pretty exactly the quantity of phosphates which a soil yields annually on the growth of hay and corn;" therefore 40 lbs. of bone dust on an acre of land is sufficient to supply three crops of wheat, clover, potatos, turnips, &c. with phosphates. The dust should be very finely powdered, and intimately mixed with the soil. The easiest and most effectual process is to "pour over the bones in a state of fine powder, half their weight of sulphuric acid, diluted with 3 or 4 parts of water, and after they have been thus digested for some time, to add 100 parts of water, and sprinkle this mixture over the field before the plough. Experiments, made to ascertain the effects of this manure, have shewn that corn and kitchen-garden plants have thriven with greater vigour from it.

It must be admitted as a principle of agriculture, that those substances which have been removed from a soil must be completely restored to it, either by excrements, ashes, or bones. "A time will come," says Leibig, "when fields will be manured with a solution of glass (silicate of potash), with the ashes of burnt straw, and with the salts of phosphoric acid prepared in chemical manufactories."

Some plants require *humus*, and do not restore it to the soil by their excrements; others can do without it altogether, and even add humus to a soil deficient in the quantity of it. A rational system of agriculture would therefore employ all the humus at command for the former, and not expend any of it for the latter; it would in fact employ the one as occasion might require to supply the other with humus.

"We may furnish a plant with carbonic acid and all the materials which it may require, and we may supply it with humus in the most abundant quantity, but it will *not attain complete developement until nitrogen is also afforded to it;* an herb will be formed, but no grain; even sugar and starch may be produced, but no *gluten*," which is the substance forming the nutritious part of wheaten flour. The production therefore of nitrogen in a form capable of assimilation or digestion is the most important object of agriculture.

Every part of the organization of a plant contains varying proportions of nitrogen, but it abounds in the seeds and roots. The atmosphere furnishes nitrogen to a plant in quantity sufficient for its own growth and reproduction; but plants constitute the food of a large proportion of animals, and by a wise adjustment they have the remarkable power of *converting to a certain degree all the nitrogen offered to them into nutriment for animals.*

An increased quantity of nitrogen enables a plant to attract with greater energy from the atmosphere the carbon which is necessary for its nutrition, when that in the soil is not sufficient. It fixes the carbon of the atmosphere in its organism. There is but little nitrogen in the excrements of black cattle, sheep and horses: it is more abundant in human fœces: it varies however in these; for it is less in the fœces of persons living in the country, or upon potatos and bread, than in persons living in a town, and eating animal food. All excrements have therefore a variable and relative value. Thus the dung of cattle and horses is of great use on soils consisting of lime and sand, and containing no silicate of potash and phosphates; it is of less value on argillaceous earths, or on soils formed of basalt, granite, porphory, clinkstone, and even mountain limestone, which all contain potash: on these human excrements are extremely beneficial.

There is only one other source of manure, which acts by its nitrogen, besides the feces of animals—namely, the urine of man and animals, which may be employed either in its liquid state, or combined with the feces. It is the urine contained in the feces which gives them the property of emitting ammonia—a property which they themselves possess only in a very slight degree.

According to Burzelius, 1000 parts of human urine contain—

Urea, - - - - - -	30 10
Free lactic acid, lactate of ammonia, and animal matter not separable from them, -	17 14
Uric acid, - - - - -	1 00
Mucus of the bladder, -	0 32
Sulphate of potash, - -	3 71
Sulphate of soda, - -	3 16
Phosphate of soda, - -	2 94
Phosphate of ammonia, -	1 65
Phosphates of magnesia and lime,	1 00
Siliceous earth, - - -	0 03
Water, - - - - -	933 00
	1000 00

It is the muriate, the phosphate, and the lactate of ammonia, which enable the soil to exercise a direct influence on plants during the progress of their growth, and not a particle of them escapes being absorbed by the roots. The existence of carbonate of ammonia in putrified urine suggested the manufacture of the sal-ammoniac from it, which was thoughtlessly carried on by farmers, when that salt commanded a high price, but the impropriety of such a wasteful practice is apparent, when we state, that the nitrogen of 100 lbs. of sal-ammoniac (which contains 26 parts of nitrogen,) is equal to the quantity of nitrogen contained in 1200 lbs. of the grain of wheat, 1480 lbs. of that of barley, and 2755 lbs. of hay.

