vious to the mixture. If, instead of chalk, we use plaster of Paris, the creamy-looking liquid will soon grow hard, and at length become quite solid. The water wholly disappears, for the two substances have combined chemically. Gunpowder may be mentioned as affording a sort of double illustration. This is a mechanical mixture,—that is, the materials of which it is composed are united by mechanical face. The mixture is a very intimate one, still it *is* a mixture, and it is easy to separate the substances of which it is composed. Gunpowder consists of charcoal, sulphur, and saltpetre. By washing it in water, the saltpetre is dissolved, and can easily be removed and separated from the other two ingredients by filtering and straining. The two other constituents can also be separated and they will be found the same precisely as before they were manufactured into gunpowder. But now, if fire be applied to gunpowder, an explosion results, the whole mixture having evidently formed a chemical combination. A small trace of solid matter, and a little smoke is all that appears to the eye, but it is quite certain that these with some invisible gases, contain all the sulphur, charcoal, and saltpetre that existed in the gunpowder.

"If" says Prof. Dawson, "we take 100 pounds of pure limestone, and expose it for some time to a red heat, an invisible air or gas escapes from it, and at length we have only 56 pounds of quick lime remaining. If we have collected the gas which has been given out, its weight will be found to be 44 pounds, or as much as the limestone has lost, and it will also be found to consist of a peculiar substance known to chemists as Carbonic Acid. Limestone therefore is a *compound* substance, and can be decomposed or separated into two other substances. But this process can becarried still farther. We can obtain from the 44 pounds of Carbonic Acid, 12 pounds of Carbon or charcoal, and 32 pounds of a gas called oxygen,—and from the 56 pounds of quick lime, 16 pounds of oxygen, and 40 of a metal named calcium. Here then we have:—

12 carbon and 32 oxygen, forming 44 carbonic acid.
40 calcium and 16 " " 56 lime.

Forming when united, 100 limestone, or Carbonate of Lime."

Another characteristic of chemical combination is that the compound substances thus formed always contain definite proportions of the elements out of which they are formed. Thus Chalk or Carbonate of Lime is precise the same material whether obtained from Chalk rocks or prepared by passing carbonic acid into lime water. In both cases, the same substance is got, and consists of 22 parts of Carbonic Acid, and 28 parts of Lime.

All the elementary substances in nature combine in certain fixed proportions They invariably unite in this way. This is called the Law of Definite Proportions. *How* this comes to pass, no one can tell. We only know that the All wise Creator has made things in this manner. And when we speak of *a law of nature*, we ought to bear in mind that it operates because of the will and power of the Great Law Giver, and be thankful that the universe is not at the mercy of chance. It is the farmer's duty to study and confirm to this law, and under its unerring operation, he knows that he will not toil in vain. Long as nature's laws continue in force, the earth will bring forth and bud, giving seed to the sower and bread to the eater.

Causes of Unproductiveness in Soils.

(*Continued from page 50.*)

2. *Soils are unproductive when they are deficient in one or more constituents found in the ashes of cultivated plants.*

In many arable soils that have been subjected to an extended course of cropping without adequate manuring, it is often found, by chemical analysis, that they become exhausted of one or more of the inorganic constituents of plants. Phosphoric acid is among the most common and important of these ingredients. The subjoined analyses of both clay and sandy soils, having, therefore, opposite physical conditions, show the great want of phosphoric acid in all these—a circumstance sufficient of itself to explain the cause of their unproductiveness, though there are other ingredients of importance in much too small proportions. It will often be found that the relative productiveness of different soils is intimately connected, either with an abundance or a deficiency of phosphoric acid.

	Sandy Soil.	Clay Soils.	
Moisture		10.00	12.37
Organic Matter	3.02	7.03	8.07
Oxides of Iron and Alumina	4.34	13.36	14.45
Phosphoric Acid	.07	.04	.01
Sulphate of Lime	.10	.17	.14
Carbonate of Lime	.17	.24	none.
Potash and Soda	.26	1 65	1.21
Magnesia	.41	46	37
Insoluble Siliceous Matter	91.63	66 33	63.39
	100.00	100.00	100.00

Lime is another substance in which cultivated soils are sometimes deficient; and hence the ancient practice of liming and marling, that has come down to the present time, is found so generally beneficial, Dry a small portion of soil, and reduce it to powder; pour upon it a little muriatic acid, and if no effervescence takes place, or only a feeble one, such soil requires the application of lime. In some of the limestone districts even of Canada, especially where covered by drift, an occasional dressing of lime will be found advantageous. In the following table, analyses of various kinds of soils are incorporated, all of which require the application of lime.

