	Turnip Roots	Barley Grain	Barley Straw	Clover	Rye Grass	Wheat Grain	Wheat Straw	Total
Potash	114.5	1.6	4.5	45.0	28.5	2.3	0.6	239.6
Soda	61.3	1.8	1.1	12.0	9.0	3.3	0.9	96.6
Lime	4.8	1.1	12.9	63.0	16.5	1.5	7.2	149.6
Magnesia	1.5	1.6	1.8	7.5	2.0	1.5	1.0	32.9
Alumina	2.2	0.5	3.4	0.3	0.8	0.4	2.7	10.3
Silica	4.6	21.0	90.0	8.0	62.0	6.0	56.0	289.2
Sulphuric Acid	40.0	1.2	2.8	10.0	8.0	0.8	1.0	72.8
Phosphoric Acid	12.4	4.2	3.7	17.0	0.6	0.6	5.0	51.5
Chlorine	11.0	0.4	1.5	8.0	0.1	0.2	0.9	25.6
Total pounds								969

A common four year's rotation of oats, turnips, or other green crops, wheat and hay would give pretty nearly the same results. Professor Dawson, to whose useful little work on "Scientific Agriculture," we have had occasion more than once to allude in the course of these "Talks," makes a number of suggestive remarks on the above table, and we cannot do better than give the substance of some of them. He says: "The table shows a loss by cropping in four years, of rather less than half a ton of mineral matter from an acre; and if we enquire as to the nature of this loss, we find that it might be repaired if we except the silica, which, being abundant in nearly all soils, may be left out of the account, by the following quantities of mineral manures.

325 lbs. Dry Pearl Ash.
333 " Carbonate of Soda.
43 " Common Salt.
30 " Gypsum.
150 " Quick Lime.
200 " Epsom Salts.
83 " Alum.
210 " Bone Dust.

These substances would be required to replace those taken away, provided that no part of the crops or the manure derived from them is returned to the soil." He goes on to say, "It will be observed that the green crop portion of the rotation carries off the greater part of the mineral substances, and consequently that grain crops are not the most exhausting to the soil. Practically, however, the difference between a rotation such as this, and no rotation, includes the supposition that manures are introduced with the green crops, whereas where there is no rotation, grain crops are often cultivated for a succession of years without manure." Again: "It is apparent that the exhaustion falls most heavily on some of the substances least abundant in the soil. We cannot exhaust any ordinary soil of silica, alumina, or oxide of iron; nor can a soil naturally calcareous be exhausted of its lime, but there are a few soils that can bear several crops without manure and not suffer an appreciable exhaustion of their available phosphates and alkalies. This gives to these substances a very great importance as mineral manures."

How plain it is that if we sell off crops or any thing that is made from crops, as beef, pork, butter, cheese, the soil must become poorer, unless we add fertilizers to make up for what is taken away. When a farmer sells any product, he sells a part of his farm, and if he keeps on doing this without putting back in just proportion to what he removes, he sells his farm by inches, disposes of it piecemeal. A pound of butter does not sensibly diminish the quantity of butter-*making material in a piece of meadow land, but in* fifty or hundred years, enough will be taken away to deprive that meadow of what is essential to the production of butter, so that it will be incapable of yielding it. Successive mowing of meadow-land without manuring it have, in many instances, so utterly impoverished the land, that it refuses to yield hay any longer. Who does not know that this is the case with many soils once renowned for wheat growing?

Such then is the evil and the cause of it. The remedy is to be found in liberal manuring and judicious rotations. By keeping a proper proportion of stock, the farmer may sell off considerable produce, and yet not injure his land. Nature is bountiful, and as we have seen supplies from the atmosphere a considerable per centage of plant-food. Certain crops that feed largely on the air should alternate with those that draw their nutriment mainly from the soil, and if the cultivator sells only his grain and animal produce, keeping for the sustenance of the land the straw, hay, roots, &c., his land will not suffer. The material that passes from the soil into the plant, passes from the plant into the animal, and from the animal back into the soil. Thus we return to the land what was taken from it, and so maintain its fertility.

The Action of the Air upon Soils.

WE are so much accustomed to consider the improvements of soils by working, such as are brought about by mechanical agencies stirring and the like that we are apt to forget that this mechanical movement of the soil *is more a means than an end*, that the object, in fact, to be obtained is more of a chemical than a mechanical one. This correct view of the case is exceedingly well put in a paper in the *Mark Lane Express*, which we here extract.

