tissue of vessels and cells, closely embracing the tree, of a white or brownish colour on the older parts of the trunk, and green on the young extremities of the twigs. This inner or true bark is covered and protected from the air by an outer skin or covering, which in some trees, as the white birch, consists of numerous thin and tough layers. In some plants, as the grasses, this outer bark is the only extreme covering which appears, and in these plants it often consists of dense inorganic matter, constituting the strongest part of the stem. The *Wood* is principally composed of cells and vessels of various forms and sizes arranged lengthwise in the stem and crossed by bundles of cells placed horizontally, and extending from the centre of the wood to the back, so as to form thin plates extending across the wood, and called the *Silver grain, or medullary processes.* The office of these is supposed to be that of conveying fluids from the bark to the heart of the tree. The *Pith*, which is present only in young branches and small stems, consists of large cells placed horizontally, and it probably serves to store up superabundant sap till it is required by the plant. These structures, though most obvious in the trunk, are continued into the roots and branches, and in some degree, into the leaves. Though the structure which we have noticed prevails in trees, and in a great number of herbaceous plants, there is a large proportion of the vegetable kingdom which shows no regular arrangement of bark wood and pith; and the whole of the grains and grasses are of this last kind. In these plants however, the parts discharging the different functions of wood and bark, are not wanting, but rather intimately united instead of being separated into different portions We may now therefore consider the functions of those organs which belong to nearly all plants.

THE ROOT.

The larger branches of the root, like those of the trunk, consist of bark and wood; but in their smaller ramifications both bark and wood become soft, porous and easily penetrated by water: and these minute and greatly divided extremities of the roots penetrating to every part of the soil around a plant are its true mouths or feeders.* The spongy rootlets are capable of taking only fluid food, no particle of clay or other undissolved matter can enter them; they absorb water and this in so large a quantity that a sunflower three feet high has been stated to draw from the soil thirty ounces of water in twelve hours of a sunny day. But the water of the soil is not pure, it contains a great variety of mineral and other substances in solution, and these it must carry to the roots of every plant which grows upon it. Do all plants then which can grow on the same soil, require from it the same kinds of food? Experiment shows that this cannot be the case. If a pea and a plant of wheat grow side by side, and if both be gathered and burned, the ashes of the wheat will be found to contain a large proportion of silica or flint, which served to strengthen the straw, while those of the pea will be found to afford scarcely any of this earth. The water of the soil must have brought a certain quantity of silica to the roots of the pea as well as to those of the wheat, but by the former plant it was rejected as useless, while to the latter it was absolutely necessary. It becomes therefore an interesting question whether the roots themselves have the power of selecting from the soil what is required by the plants, or whether they absorb all matters indifferently, and leave to the other parts of the plant the office of selecting the most proper kinds of food.

This point has been much disputed, it may however be rendered more simple by a reference to animals. Of these we know that every species is endowed with the skill necessary for choosing the most suitable nourishment, and yet that the ordinary food of each includes much that must be afterwards rejected; while also liable occasionally to mistake what is poisonous for what is nutritive. In the same manner it can be shown that plants altogether refuse to receive some substances even when placed in contact with their roots in a soluble state; and yet that they do absorb much which they afterwards reject, and in some instances that they admit matter which proves highly injurious or poisonous to them. In plants also as in animals there are always matters of various kinds, which have served some purpose in their economy, but have finally become useless; and the roots of plants are the organs by which the admission and excretion of these matters are effected.

The substances thus excreted by plants, are either organic or inorganic. *With respect to the former*, Macaire found that vegetables carefully taken from the ground, and placed in water, gave forth from their roots substances having the properties of gum, extractive matter, opium, and other organic compounds, more recent observations however, have shown that at least a part of these effects is due to the escape of the juices from wounded parts of the roots. A better instance of the excretion of organic matter is found by the fact that when grain is made to sprout in powdered chalk; after germination has taken place, a part of the chalk (carbonate of lime) is found to be converted into Acetate of lime; acetic acid (vinegar) having been produced in the young plants and given out by their roots to combine with the lime.

The quantity of *inorganic* matter voided by plants is well shown by some experiments of De Saussre. First—he found that after vegetables have attained nearly to their full growth, they yield much more ashes, in proportion to their own weight, than afterwards when the seed is ripened, thus a plant of wheat when ripe, contained less than one half the proportionate quantity of ashes contained in a plant before flowering. Secondly—that this was caused by an actual return of inorganic matter to the soil, and not by an excess in the growth of the organic parts, was shown by the circumstance, that while the whole quantity of ash diminished, some of its ingredients greatly increased in quantity. This wheat contains a large proportion of silica, and it was found that the quantity of this earth in the ripe plant was to that in the green in the proportion of four to one, so that the other ingredients must have been lost to a much greater extent than the proportion before stated. Thirdly—the quantity of silica contained in the ashes of wheat affords in another way a proof of the excretion of inorganic matters Silica alone cannot be dissolved in water, but when it combines with Potash, soda, or alkaline substances, in certain proportions, it becomes soluble, and in this state it enters into the vessels of plants. Silica however requires nearly half its weight of Potash or Soda to render it soluble, and on examining the ashes of ripe wheat, it was found that the quantity of silica which they contain is four times that of their alkaline matter; or that there is present in the ripe plant only half the quantity of alkali required for the solution of the silica which it contains. It is evident therefore that a portion of potash or soda has been separated from the silica with which it was combined, and has been expelled, and perhaps this process may take place repeatedly, so that a small quantity of alkali may be the means of introducing much silica into the straw of wheat. Plants have therefore the power of sending back to the soil useless or injurious substances, whether obtained unaltered from the ground or formed in their own system; and it is even possible that some of the matters thus ejected may, as in the case of the alkali just noticed, combine with substances

* Hence, in transplanting, great care should be taken to preserve uninjured the small fibres of the roots. Plants should not be carelessly "torn out of one place and thrust into another."