similate under the influence of sunshine. As a result of this there is stored up within the tissues of the leaf, starch, sugar, oil and other vegetable substances, all of which go to constitute the plant. So much for what they take from the atmosphere. There is a portion of their food also which they take from the soil, and which, although a very small percentage of the soil (four, five or six per cent.), is nevertheless essential to the well-being of the plant. Unless furnished by nature or by man, plants cannot normally take their quota of food from the atmosphere. Let us take a rough chemical analysis: Supposing we wished to find out what there was in a piece of Indian corn, an apple, or any other vegetable substance. Supposing we took a piece of apple. We weigh it. We let it dry out in the oven. Then we weigh it again. It has lost in weight. If we had had chemical apparatus we should have seen that which had gone was water. All green vegetable matter possesses a very large percentage of water. If it had been a piece of green corn stalk, 75 to 85 per cent. of water would have passed off by this treatment. With turnips as much as 95 per cent.; apples about 75 per cent. Very well, then, we have ascertained by this rough method of analysis that one of the constituents of vegetable matter is water. We will now take this piece of apple or corn stalk, which is quite dry and which weighs so much less than it did at first, and we will put that on a red hot stove-plate; it chars, turns black, and finally burns away until only a small quantity of ashen material is left. What has gone? Chiefly that carbonaceous material, the starch and the sugar and the oil, which I told you had been formed in the tissues of the plant by the aid of sunlight from the carbonic acid of the atmosphere. Then we have this little quantity of ash, or mineral material, which I say may be only present to the extent of three to five per cent.; this has been taken from the soil by the roots. What have we now found in our plant? We have water, a certain amount of carbonaceous material, and mineral matter or ash.

We said the plants took their food from two sources, from the air and from the soil. From the air they take it in the form of a gas through their leaves; from the soil through their roots in the form of a solution.

If we put a lump of sugar or a little bit of salt in water we should have a solution of sugar or salt, as the case might be.

Plant food, to be of value, must be present in the soil in an immediately available form; there is a great agricultural difference between soluble and insoluble soil plant food.

We must recollect that substances may be present in a soil, but of no value to the plant if that food is not soluable, either in water or in the acid fluid which is exuded from the rootlets of the plants. So you see that plant food, in order to be available for the growth and building up of the tissues, has to be either in the form of a gas or a solution.

I will now show you the difference between soluble and insoluble plant food. You know that phosphoric acid is one of the mineral constituents, and is found in the ashy or mineral material. Now in Eastern Canada there is a mineral known as apatite, or phosphate of lime. For many years, in England and also this country, that material has been mined, and converted by sulphuric acid into what we know as superphosphate. It was held by many that it would be sufficient if this apatite were ground fine and spread upon the soil, or, at all events, if first fermented with manure. We made a careful examination of the matter at Ottawa, putting it on the land in ample supply, but we found no response. Nor did we find any response from composting it. It was not soluble in water or appreciably in dilute acid solution, and for that reason it was of no use as plant food. But if that mineral phosphate had been first treated with sulphuric acid then a chemical change would have taken place and the phosphoric acid would have been rendered soluble.

The chemical elements which enter into plant construction are comparatively few, and of these few it is only necessary for the practical agriculturalist to know something about three or four of them. As we have already seen, some of them are furnished by the air; of these we need not concern ourselves for they will be supplied in abundance. Of those which are taken by the plant from the soil some are present in such large quantities or appropriated by the plant in such small quantities, that we do not find it generally necessary to replace them. As a matter of fact it is only necessary for us to concern ourselves with some three or four of them, namely: nitrogen, potash, and phosphoric acid—though occasionally it is necessary to consider the advisability of applying lime.

These are called the essential elements of fertility, because we have to be continually replenishing them, continually putting them back in the soil, in order to maintain the productiveness of our fields.