class of bodies which Way calls *double silicates*. Thus a silicate of alumina may have part of its alumina replaced by an equivalent quantity of lime, soda, potash, or ammonia. So we have a silicate of alumina and lime, another of alumina and potash, and again one of alumina and ammonia. All these double silicates are of great use to our crops, and the strangest thing seems to be, that alumina itself does not enter into the composition of our plants, but contents itself with preparing their food, and handing it to them when it is ready for their use. When we come to study the *liming of land*, we shall see more about the value of these double silicates.

Phosphoric Acid is, I may say, one of the most important constituents of the soil. It enters in large proportion into the formation of every one of our cultivated plants, and forms a great part of the skeleton of every animal. This substance is present in no soil in very great quantity, our most fertile lands seldom containing more than 2.5 per cent, i. e. one part in two hundred.

The *Organic*, or *burnable*, parts of our soil are, as we have seen, gaseous in form. They consist of substances which have grown under the influence of animal or vegetable life, and have thus become *organized* as part of some living plant or animal. Perishing, as they do, the inorganic matters which had formed part of the animal or plant are added to the mineral matter of the soil, while the organic matter forms a series of substances which practically yield to the soil—Carbon, with Oxygen and Hydrogen, in various forms of combination; and Ammonia with other nitrogenous matters.

Tha forms which these matters assume are various, but the chemist can detect them under all their disguises, and the knowledge thus obtained enables us to extend our classification of soils beyond the results obtained by our *mechanical* analysis. This determines whether a soil is a sand, a clay or a loam, but *chemical* analysis determines whether it is calcareous or peaty, that is, rich in lime or in vegetable remains.

How plants feed.—We have only one mouth, a plant has a million, visible only by means of a microscope. Plants, however, do not eat with these tiny mouths—they only breathe, and drink, like a little child, whose only substance is taken in a liquid form: it is necessary to the substance of every plants that its food be dissolved in water. The first meals are contained, in a solid form, in the seed itself. Take a few grains of barley steeped in water and keep them warm and damp—you will see in a few days that the roots will start from one end, and then the *plumule*, or green stalk, start from the other. These could not come into life when dry; but when the food in the grain was liquified and became capable of giving nourishment, the plant immediately took advantage of it, and put forth its infant roots, gradually imbibing all the store, and then, in our case, perishing for lack of further food.

But had the grain of barley been put into the ground, by the time the reserve of nourishment in the grain was exhausted it would have grown accustomed to its environment, and could have found its way to obtain support from the earth itself, until its leaves had sprung forth from the plumule, then the myriad little mouths on the leaves would have gone to work and added a third source of food—the air—to the other two—the seed and water. It is worth anybody's while to go into a *malt house* and watch the way in which the grain behaves from the first appearance of the root until the *plumule* or *acrospire* has grown half or three quarters of the way up the back, when the *maltster* puts it on the *kiln* to stop its growth, lest the green leaf should escape and begin to feed upon the sugar formed in the process.

What crops are made of.—We have seen that every plant is made up of two sorts of materials: one sort distinguished as organic, the other as inorganic; whereof, if any vegetable matter be carefully burnt, the former vanishes in smoke, the latter remains, constituting the ashes. The ash left behind consists of mineral matter entirely, and on being submitted to chemical analysis, is found to be a mixture of several kinds of substances, the proportion varying in different sorts of plants. Some varieties of plants contain more of one material than others, and some plants contain more ash than others. The seed and the straw of our grain crops, for instance, contain very different proportions of one of these inorganic matters, silica, but, at all events, every one of the substances in our list of inorganic matters is taken up by plants and worked up into their structure, except *alumina*, which, as we saw, seems to be a sort of agent to present the food to the plants in an acceptable shape, and not plant food at all.

The *organic* matter, we saw, when the plant was burnt, flew off in a gaseous form, this consists of *carbon*, with the elements of water, namely oxygen and hydrogen (*acid-maker* and *water-maker*), and ammonia and other nitrogenous matters. These exist in plants in a great variety of forms, some easily recognized in one place, but utterly different in appearance in another, and they have been divided by scientific men into two classes; *nitrogenous* and *non-nitrogenous*. The compounds containing nitrogen you will always know by their names invariably ending in the letter *n*. They are principally these. *Albumen*, *Fibrin* (gluten); *Casein* (legumin). They used to be called *Protein compounds*, from their frequent change of form, but *nitrogenous* is a more convenient, because less fanciful, term.

The *non-nitrogenous* are *Starch*; *Gum*; *Sugar*; *Cellulose* and *woody fibre*, and *Oil*. The difference between the groups is simply this: the non nitrogenous bodies are composed of carbon, hydrogen, and oxygen, the nitrogenous group contains nitrogen in addition to the carbon, hydrogen and oxygen.

Starch is a white granular body, very abundant in grain and potatoes. If you cover a tumbler with a piece of fine muslin or cambric, and wash a little wheat flour on it with a stream of water gently falling as you wash, in a short time the water which reaches the tumbler will become milky, and on being allowed to repose for a short time will deposit a white grainy substance: this is starch. On the muslin cover will be found a glutinous mass, like soft strings of india rubber; this is the *gluten* of the wheat.

Gum you all know by sight—some of you, doubtless, by taste—it is generally in a liquid state in plants, but exuding through a broken part of the bark of trees, becomes hard and transparent.

Sugar, too, is found in great quantity in a liquid form in the cane, sorghum, sugar-beet, &c, but it is also present in our cultivated crops, even when not in sufficient abundance to be separated for use. Flowing through the plant with the sap, it promotes growth in many important ways.

Cellulose, or cellular matter, is so called because with it the plants are built up. When in the incipient state, it is tender and fragile, but when old it becomes hard and strong, and at last becomes *woody fibre*. This is the change which takes place in the passage of young grass into over-ripened hay. All these substances are very much alike in composition, and sometimes pass from one form into another, but it is worth remembering that, although the quantity of carbon varies slightly, the weight of oxygen is invariably eight times the weight of hydrogen, and this one of hydrogen to eight of oxygen is—water. Thus, any of these non-nitrogenous matters may be represented as made up, in different proportions of carbon and water, as:

Carbon.		Water.				
50 lbs	with	50 lbs	make	100 lbs	of	woody fibre.
"	"	$37\frac{1}{2}$	"	$87\frac{1}{2}$	"	humic acid.
"	"	$72\frac{1}{2}$	"	$122\frac{1}{2}$	"	cane sugar, starch or gum.
"	"	56	"	106	"	vinegar.