	No. 1. Sandy Soil from Kent.	No. 2. Stiff Pasture from Somersetshire.	No. 3 Clay Soil from Demarara.	No. 4. Peaty Land from Somersetshire.
Moisture			7 03	
Organic Matter	3.62	16.80	12.58	55.32
Oxides of Iron and Alumina	7.50	10.03	11.10	13.08
Phosphoric Acid	.13		.48	.06
Sulphuric Acid			11	1 20
Lime	.43	75	13	97
Magnesia	.49	1.56	.33	54
Potash and Soda	.48	.45	.52	1.02
Insoluble Siliceous matter	87.35	64.36	67.72	27.81
	100.00	100.00	100.00	100.00

A deficiency of the alkalies, especially potash, is a frequent cause of the unproductiveness of soils. The ashes of all farm crops contain a large proportion of potash and soda, and these constituents must be found in the soil, or supplied by manure. "Root crops especially have ashes rich in potash; and as turnips are often grown on land naturally poor in alkalies, with purely mineral superphosphate of lime, and nothing else, and the produce is sometimes sold off the land, or not consumed entirely upon it, the land may thus become drained of its available potash to an injurious extent. Perhaps the failure of roots on land which formerly produced good crops, may have something to do with the gradual exhaustion of their available alkalies." Light sandy land is often found very deficient in potash, but this sometimes happens with clays as Dr. Voelcker clearly shows from several carefully made analyses.

Unproductive soils are seldom deficient in one substance only; for this reason many cannot be made fertile by the application of manures which, like lime, supply only one material. Sandy soils, more especially, often stand in need of lime, as well as of phosphoric acid and potash. Their general deficiency all these important elements of fertility is clearly seen in the following analysis, showing the

Composition of a poor Sandy Soil:—

Moisture	4.78
Organic Matter	1.03
Oxides of Iron and Alumina	1.72
Lime	.19
Magnesia	.10
Potash	23
Soda	none.
Phosphoric Acid	.04
Sulphuric Acid	.12
Carbonic Acid and Chlorine	traces.
Insoluble Matter 91.79, consisting of:	
Silica	89.32
Alumina	1.81
Lime	none.
Magnesia	.36
Potash	.15
Soda	.15
	100.00

The above analysis indicates a poor hungry soil, alike deficient in lime, phosphoric acid, and alkalies. As in this country we do not possess a cheap source of potash, a liberal dressing of good farm-yard manure is our only available remedy. Upon soils of this character, town sewage, when applied in large quantities, has produced the best economical result.

3. *Soils are barren or unproductive when they contain a large preponderance of organic matter, or of sand, lime, or even of pure clay.*

The most fertile soils consist of an intimate mechanical mixture, in due proportions of clay, lime, sand, and organic matters. "Sterility, or comparative unproductiveness, is often caused by such a preponderance in the soil of one of these. Each of these ingredients of all fertile soils possesses special chemical and physical properties, conducive to the development of plants, and it will be readily understood how essential to luxuriance of growth, is this intimate and nicely-proportioned mixture, such as we find in alluvial soils."

The following table illustrates the composition of soils which are unproductive on account of the preponderance of one of the four chief materials of all soils:—

	No. 1 Calcareous Soil.	No. 2. Sandy Soil.	No. 3. Clay Soil.	No. 4 Peaty Soil
Moisture		2.65		
Organic matter and water of composition		4 56	7 04	49.07
Oxides of Iron and Alumina	.780	5.93	10.95	10.88
Carbonate of Lime	73.807	.39	.86	2.29
Magnesia	.825		.26	.75
Potash and Soda	traces	23	.39	90
Phosphoric Acid	.242		.10	.03
Sulphuric Acid	1 546		.30	1.04
Silica	10.710	80.19		
Insoluble Siliceous matter (fine clay)	6.090		79.20	35.01
	100 000	100.00	100.00	100.00

(*To be Continued.*)

Clover as a Manure.

I have been long trying, "by precept and example too," to get the farmers of the country to believe that the clover plant, stimulated by gypsum, whenever it is proved that gypsum does aid its growth, is the most valuable manure, when we take into account its cost that can be had. In my reports on the County of Onondaga, I said, "The agriculture of Onondaga Co is based on the clover plant," and I now repeat that assertion. Yesterday, a farmer living within two miles of Syracuse, called on me, and, while passing over the farm, remarked that he would not draw manure from the city to his farm if it was given to him, preferring to manure with clover and plaster This was the opinion of a man who had spent fifty years of his life in earning a handsome fortune as a working farmer, and whose knowledge of scientific matters is quite limited—in short, a man who is governed entirely by practical results. He knows just the value of barn manure, for he has made and used large quantities every year, on the farm where he now lives and has lived for thirty years. Nothing was said by me to draw out his opinion. It was given unprompted, and having long since learned to value the opinion of such men, I was very much gratified at hearing his views. Within the last four weeks I have seen a heavy crop of clover ploughed under, and the harrow and drill to sow wheat at once put into operation. The farmer expects to get a good crop with this single ploughing, and to enrich his land for future crops. How could he do so much for his land in any other way at the same cost? He has cut one crop of hay, and from the middle of July to the middle of September the grass had so grown that it was hardly practicable to get it into furrow. The crop of hay has paid the interest on the value of the land (fully ten per cent,) and the crop of wheat will probably pay still better. Now what has this manuring cost? Do your own figuring. Do any of your Eastern farmers manure as heavily as this? They pay more money, but do they manure as highly? Let us look at the future of this land. The wheat will come off next year, and one-quarter of a bushel of clover seed sown next Spring—having put timothy grass seed on when the wheat was drilled in—the butts of the bundles of wheat will, at harvest, be full of the tops of the grasses. A little pasture will be had next Fall, if the season is dry; if it is wet and warm, the clover will blow out before frost. The following year corn, or perhaps barley, will be sown on the new clover and timothy sod, or hay may be cut that year in July, and a crop of clover seed taken off in September, and corn or barley the next year.