The ammonia emitted from the putrefying urine of stables, &c. is always in combination with carbonic acid. The escape of this volatile salt is an immediate injury to the eyes and lungs of the cattle and horses in close stables, and an eventual loss of a valuable ingredient as manure to the farmer. Both of these evils are readily remedied by strewing the floor of stables with some powdered plaister of Paris, which immediately corrects the offensive smell in the stable, decomposes the carbonate of ammonia, converts it into a sulphate which is not volatile, and retains it in a condition serviceable as manure.

We may here mention that those farmers in the vicinity of this City, and others who live near large livery stables, would do well to furnish the proprietors of such stables with powdered plaister of Paris; a mutual advantage would be received. The owner of the stable would purify his stable, and the farmer would obtain an excellent manure.

The *urea* and uric acid of urine contain more nitrogen than any other substance generated by the living organism. We thus see the value of urine as a source of nitrogen to plants, and we can recognize the importance of nitrogen in the constitution of plants, when we take into consideration that "*the whole process of nutrition in an animal consists in the progressive extraction of all the nitrogen from the food;*" wherefore, the quantity of nitrogen found in the excrements must always be less than that found in the food, as the larger quantity has gone into the organism of the animal for its nourishment.

With respect to the quantity of nitrogen contained in excrements, 100 parts of the urine of a healthy man are equal to 1300 parts of fresh horse dung, and 600 parts of those of a cow. Hence, then, we see the value of it for agricultural purposes; and this value is appreciated in Flanders and China, and in the latter country laws are enacted to prevent the waste of human excrements, as no other kind of manure is used for corn fields. The Chinese are admirable gardeners and trainers of plants. They surpass the agriculturists of Europe, and their agriculture is the most perfect in the world. They attach but little value to the excrements of animals, compared with night soil. They use the cakes that remain after the expression of their vegetable oils; horns and hoofs reduced to powder; soot, ashes, contents of sewers, old mortar, all sorts of hair, especially that obtained from the shavings of some hundred millions of heads in barbers' shops; they apply the manure to the plant rather than to the soil, and steep their seeds in *liquid manure* until they swell, and germination begins to appear, which experience has proved will hasten the growth of plants, and defend them against insects in the ground. The Chinese farmer applies *liquid manure* to the roots of plants and fruit trees, and prefers the human urine to all other manures.

The nitrogen contained in the liquid and solid excrements of a man during a year, would be sufficient to yield the nitrogen of 800 lbs. of wheat, rye, oats, or of 900 lbs. of barley. "This is more than is necessary to add to an acre of gronnd, in order to obtain, with the assistance of the nitrogen absorbed from the atmosphere the richest possible crop every year." By using night soil, and adopting the alternation or rotation of crops, and "*by using at the same time bones, and the lixiviated ashes of wood, the excrements of animals might be completely dispensed with.*" In China, weeds are not to be found in their corn fields, but we sow an abundant crop of them with the manures we employ.

Pasture lands, on large farms, replace the annual expenditure of nitrogen on them.

"It must be evident," says Leibig, "that the greatest value should be attached to the liquid excrements of man and animals when a manure is desired which shall supply nitrogen to the soil, the greatest part of a superabundant crop, or in other words, the increase of growth, which is in our power, can be obtained exclusively by their means."

"When it is considered that with every pound of ammonia that evaporates, a loss of 60 lbs. of corn is sustained, and that with every pound of urine, a pound of wheat might be produced, the indifference with which these liquid excrements are regarded is quite incomprehensible.

"In most places, only the solid excrements, impregnated with the liquid, are used, and the dung hills *containing them are protected neither from evaporation nor from rain.* The *solid* excrements contain the insoluble, the *liquid* all the soluble phosphates, and the latter contain likewise all the potash which existed as organic salts in the plants consumed by the animals."

With the preceding valuable extracts respecting the beneficial influence of the interchange or rotation of crops, and respecting the composition and value of manures, we are prepared to commence the practical details of ROTATION in our next number.

(*To be Continued.*)

MANURE FOR GRAPE VINES;

AND A SUGGESTION FOR A SIMILAR PRACTICE WITH APPLE AND OTHER FRUIT TREES.