"As practical evidence to show that it is not mechanical development that is required on most soils, it is only necessary to say if soil be ploughed in the wet it will 'bake' in the sun, and if it be harrowed when wet it will 'cap' as it dries. This is because its cohesive qualities are more or less developed by mechanical action, and chemical action is suspended or excluded during the time of, and afterwards, by the puddling when wet. This is why clay land, when cut into strips late in the autumn, remains so through the winter, and breaks up rough in the spring, after an ordinary season of frost. Such land so left had far better have remained untouched till it *would have crumbled up, after drying in the spring.* Frost itself has generally a very false estimate put on its action; little or nothing is done directly by freezing in restoring soils. The only action that here takes place is, the water that is held in the soil is turned to ice, and as water swells during the process of freezing, the combined parts of a clod or lump of soil that were divided by the ice forming, remain separated when the ice melts. If soil which had been frozen were to be stirred before the water which was ice during the frost had been dried out, it would be far more adhesive than before it had been frozen at all, and thus the advantage of frost in pulverizing land would be turned to an evil instead of good account. This is why soil is so much more sticky after a frost than after a heavy rain. Even the gentle mechanical action induced by frost, from the swelling ice prying atoms of soil or rock apart, increases its adhesiveness immediately after a thaw; and it is only after the subsequent chemical action (oxidation) has taken place, by air following in the crevices as the water that formed the ice escapes, that the soil becomes 'mellow' or 'powdery,' or broken into fine detached particles or granules. Another element of this process is comprised in the dissolution of the crude roots of the last crop. When a stubble field is first broken up, the soil will be yellow or brown, or of a similar colour to its sub earth; but after it and the roots it contains have been broken up by frosts, or by low fermenta*tion from drying and wetting, and a few days have* elapsed for the ever-ready chemical action in question to take place, then it becomes many shades darker in colour. This is because the vegetable substances, as roots of plants, contained in its surface soil, have been converted into crude carbonates, or have undergone a portion of the oxidization, by exposure to the free oxygen of the air, which constitutes one or more of the degrees of the process of forming carbonic acid the soluble carbonate that may be taken up with water by plants. It is when those roots are in an insoluble or partially oxidized state, like the substance of a rotten heap of straw manure, that they cause the soil to be of this darker colour. For when they have been perfectly oxidized or converted into carbonic acid, they then, being in this gaseous form, unite with the inorganic constituents of the soil, and become carbonates of some kind, as carbonate of alumina, carbonates of potash, soda, lime, or what*ever may be the leading character of the earth present* for which carbonic acid has an affinity. On the completion of this transformation, the soil will have lost some of its previous dark colour, as vegetable organs, when resolved into their original gas (carbonic acid), become again, like the atmosphere, colourless. Under judicious treatment, however, of fairly sound soil, this important gas, so transformed and fixed, is not dissipated and scattered to the winds by further aeration and exposition to the sun's rays; but it is held in chemical union by the inorganic substances of the soil, as the carbon of chalk (carbonate of lime) or as the carbon of peat (vegetable carbon) is. It is thus held till plants, by exercising the beautiful power they have, exude an acid and alkali that will again liberate it by making it soluble, or in a fitting form to supply them with the food their nature needs. This is one of the most beautiful faculties of vegetable physiology and economy.

"A cut mangold, from the way it turns black through the air coming in contact with its juices and organs, is an intelligible illustration of the above way in which the minute roots of plants become oxidized, and the soil holding them darkened in colour in consequence. Straw, again, turns black soon after being converted into a condition to ferment, which is the same process going on in a more rapid way, the which rapidity is indicated by the heat produced. Animal heat is produced by precisely the same process—the union of the oxygen of the air inhaled with the carbon contained in the blood circulating through the lungs breathing.

"By thus tracing the process of fermentation and transformation of vegetable substances from crude carbonates to carbonic acid, we can understand how *it is that soils become more and more friable,* and therefore more and more easily worked, as they undergo a course of judicious tillage and cropping through several years. And we may further understand why tenacious clay, sand, and gravel are poor, for just in proportion to the amount of carbonates that have been deposited and transformed in clay will it be friable and productive of the crops for which it is suitable, and just in proportion to the capacity, natural, or artificial, of sand or gravel to hold in their more porous conformation the same kind of deposit, will they with due moisture be productive of the plants for which they are suitable. This is a part of our subject worthy of the consideration requir'd for its full realization."

On the Action of Salt on Peruvian Guano.

Dr. Voelcker, in a recent article in the *Royal Agricultural Society's Journal*, has the following:

"A distinct proof is here given that common salt has the power of liberating ammonia from soils that have been highly manured with rich dung, Peruvian guano, and other ammoniacal manures, which in sandy soils especially exist in feeble combinations, that readily undergo decomposition when brought in contact with a solution of salt. In the case before us, a portion of chloride of sodium acted upon these feeble ammonia combinations, producing on the one hand soda, which became fixed in the soil, and on the other, chloride of ammonia, which passed into solution.

"This analytical result throws light on the function of salt in agriculture. It is well known that salt is most beneficially applied to light land after a good dressing with farmyard manure, alone or in conjunction with Peruvian guano, and that its application under these circumstances is particularly useful to wheat and grain crops in general. Practical experiments on a large scale have shewn, indeed, that by salt alone a large increase of grain was produced on land in good heart that is, that had been previously well manured. In this case the application of salt evidently has the effect of liberating am*monia, and rendering it available for the immediate* use of our cereal crops, which we know from experience are much benefited by it. On land out of condition, salt must not be expected to produce such a favourable effect, and as this manure no doubt is sometimes put upon land exhausted by previous cropping, in which, therefore, it does not find ammoniacal compounds upon which it can act, one reason becomes evident why salt is inefficacious as a manure in some cases, whilst in others its beneficial effects are unmistakable. Peruvian guano and salt is a favourite dressing with many farmers, and justly so. It has been supposed by agricultural writers that the benefits resulting from this mixture are due to the property of salt to fix ammonia; I have shewn, however, elsewhere, that good Peruvian guano does no contain any appreciable quantity of free ammonia, and, moreover, that salt does not fix ammonia. Whilst theory has erred in ascribing to salt a power which it does not possess, the practice of mixing guano with salt is one which can be confidently recommended. So far from fixing ammonia, salt rather tends to liberate and disseminate through the soil the ammonia contained in the Peruvian guano applied to the land, which then becomes fixed by the soil."