As the grape is cultivated with comparative success in several parts of Nova Scotia and New Brunswick, we would direct the attention of horticulturists to the following interesting statements, which prove that a vineyard may be retained in fertility without the application of animal matters, when *the leaves and branches pruned from the vines are cut into small pieces and used as manure.* This simple process has maintained the fertility of the soil for ten years. Leibig relates several cases confirmatory of the fact; one "vineyard was manured in this manner for eight years, without receiving any other kind of manure, and yet, more richly laden vines could scarcely be pointed out." The writer of this statement says: "I feel inclined to say to all, come to my vineyard, and see how a bountiful Creator has provided that vines shall manure themselves, like trees in the forest, and even better than they. The foliage falls from the tree in a forest, only when they are withered, and they lie for years before they decay. But the branches are pruned from the vine in the end of July and beginning of August, whilst still fresh and moist. If they are then cut into small pieces, and mixed with the earth, they undergo putrefaction so completely, that, as I have learned by experience, at the end of four weeks not the smallest trace of them could be found."

M. Frauenfelder says, "I remember that twenty years ago, a man, called Peter Muller, had a vineyard here, which he manured with the branches pruned from the vines, and continued the practice for thirty years. His way of applying them was to hoe them into the soil, after having cut them into small pieces. His vineyard was always in a thriving condition; so much so, that the peasants here speak of it to this day, wondering that old Muller had so good a vineyard, and yet used no manure.

Other cases are given, proving that a barren vineyard was restored to fruitfulness by such cuttings. In addition to these cuttings we would suggest the use of the liquid manure as worthy of trial.

Quere—Since experience has proved that the cuttings of the vine is such a valuable manure for the vine from which it is taken, is it not probable that the limbs pruned from apple and other fruit trees would answer also as manures to their respective trees. One thing is certain, that as wood is formed primarily from the silicate of potash, this important salt, with others, would be restored to the soil. Large quantities of limbs are annually cut from fruit trees, and removed from the field.

We would recommend the experiment with one or two trees, by cutting the limbs in small pieces and covering them with earth around the roots of the tree, and if this should prove too troublesome upon the large scale in orchards, in such places, the limbs might be cut up in larger pieces and burnt, and the ashes incorporated with the soil immediately around the tree. The condition of the orchards generally throughout both these Provinces calls loudly for improvement. The moss upon the bark, the suckers around the *grass-bound* stem, the superfluous wood upon the branches, and the wounds which the roots of the tree have received from the ploughshare; and the body and branches, from the horns of oxen and the teeth of browsing cattle, are proofs of the necessity for it; but as the limits of our present paper prevent us from giving this subject a portion of its merited attention, we must reserve it for future consideration, as we intend to enlarge upon the cultivation of those fruit-trees, which experience has proved thrive and ripen their fruit in our Provinces.

BOTANY.

"From giant oaks, that wave their branches dark,
To the dwarf moss that clings upon their bark."

Botany may be divided into three branches. 1stly, The physiology of plants, or a knowledge of the structure and functions of the different parts of them. 2dly, The systematical arrangement and denomination of their several kinds: and, 3dly, their economical, useful, or deleterious properties. The two first are of essential service to each other, and the last is only to be pursued with any certainty by such as are versed in the other two. Botany has one advantage over many other useful and necessary studies, that even its first beginning are pleasing and profitable. The objects of it are in themselves beautiful, and the charm is increased by the interest, which science gives them: and while the study expands and cultivates the mind, the practice of it gives health to the body. The vegetable frame is not merely a collection of tubes holding different fluids, but it is endowed with life, capable of imbibing particular fluids, and of altering their nature according to certain laws, forming peculiar secretions, giving use to their various juices and fruits. This is the exclusive property of a living being. Animals secrete fat and milk from food which has no resemblance to those substances. So vegetables secrete gum, sugar, and various resinous substances from the uniform juices of the earth, or perhaps from mere water and air. The principle of life keeps the most different fluids, separated by the finest film or membrane, and in proper action, but death terminates secretion, and dissolution is absolute. The microscope has assisted botanists greatly in detecting the general structure of vegetables, and the science is indebted to the magnified dissections of M. Mirbel for his recent discoveries.

COMMUNICATION.

[For the New Brunswick Agriculturist.]

UPON THE EMPLOYMENT OF COWS FOR DRAUGHT.

In a June number of "The New England Farmer," I read a communication respecting the use of "*Cows as beasts of draught.*" Among other observations, the writer mentions that the *Flemings* employ the cow in the cart, the plough, and drill four or five hours every day, and he suggests the benefit that the poor man would receive from the use of his cow as a beast of burden, if working her moderately would not injure her secretion of milk. I confess to you that I entertain a similar opinion, and although the suggestion may meet with opposition from prejudice and usage, still I consider the subject worthy of attention. The suggestion will receive support from the employment of other animals during the time of their giving milk: the mare is an instance. Two questions present themselves respecting the use of the cow as an animal of labour. In the first place, would this labour increase or diminish the quantity of milk? and in the second place, would it vitiate the quality of the secretion?

The reply to the first question involves another, namely, is rest essential for the secretion of milk? We find that cows after feeding seek the shade during the day, and lay down, and that their udders in the evening are frequently so distended, that the milk spontaneously flows from them: hence we would conclude that the feeding and alternate rest favour the copious secretion. We find, however, that the udder of the mare is similarly distended, and frequently discharges itself in the same manner, either whilst travelling on the road, or in harness on the farm—and if we seek for the highest authority; we find in the human species, that the labouring mothers among the poor are generally the most abundant nurses, and have the healthiest and the hardiest children. There is no reason to suppose that moderate work would lessen the quantity of milk in a ratio so great, as to make it a loss compared with the gain, that would be derived from the labour of the cow. Generous feed and rest have hitherto been attended with copious flows of milk, but it remains to be proved whether the exercise of moderate labour, by acting as a stimulant to the system generally, would not excite a healthy and increased action in the vessels secreting the milk. Theory is certainly in favour of it—experience in other animals is not against it, and the experiment in this case is well worth the trial. In answer to the question, whether labour would vitiate the quality of the milk: this would depend upon the amount of labour. If the animal was worried, wearied, and heated, the quality of the milk would in all probability be injured; but if we can judge from the growth and health of the young of animals that are worked in moderation, and from the plump and ruddy faces of the children of the industrious poor, the argument will be in favor of moderate exercise.

If the moderate working of cows does not injure them as milchers; every farmer would be a gainer by the employment of them. But their labour would be particularly beneficial to the poor man. And I have no hesitation in saying, that the gain in labour, would amply compensate him for the trifling loss he might sustain from the diminished quantity of milk, even if such a diminution should follow as a consequence. Let us suppose, what I really believe to be the truth of the case, that there are no other objections, than those of prejudice and usage, against the propriety and advantage of using "cows in draught." and let us now enquire, what would be the gain? Those who have even a slight acquaintance with farming matters in these Provinces, must have witnessed the want of team-strength in spring work, and the disproportionate labour under which the strained and worn-out oxen actually sink in the field. This want is observeable on the generality of farms: it is very conspicuous on farms worked by one or two yokes of cattle, and still more so with the cottager, who is himself the creature of burden, whose spade is his plough, and whose back is his hay cart. Now, if we can increase the team-strength without increasing expense we shall materially expedite and ease the labour of our short springs, for it is no uncommon occurrence to lose hours of labour during the feeding of oxen, or the rest of their weak and wearied limbs in the furrow beneath the yoke. Light ploughing, harrowing, and drill work might be done with one or two, or more yokes of well fed cows. Light loads of manure might be taken to the field by them. The individual ability of the animals may be small, but their united powers would give an accession of strength to team-work, which would amply reward the farmer for *breaking in* his heifers, and *breaking down* the barrier of prejudice. Many weeks and months of profitable labour might be obtained from cows, both in and out of milk which would more than counterbalance the expense of keeping them through the year. The poor farmer and the cottager are the persons, who would be principally benefitted by the work of these cows. Many of these have no oxen, and they are often compelled to give their own labour for the use of a plough and yoke of oxen, when the field work of the owner is finished, which makes their own planting late, and their crops scanty and doubtful. I certainly agree in sentiment with the writer in the "*New-England Farmer*," and recommend the suggestion to the unprejudiced consideration of experienced farmers. Trial only can furnish a satisfactory reply: and until the trial is fairly made, objections would be unjust. The correct experiment would with three animals as nearly alike as possible from the first breaking in of a pair of heifer yearlings or two year olds: Let their feed be the same, with the exception of a more generous allowance to the working cattle during the working season; and when all are in milk, ascertain the relative quantities of milk and butter, which each furnishes. I am inclined to suspect, that if even the quantity of milk was less, there would not be a similar reduction in the amount of butter obtained from it; as quantity of milk does not always imply a corresponding quantity of butter. Much more might be said in support of the experiment; but I hope the preceding remarks are sufficient to entitle the proposition to the candid consideration of enquiring agriculturists. COLONUS.

WE have received a communication from Hampton, upon the "*Rotation of Crops*," and thank our correspondent for his useful remarks, but as we have commenced the subject of rotation, and shall enter as fully into the consideration of it as the limits of "The New Brunswick Agriculturist" will admit, we must reserve the publication of his letter for some future number.

WE shall devote a large proportion of our next number *to Horticultural matters.*